# Mini8 Controller

User Guide

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Eurotherm.

by Schneider Electric

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Eurotherm Limited software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Table of Contents

Safety Information

Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.

Note: Electrical equipment must be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

Note: A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment, and has received safety training to recognize and avoid the hazards involved.

Safety and EMC

Reasonable Use and Responsibility

The safety of any system incorporating this product is the responsibility of the assembler/installer of the system.

The information contained in this manual is subject to change without notice. While every effort has been made to improve the accuracy of the information, your supplier shall not be held liable for errors contained herein.

This programmable controller is intended for industrial temperature and process control applications, which meet the requirements of the European Directives on Safety and EMC.

Use in other applications, or failure to observe the installation instructions of this manual may compromise safety or EMC. The installer must ensure the safety and EMC of any particular installation.

Failure to use approved software/hardware with our hardware products may result in injury, harm, or improper operating results.

⚠ **DANGER**

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Do not use the product for critical control or protection applications where human or equipment safety relies on the operation of the control circuit.

This product must be installed, connected and used in compliance with prevailing standards and/or installation regulations. If this product is used in a manner not specified by the manufacturer, the protection provided by the product may be impaired.

Personnel

Electrical equipment must be installed, operated, serviced and maintained only by qualified personnel.

Enclosure of Live Parts

To help prevent hands or metal tools touching parts that may be electrically live, the controller must be installed in an enclosure.

Live sensors

The controller is designed to operate if the temperature sensor is connected directly to an electrical heating element. However, you must ensure that service personnel do not touch connections to these inputs while they are live. With a live sensor, all cables, connectors and switches for connecting the sensor must be mains rated for use in 230Vac +15% CATII.

Voltage rating.

The maximum continuous voltage applied between any of the following terminals must not exceed 230Vac +15%:

- relay output to logic, dc or sensor connections

- any connection to a protective earth ground

Power Isolation

The installation must include a power isolating switch or circuit breaker. This device must be in close proximity of the controller, within easy reach of the operator and marked as the disconnecting device for the instrument.

Overcurrent protection

The power supply to the system must be fused appropriately to protect the cabling to the controller.

Conductive pollution

Electrically conductive pollution must be excluded from the enclosure in which the controller is installed. For example, carbon dust is a form of electrically conductive pollution. To secure a suitable atmosphere in conditions of conductive pollution, fit an air filter to the air intake of the enclosure. Where condensation is likely, for example at low temperatures, include a thermostatically controlled heater in the enclosure. This product has been designed to conform to EN61010 installation category II, pollution degree 2. These are defined as follows:

Pollution Degree 2. Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

Installation Category II (CAT II). The rated impulse voltage for equipment on nominal 230V supply is 2500V.

Grounding of the temperature sensor shield.

In some installations it is common practice to replace the temperature sensor while the controller is still powered up. Under these conditions, as additional protection against electric shock, we recommend that the shield of the temperature sensor is grounded. Do not rely on grounding through the framework of the machine.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Safety and EMC

Safety and EMC protection can be seriously impaired if the unit is not used in the manner specified. The installer must ensure the safety and EMC of the installation. This instrument complies with the European Low Voltage Directive 2014/35/EU, by the application of the safety standard EN 61010.

Electrostatic discharge precautions.

Always observe all electrostatic precautions before handling the unit. When the controller is removed from its sleeve, some of the exposed electronic components are vulnerable to damage by electrostatic discharge from someone directly handling the controller.

Service and repair.

This instrument has no user serviceable parts. Contact your supplier for repair

Electromagnetic compatibility.

This instrument conforms with the essential protection requirements of the EMC Directive 2014/35/EU. It satisfies the general requirements of the industrial environment defined in EN 61326.

Installation requirements for EMC.

To comply with the European EMC directive certain installation precautions are necessary:

- General guidance. Refer to EMC Installation Guide, Part no. HA025464.

- Relay outputs. It may be necessary to fit a suitable filter to suppress conducted emissions.

- Table top installation. If using a standard power socket, compliance with commercial and light industrial emissions standard is required. To comply with conducted emissions standard, a suitable mains filter must be installed.

Wiring.

It is important to connect the controller in accordance with the wiring data given in this guide. Take particular care not to connect AC supplies to the low voltage sensor input or other low level inputs and outputs. Only use copper conductors for connections (except thermocouple inputs) and ensure that the wiring of installations complies with all local wiring regulations. For example, in the UK use the latest version of the IEE wiring regulations, (BS7671). In the USA use NEC Class 1 wiring methods.

Routing of wires.

To minimise the pick-up of electrical noise, the low voltage DC connections and the sensor input wiring should be routed away from high-current power cables. Where it is impractical to do this, use shielded cables with the shield grounded. In general keep cable lengths to a minimum.

Hazard of Incorrect Configuration.

Incorrect configuration can result in damage to the process and/or personal injury and must be carried out by a competent person authorised to do so. It is the responsibility of the person commissioning the controller to ensure the configuration is correct.

Loss of Communications

If the output is not wired, but written to by communications, it will continue to be controlled by the communications messages. In this case take care to allow for the loss of communications

Failure to follow these instructions can result in death, serious injury or equipment damage.

Please Note

Electrical equipment must be installed, operated, serviced, and maintained only by qualified personnel.

No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product.

The qualified person must be able to detect possible hazards that may arise from parameterization, modifying parameter values and generally from mechanical, electrical, or electronic equipment.

The qualified person must be familiar with the standards, provisions, and regulations for the prevention of industrial accidents, which they must observe when designing and implementing the system.

Intended Use

The product described or affected by this document, together with software and options, is the Mini8 Controller (referred to herein as "programmable controller", or "controller" or "Mini8"), intended for industrial use according to the instructions, directions, examples, and safety information contained in the present document and other supporting documentation.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements, and the technical data.

Prior to using the product, a risk assessment must be performed in respect of the planned application. Based on the results, the appropriate safety-related measures must be implemented.

Since the product is used as a component within a machine or process, you must ensure the safety of this overall system.

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

Any use other than the use explicitly permitted is prohibited and can result in unanticipated hazards.

⚡ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Electrical equipment must be installed, operated and maintained by only qualified personnel.

Turn off all power to product and all I/O circuitry (alarms, control I/O etc.) before starting the installation, removal, wiring, maintenance or inspection of the product.

Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment, i.e. UK, the latest IEE wiring regulations, (BS7671), and USA, NEC class 1 wiring methods.

The unit must be installed in an enclosure or cabinet. Failure to do this impairs the safety of the unit. An enclosure or cabinet should provide fire enclosure and/or restriction of access to hazards.

Do not exceed the device's ratings.

This product must be installed, connected and used in compliance with prevailing standards and/or installation regulations. If this product is used in a manner not specified by the manufacturer, the protection provided by the product WILL be impaired.

Do not insert anything through the case apertures.

Tighten all connections in conformance with the torque specifications. Periodic inspections to ensure continued compliance is required.

Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E, CSA Z462 BS 7671, NFC 18-510.

The installer must ensure the mandatory protective ground connection is connected during installation. Connection of this protective ground connection must be made before turning on any power supplying this product.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

FIRE HAZARD

If upon receipt, the unit or any part within is damaged, do not install but contact your supplier.

Do not allow anything to fall through the case apertures and ingress the controller.

Ensure the correct wire gauge size is used per circuit and it is rated for the current capacity of the circuit.

When using ferrules (cable ends) ensure the correct size is selected and each is securely fixed to the wire using a crimping tool.

The product must be connected to the correct rated power supply unit or supply voltage in accordance with the supply voltage rating displayed on the product label or in the User guide.

Ensure only the originally supplied connectors are used.

Failure to follow these instructions will result in death or serious injury.

⚠ **WARNING**

UNINTENDED EQUIPMENT OPERATION

Do not use the product for critical control or protection applications where human or equipment safety relies on the operation of the control circuit or the triggering of an alarm.

Observe all electrostatic discharge precautions before handling the unit.

Electrically conductive pollution must be excluded from the cabinet in which the controller is mounted. To ensure a suitable atmosphere in conditions of conductive pollution, fit an adequate air filter. Where condensation is likely, for example, at low temperature, include a thermostatically controlled heater in the cabinet.

Avoid ingress of conductive materials during installation.

Use appropriate safety interlocks where personnel and/or equipment hazards exist.

Install and operate this equipment in an enclosure appropriately rated for its intended environment.

Routing of wires, to minimize the pick-up of EMI (Electromagnetic interference), the low voltage DC connections and the sensor input wiring must be routed away from high-current power cables. Where it is impractical to do this, use shielded cables with the shield grounded. In general keep cable lengths to a minimum.

Modifying, disassembling or repairing the product beyond what is stated in this User Guide is strictly forbidden. Contact your supplier for repair.

Ensure all cables and wiring harness are secured using a relevant strain relief mechanism.

Wiring, it is important to connect the product in accordance with the data in this User Guide and use copper cables (except the thermocouple wiring).

Only connect wires to identified terminals shown on the product warning label, the wiring section of the product User guide or Installation sheet.

Safety and EMC protection can be seriously impaired if the unit is not used in the manner specified. The installer must ensure the safety and EMC of the installation.

If the output is not wired, but written to by communications, it will continue to be controlled by the communications messages. In this case take care to allow for the loss of communications.

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise must be allowed to program, install, alter and commission this product.

Do not use, or implement a controller configuration (control strategy) into service without ensuring the configuration has completed all operational tests, been commissioned and approved for service.

During commissioning ensure all operating states and potential fault conditions are carefully tested.

It is the responsibility of the person commissioning the controller to ensure the configuration is correct.

The controller must not be configured while it is connected to a live process as entering Configuration Mode pauses all outputs. The controller remains in Standby until Configuration Mode is exited.

Failure to follow these instructions can result in death, serious injury or equipment damage.

> # ⚠ CAUTION
>
> **EQUIPMENT OPERATION HAZARD**
>
> If being stored before use, store within the specified environmental conditions.
>
> A Cold Start function erases ALL settings, removes the existing configuration and returns the controller to its original state. To minimize data loss the controller's configuration should be saved using a backup file, before committing a Cold Start.
>
> To minimize any potential loss of control or controller status when communicating across a network or being controlled via a third party master (i.e. another controller, PLC or HMI) ensure all system hardware, software, network design, configuration and cybersecurity robustness have been correctly configured, commissioned and approved for operation.
>
> **Failure to follow these instructions can result in injury or equipment damage.**

Symbols

Various symbols may be used on the controller. They have the following meaning:

⚠ Risk of electric shock.

⚠ Take precautions against static.

⚠ The RCM is a trademark owned by Australian and New Zealand Regulators with RCM mark.

🔟 Complies with the 40 year Environment Friendly Usage Period.

Hazardous Substances

This product conforms to European **R**estriction **o**f **H**azardous **S**ubstances (RoHS) (using exemptions) and **R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emicals (REACH) Legislation.

RoHS Exemptions used in this product involve the use of lead. China RoHS legislation does not include exemptions and so lead is declared as present in the China RoHS Declaration.

Californian law requires the following notice:

⚠WARNING: This product can expose you to chemicals including lead and lead compounds which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to: http://www.P65Warnings.ca.gov

Installation

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⚡ ⚠ DANGER

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Ensure all cables and wiring harness are secured using a relevant strain relief mechanism.

Wiring, it is important to connect the product in accordance with the data in this User Guide and use copper cables (except the thermocouple wiring).

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What's in this Chapter

- A general description of the instrument

- What is in the package

- Order codes

- Instrument dimensions and mechanical mounting

What Instrument Do I Have?
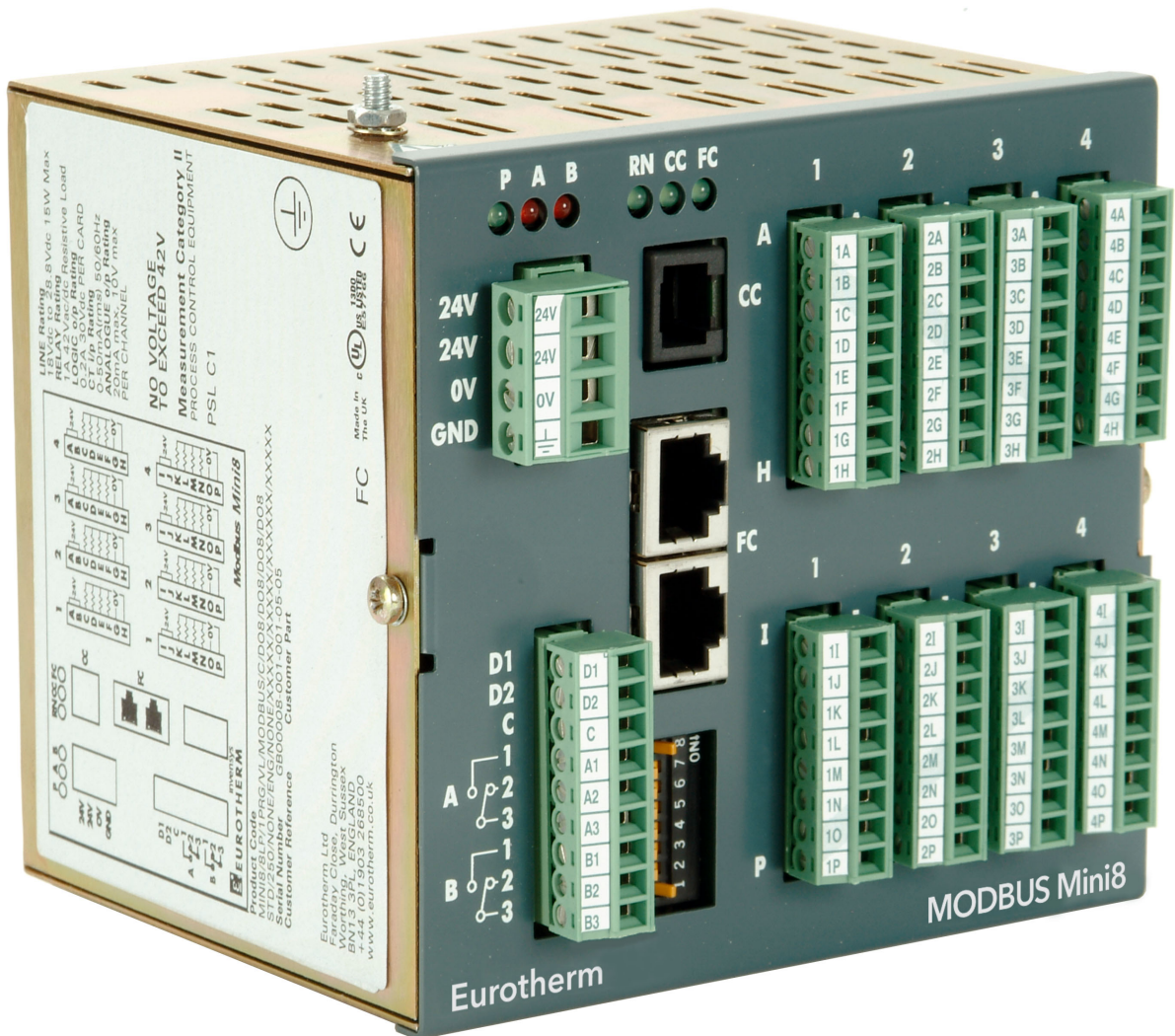
The Mini8 controller is a compact DIN rail mounting multi-loop PID controller and data acquisition unit. It offers a choice of I/O and a choice of field communications.

The Mini8 controller mounts on 35mm Top Hat DIN Rail. It is designed for permanent installation, for indoor use only, and to be enclosed in an electrical panel or cabinet.

The Mini8 controller is pre-assembled in the factory to give the I/O required for the application as specified in the order code. With standard applications the Mini8 controller is also supplied configured. Alternatively, the Mini8 controller is configured using Eurotherm's iTools configuration suite running on a personal computer.

All Safety & EMC information is in the Chapter titled "Safety Notes" on page 17.

The full Technical Specification is in "Technical Specification" on page 354.

Note: Whenever the symbol ☺ appears in this handbook it indicates a helpful hint.

Mini8 Controller Ordering Code

1	Basic Product
MINI8	Mini8 Controller

2	Control Loops
ACQ	IO Acquisition only (not with EC8). No loops enabled.
4LP	4 Control loops
8LP	8 Control loops
16LP	16 Control loops

3	Programs
0PRG	No Programs
1PRG	1 Profile – 50 programs
XPRG	Multi-profile – 50 programs. If four loops are ordered, four programmers are supplied. If 8 or 16 loops are ordered, eight programmers are supplied.

4	PSU
VL	24Vdc

5	Communications
MODBUS	Non Isolated Modbus RTU slave
ISOLMBUS	Isolated Modbus RTU slave
DEVICENET	DeviceNet Slave
PBUSRJ45	Profibus Slave RJ45 (Profibus motherboard fitted)
PBUS9PIN	Profibus Slave 9 pin D type (Profibus motherboard fitted)
ENETMBUS	EtherNet Modbus TCP/IP Slave
	CANopen Slave (no longer available)
DNETMI2	DeviceNet M12 connector slave
ENETIP	EtherNet/IP
ETHERCAT	EtherCAT (Slave) (Available from version V2.7)

6	Temperature Units
C	Centigrade (Celsius)
F	Fahrenheit

7 - 10	IO Slots 1, 2, 3, 4	
XXX	No module fitted	
TC4	Four Channel TC Input	
TC8	Eight Channel TC Input	
ET8	Eight Channel Enhanced TC Input (see Note 1)	
RT4	Four Channel RTD input	
RTT	Four Channel RTD input, Pt1000	
AO4	Four Channel 4-20mA output	(slot 4 only)
AO8	Eight Channel 4-20mA output	Not EC8
DO8	Eight Channel logic output	
CT3	Three Channel CT input (only one CT per Mini8)	
RL8	Eight Channel relay (slots 2, 3 only)	
DI8	Eight Channel logic input	

11	Application	
STD	No configuration (always available)	
EC8	Eight Loop extrusion controller (EC8 is a preconfigured version offering eight control loops with heat/cool logic outputs). Requires 8LP and 250 wires	
	Slot 1 = TC8	Slot 2 = CT3 or None
	Slot 3 = DO8	Slot 4 = DO8
FC8	Eight Loop furnace controller with analog outputs Requires 8LP and 250 wires	
	Slot 1 = TC8	Slot 4 = AO8

12	Wires
30	30 User Wires
60	60 User Wires
120	120 User Wires
250	250 User Wires

13	Recipes
None	No Recipes
RCP	Eight Recipes

14	Manual
ENG	English
FRA	French

15	Configuration Software
NONE	No configuration software
ITOOLS	iTools licence only

16	Warranty
XXXXX	Standard
WL005	Extended

17	Calibration Certificates
XXXXX	None
CERT1	Declaration of Conformity
CERT2	Factory input calibration per input (5 point calibration)

18	Special
XXXXX	No special
YYNNNN	Special number

19	Label
XXXXX	No custom label
YYNNNN	Custom label

Accessories			
SubMini8/Mechanics/Mtgplate	Bulkhead mounting plate	SubMin8/Mechanics/InputCover	Input Cover (see Note 2)
SubMini8/Cable/RJ45/0.5	Network 0.5m RS485 cable	SubMini8/Shunt/249R.1	2.49Ω 0.1% Burden resistor
SubMini8/CD/Std	Config tools and manuals	SubMini8/Resistor/Term/Mbus/RJ45	Modbus load terminator
SubMini8/Cable/Config	Config cable	SubMini8/Resistor/Term/Pbus/RJ45	Profibus load terminator
SubMini8/Manual/Inst	Installation booklet	SubMini8/Cable/RJ45/3.0	Network 3.0m RS485 cable
SubMini8/Manual/Eng	Engineering manual		

Notes:

1. If you are using ET8 modules, ensure that the firmware is at version 3.01 or higher.

2. If an ET8 module is ordered, an Input Cover (Protective Cover) will be supplied with the CJC connectors.

How to Install the Controller

This instrument is designed for permanent installation, for indoor use only, and to be enclosed in an electrical panel.

Select a location where minimum vibrations are present and the ambient temperature is within 0 and 50°C (32 and 122°F).

Dimensions
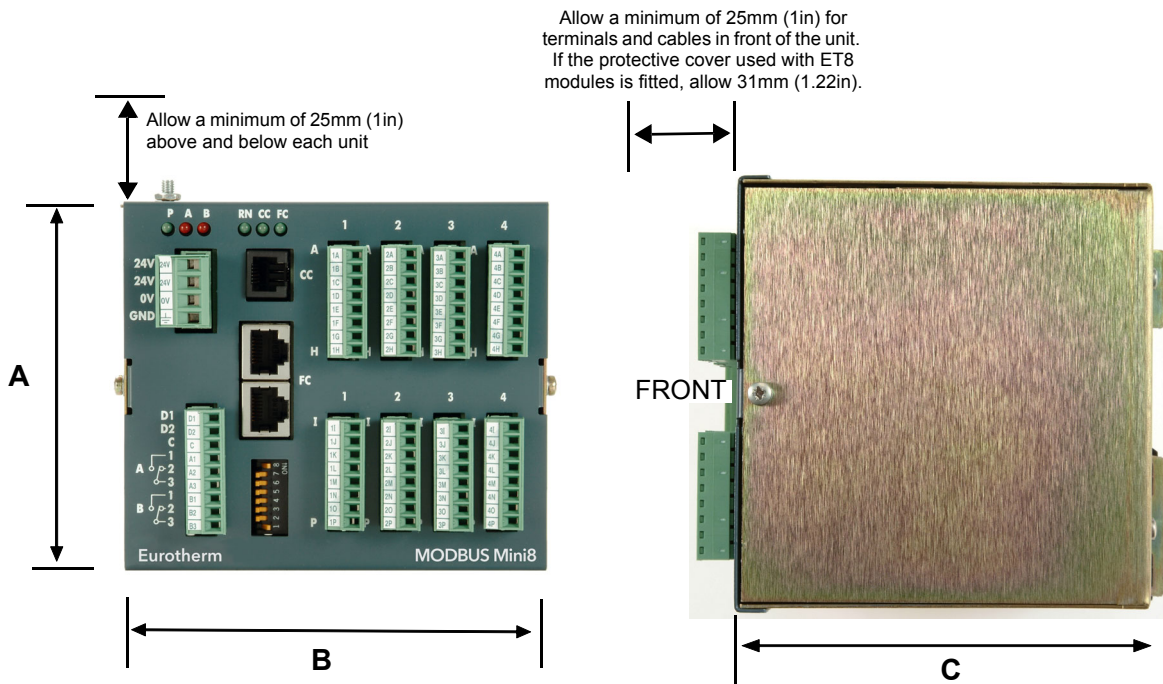
Dimension	mm	in
A	108	4.25
B	124	4.88
C	115	4.53

Figure 1 Mini8 Controller Dimensions

To Install the Controller

Proceed as follows:

1. Use 35mm symmetrical DIN Rail to EN50022-35 x 7.5 or 35 x 15.

2. Mount the DIN Rail horizontally as indicated in Figure 1. The Mini8 controller is NOT designed to be mounted in other orientations.

3. Hook the upper edge of the DIN rail clip on the instrument on the top of the DIN rail and push.

4. To remove use a screwdriver to lever down the lower DIN rail clip and lift forward when the clip has released.

5. A second unit on the same DIN rail may be mounted adjacent to the unit.

6. A second unit mounted above or below the unit requires a gap of at least 25mm (1in) between the top of the lower one and the bottom of the higher one.

7. Allow a minimum of 25mm (1in) for terminals and cables in front of the unit. If the protective cover used with ET8 modules is fitted, allow 31mm (1.22in).

Protective Cover

If at least one ET8 module is fitted, the protective/input cover must be fitted. This provides thermal stability so that the high specification of the ET8 card is met. Figure 2 shows the Mini8 controller with this cover fitted. The image shows the cover mounted with the slot at the bottom, to accommodate alternative cabling requirements, this cover can be mounted with the slot at the top.

Figure 2 View of Mini8 Controller with Protective Cover Fitted

Environmental Requirements

Mini8 controller	Minimum	Maximum
Temperature	0°C (32°F)	55°C (131°F)
Humidity (non condensing)	5% RH	95% RH
Altitude		2000m (6562ft)

Electrical Connections – Common to All Instruments

> ## ⚡ ⚠ DANGER
>
> **HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**
>
> The installer must ensure the mandatory protective ground connection is connected during installation. Connection of this protective ground connection must be made before turning on any power supplying this product.
>
> The Mini8 controller is intended for operation at safe low voltage levels, except the RL8 relay module. Voltages in excess of 42V must not be applied to any terminals other than the RL8 relay module.
>
> **Failure to follow these instructions will result in death or serious injury.**

> ## *NOTICE*
>
> **BATTERY REPLACEMENT**
>
> Do not replace the internal battery. Return to factory if a replacement battery is required.
>
> **Failure to follow these instructions can result in equipment damage.**
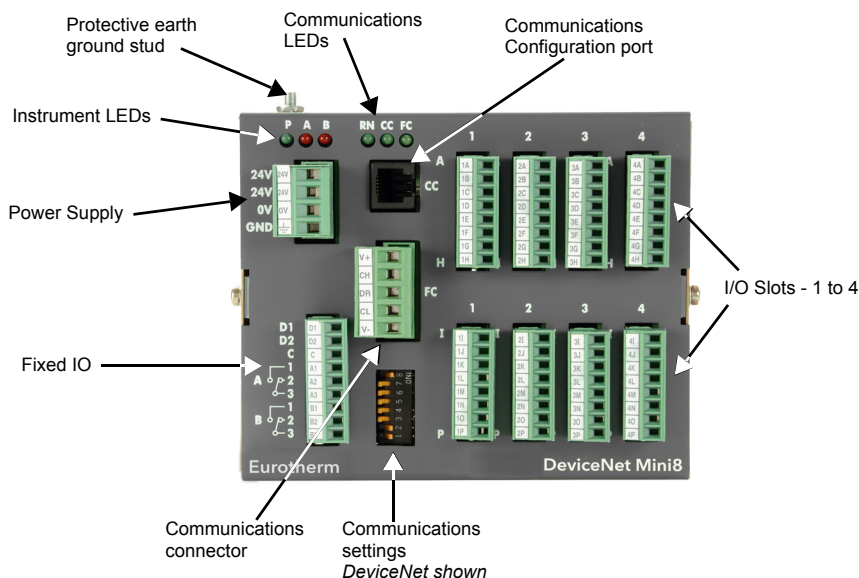
Figure 3 Terminal Layout for Mini8 Controller

Power Supply

The power supply requires a supply between 17.8 to 28.8Vdc, 15W maximum.

Power Supply User Terminals   Power Supply Male Connector

24V	Ø	24V dc
24V	Ø	24V dc
0V	Ø	0V dc
GND	Ø	Ground
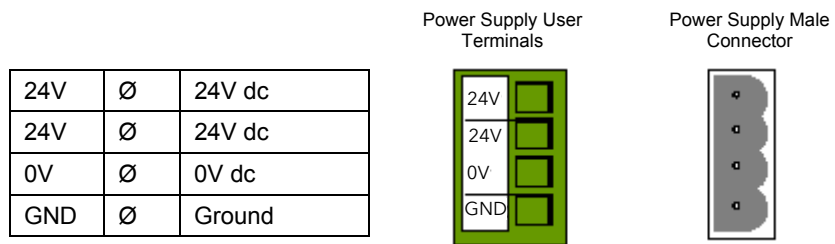
Connector terminals will accept wire sizes from 0.2 to 2.5, 24 to 12 AWG.

NOTICE

USE WITH VT505 PANEL

If the Mini8 is used with the VT505 panel ensure that the power supply connectors cannot be mistakenly changed over. The connectors are physically the same, but the electrical connections are not compatible. Plugging the connector into the Mini8 controller will short-circuit the 24V supply.

Failure to follow these instructions can result in equipment damage.

Fixed IO Connections

These I/O are part of the power supply board and are always fitted.
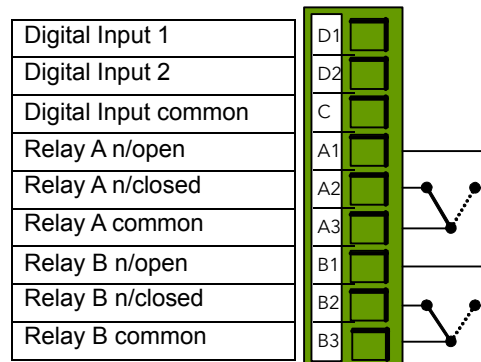
Digital Input 1	D1
Digital Input 2	D2
Digital Input common	C
Relay A n/open	A1
Relay A n/closed	A2
Relay A common	A3
Relay B n/open	B1
Relay B n/closed	B2
Relay B common	B3

Digital Inputs:

• ON requires +10.8V to +28.8V.

• OFF requires -28.8V to +5V.

• +5V to +10.8V is undefined.

• Typical drive 2.5mA at 10.8V.

Relays contacts: 1A max, 42Vdc. These contacts are NOT rated for mains operation.

Digital Communications Connections

Two communications connections are fitted – a Modbus Configuration port (RJ11) and a Fieldbus port.

The Fieldbus is either Modbus (2 x RJ45), DeviceNet, Profibus, EtherNet Modbus TCP (10Base-T) or EtherNet/IP.

Configuration Port (CC)

The configuration port (Modbus) is on an RJ11 socket. It is always fitted just to the right of the power supply connections. It is a point to point EIA-232 connection. Eurotherm supply a standard cable to connect a serial COM port on a computer to the RJ11 socket, part no. SubMin8/cable/config.

9 pin DF to PC COM port (RS232)	RJ11 Pin	Function
-	6	N/C
3 (Tx)	5	Rx
2 (Rx)	4	Tx
5 (0v)	3	0v (gnd)
	2	N/C
	1	N/C (Reserved)

Pin 6

Pin 1
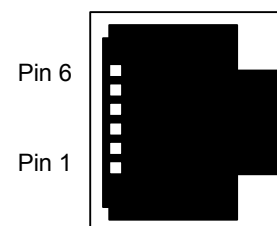
Shielded Communications Cables

Use shielded cables. To reduce the effects of RF interference, ground the transmission line at one end of the shielded cable. However, take care to remove differences in ground potentials allowing circulating currents to flow as these can induce common mode signals in the data lines. Where doubt exists it is recommended that the shield be grounded at only one section of the network. This applies to all communications protocols.

Note: Shielded cables as used for communication connections, such as EtherNet, are connected to the Mini8 case through the RJ45 connector. Take care to avoid ground loops if the body of the Mini8 is grounded.

Electrical Connections for Modbus

For Modbus operation see "Modbus" on page 134.
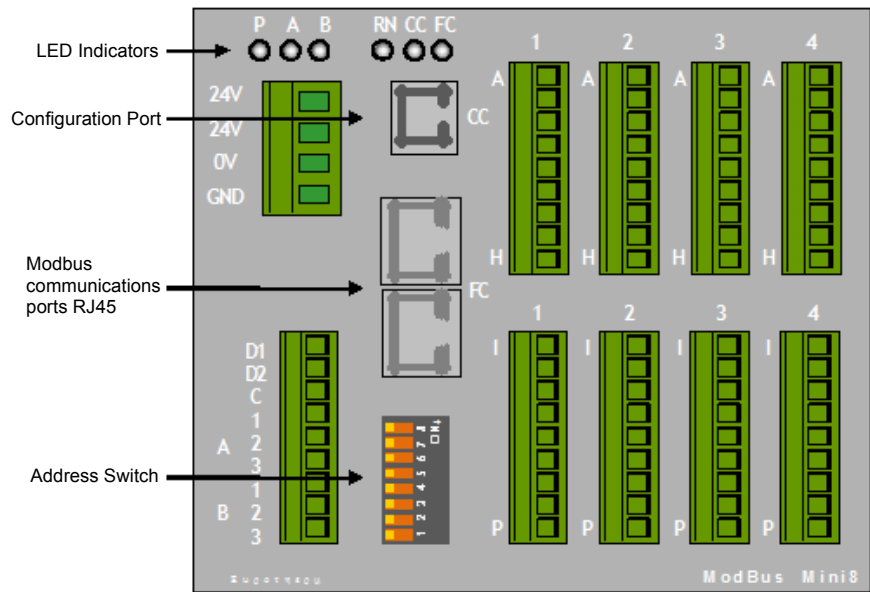
Figure 4 Front Panel Layout Modbus

Modbus Connectors

In the Mini8 controller two RJ45 sockets are provided on the front panel for Modbus connections. One is for the incoming connection to a PC acting as a master, the second may be used either to loop onto the next instrument or for a line terminator, see Figure 10.

The wiring of the RJ45 plug allows both EIA-485 3-wire or EIA-485 4-wire or EIA-422 connections.

To construct a cable for EIA-485/EIA-422 operation use a shielded cable with twisted pairs plus a separate core for common.

RJ45 pin	3-wire	5-wire
8		RxA
7		RxB
6		Ground
5		
4		
3	Ground	Ground
2	A	TxA
1	B	TxB
Plug shroud to cable shield		
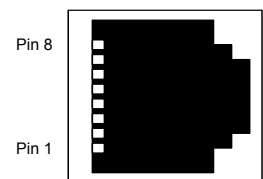
The 2000 series Communications Handbook, part number HA026230, gives further information on digital communications and is available on www.eurotherm.co.uk.

EIA-485

EIA-485 is a standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems. A balanced line consists of two identical conductors, other than ground, to transmit and receive the signal. This is usually referred to as a 2-wire system, or sometimes 3-wire. The two wires consist of a shielded twisted pair of equal length and equal impedances designed to reduce the effects of radiated and received electromagnetic interference. Terminating resistors are required at either end of the transmission line to reduce the effects of reflected signals. The EIA-485 standard is, thus, suited for use over long distances and in electrically noisy environments.

The Mini8 controller also provides connections for EIA-485 4-wire or EIA-422. This system consists of two shielded twisted pairs. One pair is used for transmit and the second for receive. A common is also provided.

One or more devices configured as network slaves may be connected to such a network in a linear, multi-drop configuration as described in "EIA-485 to EIA-232 Converter" on page 34 and "One Master, Multiple Slaves Short Network" on page 34.

Direct Connection – Master and One Slave

It is a common requirement to connect one master and one slave. Termination resistors (RT) are to be installed at both the transmitter end and receiver end of the cable. These are particularly required for long cable runs (e.g. 2m to 200m) although for short local connections it may be found that these are not strictly necessary.

A Modbus terminator is available from your supplier which is designed to fit into the spare RJ45 connector on the Mini8 controller. The order code is SubMin8/RESISTOR/MODBUS/RJ45. It is colored black.

Example 1: Two-wire EIA-485 Connection

For 2-wire both master and slave ends act as Tx and Rx.
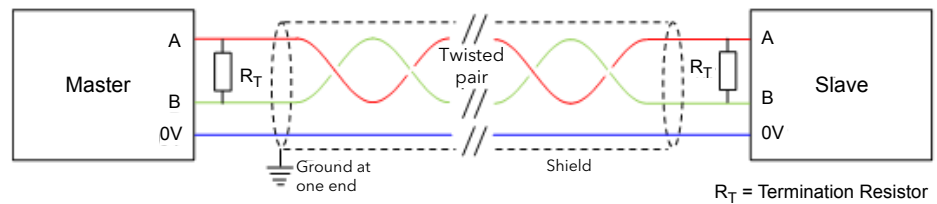
Figure 5 Two-wire EIA-485 Connection

Example 2: Four-wire EIA-485 Connection
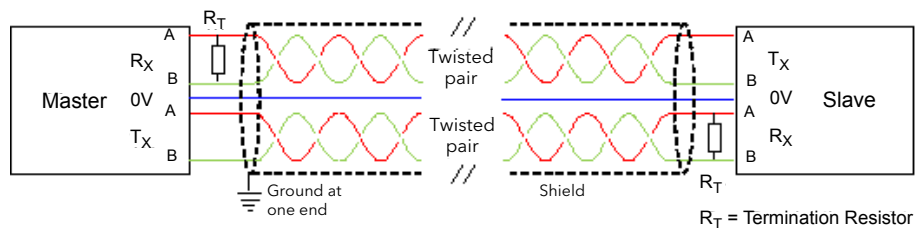
Figure 6 Four-wire EIA-485 Connection

EIA-485 to EIA-232 Converter

In practice it is often necessary to use a buffer to convert EIA-485 (or EIA-422) connections from the Mini8 controller to the serial port of the PC. The Eurotherm Controls KD485 Communications Adapter unit is recommended for this purpose. The use of an EIA-485 board built into the computer is not recommended since this board may not be isolated and the Rx terminals may not be biased correctly for this application. This may cause electrical noise problems or damage to the computer.

To make the connections between the KD485 converter and the RJ45 connection on the Mini8 controller, either create a patch cable and connect the open end to the KD485 converter or, using twin shielded cable, crimp an RJ45 plug on the Mini8 controller end.

Connections for a KD485 converter are shown in the following diagrams.
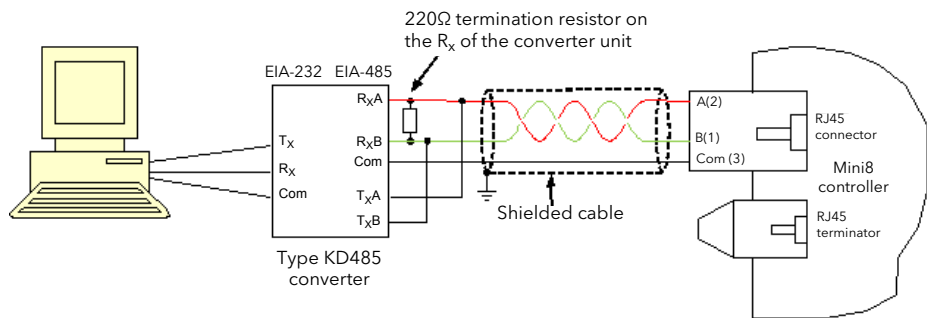
Figure 7 KD485 Communications Converter - 2-wire Connections
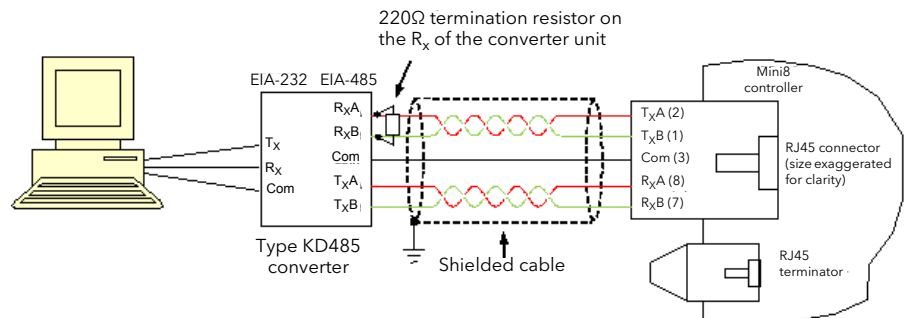
Figure 8 KD495 Communications Converter - 4-wire Connections

The above diagrams assume a serial port on the PC. For a PC using USB a USB to serial converter is required between the PC and KD485.

One Master, Multiple Slaves Short Network

The EIA-485 standard allows one or more instruments to be connected (multi dropped) using a 2-wire or 4-wire connection, with cable length of less than 1200m (3937ft). Up to 31 slaves and one master may be connected. Slaves may be Mini8 controllers or other instruments such as Eurotherm controllers or indicators.

NOTICE
COMMUNICATION LINE PARAMETERS
The communication line must be daisy chained from device to device and, if the communications line is more than around two meters long, it must be correctly terminated. A Modbus terminator containing the correct termination resistors is available from Eurotherm, order code: SubMin8/RESISTOR/MODBUS/RJ45.
Failure to follow these instructions can result in equipment damage.

The Modbus terminator is colored BLACK.
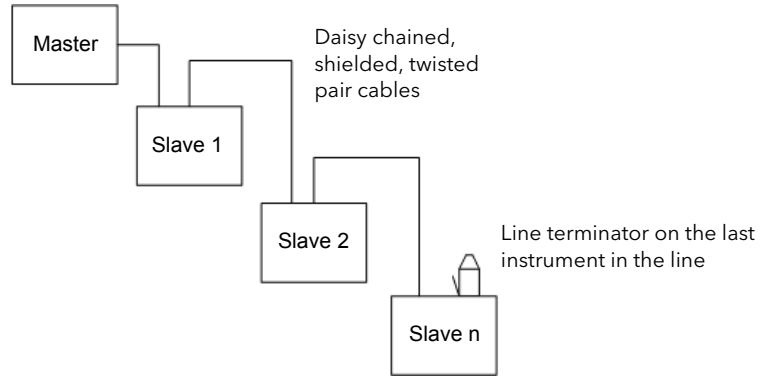
Figure 9 Multiple Slaves - Overview
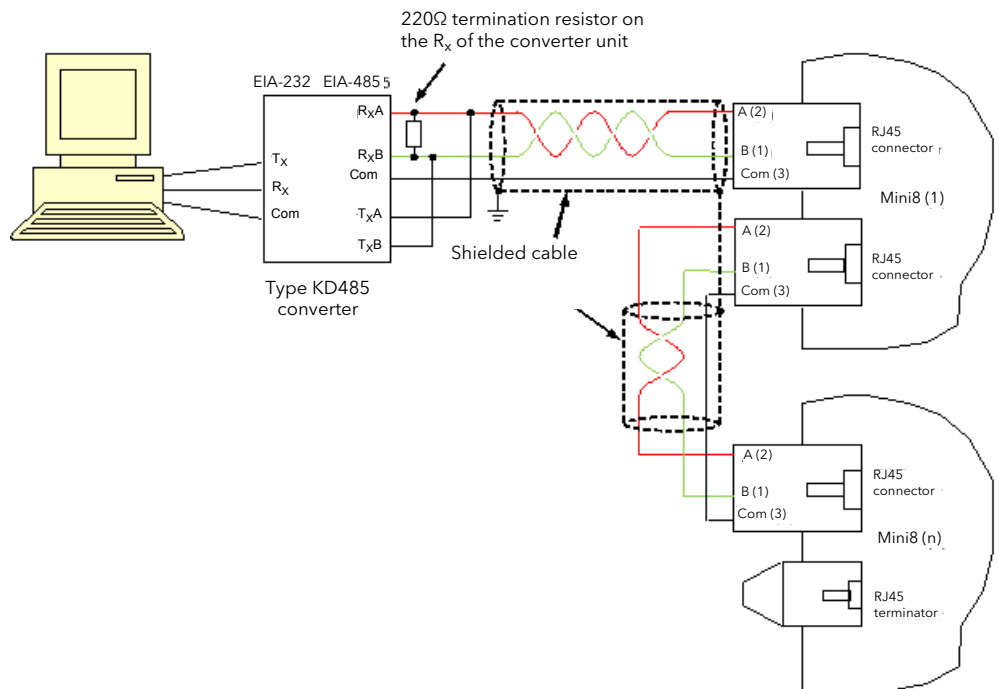
Figure 10 Multiple Slaves - EIA-485 2-wire Connections

Wiring Connections for Modbus Broadcast Communications

The Digital Communications module for the master must be the Field Comms and is only EIA-485/EIA-422. EIA-232 is not available.

The Digital Communications module for the slave can be the Config port (EIA-232 only) or the Field Comms port (not EIA-232).

Standard patch cables cannot be used, as the connections do not 'cross over'. Wire using twisted pair(s) cable and crimp on the appropriate RJ45 or RJ11 plug.

EIA-485 2-wire

Connect A (+) in the master to A (+) of the slave.

Connect B (-) in the master to B (-) of the slave.

This is shown diagrammatically below:
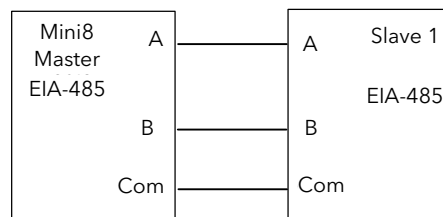
Figure 11 Rx/Tx Connections EIA-485 2-wire

EIA-422, EIA-485 4-wire

Rx connections in the master are wired to Tx connections of the slave.

Tx connections in the master are wired to Rx connections of the slave.
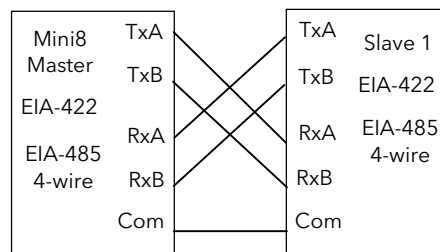
Figure 12 Rx/Tx Connections for EIA-422, EIA-485 4-wire

Electrical Connections for DeviceNet

DeviceNet uses a 5-way, 5.08mm pitch, connector/screw terminal. The DeviceNet bus is powered (24V) from the system network, not from the instrument. The Mini8 controller requirement is a load of around 100mA. For the address switch see "DeviceNet" on page 138.
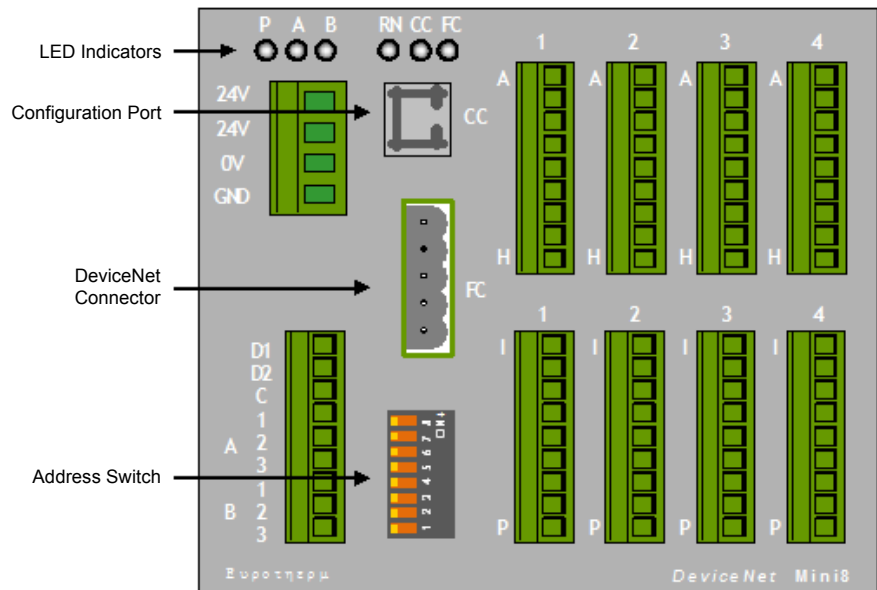
Figure 13 Front Panel Layout DeviceNet

DeviceNet Connector

Pin	Legend	Function
5	V+	V+
4	CH	CAN HIGH
3	DR	DRAIN
2	CL	CAN LOW
1	V-	V-

Mini8 controller Label	Color	Description
V+	Red	Network power positive terminal. Connect the red wire of the DeviceNet cable here. If the network does not supply the power, connect the positive terminal of an external 11-25Vdc power supply.
CAN_H	White	CAN_H data bus terminal. Connect the white wire of the DeviceNet cable here.
SHIELD	None	Shield/Drain wire connection. Connect the DeviceNet cable shield here. To avoid ground loops, ground the network in only one location.
CAN_L	Blue	CAN_L data bus terminal. Connect the blue wire of the DeviceNet cable here.
V-	Black	Network power negative terminal. Connect the black wire of the DeviceNet cable here. If the DeviceNet network does not supply the power, connect the negative terminal of an external 11-25Vdc power supply.

The DeviceNet specification states that the bus terminators of 121Ω should not be included as any part of a master or slave. They are not supplied but should be included in the cabling between CAN_H and CAN_L where required.

Network Length

Network length depends on Baud rate:

Network Length	Varies w/speed, up to 4000m possible w/repeaters		
Baud Rate	125bps	250bps	500bps
Thin trunk	100m (328ft)	100m (328ft)	100m (328ft)
Max drop	6m (20ft)	6m (20ft)	6m (20ft)
Cumulative drop	156m (512ft)	78m (256ft)	39m (128ft)

Typical DeviceNet Wiring Diagram
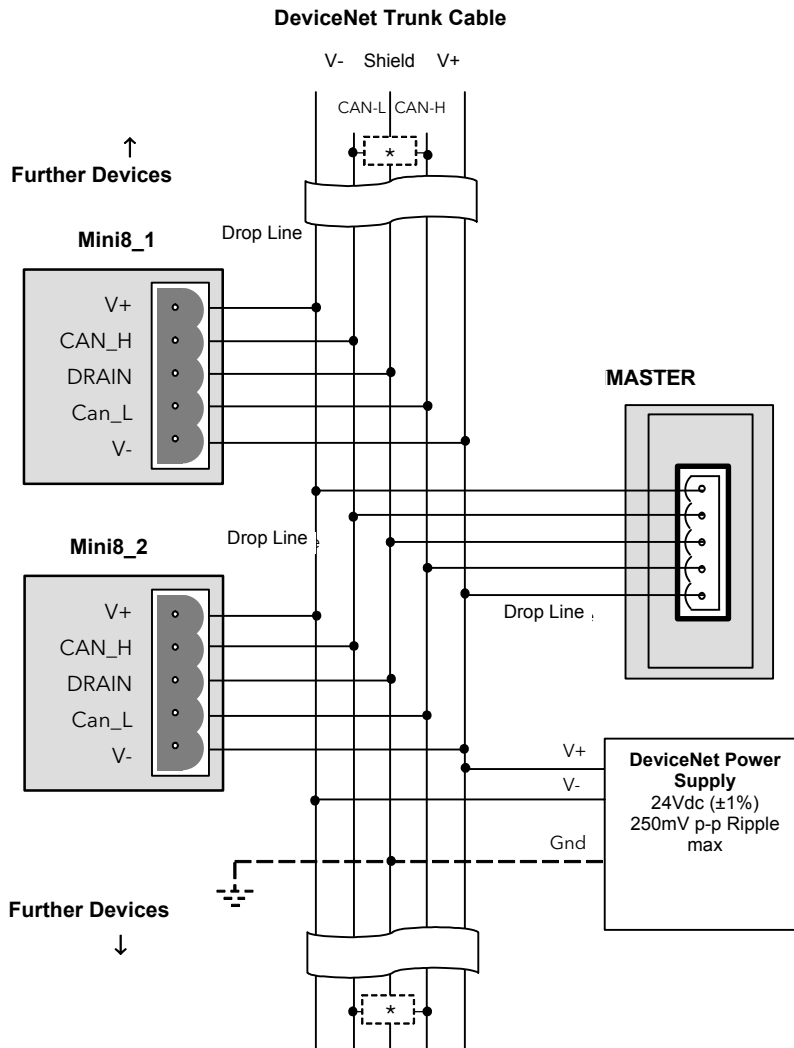
* 121Ω 1% 1/W terminating resistor must be connected across the blue and white wires at each end of the DeviceNet trunk cable.

Note: this resistor is sometimes included in the master or other devices but should only be switched into circuit on the last device on the trunk cable.

Notes:

1. The DeviceNet network is powered by an external independent 24V supply which is separate from the internal powering of the individual controllers.
2. Power taps are recommended to connect the DC power supply to the DeviceNet trunk line.

Power taps include:

•   A Schottky diode to connect the power supply V+ and allows for multiple power supplies to be connected.

- Two fuses or circuit breakers to help protect the bus from excessive current which could damage the cable and connectors.

- The ground connection, HF, to be connected to the main supply ground terminal at one point only.

See also the DeviceNet Communications Handbook HA027506.

Electrical Connections for Enhanced DeviceNet Interface

This version of DeviceNet has been added for use in the Semiconductor industry. Configuration for both versions is the same and is described in the DeviceNet Handbook HA027506 which can be downloaded from www.eurotherm.com. The Enhanced DeviceNet interface uses a different connector, as described below, but cabling, cable specification and termination are the same as described in the previous section.
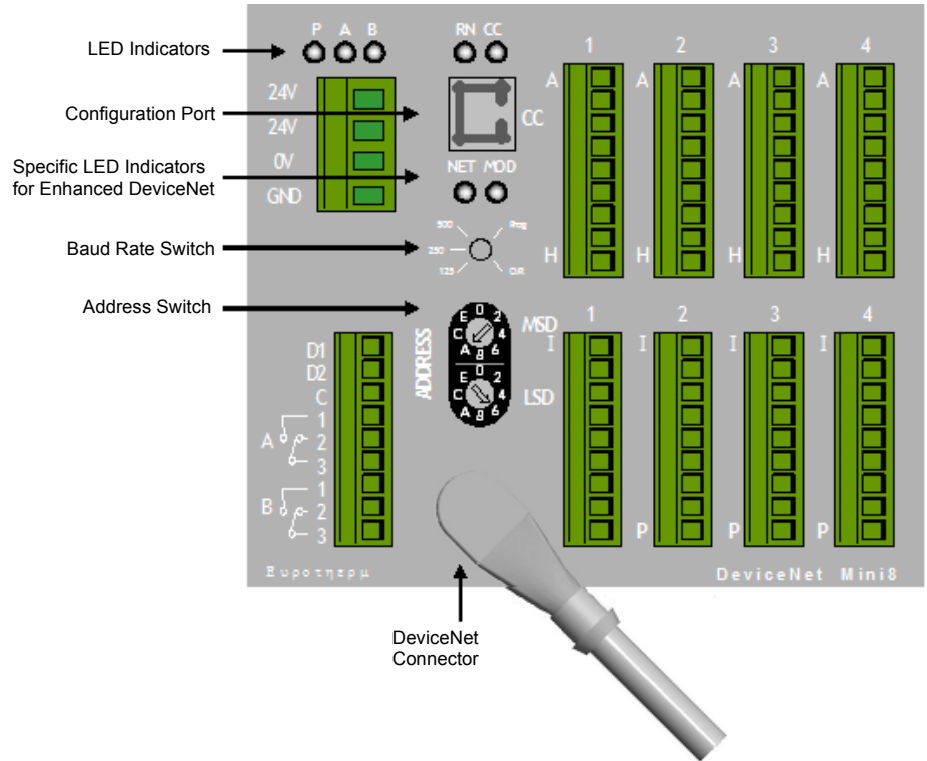
Figure 14 Enhanced DeviceNet Panel Layout

Enhanced DeviceNet Connector

The 5-way connector shown in the previous section is replaced by a 'Micro-Connect' circular 5-pin M12 male connector mounted in the module.

Pin	Legend	Function
5	CAN_L	CAN LOW
4	CAN_H	CAN HIGH
3	V-	V-
2	V+	V+
1	DR	DRAIN

View from front
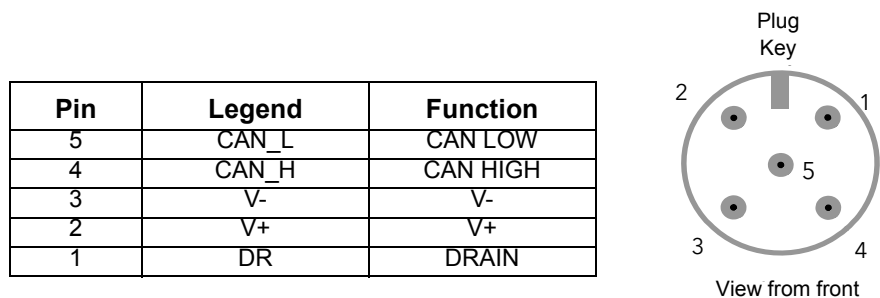
Switches and LED Indicators

The Enhanced DeviceNet interface also uses different Module and Network Status indicators, address and baud rate switches. To set the Address and Baud Rate, see"Enhanced DeviceNet Connector" on page 40. For Module and Network Status indication see "Status Indication for Enhanced DeviceNet" on page 51.

Electrical Connections for Profibus DP

Two Profibus communications board options are available for the Mini8 controller.

1. Standard Profibus 3-wire EIA-485 9-pin D connector for installation using standard Profibus cabling.

Note: In this arrangement line terminations must be catered for in the cabling.

2. Profibus 3-wire EIA-485 via two paralleled RJ45 sockets. The front panel layout for this version is the same as Modbus (Figure 4). Instruments may be daisy chained in the same way as shown in the Modbus sections using suitable RJ45 cables and the RJ45 termination plug to terminate the line.
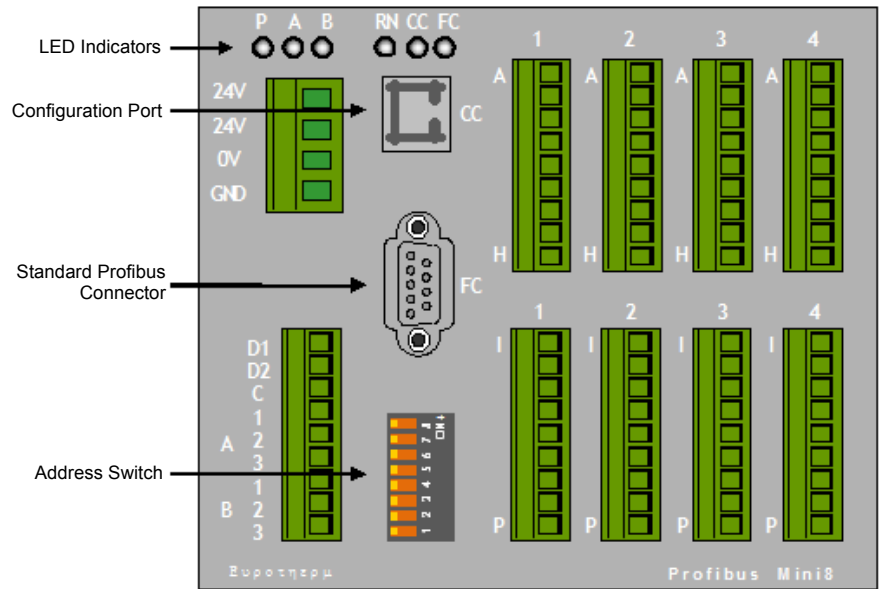
Figure 15 Profibus Panel Layout - Standard D Connector

Profibus Interface (D-Type Connector)

Connector: 9-Way D-Type, R/A, Female, 4-40 UNC Studs:

Pin	Function
1	Shield (Case)
2	N/C
3	**RxD/TxD+ P (B)**
4	N/C
5	GND (0V)
6	VP (+5V)
7	N/C
8	**RxD/TxD- N (A)**
9	N/C

Include terminations in the cabling as follows:
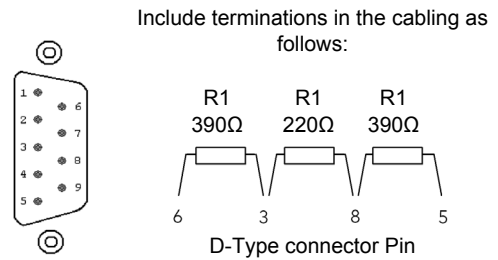
Profibus Interface (RJ45 Connector)

Connector: Two RJ45, parallel connected (for daisy-chain):

Pin	3-Wire
8	(do not use)
7	(do not use)
6	VP (+5V)
5	
4	
3	GND
2	RxD/TxD+ P (B)
1	RxD/TxD- N (A)

One connector may be used to terminate line using SubMini8/Term/Profibus/RJ45

This terminator is colored gray
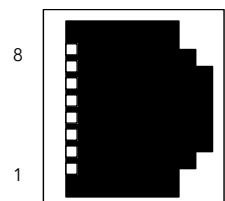
Electrical Connections for EtherNet (Modbus TCP)

The EtherNet connection uses standard Cat5e patch cables (RJ45). These would be used with a 10Base-T hub to create a network.

A crossover patch cable may be used 'point-to-point' that is, to connect a single instrument directly to a PC.
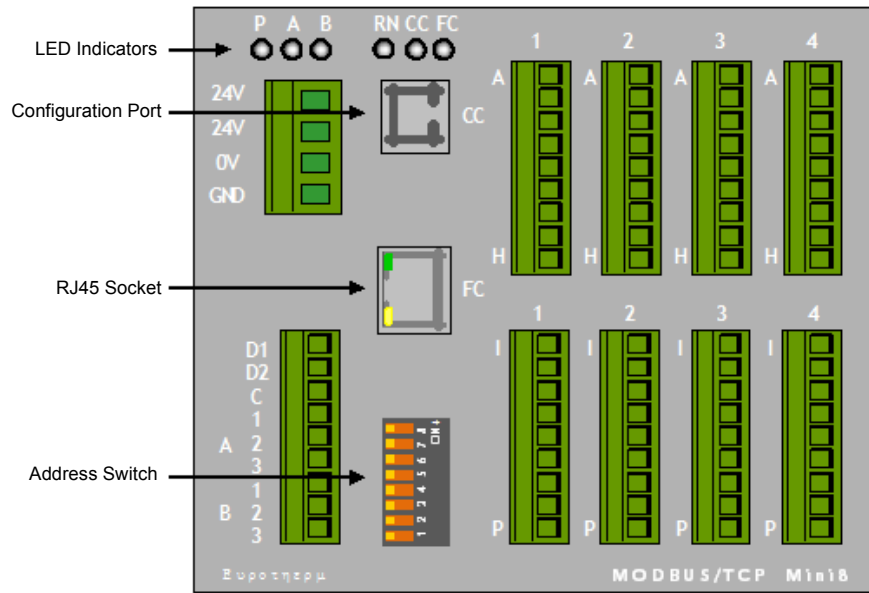
Figure 16 EtherNet Front Panel Layout

Connector: RJ45

Pin	Function
8	
7	
6	RX-
5	
4	
3	RX+
2	TX-
1	TX+

Network activity (yellow)

Controller communicating (green)
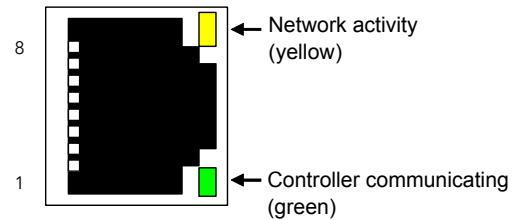
Electrical Connections for EtherNet/IP
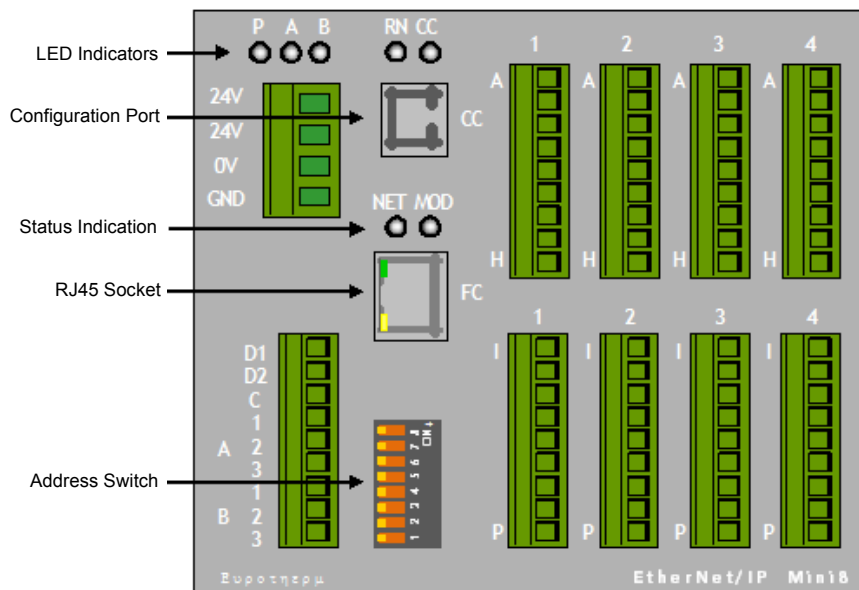
Figure 17 EtherNet/IP Front Panel Layout

Connector: RJ45

This is the same as the connector shown in Connector: RJ45, above.

Pin	Function
8	
7	
6	RX-
5	
4	
3	RX+
2	TX-
1	TX+
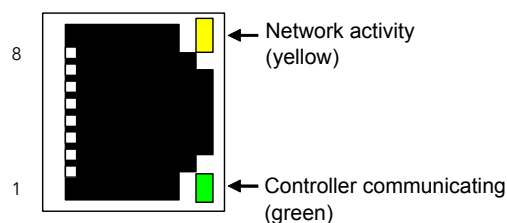
Note: Use shielded cable, see "Shielded Communications Cables" on page 31 for further details.

Electrical Connections for EtherCAT

EtherCAT stands for 'Ethernet for Control Automation Technology'. A further description is given in "EtherCAT" on page 161.

The EtherCAT slave uses full duplex Ethernet physical layers. EtherCAT slaves can be daisy-chained using RJ45 sockets in a wide variety of network topologies.
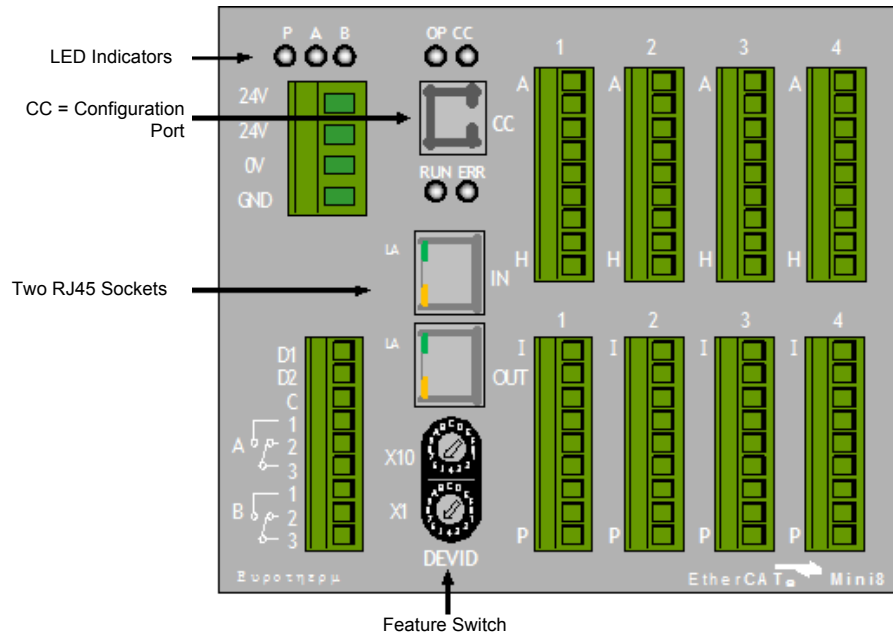
Figure 18 EtherCAT Front Panel Layout

Connector: RJ45

This is the same as the connector shown in Connector: RJ45, above.

Pin	Function
8	
7	
6	RX-
5	
4	
3	RX+
2	TX-
1	TX+
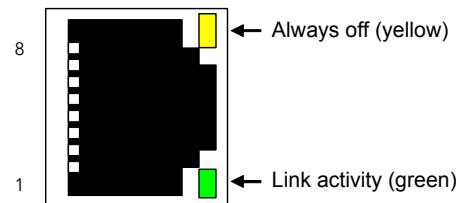
Notes:

1. Use shielded cable, see Shielded Communications Cables for further details.

2. Where EtherCAT is used in a network, switches/hubs must be EtherCAT compatible.

Electrical Connections for Thermocouple Input TC4, TC8 and ET8

The TC8 and ET8 thermocouple modules both take eight thermocouples (TC1 to TC8 on terminals A to P).

The TC4 module takes four thermocouples (TC1 to TC4 on terminals A to H).

They may be placed in any slot in the Mini8 controller.

Up to four thermocouple modules may be fitted in a Mini8 controller.

Each input can be configured to any thermocouple type or a linear mV input.

Notes:

1. Configuration of Mini8 Controller is performed using 'iTools' configuration suite running on a PC.

2. If you are using ET8 modules, ensure that the firmware is at version 3.01 or higher.

3. If ET8 modules are fitted, also fit the supplied protective cover for thermal stability.

See subsequent chapters in this manual and specifically Example 1 given in "The I/O" on page 69 for further information.
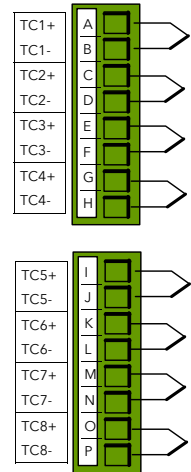
Electrical Connections for RTD

The RT4 module provides four RTD / Pt100 or four RTD / Pt1000 inputs for 2, 3 or 4 wire connections.

Each input can be configured for Pt100 standard linearization or Pt1000 standard linearization. When configured for Pt100 the input will accept up to 420Ω. When configured for Pt1000 the input will accept up to 4200Ω.

Up to four modules may be fitted in a Mini8 controller and they may be placed in any slot.

Note: Configuration of Mini8 Controller is performed using 'iTools' configuration suite running on a PC.

See subsequent chapters in this manual and specifically Example 2 given in "The I/O" on page 69 for further information.

☺ Tip:

Spare RT4 input channels may be configured as mA inputs using a 2.49Ω resistor, order code: SubMini8/resistor/Shunt/249R.1 and setting the Resistance Range to Low (see "Using RT4 as mA input" on page 108.)
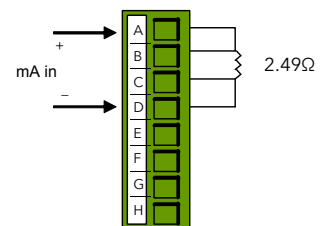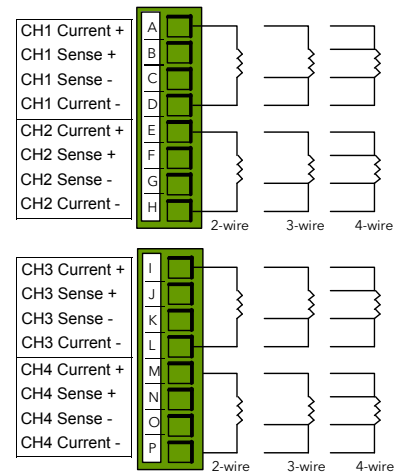
Electrical Connections for Logic Input DI8
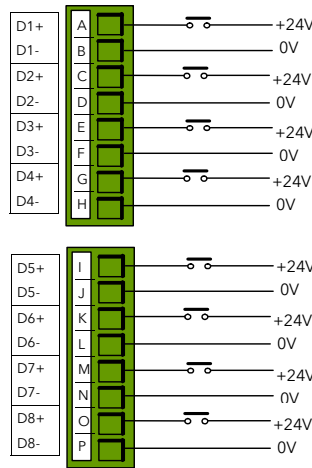
The DI8 module provides eight logic inputs.

They may be placed in any slot in the Mini8 controller.

Up to four modules may be fitted in a Mini8 controller.

Digital Inputs:

• ON requires +10.8V to +28.8V.

• OFF requires -28.8V to +5V.

• +5V to +10.8V is undefined.

• Typical drive 2.5mA at 10.8V.

Electrical Connections for Logic Output DO8
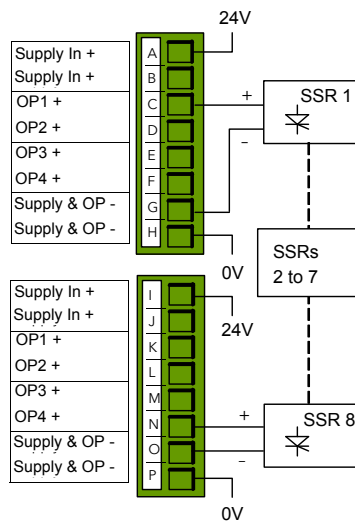
The DO8 module provides eight logic outputs.

They may be placed in any slot in the Mini8 controller.

Up to four may be fitted in a Mini8 controller.

Each output can be configured to Time Proportioning or On/Off.

Supply In + (A,B,I,J) are all linked internally.

Supply In – (G,H,O,P) are all linked internally.

Electrical Connections for Inductive Loads
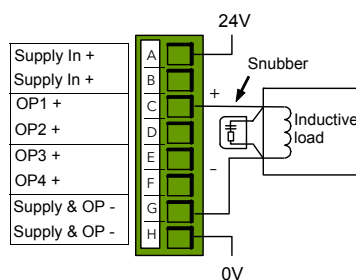
This section applies if logic outputs are used to switch inductive loads.

Some inductive loads may produce a large back EMF when switching off. If the back EMF is >30V this may cause damage to the switching transistor in the module.

For this type of load it is recommended to add transient suppressors or 'snubbers' across the coils as shown. A snubber typically consists of a 15nF capacitor in series with a 100Ω resistor.

Snubbers are available to order from your supplier by quoting part number SUB32-snubber.

It is the user's responsibility to determine the type of load which is to be used.

Electrical Connections for Relay Output RL8

The RL8 module provides eight relay outputs.

Note: Up to two modules may be fitted and in slots 2 and/or 3 only.

Relay contacts for full contact life:

- Maximum 264Vac 2A with snubber fitted.

- Minimum 5Vdc, 10mA

Snubbers are used to prolong the life of relay contacts and to reduce interference when switching inductive devices such as contactors or solenoid valves. If the relay is used to switch a device with a high impedance input, no snubber is necessary.

All relay modules are fitted internally with a snubber since these are generally required to switch inductive devices. However, snubbers pass 0.6mA at 110V and 1.2mA at 230Vac, which may be sufficient to hold on high impedance loads. If this type of device is used it will be necessary to remove the snubber from the circuit.

The relay module has to be removed from the instrument, see "Adding or Replacing an IO Module" on page 48. The snubber is removed from the relay module by inserting a screwdriver into one of the pair of slots either side of the track of each snubber network. Twist the screwdriver to break out this track between the slots.

This action is not reversible.
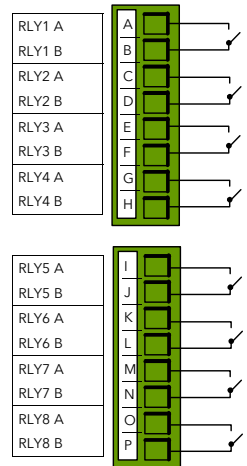
Electrical Connections for Analog Output AO4 and AO8

The AO8 modules provides eight analog outputs and the AO4 provides four analog outputs.

Each output is configurable within 0 to 20mA, max load 360Ω.

The AO4 offers OP1 to OP4 on terminals A to H.

Note: Only one module may be fitted and in slot 4 only.

☺ Tip:

A 0 to 10V output can be obtained by scaling the drive to 0 to 10mA and fitting an external 1kΩ resistor (for example). Low load impedance may alter the results but this can be corrected by adjusting the output range accordingly.
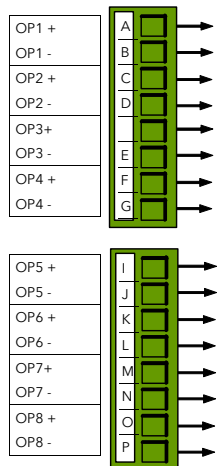
Electrical Connections for Current Transformer Input Module CT3
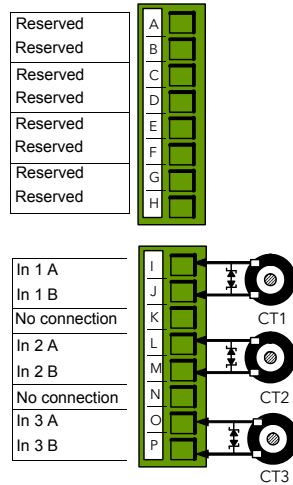
This provides inputs for three current transformers.

The heater load cables are threaded through the transformers.

Each input is 50mA max into 5Ω.

The current transformers provide channel isolation; there is no channel-to-channel isolation in the module.

It is recommended that the current transformer is fitted with a voltage limiting device such as two back-to-back zener diodes between 3 and 10V, rated for 50mA.

There are three CT inputs, one for each phase. Up to a maximum of 16 heaters may be threaded through the CTs but with a further limit of six heater wires through each individual CT.

See "Current Monitor" on page 111 for typical circuit arrangements.

Adding or Replacing an IO Module

⚠ WARNING

STATIC-SENSITIVE DEVICES

Modules contain static sensitive electronic devices. Take full antistatic protection when replacing modules by working on a grounded mat with a grounded wrist strap. Avoid touching components, keep fingers on the green connectors or the edge of the printed circuit boards.

Failure to follow these instructions can result in equipment damage.
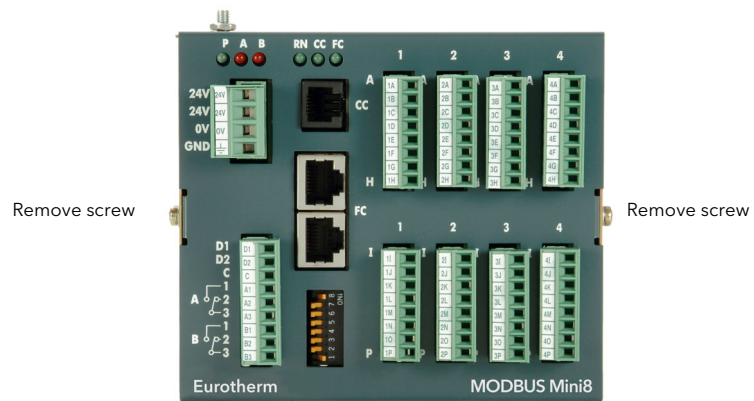
Figure 19 Mini8 controller Cover Retaining Screws

1. Remove all connectors.

2. Remove the two screws indicated above.

3. Remove the cover.

4. If removing a module, gently prise it out using the green connectors.

5. Insert the new module carefully using the guides on the side of the case to

help to line up the lower connector with its mate on the motherboard. This requires great care as the guides provide mechanical support rather than being plug in guides.

6. Once you are certain the two connectors are lined up, push the module gently into place. Do NOT force.

7. Replace cover and the two cover screws.

8. Replace all connectors onto their correct modules.

Mini8 Controller LED Indicators

LED indicators P, A and B are common to all Mini8 controllers and indicate the power and the state of the output relays as shown in the following table.
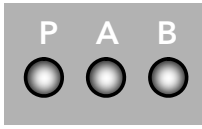
	P	A	B
Color	Green	Red	Red
OFF	Power off	Relay A De-energized	Relay B De-energized
ON	Power on (24V)	Relay A Energized	Relay B Energized

LED indicators RN (OP for EtherCAT) and CC are common to all Mini8 controllers and show the status of the Mini8 controller and communications activity.

FC is replaced by Network and Module Status LEDs when DeviceNet or EtherNet/IP communications modules are fitted.
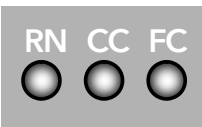
	RN	CC	FC		
			Modbus/ Profibus	**DeviceNet**	**Ethernet**
Color	Green	Green	Green	Green	Green
Function	Run mode	Configuration activity (EIA-232)	Field comms activity	Status	Field comms activity
OFF	Not running	--	Offline	Offline	No port traffic
Flashing	Standby	Config traffic	Traffic	Ready	Port traffic excluding local housekeeping
ON	Running	--		Connected	

Notes:

1. The Modbus/EtherNet/EtherCAT connector itself has two in-built LEDs (see "Electrical Connections for EtherNet (Modbus TCP)" on page 42, "Electrical Connections for EtherNet/IP" on page 43, and "Electrical Connections for EtherCAT" on page 44).

2. The Mini8 controller is controlling normally ONLY if the green RN LED is permanently ON.

3. In iTools the parameter 'Comms Network Status' is available enumerated as shown in the following table. The enumerations correspond to the FC indicator as shown in the final column:

'Status' Parameter Enumeration	Meaning	Corresponding FC LED
RUNNING (0)	Network connected and running	On
INIT (1)	Network initializing	Off
READY (2)	DeviceNet traffic detected but not for this address	Flashing
OFFLINE (3)	No DeviceNet traffic detected	Off

Status Indication for Enhanced DeviceNet
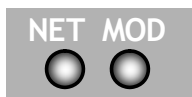
NET   MOD

If an Enhanced DeviceNet module is fitted (see "Electrical Connections for Enhanced DeviceNet Interface" on page 40), two bi-color LEDs are used to indicate Module and Network status.

These two LEDs replace the single LED shown as FC on other modules, see previous section.

Module Status Indication

The module status LED (MOD) has the functionality shown below:

LED State	Device State	Description
OFF	Off	No power applied to DeviceNet network.
Green/Red flashing	Self test	Irregular flash: LED power-up test. Regular flash: Interface module initializing. If the LED remains in this flashing state indefinitely, check the Baud rate switch setting.
Green ON	Operational	DeviceNet interface is operational.
Red ON	Unrecoverable fault detected	Mini8 Controller not powered. Non-volatile memory checksum incorrect.
Red/off flashing	Recoverable fault detected	Communication problem detected between the network and the DeviceNet module.

Network Status Indication

The network status LED (NET) indicates the status of the DeviceNet communications link as shown in the table below.

Note: The final column shows the enumerated values for the 'Comms Network Status' parameter available in iTools.

LED State	Network State	Description	'Status' Parameter Enumerations
OFF	Off	Module is not on line	OFFLINE (10)
Green flashing	On-line, not connected	Module is on line but has no connections established	READY (11)
Green ON	On-line and connected	Module is on line and has connections established	ONLINE (12)
Red flashing	Connection timed out	One or more connections have timed out	IO TIMEOUT (13)
Red ON	Critical communication problem detected	Communication problem detected that results in the device being incapable of communicating on the network	'LINK FAIL' (14)
Green/Red	Communications problem detected	Communications problem detected but the device has received an 'Identify Communication Faulted' Request	'COMM FAULT' (15)

Status Indication for EtherNet/IP

NET   MOD
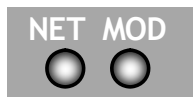
If an EtherNet/IP module is fitted (see "Electrical Connections for EtherNet/IP" on page 43) two bi-color LEDs are used to indicate Module and Network status.

These two LEDs replace the single LED shown as FC on other modules, see previous section.

Module Status Indication

The module status LED (MOD) has the functionality shown below:

MOD LED State	Description
OFF	Module has no power
Flashing green	Module is not configured
Steady green	Module is on line and operating correctly
Flashing red	Module has detected a minor recoverable issue
Steady red	Module has detected a major non-recoverable issue
Flashing green and red	Module is performing power up testing

Notes:

1. MOD LED flashing red can indicate the following:

    ○   DHCP server is unavailable.

    ○   EtherNet link is lost.

    ○   Invalid sub net mask.

    ○   Invalid IP Address.

    ○   Explicit message incorrect. For example, bad parameter address, writing to a read-only parameter, and so on.

2. MOD LED steady red can indicate:

    ○   Internal problem – return to your supplier for service.

Network Status Indication

The network status LED (NET) indicates the status of the EtherNet/IP communications link as shown in the table below.

Note: The final column shows the enumerated values for the 'Comms Network Status' parameter available in iTools.

NET LED State	Mnemonic	Description	'Status' Parameter Enumerations
OFF	Off	Module is not on line	20 OffLine
Flashing Green	No connections	Module is on line but has no EtherNet/IP connections established	21 NoConns
Steady Green	Online	Module is on line and has at least one EtherNet/IP connection established	22 OnLine
Flashing Red	Connection timeout	A connection has timed out	23 Timeout
Steady Red	Duplicate IP	A duplicate IP address has been detected	24 DupIP
Flashing Green/Red	Initialization	Module is initializing	25 Init

Status LEDs for EtherCAT

OP CC

RUN ERR
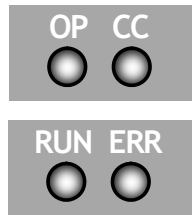
If an EtherCAT module ("Electrical Connections for EtherCAT" on page 44) is fitted, the status of the module is indicated by four LEDs which have the meanings listed below:

'OP' – Mini8 Run Status Indication

Note: This indicator is equivalent to 'RN' in other protocols.

LED State	Color	State Name	Description
On	Green	Mini8 run mode	The device is running normally
Off		Not running	
Flashing	Green	Standby	

'CC' - Configuration Port Status Indication

Note: This indicator is the same as in other protocols.

LED State	Color	Description
Flashing	Green	EIA-232 configuration port activity
Off		Configuration inactive
On	Green	Not applicable

'RUN' – EtherCAT Slave Run Status Indication

LED State	Color	Slave State	Description
Off		'Initialization'	The device is in state 'INIT'
Flashing	Green	'Pre-Operational'	The device is in state 'PRE OPERATIONAL'
Single Flash	Green	'Safe-Operational'	The device is in state 'SAFE OPERATIONAL'
On	Green	'Operational'	The device is in state 'OPERATIONAL'
Flashing	Green	'Initialization' or 'Bootstrap'	The device is booting and has not entered the INIT state, or: The device is in state bootstrap. Clone download operation in progress.

'ERR' – Status Indication

LED State	Color	Status	Description
Off		Normal operation	
On	Red	Communication problem detected	No communication with the Mini8 controller
Double flash	Red	EtherCAT Process Data watchdog timeout	Communication with EtherCAT master has been lost
Single flash	Red	Local issue detected	The EtherCAT comms has changed the EtherCAT state autonomously
Flashing	Red	Invalid configuration	Mini8 controller and EtherCAT master configuration do not match

Using the Mini8 Controller

The Mini8 controller does not have a display. The only means of configuring it, and of interfacing with it during normal operation, is via digital communications.

The auxiliary communications port CC (RJ11) gives a Modbus interface, usually connected to iTools, for configuration and commissioning.

The main communications port, FC, offers Modbus, DeviceNet, Profibus, EtherNet TCP, EtherNet/IP,or EtherCAT and is normally connected to the system of which the Mini8 controller is a part. It is the means by which the Mini8 controller is operated.

Below are ways the Mini8 controller may be used in a system. iTools is the preferred PC-based solution. The Modbus single register addressing is preferred for Operator panels and PLCs where floating point may not be available or necessary. Some parameters may also be read this way as floats or long integers.

iTools

iTools offers a PC-based solution. The iTools suite allows configuration, commissioning, trend graphs and logging with OPC Scope, Program Editing, Recipes and User pages with View Builder.

iTools OPC Open server

With an OPEN OPC server running on a PC all the Mini8 controller parameters are available to any third party package with an OPC client. The advantage of this is that all the parameters are addressed by name – the iTools OPC server handles all the physical communication addresses. An example would be with Wonderware inTouch using OPCLink. In this situation the user would not have to know any of the parameter addresses, and would just select a parameter by browsing through the namespace.

For example, Eurotherm.ModbusServer.1.COM1.ID001-Mini8.Loop.1.Main.PV.

Modbus, Single Register, SCADA addressing

The key parameters of the Mini8 controller are available at a fixed single 16-bit register address, independent of its configuration. These can be used with any device with a serial Modbus master. The parameters are listed in full with their addresses in "Modbus SCADA Table" on page 286.

By default, iTools displays the SCADA address of those parameters which are available.
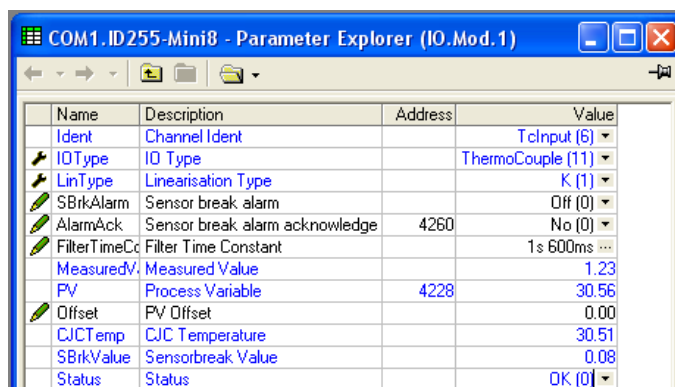
Figure 20 iTools Parameter Explorer showing SCADA addresses

As shown, not all the parameters within the instrument are available. If other parameters are required they can be obtained by using the Commstab folder. This allows up to 250 other parameters to be made available using indirection addressing. This is explained in "Modbus SCADA Table" on page 286.

Also note that in this area the resolution (number of decimal points) has to be configured and the serial Master has to scale the parameter correctly.

Modbus (Floating Point)

If the application requires the extra resolution, the Commstab folder also offers an alternative solution where a parameter can be indirectly addressed and communicated either as a floating point or as a double integer value – its 'Native' format. This can be used with any device, for example, PC or PLC, with a serial Modbus master, able to decode a double register for floating point numbers and long integers. See "Modbus SCADA Table" on page 286.

Fieldbus

The Mini8 controller may be ordered with the option of DeviceNet, Profibus, EtherNet/IP, or EtherCAT.

DeviceNet comes pre-configured with the key parameters of eight PID loops and alarms (60 input parameters process variables, alarm status, and so on and 60 output parameters – setpoints, and so on). Loops 9-16 are not included in the DeviceNet tables as there are insufficient attributes for the DeviceNet parameters. See "DeviceNET Parameter Tables" on page 336.

Profibus is set up using a GSD editor included on the iTools DVD. The GSD editor sets up the instrument parameters that are required to be communicated with the master.

EtherNet (Modbus TCP)

The Mini8 controller may be ordered with an EtherNet connection (10Base-T) running ModbusTCP as the protocol. An instrument can therefore have a unique identity on the EtherNet network as well as a unique Modbus address for the Modbus master.

Mini8 Controller Execution

The nominal update of all inputs and function blocks is 110ms. However, in complex applications the Mini8 controller will automatically extend this time in multiples of 110ms.

For example, eight simple heat/cool loops each with two alarms (40 wires) will run at 110ms, while the full EC8 configuration will run at 220ms because of the extra wiring and functionality.

The communications traffic will also have some effect on the update rate.

For example, an application using every function block and all 250 wires will run at 220ms with light communications traffic but may be slowed to 330ms with heavy traffic.

Note: As loading changes, the sample rate may increase or decrease automatically. To recover to a faster sample rate, the Mini8 controller must be running consistently with processing power to spare for at least 30s.

The iTools Operator Interface

Much of this manual is about configuring the Mini8 controller with iTools. However iTools also provides a commissioning tool and can be used as a long-term operator view.

First it is necessary to go 'on-line' to the Mini8 controller(s). This assumes the communication ports have been wired up to the COM port on the iTools computer (see "Digital Communications" on page 132).

Scanning

Open iTools and, with the controller connected, press [Scan] on the iTools menu bar. iTools will search the communications ports for recognizable instruments. Controllers connected using the RJ11 configuration port or with the configuration clip (CPI), may be found at address 255 (as a single point-to-point connection) or on a multidrop EIA-485 or EIA-422 network will be found at the address configured in the controller.

The iTools handbook, part no. HA028838, provides further step by step instructions on the general operation of iTools. This and the iTools software may be downloaded from www.eurotherm.co.uk.

When an instrument is found on the network it will be shown as, for example:

'COM1.ID001-Min8' which represents <computer com port>.ID<instrument address>-<Instrument type>

Stop the scan once all the instruments have been found.
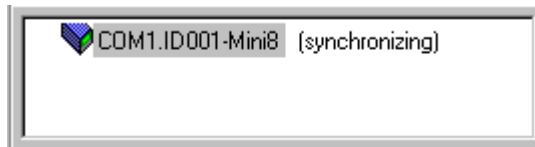
Figure 21 Synchronizing message

Once an instrument is found on the network a message 'sync pending' or 'synchronizing' is displayed next to it whilst iTools extracts the exact configuration from the instrument. Wait until this message disappears.

Browsing and Changing Parameter Values

Once the instrument is synchronized, the parameter navigation tree is displayed. The contents of this tree will vary depending on the actual configuration of the instrument.
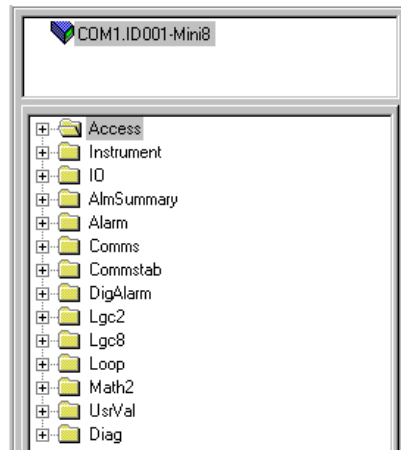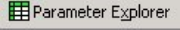
Figure 22 Parameter Navigation Tree

To view or change a parameter:

1. Highlight the folder

2. Press [Parameter Explorer] to get the parameter window or open up the parameter list by clicking on the required folder. Right-click in the parameter list to reveal or hide columns.

3. To change the value of a parameter,

   a. Click the parameter value.

   b. Type in the new value. Note a pop-up window indicates the current value, and the high and low limits.

   c. Press <Enter> to enter the new value or <Esc> to cancel.
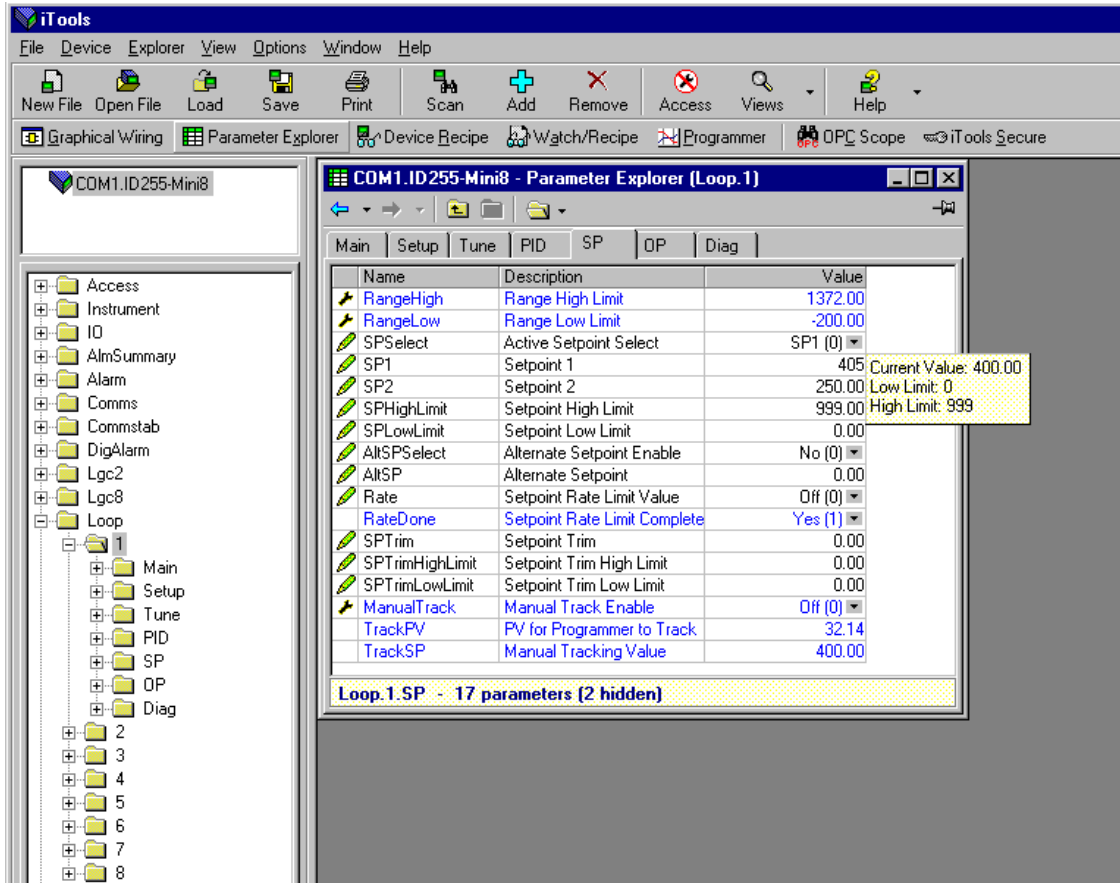
Figure 23 Parameter Values

The 'Access' button puts the controller into configuration mode. In this mode the controller can be set up without its outputs being active. Click 'Access' again to return to operating level.
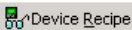
To find a parameter use the 'Find' tab at the bottom of the folder list.

☺   Tip: In parameter lists:

•   Parameters in BLUE are read-only.

•   Parameters in BLACK are read/write.

☺   Tip: Every parameter in the parameter lists has a detailed description in the help file – just click on a parameter and press Shift-F1 on the keyboard or right-click and select parameter help.

Recipe Editor

Press   🔧 Device Recipe   for this feature. Up to eight recipes can be stored. They can also be named by the user. Recipes allow the operator to change the operating values of up to 24 parameters in an instrument for different batch items/processes by simply selecting a particular recipe to load. Recipes are useful during setup and they remove the need for operator instructions fixed to the panel next to the instrument.

Note: Loading a recipe set causes the instrument to enter Standby mode momentarily during which time it does not control.

The Recipe Editor is used during configuration to assign the required parameters and to set up the values to be loaded for each recipe.
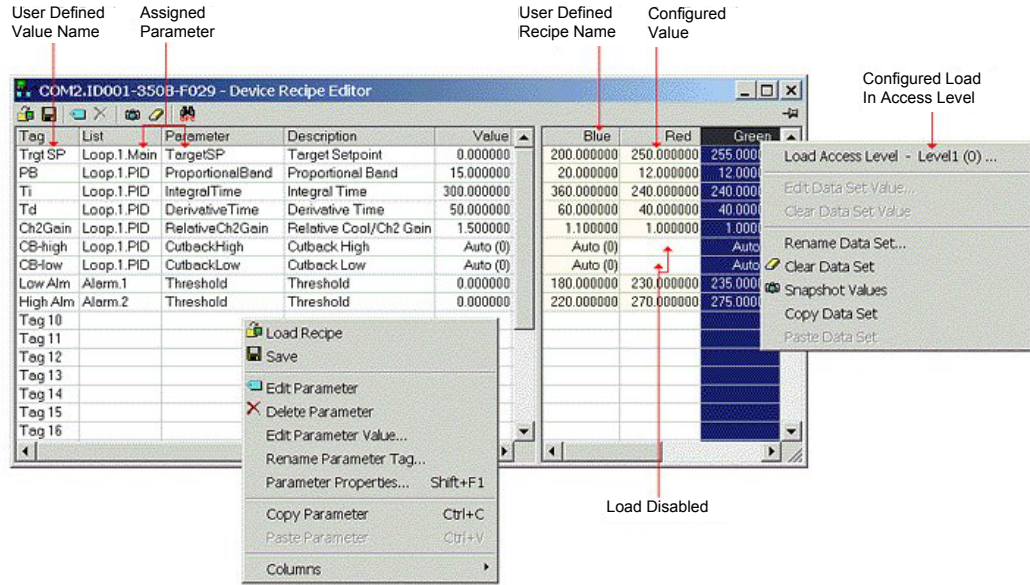
Figure 24 Recipe Editor

Recipe Menu Commands

Command	Description
Load Recipe	Used to load a recipe file into the instrument
Save	Used to save the current recipe configuration into a file
Edit Parameter	Used to assign a parameter to a Tag. Parameters can also be assigned by 'drag and drop' from the iTools parameter list
Delete Parameter	Used to delete an assigned parameter from the recipes
Edit Parameter Value	Used to edit the current value of the assigned parameter
Rename Parameter Tag	Allows the user to rename the Tag of the associated parameter. This tag is used on the instrument to identify assigned parameters (default Value1 - Value24)
Parameter Properties	Used to find the properties and help information of the selected parameter
Copy Parameter	Used to copy the currently selected parameter
Paste Parameter	Used to assign a previously copied parameter to the selected Tag
Columns	Used to hide/show the Description and Comment Columns
Load Access Level	Used to configure the lowest access level in which the selected recipe is allowed to load
Level1	Permitted to load when the instrument is in any of the access levels
Config	Permitted to load when the instrument is in the Config access level
Never	Never permitted to load
Edit Data Set Value	Used to edit the value of the selected assigned parameter within the selected recipe. Values can also be edited via double left clicking the value itself
Clear Data Set Value	Used to clear the value of the selected assigned parameter within the selected recipe, thus disabling it from loading when the recipe is selected to load
Rename Data Set	Allows the user to rename the selected recipe. This name is used to identify individual recipes (default Set1 - Set8). Note: Number of recipes dependent upon features
Clear Data Set	Used to clear all values in the selected recipe, thus disabling all from loading when the recipe is selected to load
Snapshot Values	Used to copy all the assigned parameters current values into the selected recipe
Copy Data Set	Used to copy all values of the selected recipe
Paste Data Set	Used to paste all values of a previously copied recipe into the selected recipe

OPC Scope

OPC Scope is a standalone OPC client that can be used to attach to the iTools OPC Server. It offers real-time trend charts and data logging to disk in a .csv (comma separated variable) format which can easily be opened in a spreadsheet such as Excel.

With iTools open, OPC Scope can be started using the icon [🔍 OPC Scope] .

But it can also be started on its own using the Windows Start/Programs/Eurotherm iTools/OPC Scope.

Select Server/Connect or click the icon [💡] and the OPC Server will start up (if it is not running) and will display the active ports on the computer. Opening the COM port will show the attached instruments as shown below.
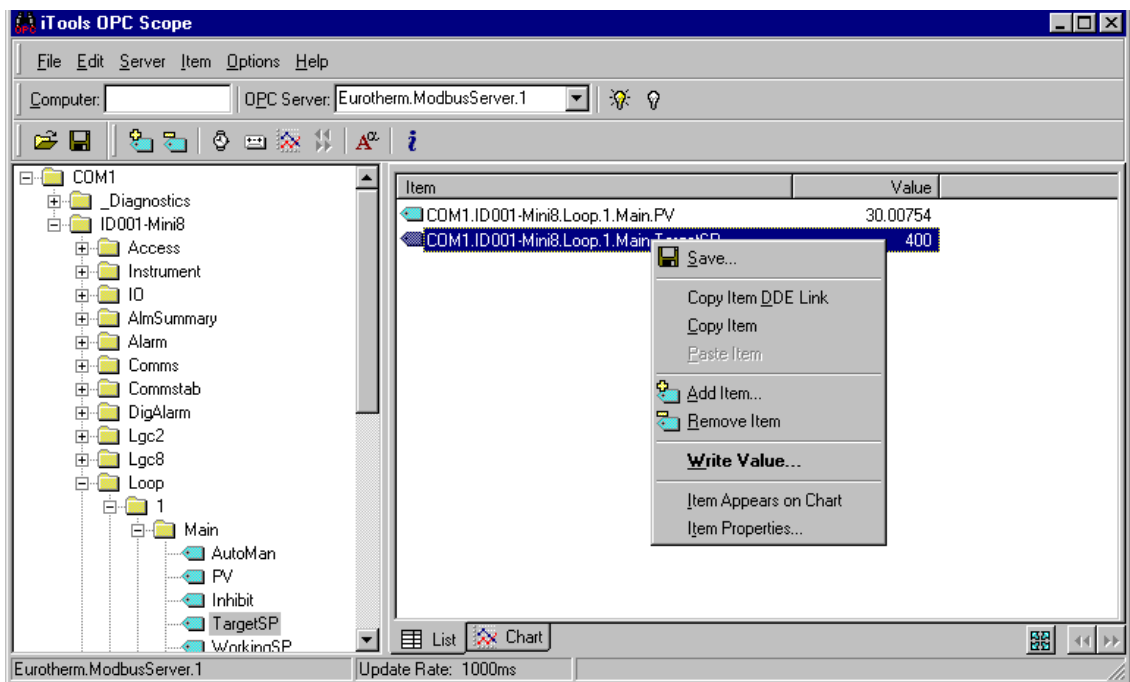
Figure 25 COM Port - Attached Instruments

The 'ID001-Mini8' folder will contain all the same folders for the instrument that would have been seen in iTools itself.

Expand the folder and double-click on the blue item tag to add to the List Window. The List Window shows all the selected parameters and their current value.

Right-click on a parameter to get the context menu.

OPC Scope List Window Context Menu

Command	Description
Save	Saves the OPC Scope configuration as <filename>.uix. See "OPC Server" on page 62.
Copy Item DDE link	Copies the DDE path to the clipboard. Use 'Paste Special' in an Excel cell and select 'Paste Link' and the current parameter value will be displayed in the cell.
Copy/Paste Item	Copy & Paste
Add Item	Add a new variable by name (easier to browse the navigation tree)
Remove Item	Remove the selected item.
Write Value	Write a new value (not if the item is Read Only).
Item appears on Chart	Up to eight items can be trended on the Chart Window
Item Properties	Gives the item properties as seen by OPC

The OPC List can contain parameters from any instrument attached to the Modbus network.

If you have iTools Open (not iTools Standard) then OPC Scope can run on a remote networked computer. Enter the name of the server computer (attached to the instruments) the 'Computer' window and browse for the 'Eurotherm.ModbusServer1'.

OPC Scope Chart Window

Click the Chart tab ⟮ 🗱 Chart ⟯ at the bottom of the display window and select Chart Control Panel.
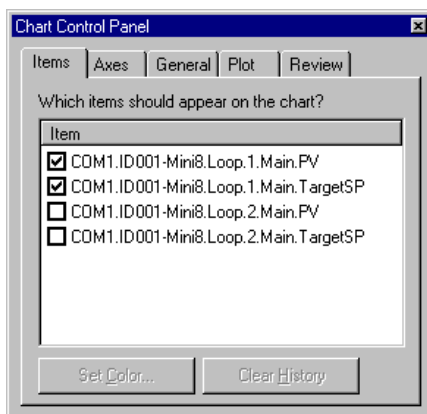
Figure 26 Chart Control Panel

1. **Items**. Includes all the items in the list window. Those items ticked (up to eight) will appear on the chart.

2. **Axes**. Allows time intervals from 1 minute to 1 month. Vertical axes can be 'auto' scaled or a fixed range may be entered.

3. **General**. Allows selection of colors, grid, legends and a data box.

4. **Plot**. Allows selection of line thickness and printing.

5. **Review**. Allows review of early history charts.

These are also available on the toolbar.

iTools Trend Graph showing Loop1 SP and PV
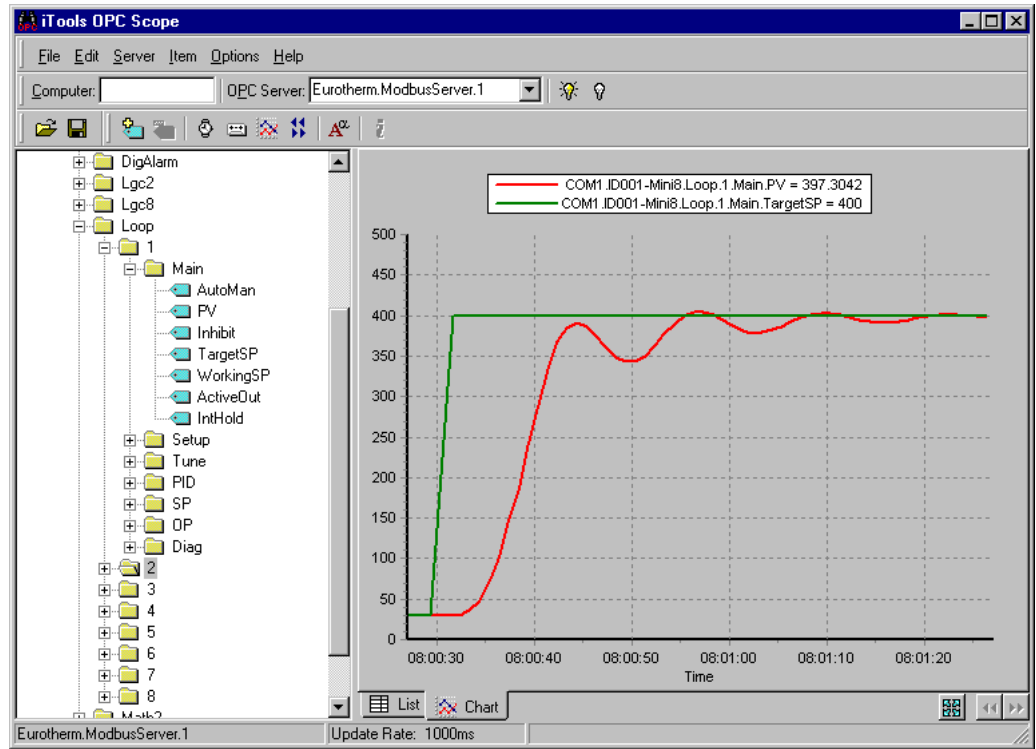
Figure 27 iTools Trend Graph

The [icon] icon allows the chart to occupy all the window space.

OPC Server

iTools and OPC Scope all use the Eurotherm OPC Server to provide the connection between the instruments and the computer displays. When you 'scan' for instruments on iTools it is in fact the OPC Server that is actually doing the work in background (the window is not usually displayed).

OPC Scope can run on its own but for it to find the instruments on the network it is necessary to tell the server where they are.

1. Start OPC Server (Windows Start/Programs/Eurotherm iTools/OPC Server).

2. On the menu go to 'Network' and select 'Start One-Shot Scan'.

3. Stop the scan when all the instruments have been found.
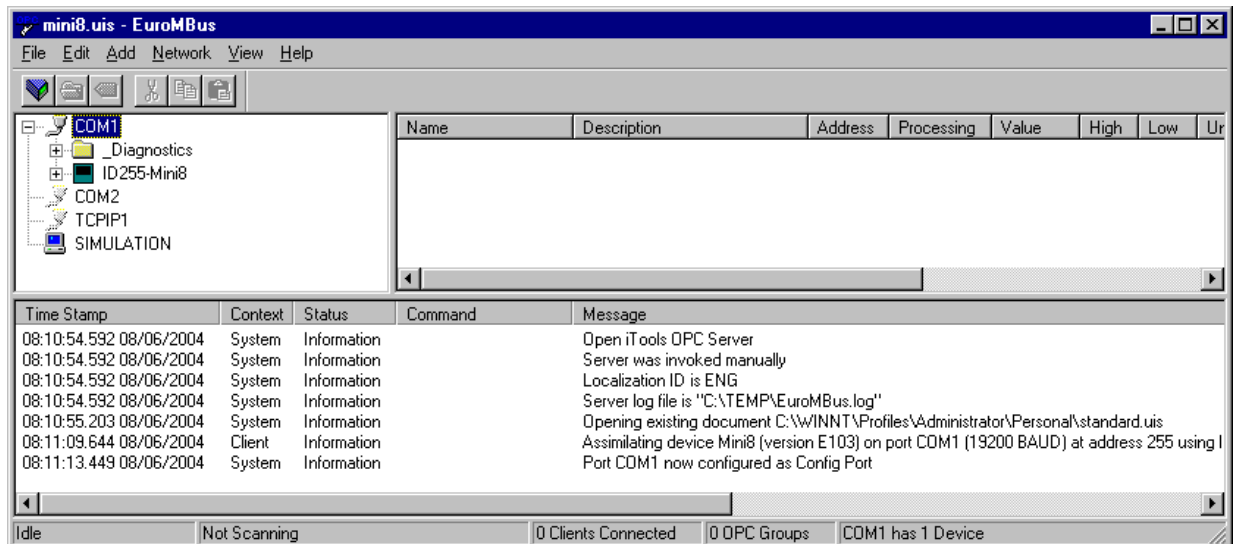
Figure 28 Running OPC Server

4. On the menu go to 'File' and select 'Save As' and save the file with a suitable name.

5. Once saved you will be asked 'Would you like to make this file the default start server address file?' – select 'Yes'.

6. Close the server.

Now if you double-click on an OPC Scope file (for example, Mini8 Project.uix) then this file will open OPC Scope and in turn, in the background, OPC Scope will open the OPC Server with this instrument file loaded. OPC Scope will then be active with live data from the instrument(s).

Configuration Using iTools

> ## ⚠ WARNING
>
> **UNINTENDED EQUIPMENT OPERATION**
>
> It is the responsibility of the person commissioning the controller to ensure the configuration is correct.
>
> The controller must not be configured while it is connected to a live process as entering Configuration Mode pauses all outputs. The controller remains in Standby until Configuration Mode is exited.
>
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Configuration

The Mini8 controller is supplied unconfigured, unless ordered preconfigured, for example, EC8. An unconfigured Mini8 controller has to be configured for use in an application. This is performed using iTools.

The iTools handbook, part no. HA028838 provides further step by step instructions on the general operation of iTools. This and the iTools software may be downloaded from www.eurotherm.co.uk.

On-Line/Off-line Configuration

If iTools is connected to a real Mini8 controller then all the parameter changes made will be written to the device immediately. Once the Mini8 controller is configured and working as required, its final configuration can be saved to disk as a 'clone' file of the format <name>.uic.

Alternatively iTools can be used 'off-line' without a real Mini8 controller connected at all. This virtual Mini8 controller can be created in iTools and again saved to disk as a clone file. This file can later be loaded into a real Mini8 controller to create the required real application. See "Cloning" on page 65.

Connecting a PC to the Mini8 Controller

Configuration Cable and Clip

The controller may be connected to the PC running iTools using the Eurotherm cable SubMin8/Cable/Config from the RJ11 port connecting to a serial port on the PC.

Alternatively a Configuration Clip is available from Eurotherm that can be fitted into the rear of the controller.

The benefit of using this arrangement is that it is not necessary to power the controller, since the clip provides the power to the internal memory of the controller.

Scanning

Open iTools and, with the controller connected, press [Scan] on the iTools menu bar. iTools will search the communications ports and TCP/IP connections for recognizable instruments. Controllers connected using the RJ11 configuration port or with the configuration clip (CPI), will be found at address 255 regardless of the address configured in the controller. These connections only work from iTools to a single controller.

The iTools handbook, part no. HA028838, provides further step by step instructions on the general operation of iTools. This and the iTools software may be downloaded from www.eurotherm.co.uk.

In the following pages it is assumed that the user is familiar with iTools and has a general understanding of Windows.

Cloning

Saving a Clone File

On the iTools menu 'File – Save to File' allows the clone file of the attached Mini8 controller to be saved to disc as <user name>.UIC file. This can be loaded into another Mini8 controller.

Note that after synchronization, iTools using uses a 'quick' save and will only resave parameters that have been changed through iTools itself. If there is any chance that parameters have been changed through the other port then it is necessary to resave all the parameters. On the menu bar under Options – Cloning, select **Reload**. The recommended option is to keep **Ask** selected.
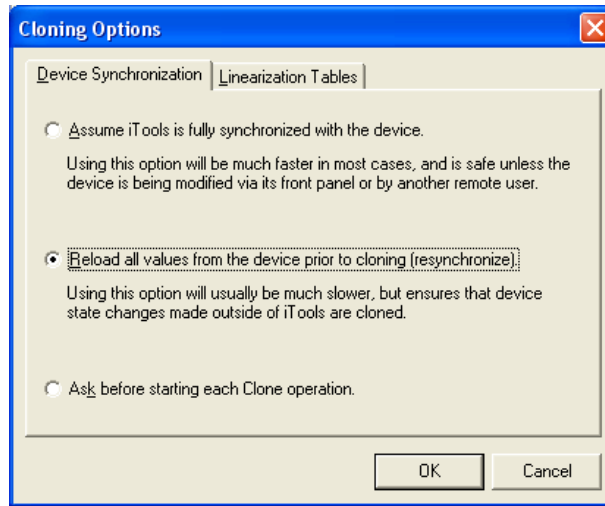
Figure 29 Cloning Options

Loading a Clone File

On the iTools menu 'File – Load values File' allows a clone file of the form <user name>.UIC to be loaded into an attached Mini8 controller unit. Whilst loading, the report window will indicate what is happening. It makes a number of attempts to load all the values and may report some problems. This is generally not an issue. If, for some reason, it cannot be loaded, iTools will report specifically that the load '**Failed**'.

Communications port parameters

A Mini8 controller clone file contains information on both the CC and FC port configuration settings. Depending on which communication port is used to load a clone file, cloning will behave in a different manner.

- Loading the clone file through the FC port will cause the CC port settings to be updated.

- Loading the clone file through the CC port will cause the FC port settings to be updated.

Configuring the Mini8 Controller

Once iTools is successfully connected to a Mini8 controller, it can be configured for the application in hand. Configuration involves selection of the required elements of functionality called 'function blocks' and setting their parameters to the correct values. The next stage is to connect all the function blocks together to create the required strategy of control for the application.

Function Blocks

The controller software is constructed from a number of 'function blocks'. A function block is a software device that performs a particular duty within the controller. It may be represented as a 'box' that takes data in at one side (as inputs), manipulates the data internally (using internal parameter values) and 'outputs' the results. Some of these internal parameters are available to the user so that they can be adjusted to suit the characteristics of the process that is to be controlled.

A representation of a function block is shown below.
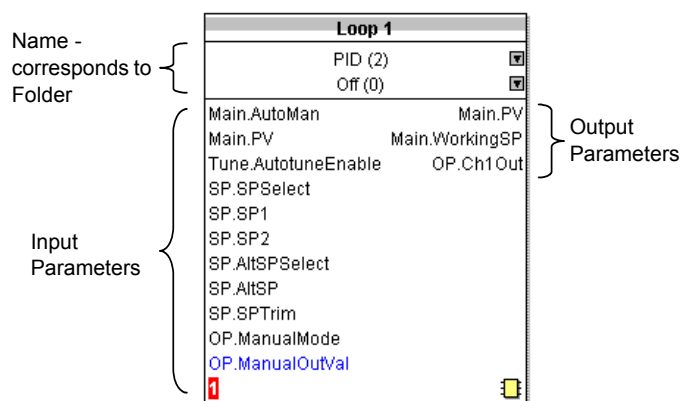
Figure 30 Representation of a Function Block

Internal Parameters

Figure 31 Example of a Function Block

In the controller, parameters are organized in simple lists. The top of the list shows the list header. This corresponds to the name of the function block and is generally presented in alphabetical order. This name describes the generic function of the parameters within the list. For example, the list header 'AnAlm' contains parameters that enable you to set up analog alarm conditions.

Soft Wiring

Soft Wiring (sometimes known as User Wiring) refers to the connections that are made in software between function blocks. Soft wiring, which will generally be referred to as 'Wiring' from now on, is created during the instrument configuration using the iTools configuration package.

In general every function block has at least one input and one output. Input parameters are used to specify where a function block reads its incoming data (the 'Input Source'). The input source is usually wired from the output of a preceding function block. Output parameters are usually wired to the input source of subsequent function blocks.

All parameters shown in the function block diagrams are also shown in the parameter tables, in the relevant chapters, in the order in which they appear in iTools.

Figure 32 shows an example of how the thermocouple is wired to the PID Loop input and the PID Loop channel 1 (heat) output is wired to the time proportioning logic output.
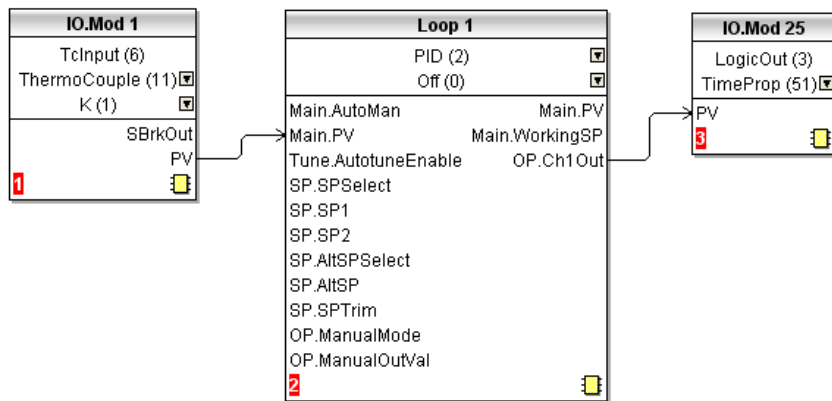
Figure 32 Function Block Wiring

Simple Worked Example

Using function blocks and wiring the following sections will show a blank Mini8 controller being configured to have one PID loop.

The I/O

With the Mini8 controller successfully connected to iTools configuration can begin.

☺ Tip:

In parameter lists:

- Parameters in BLUE are read-only.

- Parameters in BLACK are read/write.

☺ Tip:

Every parameter in the parameter lists has a detailed description in the help file – just click on a parameter and press Shift-F1 on the keyboard or right-click and select parameter help.

The I/O will already have been installed in the Mini8 controller and can be checked in iTools.

Example 1: Thermocouple Input Configuration

In the IO list ModIDs select the type of module. Thermocouple modules may be four-input modules or eight-input modules.
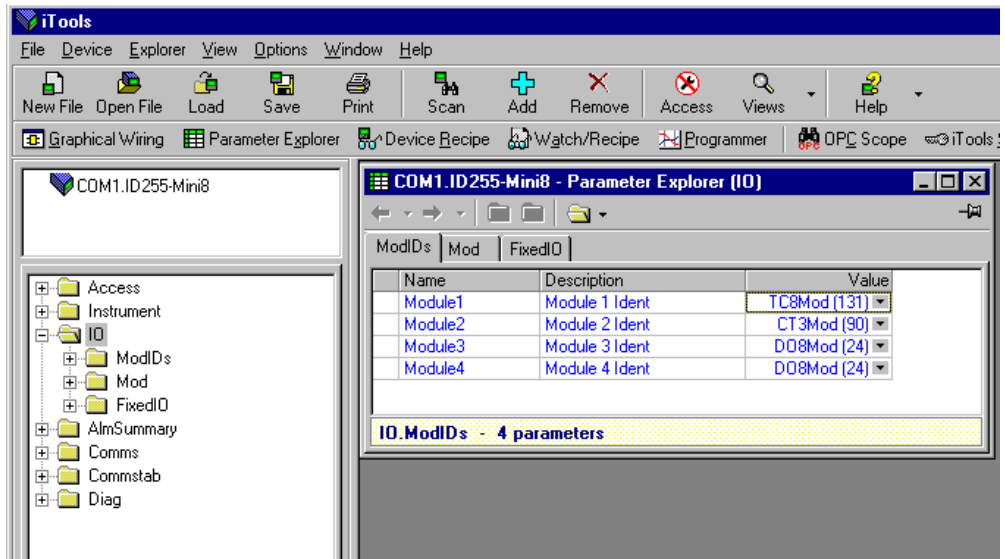
Figure 33 Mini8 controller I/O Modules

This unit has an eight thermocouple input board in slot 1, a CT3 input card in slot 2, and two DO8 output cards in slot 3 and slot 4. Clicking on the 'Mod' tab will enable the first channel of the thermocouple card to be configured. Firstly the Mini8 controller has to be put into configuration mode. Go to Device/Access/Configuration or click on the Access button:
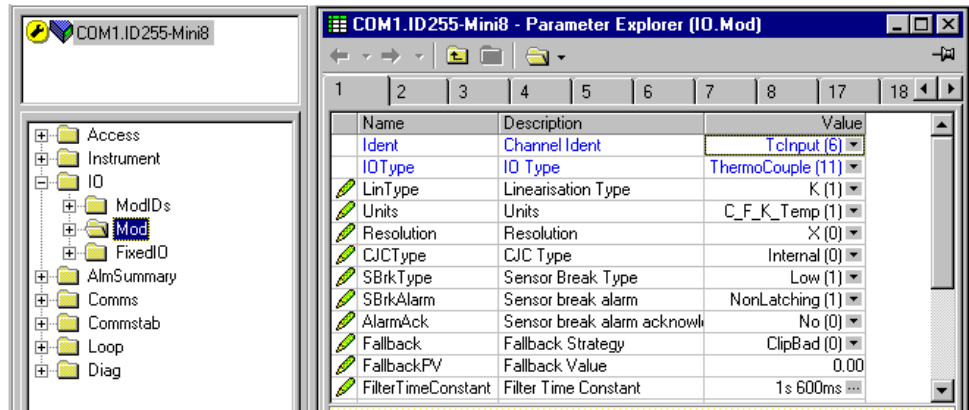
Figure 34 Thermocouple Input

Select the I/O type, linearization, units, resolution, and so on, required. Parameter details are in "Thermocouple Input" on page 99.

The other thermocouple channels can be found by using the 2, 3, 4…7, 8 tabs on the top of the parameter window.

Slot 2 in the Mini8 controller has a CT3 input card and this is configured elsewhere so the Tabs 9 to 16 are not shown.

Slot 3 has a DO8 output card and the first channel of this will be on tab 17 (to 24).

Slot 4 has a DO8 output card and the first channel of this will be on tab 25 (to 32).
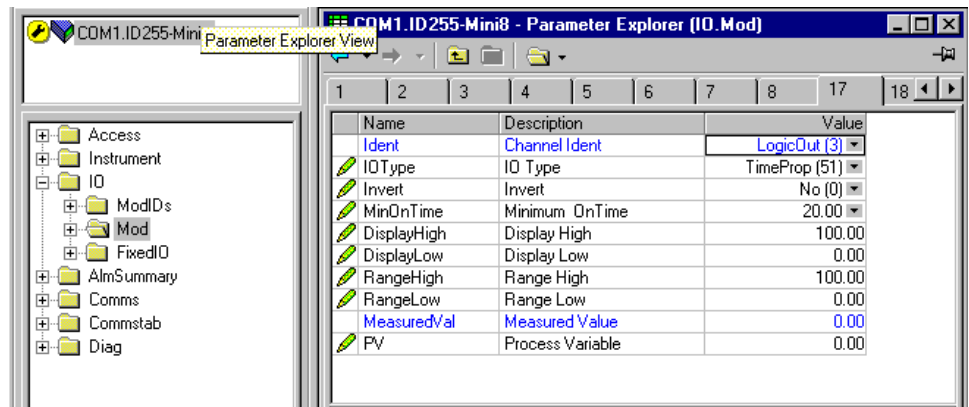
Figure 35 Digital Output Channel

Set this channel up as required, IOType, MinOnTime, and so on as required. The parameters are detailed in "Logic Output" on page 97.

The remaining channels on this slot will be found under the tabs 18 to 24.

Slot 4 also contains a DO8 output card with outputs under tabs 25 to 32.

The Fixed I/O is always there and there is nothing that has to be configured.

The Current Monitor is covered in "Current Monitor" on page 111.

Example 2: RTD Input Configuration

In the IO list ModIDs select the type of module. RTD modules are four-input modules [RT4Mod (173)].
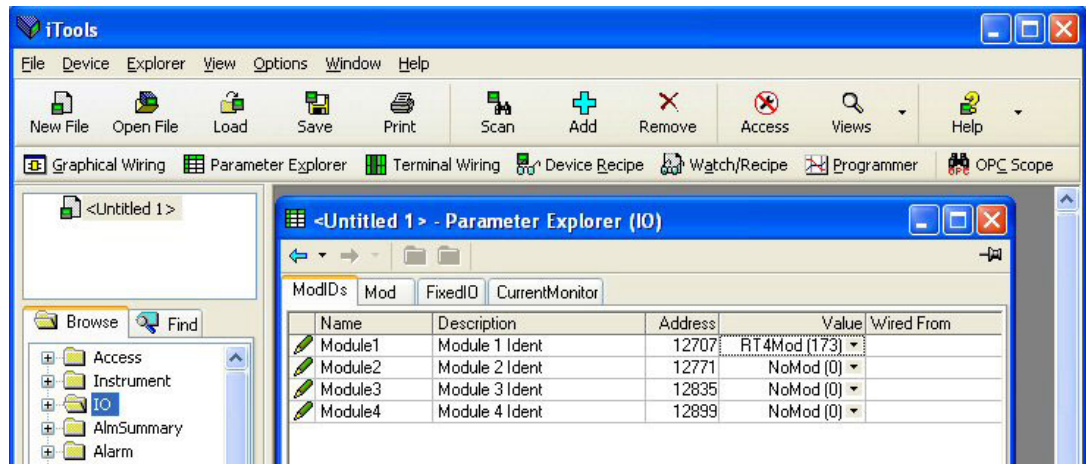
Figure 36 Mini8 Controller IO Module1 Defined as RTD

RTDs can be defined as 2-wire [RTD2 (32)], 3-wire [RTD3 (33)] or 4-wire [RTD4 (34)] in the module definition list.

NOTICE

Configure the 'IO Type' and the 'Resistance Range' to match the RTD in use so that the correct lead compensation calculation is selected.

.
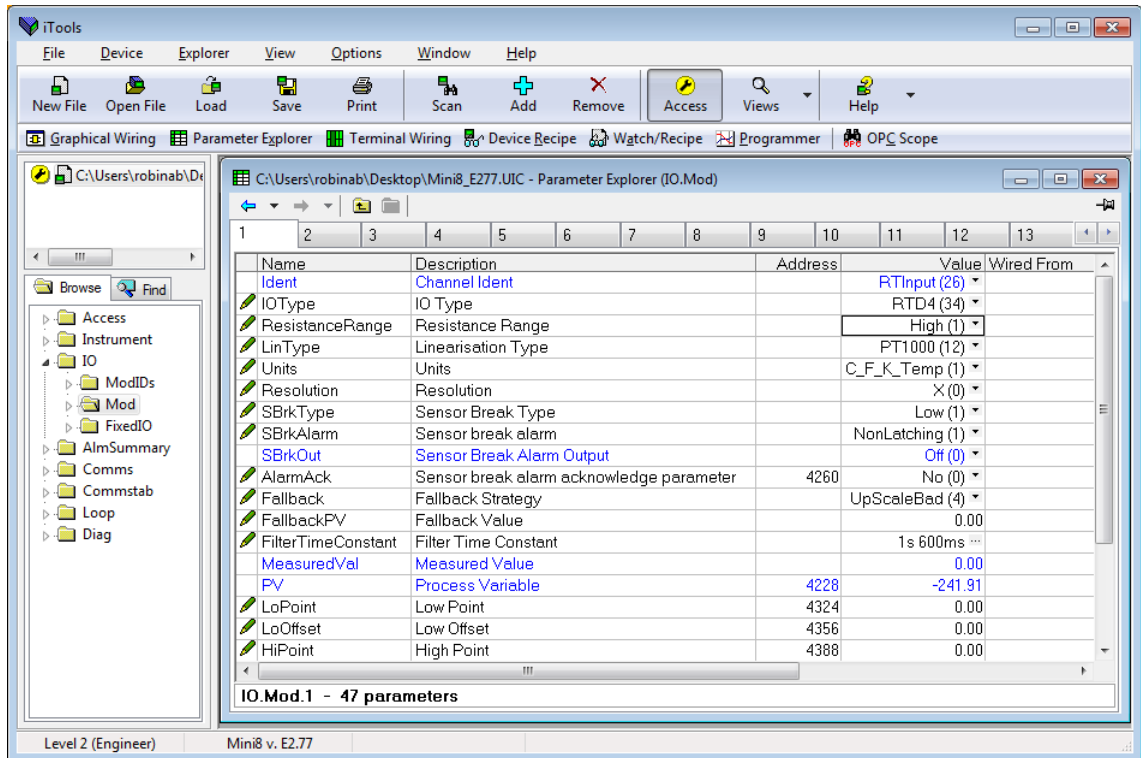
Figure 37 Module 1 defined as RTD4

Wiring

The IO that has been configured now needs to be wired to PID loops and other function blocks.

Select [Graphical Wiring] (GWE) to create and edit instrument wiring.
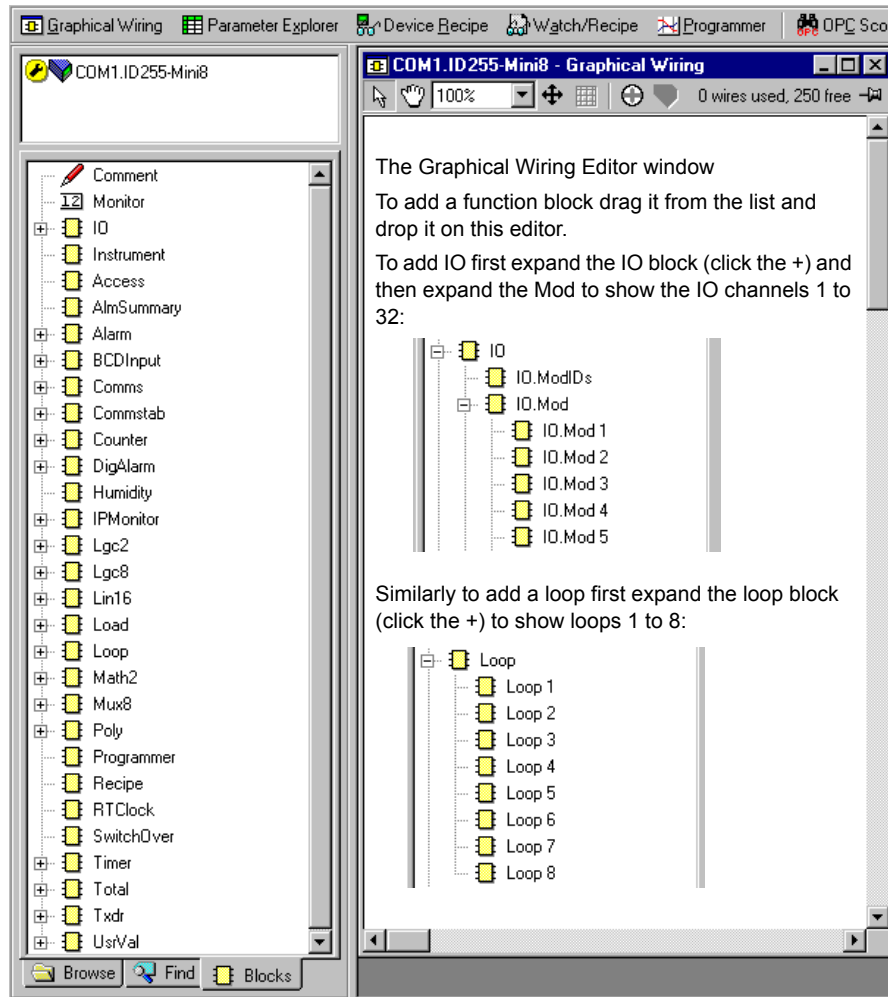
Figure 38 List of Function Blocks & Graphical Wiring Window

The left window now contains a list of the function blocks available.

Use drag and drop to select the first thermocouple from IOMod 1, the Cool output from IOMod 17 and the Heat output from IOMod 25 and drop them on the wiring window.

Finally take the first PID block from Loop/Loop 1 and drop it on the wiring window. Note that as each block is used it grays out on the list.

There should now be four blocks on the window. Those blocks are shown with dotted lines, as they have not been loaded into the Mini8 controller.

First make the following wire connections.

1. Click on IO.Mod1.PV and move the pointer to Loop 1.MainPV and click again. A dotted wire will have connected the two together.

2. Similarly join Loop1.OP.Ch1Out to IOMod 25.PV (heat output).

3. Enable the Cool output by clicking the select arrow to the top of the loop block:
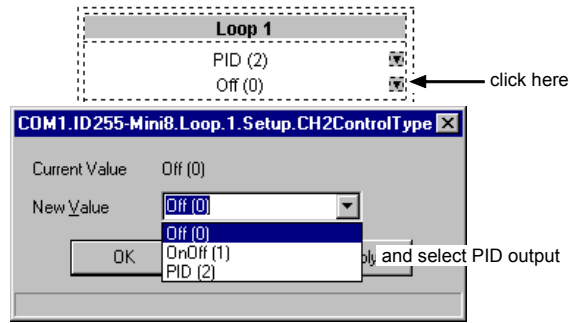
Figure 39 Enabling Cool Output

4. Loop1.OP.Ch2Out to IOMod 17.PV (cool output)
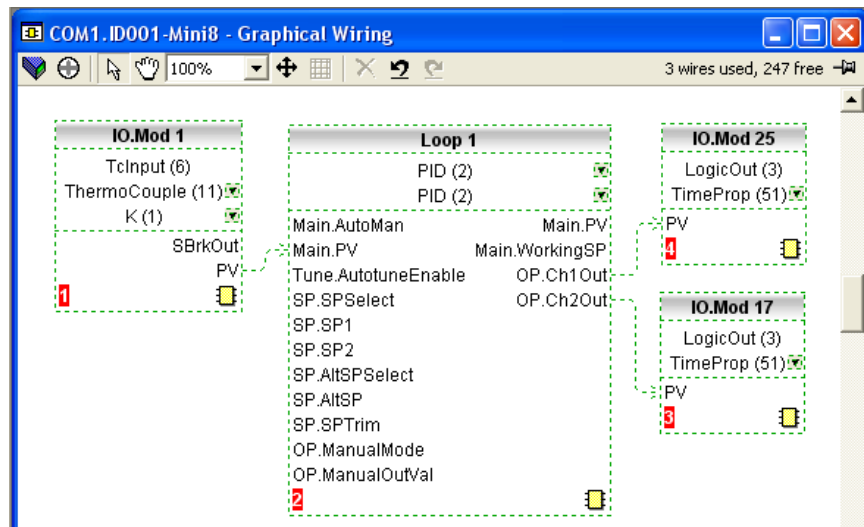
Figure 40 Wired Blocks before download

5. Right-click on the Loop 1 function Block and select 'Function Block View'. This opens the Loop parameter list on top of the wiring editor.
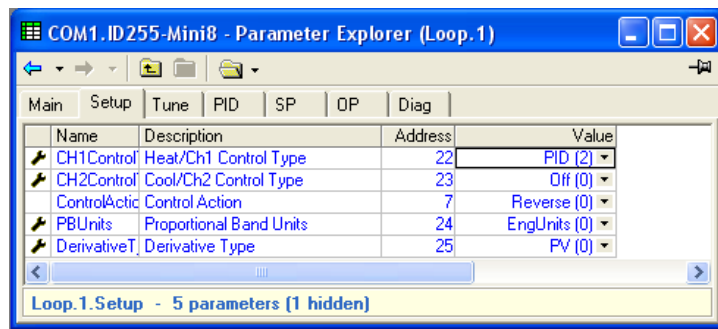
Figure 41 PID Function Block

This enables the PID function block to be set up to suit the required application. See "Control Loop Setup" on page 208 for details.

6. Click on the instrument button to download the application:

7. Once downloaded the dotted lines around the function blocks and the wires will become solid to show that the application is now in the Mini8 controller. The upper status line also shows that three wires have been used out of those available. Max is 250 but quantity depends on number of wires ordered (30, 60, 120 or 250).

8. Put the Mini8 controller back into Operating mode by clicking the Access button:

9. The Mini8 controller will now control the Loop1 as configured.

Graphical Wiring Editor

Select   Graphical Wiring (GWE) to view and edit instrument wiring. You can also add comments and monitor parameter values.

1. Drag and drop required function blocks into the graphical wiring from the list in the left pane.

2. Click on parameter to be wired from and drag the wire to the parameter to be wired to (do not hold mouse button down).

3. Right-click to edit parameter values.

4. Select parameter lists and switch between parameter and wiring editors.

5. Download to instrument when wiring completed.

6. Add comments and notes.

7. Dotted lines around a function block show that the application requires downloading.
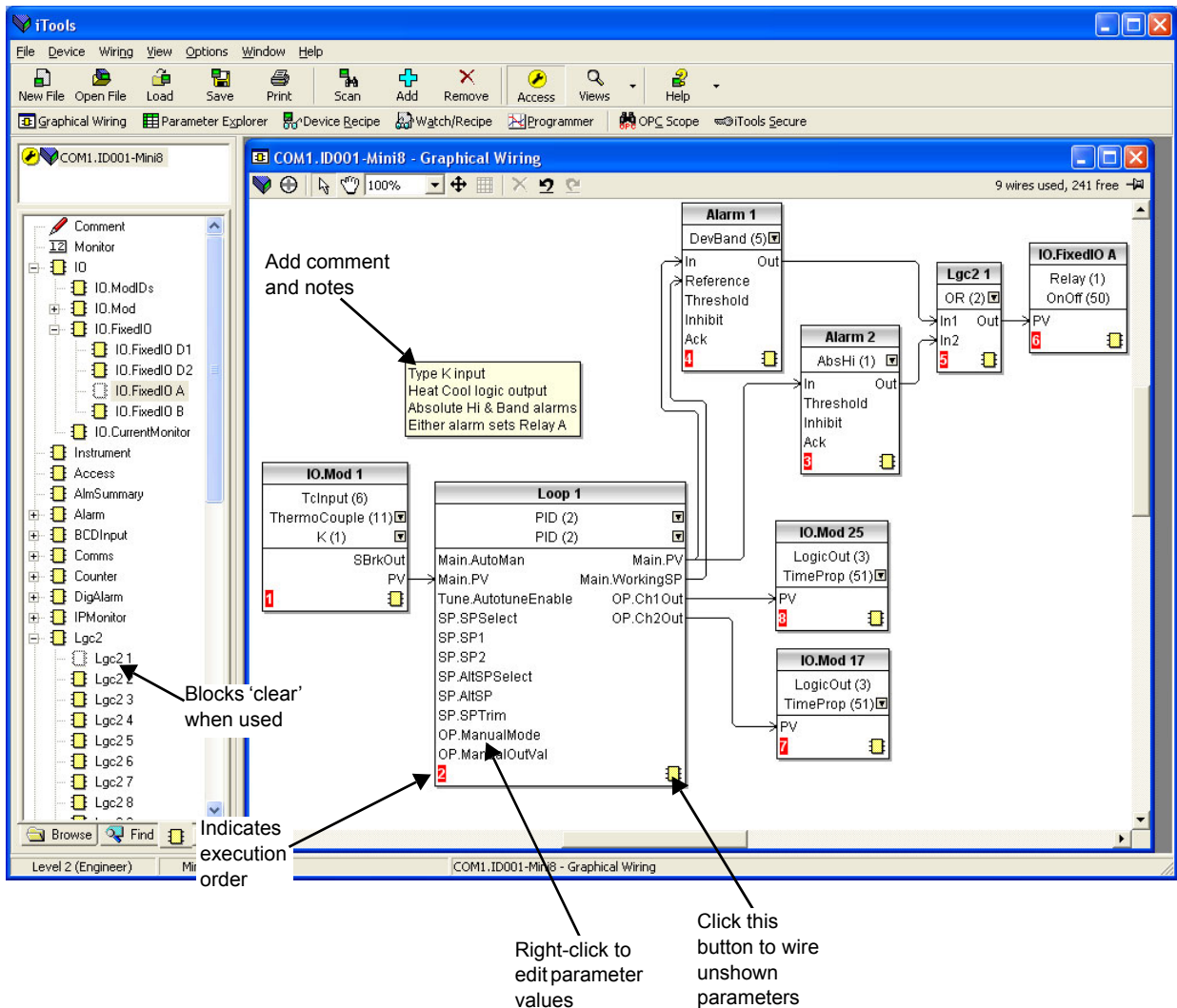
Figure 42 Graphical Wiring Editor

Graphical Wiring Toolbar
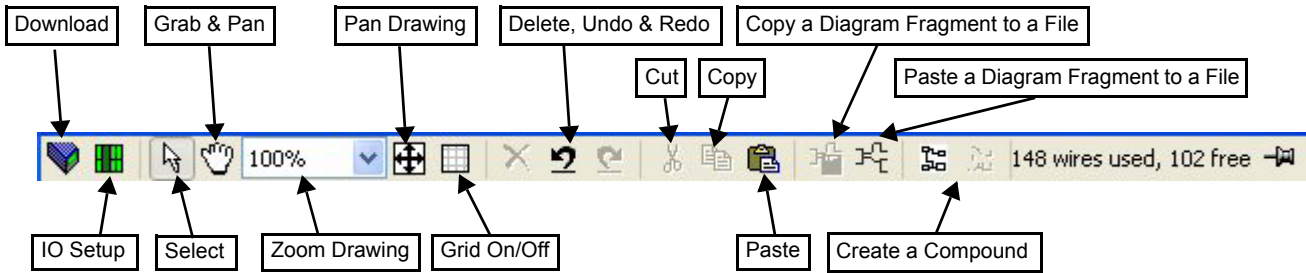
Figure 43 Graphical Wiring Toolbar

Function Block

A Function Block is an algorithm that may be wired to and from other function blocks to make a control strategy. The Graphical Wiring Editor groups the instrument parameters into function blocks. Examples are: a control loop and a mathematical calculation.

Each function block has inputs and outputs. Any parameter may be wired from, but only parameters that are alterable may be wired to.

A function block includes any parameters that are needed to configure or operate the algorithm.

Wire

A wire transfers a value from one parameter to another. They are executed by the instrument once per control cycle.

Wires are made from an output of a function block to an input of a function block. It is possible to create a wiring loop, in this case there will be a single execution cycle delay at some point in the loop. This point is shown on the diagram by a || symbol and it is possible to choose where that delay will occur.

Block Execution Order

The order in which the blocks are executed by the instrument depends on the way in which they are wired.

The order is automatically worked out so that the blocks execute on the most recent data.

Using Function Blocks
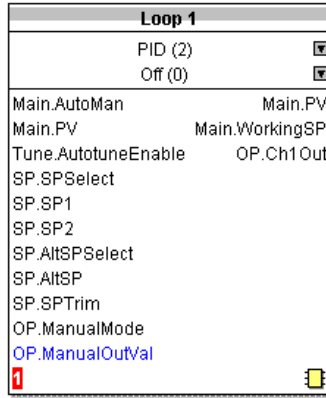
If a function block is not faded in the tree then it can be dragged onto the diagram. The block can be dragged around the diagram using the mouse.

A labeled loop block is shown here. The label at the top is the name of the block.

When the block type information is alterable, click on the box with the arrow in it on the right to edit that value.

Figure 44 Function Block

The inputs and outputs that are considered to be of most use are always shown. In most cases all of these will need to be wired up for the block to perform a useful task. There are exceptions to this and the loop is one of those exceptions.

If you wish to wire from a parameter, which is not shown as a recommended output click on the icon in the bottom right, and a full list of parameters in the block will be shown, click on one of these to start a wire.

To start a wire from a recommended output just click on it.

Click the icon in the bottom right hand corner to wire other function block parameters not shown on the list on the right-hand side.

Function Block Context Menu

Right-clicking displays the context menu with the following entries.
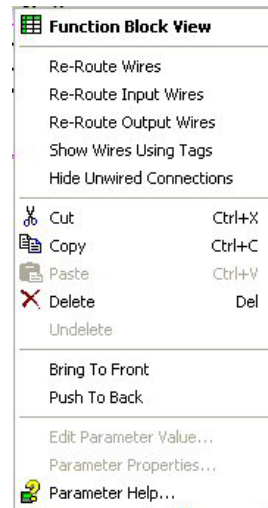
Figure 45 Function Block Context Menu

Function Block View

Brings up an iTools parameter list which shows all the parameters in the function block. If the block has sub-lists these are shown in tabs.

Re-Route Wires Throw away current wire route and do an auto-route of all wires connected to this block.

Re-Route Input Wires

Only do a re-route on the input wires

Re-Route Output Wires

Only do a re-route on the output wires

Show wires using tags

    Shows the beginning and end of each wire with a descriptor showing the source or destination. Used to simplify a diagram with many wires.

Hide Unwired Connections

    Hides function block pins that are not used.

Cut	Cut the selected function block.
Copy	Right-click over an input or output and copy will be enabled, this menu item will copy the iTools "url" of the parameter which can then be pasted into a watch window or OPC Scope.
Paste	Add a new copy of the function block.
Delete	If the block is downloaded mark it for delete, otherwise delete it immediately.
Undelete	This menu entry is enabled if the block is marked for delete and unmarks it and any wires connected to it for delete.
Bring To Front	Bring the block to the front of the diagram. Moving a block will also bring it to the front.
Push To Back	Push the block to the back of the diagram. Useful if there is something underneath it.

Edit Parameter Value

    This menu entry is enabled when the mouse is over an input or output parameter. When selected it creates a parameter edit dialog so the value of that parameter can be changed.

Parameter Properties

    Selecting this entry brings up the parameter properties window. The parameter properties window is updated as the mouse is moved over the parameters shown on the function block.

Parameter Help	Selecting this entry brings up the help window. The help window is updated as the mouse is moved over the parameters shown on the function block. When the mouse is not over a parameter name the help for the block is shown.

Tooltips

Hovering over different parts of the block will bring up tool-tips describing the part of the block beneath the mouse.

If you hover over the parameter values in the block type information a tool-tip showing the parameter description, its OPC name, and, if downloaded, its value will be shown.

A similar tool-tip will be shown when hovering over inputs and outputs.

Function Block State

The blocks are enabled by dragging the block onto the diagram, wiring it up, and downloading it to the instrument.

When the block is initially dropped onto the diagram it is drawn with dashed lines.

When in this state the parameter list for the block is enabled but the block itself is not executed by the instrument.

Once the download button is pressed the block is added to the instrument function block execution list and it is drawn with solid lines.

If a block which has been downloaded is deleted, it is shown on the diagram in a ghosted form until the download button is pressed.

This is because it and any wires to/from it are still being executed in the instrument. On download it will be removed from the instrument execution list and the diagram. A ghosted block can be undeleted using the context menu.
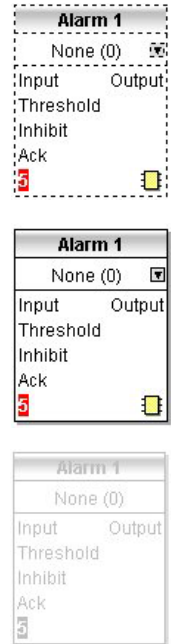
Figure 46 Function Block States

When a dashed block is deleted it is removed immediately.

Using Wires

Making a Wire between Two Blocks

To make a wire between two blocks:

1. Drag two blocks onto the diagram from the function block tree.

2. Start a wire by either clicking on a recommended output or clicking on the icon at the bottom right corner of the block to bring up the connection dialog. The connection dialog shows all the connectable parameters for the block, if the block has sub-lists the parameters are shown in a tree. If you wish to wire a parameter which is not currently available click the red button at the bottom of the connection dialog. Recommended connections are shown with a green plug, other parameters which are available are yellow and if you click the red button the unavailable parameters are shown red. To dismiss the connection dialog either press the escape key on the keyboard or click the cross at the bottom left of the dialog.

3. Once the wire has started the cursor will change and a dotted wire will be drawn from the output to the current mouse position.

4. To make the wire either click on a recommended input to make a wire to that parameter or click anywhere except on a recommended input to bring up the connection dialog. Choose from the connection dialog as described above.

The wire will now be auto-routed between the blocks. New wires are shown dotted until they are downloaded.
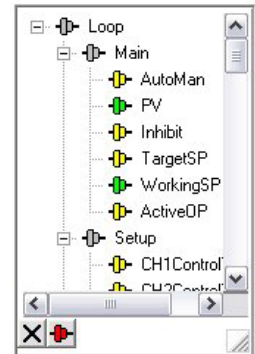
Figure 47
Wires Between
Blocks

Wire Context Menu

The wire block context menu has the following entries on it.

Force Exec Break	If wires form a loop a break point has to be found where the value which is written to the block input comes from a block which was last executed during the previous instrument execute cycle thus introducing a delay. This option tells the instrument that if it needs to make a break it should be on this wire.	

Figure 48
Wire Context Menu

Re-Route Wire	Throw away wire route and generate an automatic route from scratch.
Use Tags	If a wire is between blocks which are a long way apart, then, rather than drawing the wire, the name of the wired to/from parameter can be shown in a tag next to the block. Draw the wire first then use this menu to toggle this wire between drawing the whole wire and drawing it as tags.

Figure 48
Use Tags

Find Start	Find the source of the selected wire.
Find End	Find the destination of the selected wire.
Delete	If the wire is downloaded mark it for deletion, otherwise delete it immediately.
Undelete	This menu entry is enabled if the wire is marked for deletion and unmarks it for deletion.
Bring To Front	Bring the wire to the front of the diagram. Moving a wire will also bring it to the front.
Push To Back	Push the wire to the back of the diagram.

Wire Colors

Wires can be the following colors:

Black	Normal functioning wire.
Red	The wire is connected to an input which is not alterable when the instrument is in operator mode and so values which travel along that wire will be rejected by the receiving block.
Blue	The mouse is hovering over the wire, or the block to which it is connected it selected. Useful for tracing densely packed wires.
Purple	The mouse is hovering over a 'red' wire.

Routing Wires

When a wire is placed it is auto-routed. The auto routing algorithm searches for a clear path between the two blocks. A wire can be auto-routed again using the context menus or by double-clicking the wire.

If you click on a wire segment you can drag it to manually route it. Once you have done this it is marked as a manually routed wire and will retain its current shape. If you move the block to which it is connected the end of the wire will be moved but as much of the path as possible of the wire will be preserved.

If you select a wire by clicking on it, it will be drawn with small boxes on its corners.

Tool-tips

Hover the mouse over a wire and a tool-tip showing the names of the parameters which are wired and, if downloaded, their current values will also be shown.

Using Comments

Drag a comment onto the diagram and the comment edit dialog will appear.

Figure 49 Comment Edit Dialog

Type in a comment. Use new lines to control the width of the comment, it is shown on the diagram as typed into the dialog. Click OK and the comment text will appear on the diagram. There are no restrictions on the size of a comment. Comments are saved to the instrument along with the diagram layout information.

Comments can be linked to function blocks and wires. Hover the mouse over the bottom right of the comment and a chain icon will appear, click on that icon and then on a block or a wire. A dotted wire will be drawn to the top of the block or the selected wire segment.

Comment Context Menu

The comment context menu has the following entries on it.

Edit	Open the comment edit dialog to edit this comment.	
Unlink	If the comment is linked to a block or wire this will unlink it.	
Cut	Remove the comment.	
Copy	Make a copy of the comment.	
Paste	Paste a new copy of the comment.	
Delete	If the comment is downloaded mark it for deletion, otherwise delete it immediately.	
Undelete	This menu entry is enabled if the comment is marked for deletion and unmarks it for deletion.	
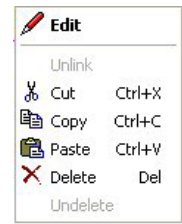
Figure 50
Comment
Context Menu

Using Monitors

Drag a monitor onto the diagram and connect it to a block input or output or a wire as described in 'Using Comments'.

The current value (updated at the iTools parameter list update rate) will be shown in the monitor. By default the name of the parameter is shown, double-click or use the context menu to not show the parameter name.

Monitor Context Menu

The monitor context menu has the following entries on it.

Show Names	Show parameter names as well as values.
Unlink	If the monitor is linked to a block or wire this will unlink it.
Cut	Remove the monitor.
Copy	Make a copy of the monitor.
Paste	Paste the copy of the monitor.
Delete	If the monitor is downloaded mark it for deletion, otherwise delete it immediately.
Undelete	This menu entry is enabled if the monitor is marked for deletion and unmarks it for deletion.
Bring To Front	Bring the monitor to the front of the diagram. Moving a monitor will also bring it to the front.
Push To Back	Push the monitor to the back of the diagram. Useful if there is something underneath it.
Parameter Help	When a parameter is selected, this menu entry provides help on that parameter.

Figure 51
Monitor Context
Menu

Downloading

The wires have to be downloaded to the instrument together. When the wiring editor is opened the current wiring and diagram layout is read from the instrument. No changes are made to the instrument function block execution or wiring until the download button is pressed.

When a block is dropped on the diagram, instrument parameters are changed to make the parameters for that block available. If you make changes and close the editor without saving them there will be a delay while the editor clears these parameters.

When you download, the wiring is written to the instrument that then calculates the block execution order and starts executing the blocks. The diagram layout including comments and monitors is then written into instrument flash memory along with the current editor settings. When you reopen the editor the diagram will be shown positioned the same as when you last downloaded.

Selections

Wires are shown with small blocks at their corners when selected. All other items have a dotted line drawn round them when they are selected.

Selecting Individual Items

Clicking on an item on the drawing will select it.

Multiple Selection

Control-click an unselected item to add it to the selection, doing the same on a selected item unselects it.

Alternatively, hold the mouse down on the background and swipe it to create a rubber band, anything which isn't a wire inside the rubber band will be selected.

Selecting two function blocks also selects any wires which join them. This means that if you select more than one function block using the rubber band method any wires between them will also be selected.

Pressing Ctrl-A selects all blocks and wires.

Colors

Items on the diagram are colored as follows:

Red	Function blocks, comments and monitors which partially obscure or are partially obscured by other items are drawn red. If a large function block like the loop is covering a small one like a math2, the loop will be drawn red to show that it is covering another function block. Wires are drawn red when they are connected to an input which is currently unalterable. Parameters in function blocks are colored red if they are unalterable and the mouse pointer is over them.
Blue	Function blocks, comments and monitors which are not colored red are colored blue when the mouse pointer is over them. Wires are colored blue when a block to which the wire is connected is selected or the mouse pointer is over it. Parameters in function blocks are colored blue if they are alterable and the mouse pointer is over them.
Purple	A wire which is connected to an input which is currently unalterable and a block to which the wire is connected is selected or the mouse pointer is over it is colored purple (red + blue).

Diagram Context Menu

Highlight an area of the graphical wiring by left-clicking the mouse button and dragging around the required area. Right-click in the area to show the Diagram Context Menu. The diagram context menu has the following entries:

Cut	To delete the selected area.
Copy	To make a copy of the selected area.
Paste	To paste the selected area.
Re-Route Wires	Discard current wire route and do an auto-route of all selected wires. If no wires are selected this is done to all wires on the diagram.
Align Tops	Line up the tops of all the selected items except wires.
Align Lefts	Line up the left hand side of all the selected items except wires.
Space Evenly	This will space the selected items such that their top left corners are evenly spaced. Select the first item, then select the rest by Control-clicking them in the order you wish them to be spaced, then choose this menu entry.
Delete	Marks all selected items for deletion (will be deleted on next download).
Undelete	This menu entry is enabled if any of the selected items are marked for deletion and unmarks them when selected.
Select All	To select the complete graphical wiring.
Create Compound	Create a new tab (Compound 1, 2, and so on) of the selected area.
Rename	To customize the Compound name.
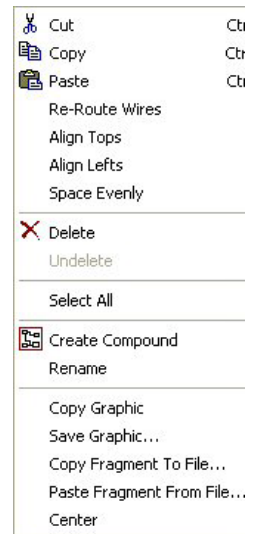
Figure 52
Diagram Context
Menu

Copy Graphic		If there is a selection it is copied to the clipboard as a Windows metafile, if there is no selection the whole diagram is copied to the clipboard. Paste into your favorite documentation tool to document your application.
Save Graphic		Same as Copy Graphic but saves to a metafile rather than putting it on the clipboard.
Copy Fragment to File		
		To make a copy of the selected area and save it to file
Paste Fragment from File		
		To paste the selected area from file.
Center		To place the selected area in the center of the graphical wiring view.

Wiring Floats with Status Information

There is a subset of float values which may be derived from an input which may not be accurate for some reason, for example, sensor break, over-range, and so on. These values have been provided with an associated status which is automatically inherited through the wiring. The list of parameters which have associated status is as follows:

Block	Input Parameters	Output Parameters
Loop.Main	PV	PV
Loop.SP		TrackPV
Math2	In1	Out
	In2	
Programmer.Setup	PVIn	
Poly	In	Out
Load		PVOut1
		PVOut2
Lin16	In	Out
Txdr	InVal	OutVal
IPMonitor	In	Out
SwitchOver	In1	
	In2	
Total	In	
Mux8	In1 to 8	Out
Multi-oper	In1 to 8	SumOut, MaxOut, MinOut, AverageOut
Lgc2	In1	
	In2	
UsrVal	Val	Val
Humidity	WetTemp	RelHumid
	DryTemp	DewPoint
	PsychroConst	
	Pressure	
IO.MOD	1.PV to 32.PV	1.PV to 32.PV

Parameters appear in both lists where they can be used as inputs or outputs depending on configuration. The action of the block on detection of a 'Bad' input is dependent upon the block. For example, the loop treats a 'Bad' input as a sensor break and takes appropriate action; the Mux8 simply passes on the status from the selected input to the output, and so on.

The Poly, Lin16, SwitchOver, Multi-Operator, Mux8, IO.Mod.n.PV blocks can be configured to act on bad status in varying ways. The options available are as follows:

0: Clip Bad

The measurement is clipped to the limit it has exceeded and its status is set to 'BAD', so that any function block using this measurement can operate its own fallback strategy. For example, a control output may be held at its current value.

1: Clip Good

The measurement is clipped to the limit it has exceeded and its status is set to 'GOOD', such that any function block using this measurement may continue to calculate and not employ its own fallback strategy.

2: Fallback Bad

The measurement will adopt the configured fallback value that has been set by the user. In addition the status of the measured value will be set to 'BAD', such that any function block using this measurement can operate its own fallback strategy. For example, control loop may hold its output to the current value.

3: Fallback Good

The measurement will adopt the configured fallback value that has been set by the user. In addition the status of the measured value will be set to 'GOOD', such that any function block using this measurement may continue to calculate and not employ its own fallback strategy.

4: Up Scale

The measurement will be forced to adopt its high limit. This is like having a resistive pull up on an input circuit. In addition the status of the measured value will be set to 'BAD', such that any function block using this measurement can operate its own fallback strategy. For example, the control loop may hold its output to the current value.

5: Down Scale

The measurement will be forced to adopt its low limit. This is like having a resistive pull down on an input circuit. In addition the status of the measured value will be set to 'BAD', such that any function block using this measurement can operate its own fallback strategy. For example, the control loop may hold its output to the current value.

Edge Wires

If the Loop.Main.AutoMan parameter were wired from a logic input in the conventional manner it would be impossible to put the instrument into manual via communications. Other parameters need to be controlled by wiring but also need to be able to change under other circumstances, for example, Alarm Acknowledgements. for this reason some Boolean parameters are wired in an alternative way.

These are listed as follows:

Set Dominant

When the wired-in value is 1 the parameter is always updated. This will have the effect of overriding any changes through digital communications. When the wired-in value changes to 0 the parameter is initially changed to 0 but is not continuously updated. This permits the value to be changed through digital communications.

Loop.Main.AutoMan → Programmer.Setup.ProgHold → Access.StandBy

Rising Edge

When the wired-in value changes from 0 to 1, a 1 is written to the parameter. At all other times the wire does not update the parameter. This type of wiring is used for parameters that start an action and, when once completed, the block clears the parameter. When wired to, these parameters can still be operated via digital communications.

Loop.Tune.AutotuneEnable	Txdr.ClearCal	Alarm.Ack
	Txdr.StartCal	DigAlarm.Ack
Programmer.Setup.ProgRun	Txdr.StartHighCal	AlmSummary.GlobalAck
Programmer.Setup.AdvSeg	Txdr.StartTare	
Programmer.Setup.SkipSeg		Instrument.Diagnostics.ClearStats
IPMonitor.Reset		

Both Edge

This type of edge is used for parameters which may need to be controlled by wiring or but should also be able to be controlled through digital communications. If the wired-in value changes then the new value is written to the parameter by the wire. At all other times the parameter is free to be edited through digital communications.

Loop.SP.RateDisable → Loop.OP.RateDisable

Mini8 Controller Overview

Input and output parameters of function blocks are wired together using software wiring to form a particular control strategy within the Mini8 controller. An overview of all the available functions and where to obtain more detail is shown below.

Inputs

Thermocouples →

Mod.1 to Mod.32
T/C, RTD, mA, mV
See:
Thermocouple
Input

Setpoint
**Loop/SP folder
Folder**
See: Control Loop
Setup

Input Linearization
Lin 16 Folder
See: Input
Characterization

Polynomial
Poly Folder
See: Input
Characterization

Dig Inputs →

FixedIO/IO
Logic Input
See: I/O Folder

BCD Input
BCD In Folder
See: BCD
Parameters

Switchover
SwOver Folder
See: Switch Over
Parameters

Transducer
Scaling
Txdr Folder
See: Transducer
Scaling

User Values
UsrVal Folder
See: User Values

Current
Transformers →

Current I/p
**IO.Current
Monitor Folder**
See: I/O Folder

Control Processes

Loops 1 to 16
Loop Folder
See: Control Loop
Setup

Programmer
Prog Folder
See: Setpoint
Programmer

Application specific
Humidity Zirconia
See: Applications

Alarm(s)
Alarm Folder
See: Alarms

Digital Alarms
Dig Alm Folder
See: Alarms

Alarm Summary
**Alarm Summary
Folder**
See: Alarms

Maths
**Math2 & Mux8
Folder**
See: Logic and
Maths Operators

Maths
**Lgc2 & Lgc8
Folder**
See: Logic and
Maths Operators

Timer/Clock
Counter/Totalizer
See: Counters,
Timers, Totalizers,
and RT Clock

Field Comms
**Comms/FC
Folder**
See: Digital
Communications

Outputs

Mod.1 to Mod.32
Logic Output
See: I/O Folder

Mod.25 to Mod.32
Analog Output
See: I/O Folder

→ To plant
devices

FixedIO/IO
Relay O/P
See: I/O Folder

→ PC, PLC

Figure 53 Controller Example

Mini8 controllers are supplied unconfigured, and with those blocks included in the order code. Option EC8 is supplied with function blocks pre-wired to give an eight loop heat/cool controller suitable for Extrusion. See data sheet HA028519.

The purpose of the PID control blocks is to reduce the difference between SP and PV (the deviation or 'control error' signal) to zero by providing a compensating output to the plant via the output driver blocks.

The timer, programmer and alarms blocks may be made to operate on a number of parameters within the controller, and digital communications provides an interface to data collection and control.

The controller can be customized to suit a particular process by 'soft wiring' between function blocks.

Complete list of Function Blocks
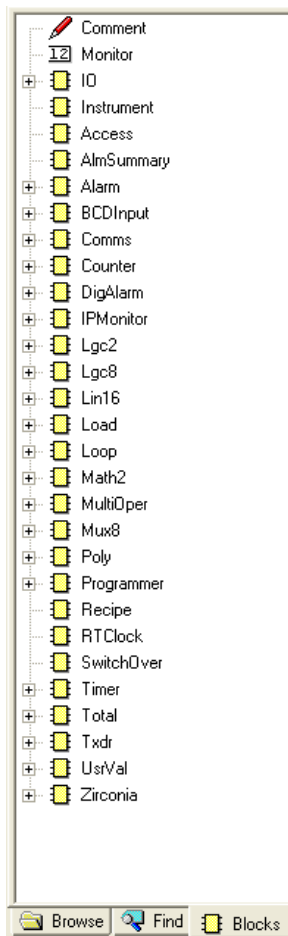
The list opposite represents an unconfigured Mini8 controller that has been ordered with all features enabled.

If a particular block or blocks do not appear in your instrument then the option has not been ordered. Check the order code of your instrument and contact Eurotherm.

Examples of features that may not have been enabled are:

• Loops

• Programmer

• Recipe

• Humidity

Once a block is dragged and dropped onto the graphical wiring window, the block icon in the block list opposite will be grayed out. At the same time a folder containing the blocks parameters will have been created in the Browse List.

Figure 54 Complete List of Function Blocks

Access Folder

Folder: Access		Sub-folder: none			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
ClearMemory	Cold start the instrument	No	Disabled	No	Conf
		App	Mini8 controller memory reset but comms and linearization tables retained		
		LinTables	Custom Linearization tables are deleted		
		InitComms	Comms ports reset to default configurations		
		Wires	Clear all wiring		
		AllMemory	All instrument memory is set to default values		
		Programs	All Programs cleared		
CustomerID	Customer Identifier	Reference number for customer use		0	Oper
Standby	Set Instrument to standby	No / Yes		No	Oper

Instrument Folder

Instrument / Enables

The following table lists the options that can be enabled in the instrument.

Enable flags are one bit for each item – i.e. Bit 0 (=1) enables item 1, Bit 1 (=2) item 2, Bit 3 (=4) item 3, and so on to Bit 7 (=128) enables Item 8. All eight items enabled adds up to 255.

☺ Tip: Features are not normally enabled this way. Dragging and dropping a function block onto the graphical wiring window automatically sets the required enable flag.

Folder: Instrument		Sub-folder: Enables		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
AlarmEn1	Analog alarms Enable Flags	Alarms 1 to 8. 0 (none) to 255 (all 8)	0	Conf
AlarmEn2	Analog alarms Enable Flags	Alarms 9 to 16. 0 (none) to 255 (all 8)	0	Conf
AlarmEn3	Analog alarms Enable Flags	Alarms 17 to 24. 0 (none) to 255 (all 8)	0	Conf
AlarmEn4	Analog alarms Enable Flags	Alarms 25 to 32. 0 (none) to 255 (all 8)	0	Conf
BCDInEn	BCD switch input Enable Flags	BCD input 1 and 2. 0 (none) to 3 (both)	0	Conf
CounterEn	Counters Enable Flags	Counters1 and 2. 0 (none) to 3 (both)	0	Conf
CurrentMon (Only if CT3 module fitted)	Current Monitor Enable Flag	0 = Off 1 = On	0	Conf
DigAlmEn1	Digital alarms Enable Flags	Dig Alarms 1 to 8. 0 (none) to 255 (all 8)	0	Conf
DigAlmEn2	Digital alarms Enable Flags	Dig Alarms 9 to 16. 0 (none) to 255 (all 8)	0	Conf
DigAlmEn3	Digital alarms Enable Flags	Dig Alarms 17 to 24. 0 (none) to 255 (all 8)	0	Conf
DigAlmEn4	Digital alarms Enable Flags	Dig Alarms 25 to 32. 0 (none) to 255 (all 8)	0	Conf
HumidityEn	Humidity control Enable Flag	0 = off 1 = On	0	Conf
IP Mon En	Input monitor Enable Flags	Input Monitor 1 and 2. 0 (none) to 3 (both)	0	Conf
Lgc2 En1	Logic operators Enable Flags	Logic operators 1 to 8. 0 (none) to 255 (all 8)	0	Conf
Lgc2 En2	Logic operators Enable Flags	Logic operators 9 to 16. 0 (none) to 255 (all 8)	0	Conf
Lgc2 En3	Logic operators Enable Flags	Logic operators 17 to 24. 0 (none) to 255 (all 8)	0	Conf
Lgc8 En	Logic 8 operator Enable Flags	8-input Logic operators 1 & 2. 0 (none) to 3 (both)	0	Conf
Lin16Pt En	Input linearization 16 point	Input Linearization 1 and 2. 0 (none) to 3 (both)	0	Conf
Load En	Load Enable Flags	Loads 1 to 8. 0 (none) to 255 (all 8)	As order code	Conf
Load En2	Load Enable Flags	Loads 9 to 16. 0 (none) to 255 (all 8)	As order code	Conf
Loop En	Loop Enable Flags	Loops 1 to 8. 0 (none) to 255 (all 8)	As order code	Conf
Loop En2	Loop Enable Flags	Loops 9 to 16. 0 (none) to 255 (all 8)	As order code	Conf
Math2 En1	Analog (Maths) Operators Enable Flags	Analog operators 0 to 8. 0 (none) to 255 (all 8)	0	Conf
Math2 En2	Analog (Maths) Operators Enable Flags	Analog operators 9 to 16. 0 (none) to 255 (all 8)	0	Conf
Math2 En3	Analog (Maths) Operators Enable Flags	Analog operators 17 to 24. 0 (none) to 255 (all 8)	0	Conf
MultiOperEn	Analog Multi- Operator Enable Flags	Multi-operators 0 to 4. 0 (none) to 15 (all 4)	0	Conf
Mux8 En	Multiplexor Enable Flags	8-input multiplexer 1 and 2. 0 (none) to 3 (both)	0	Conf

Folder: Instrument		Sub-folder: Enables		
Name	Parameter Description	Value	Default	Access Level
Poly En	Polynomial linearization block Enable Flags	Poly Linearization 1 and 2. 0 (none) to 3 (both)	0	Conf
Prog En	Programmer Enable Flags	0 = off, 1 to 8. 0 (none) to 255 (all 8)	0	Conf
RTClock En	Real time clock Enable Flags	0 = off 1 = On	0	Conf
SwOver En	Switch over block Enable Flags	0 = off 1 = On	0	Conf
Timer En	Timers Enable Flags	Timers 1 to 4. 0 = none to 15 = 4	0	Conf
Totalise En	Totalizers Enable Flags	Totalizers 1 & 2. 0 (none) to 3 (both)	0	Conf
TrScale En	Transducer scaling Enable Flags	Transducer scalers 1 and 2. 0 (none) to 3 (both)	0	Conf
UsrVal En1	User values Enable Flags	User Values 1 to 8. 0 (none) to 255 (all 8)	0	Conf
UsrVal En2	User values Enable Flags	User Values 9 to 16. 0 (none) to 255 (all 8)	0	Conf
UsrVal En3	User values Enable Flags	User Values 17 to 24. 0 (none) to 255 (all 8)	0	Conf
UsrVal En4	User values Enable Flags	User Values 25 to 32. 0 (none) to 255 (all 8)	0	Conf
Zirconia En	Zirconia Input Functions	0 = Off 1 = On	0	Conf

Instrument / Options

Folder: Instrument		Sub-folder: Options		
Name	Parameter Description	Value	Default	Access Level
Units	Units	°C,°F or Kelvin scale for all temperature parameters	DegC	Oper
ProgPVstart	To enable PV start	No, Yes – see "Setpoint Programmer" on page 238	No	Conf

Instrument / InstInfo

Folder: Instrument		Sub-folder: InstInfo		
Name	Parameter Description	Value	Default	Access Level
InstType	Instrument Type		MINI8	NONE
Version	Version Identifier		-	NONE
Serial No	Serial Number			NONE
Passcode1	Passcode1	0 to 65535		Oper
Passcode2	Passcode2	0 to 65535		Oper
Passcode3	Passcode3	0 to 65535		Oper
CompanyID	CompanyID		1280	NONE

Instrument / Diagnostics

This list provides diagnostic information as follows:

Folder: Instrument	Sub-folder: Diagnostics
Name	**Parameter Description**
CPUFree	This is the amount of free CPU time left. It shows the percentage of the tasks ticks that are idle.
MinCPUFree	A benchmark of the lowest reached value of the CPU free percentage.
CtrlTicks	This is the number of ticks that have elapsed while the instrument was performing the control task.
Max Con Tick	A benchmark of the maximum number of ticks that have elapsed while the instrument was performing the control task
Clear Stats	Resets the instrument performance benchmarks.
ErrCount	The number of items logged since the last Clear Log. Note: If an the same issue occurs multiple times only the first occurrence will be logged, but each event will increment the count.

Err1	The first entry in the log	0 Normal operation.
Err2	The second entry in the log	1 Bad or unrecognized module identity. A module has been inserted and has a bad or unrecognized identity. Either the module is damaged or the module is unsupported.
Err3	The third entry in the log	3 Factory calibration data bad.The factory calibration data has been read from an I/O module and has not passed the checksum test. Either the module is damaged or has not been initialized.
Err4	The fourth entry in the log	4 Module changed for one of a different type. A module has been changed for one of a different type. The configuration may now be incorrect.
Err5	The fifth entry in the log	10 Calibration data write unsuccessful. Writing calibration data back to an I/O module's EE did not succeed.
Err6	The sixth entry in the log	11 Calibration data read unsuccessful. Reading calibration data back from the EE on an I/O module did not succeed.
Err7	The seventh entry in the log	18 Invalid checksum. The checksum of the Non-volatile (NVol) RAM is incorrect. The NVol is considered corrupt and therefore the instrument configuration may be incorrect.
Err8	The eighth entry in the log	20 Resistive identifier incorrect. The value returned when reading the resistive identifier from an I/O module was incorrect. The module may be damaged.
		43 Invalid custom linearization table. One of the custom linearization tables is invalid. Either it has not passed checksum tests or the table downloaded to the instrument is invalid.
		55 The Instrument wiring is either invalid or corrupt.
		56 Non-volatile write to volatile. An attempt was made to perform a checksummed write to a non-checksummed area.
		58 Recipe load did not succeed. The selected recipe did not load.
		59 Bad User CT calibration data. Corrupted or invalid user calibration data for the current monitor.
		60 Bad Factory CT calibration data. Corrupted or invalid factory calibration data for the current monitor.
		62 to 65 Slot1 card DFC1 to DFC4 issue / 66 to 69 Slot2 card DFC1 to DFC4 issue / 70 to 73 Slot3 card DFC1 to DFC4 issue / 74 to 77 Slot4 card DFC1 to DFC4 issue — The generic I/O DFC chip will not communicate. This could indicate an issue with the build.

Clear Log	Clears the log entries and count. Value options No: Yes
UserStringCount	Number of User Strings Defined
UserStringCharsLeft	Space Available For User Strings.
Segments Left	Number of Available Program Segments Gives the number of unused program segments. Each time a segment is allocated to a program, this value is reduced by one.
CtrlStack	Control Stack Free Space (words) The number of words of unused stack for the control task
CommsStack	Comms Stack Free Space (words) The number of words of unused stack for the comms task
IdleStack	Idle Stack Free Space (words) The number of words of unused stack for the idle (background) task.
MaxSegments	The maximum number of setpoint programmer segments available given the feature's security settings for the connected instrument.
MaxSegsPerProg	Specifies the maximum number of segments that can be configured for a single program
CntrlOverrun	Indicates the amount of control overrun.

Folder: Instrument	Sub-folder: Diagnostics
Name	**Parameter Description**
PSUident	Shows type of PSU fitted. 0 = Mains 1= 24V dc
PwrFailCount	Counts the number of times the instrument power has been switched off. Can be used to see if the supply to the instrument has been disconnected.
IntCRCErr	'Internal CRC Error Count'. A count of CRC issues seen on the internal Modbus channel for the FC port.
IntUARTErr	'Internal UART Error Count'. A count of uART issues (overrun, framing or parity) seen on the internal Modbus channel for the FC port.
Cust1Name	Name for custom linearization table 1
Cust2Name	Name for custom linearization table 2
Cust3Name	Name for custom linearization table 3

I/O Folder

This lists the modules fitted into the instruments, all the IO channels, the fixed IO and the current monitoring.

The IO folder lists all the channels of each of the IO boards in the four available slots. Each board has up to eight inputs or outputs making a maximum of 32 channels. The channels are listed under Mod1 to Mod32.

Slot	Channels
1	IO.Mod.1 to IO.Mod.8
2	IO.Mod.9 to IO.Mod.16
3	IO.Mod.17 to IO.Mod.24
4	IO.Mod.25 to IO.Mod.32

Note: The current transformer input, CT3, is not included in this arrangement. There is a separate folder for current monitoring under IO.CurrentMonitor. If this board is fitted into slot 2 the IO.Mod.9 to Mod.16 would not exist.

Module ID

Folder: IO		Sub-folder: ModIDs		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Module1	Module1Ident	0 NoMod – No Module 24 DO8Mod – 8 logic outputs 18 RL8Mod – 8 relay outputs	0	Read Only
Module2	Module2Ident	60 DI8 – 8 logic inputs 90 CT3Mod – 3 current transformer inputs 131 TC8Mod – 8 thermocouple/mV inputs 133 TC4Mod – 4 thermocouple/mV inputs	0	Read Only
Module3	Module3Ident	147 - ET8Mod– 8 thermocouple/mV inputs 173 RT4 – 4 Pt100 or Pt1000 inputs 201 AO8Mod – 8. 0-20 mA outputs (Slot 4 only)	0	Read Only
Module4	Module4Ident	203 AO4Mod – 4. 0-20 mA outputs (Slot 4 only)	0	Read Only

Modules

The content of the Mod folders depends on the type of IO module fitted in each slot. These will be covered in the following sections.

Logic Input

Each DI8 card provides eight logic input channels (voltage controlled) to the system. These can be wired to provide digital inputs to any function block within the system.

Logic Input Parameters

Folder – IO		Sub-folder Mod.1 to .32			
Name	Parameter Description	Value		Default	Access Level
Ident	Channel Identity	LogicIn			Read Only
IOType	IO Type	OnOff	On off input		Conf
Invert	Sets the sense of the logic input	No Yes	Normal logic applied Logical NOT applied	No	Conf
Measured Val	Measured Value	On/Off	Value seen at the terminals	Off	Read Only
PV	Process Variable	On/Off	Value after allowing for Invert	Off	Read Only

Logic Output

If a slot is fitted with a DO8 board then eight channels will be available to be configured and connected to Loop outputs, alarms or other logic signals.

Logic Out Parameters

Folder – IO		Sub-folder Mod.1 to .32			
Name	Parameter Description	Value		Default	Access Level
Ident	Channel Identity	LogicOut			Read Only
IOType	IO Type	OnOff	On off output		Conf
		Time Prop	Time proportioning output		
Invert	Sets the sense of the logic input or output	No Yes	Normal logic applied Logical NOT applied	No	Conf
SbyAct	Action taken by output when instrument goes into Standby Mode	Off, On Continue	Switches On/Off Remains in its last state	Off	Conf
The next five parameters are only shown when 'IO Type' = 'Time Prop' outputs					
MinOnTime	Minimum output on/off time. Stops relays from switching too rapidly	Auto 0.01 to 150.00 seconds	Auto = 20ms. This is the fastest allowable update rate for the output	Auto	Oper
DisplayHigh	The maximum displayable reading	0.00 to 100.00		100.00	Oper
DisplayLow	The minimum displayable reading	0.00 to 100.00		0.00	Oper
RangeHigh	The maximum (electrical) input/output level	0.00 to 100.00		100	Oper
RangeLow	The minimum (electrical) input/output level	0.00 to 100.00		0	Oper
Always displayed					
MeasuredVal	The current value of the output demand signal to the hardware including the effect of the Invert parameter.	0 1	Off On		Read only
PV	This is the desired output value, before the Invert parameter is applied	0 to 100 or 0 to 1 (OnOff)			Oper

PV can be wired from the output of a function block. For example if it is used for control it may be wired from the control loop output (Ch1 Output).

Logic Output Scaling

If the output is configured for time proportioning control, it can be scaled such that a lower and upper level of PID demand signal can limit the operation of the output value.

By default, the output will be fully off for 0% power demand, fully on for 100% power demand and equal on/off times at 50% power demand. You can change these limits to suit the process. It is important to note, however, that these limits are set to recommended values for the process. For example, for a heating process it may be required to maintain a minimum level of temperature. This can be achieved by applying an offset at 0% power demand which will maintain the output on for a period of time. Take care to ensure that this minimum on period does not cause the process to overheat.

If Range Hi is set to a value <100% the time proportioning output will switch at a rate depending on the value - it will not switch fully on.

Similarly, if Range Lo is set to a value >0% it will not switch fully off.
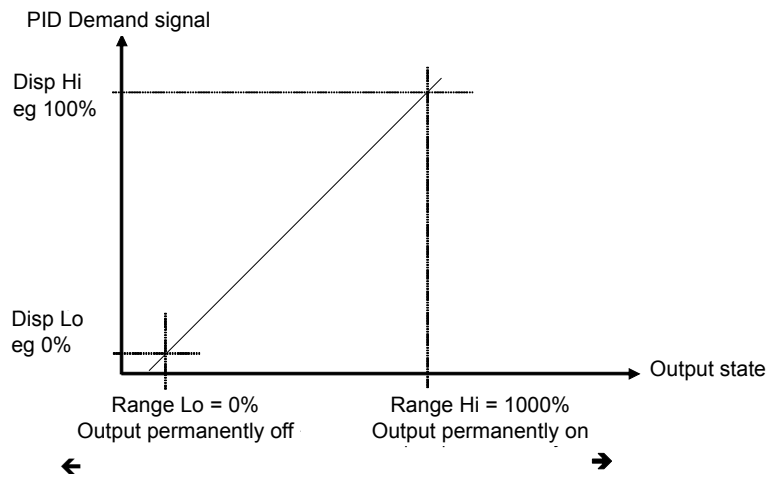
Figure 55 Time Proportioning Output

Example: To Scale a Proportioning Logic Output

Set Access level to 'configuration'.
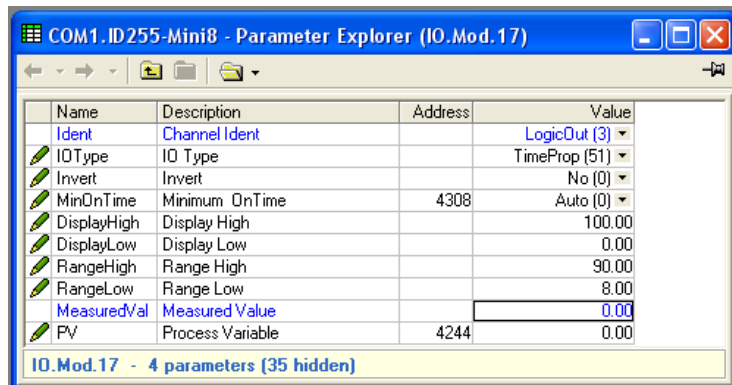
Figure 56 Example (Scaling Proportioning Logic Output)

In this example the output will switch on for 8% of the time when the PID demand wired to 'PV' signal is at 0%.

Similarly, it will remain on for 90% of the time when the demand signal is at 100%.

Relay Output

If slot 2 and/or 3 is fitted with a RL8 board then eight channels will be available to be configured and connected to Loop outputs, alarms or other logic signals.

Relay Parameters

Folder – IO		Sub-folder Mod.9 to Mod.24			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Channel Identity	Relay			Read Only
IOType	IO Type	OnOff	On off output		Conf
		Time Prop	Time proportioning output		
Invert	Sets the sense of the logic input or output	No	Normal logic applied	No	Conf
		Yes	Logical NOT applied		
SbyAct	Action taken by output when instrument goes into Standby Mode	Off, On	Switches On/Off	Off	Conf
		Continue	Remains in its last state		
The next five parameters are only shown when 'IO Type' = 'Time Prop' outputs					
MinOnTime	Minimum output on/off time. Stops relays from switching too rapidly	Auto 0.01 to 150.00 seconds	Auto = 220ms. This is the fastest allowable update rate for the output	Auto	Oper
DisplayHigh	The maximum displayable reading	0.00 to 100.00		100.00	Oper
DisplayLow	The minimum displayable reading	0.00 to 100.00		0.00	Oper
RangeHigh	The maximum (electrical) input/output level	0.00 to 100.00		100	Oper
RangeLow	The minimum (electrical) input/output level	0.00 to 100.00		0	Oper
Always displayed					
MeasuredVal	The current value of the output demand signal to the hardware including the effect of the Invert parameter.	0 1	Off On		Read only
PV	This is the desired output value, before the Invert parameter is applied	0 to 100 or 0 to 1 (OnOff)			Oper

Thermocouple Input

A TC4 offers four channels and the TC8/ET8 boards offer eight channels which may be configured as thermocouple inputs or mV inputs.

Thermocouple Input Parameters

Folder – IO		Sub-headers: Mod.1 to Mod.32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Channel Ident	TCinput			Read Only
IO Type	IO Type	Thermocouple	For direct T/C connection		Conf
		mV	For mV inputs, usually linear, scaled to engineering units.		
Lin Type	Input linearization	see "Linearization Types and Ranges" on page 108			Conf
Units	Display units used for units conversion	see "Input Linearization Parameters" on page 202			Conf
Resolution	Resolution	XXXXX to X.XXXX	Sets scaling for digital communications using the SCADA table		Conf
CJC Type	To select the cold junction compensation method	Internal 0°C (32°F) 45°C (113°F) 50°C (122°F) External Off	See description in "CJC Type" on page 102 for further details	Internal	Conf
SBrk Type	Sensor break type	Low	Sensor break will be detected when its impedance is greater than a 'low' value		Conf
		High	Sensor break will be detected when its impedance is greater than a 'high' value		
		Off	No sensor break		
SBrk Alarm	Sets the alarm action when a sensor break condition is detected	ManLatch	Manual latching	see also "Alarms" on page 120		Oper
		NonLatch	No latching	Alarms		
		Off	No sensor break alarm			
AlarmAck	Sensor Break alarm acknowledge	No Yes		No	Oper
DisplayHigh	The maximum display value in engineering units	-99999 to 99999		100	Oper
DisplayLow	The minimum display value in engineering units	-99999 to 99999	For IO Type mV only Limits apply to Linear and SqRoot linearization.	0	Oper
RangeHigh	The maximum (electrical) input mV	RangeLow to 70		70	Oper
RangeLow	The minimum (electrical) input mV	-70 to RangeHigh		0	Oper
Fallback	Fallback Strategy See also "Fallback" on page 103.	Downscale	Meas Value = Input range Lo - 5% of the mV signal received from the PV input.		Conf
		Upscale	Meas Value = Input range Hi + 5% of the mV signal received from the PV input.		
		Fall Good	Meas Value = Fallback PV		
		Fall Bad	Meas Value = Fallback PV		
		Clip Good	Meas Value = Input range Hi/Lo +/- 5%		
		Clip Bad	Meas Value = Input range Hi/Lo +/- 5%		
Fallback PV	Fallback value See also "Fallback" on page 103	Instrument range			Conf

Folder – IO		Sub-headers: Mod.1 to Mod.32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Filter Time Constant	Input filter time. An input filter provides damping of the input signal. This may be necessary to mitigate the effects of excessive electrical noise on the PV input.	Off to 500:00 (hhh:mm) s:ms to hhh:mm		1s600ms	Oper
Measured Val	The current electrical value of the PV input				Read Only
PV	The current value of the PV input after linearization	Instrument range			Read Only
LoPoint	Low Point	Lower cal point		0.0	Oper
LoOffset	Low Offset	Offset at lower point		0.0	Oper
HiPoint	High Point	Higher cal point		0.0	Oper
HiOffset	High Offset	Offset at Higher point		0.0	Oper
Offset	Used to add a constant offset to the PV see "PV Offset (Single Point)" on page 104	Instrument range		0.0	Oper
CJC Temp	Reads the temperature of the rear terminals at the thermocouple connection				Read Only
SBrk Value	Sensor break Value Used for diagnostics only, and displays the sensor break trip value				Read Only
Cal State	Calibration State. Calibration of the PV Input is described in "Calibration Parameters" on page 276	Idle			Conf
Status	PV Status The current status of the PV.	0 - OK 1 - Startup 2 - SensorBreak 4 – Out of range 6 - Saturated 8 – Not Calibrated 25 – No Module	Normal operation Initial startup mode Input in sensor break PV outside operating limits Saturated input Uncalibrated channel No Module		Read Only
SbrkOutput	Sensor Break Output	Off /On			Read Only

Linearization Types and Ranges

Input Type		Min Range	Max Range	Units	Min Range	Max Range	Units
J	Thermocouple type J	-210	1200	°C	-346	2192	°F
K	Thermocouple type K	-200	1372	°C	-328	2501	°F
L	Thermocouple type L	-200	900	°C	-328	1652	°F
R	Thermocouple type R	-50	1768	°C	-58	3214	°F
B	Thermocouple type B	0	1820	°C	32	3308	°F
N	Thermocouple type N	-200	1300	°C	-328	2372	°F
T	Thermocouple type T	-250	400	°C	-418	752	°F
S	Thermocouple type S	-50	1768	°C	-58	3214	°F
PL2	Thermocouple Platinel II	0	1369	°C	32	2496	°F
C	Custom						
Linear	mV linear input	-70	70	mV			
SqRoot	Square root						
Custom	Customized linearization tables						

CJC Type

A thermocouple measures the temperature difference between the measuring junction and the reference junction. The reference junction, therefore, must either be held at a fixed known temperature or accurate compensation be used for any temperature variations of the junction.

Measuring junction

Reference junction
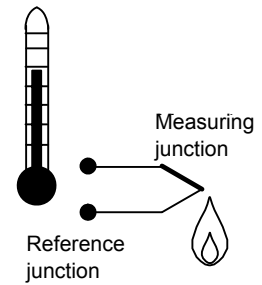
Figure 57 CJC Action

Internal Compensation

The controller is provided with a temperature sensing device which senses the temperature at the point where the thermocouple is joined to the copper wiring of the instrument and applies a corrective signal.

Where very high accuracy is needed and to accommodate multi-thermocouple installations, larger reference units are used which can achieve an accuracy of ±0.1°C or better. These units also allow the cables to the instrumentation to be run in copper. The reference units are contained basically under three techniques, Ice-Point, Hot Box and Isothermal.

Ice-Point

There are usually two methods of feeding the EMF from the thermocouple to the measuring instrumentation via the ice-point reference, bellows type and temperature sensor type.

The bellows type utilizes the precise volumetric increase which occurs when a known quantity of ultra pure water changes state from liquid to solid. A precision cylinder actuates expansion bellows which control power to a thermoelectric cooling device. The temperature sensor type uses a metal block of high thermal conductance and mass, which is thermally insulated from ambient temperatures. The block temperature is lowered to 0°C (32°F) by a cooling element, and maintained there by a temperature sensing device.

Special thermometers are obtainable for checking the 0°C (32°F) reference units and alarm circuits that detect any movement from the zero position can be fitted.

Hot Box

Thermocouples are calibrated in terms of EMF generated by the measuring junctions relative to the reference junction at 0°C (32°F). Different reference points can produce different characteristics of thermocouples, therefore referencing at another temperature does present problems. However, the ability of the hot box to work at very high ambient temperatures, plus a good reliability factor has led to an increase in its usage. The unit can consist of a thermally insulated solid aluminium block in which the reference junctions are embedded.

The block temperature is controlled by a closed loop system, and a heater is used as a booster when initially switching on. This booster drops out before the reference temperature, usually between 55°C (131°F) and 65°C (149°F), is reached, but the stability of the hot box temperature is now important. Measurements cannot be taken until the hot box reaches the correct temperature.

Isothermal Systems

The thermocouple junctions being referenced are contained in a block which is heavily thermally insulated. The junctions are allowed to follow the mean ambient temperature, which varies slowly. This variation is accurately sensed by electronic means, and a signal is produced for the associated instrumentation. The high reliability factor of this method has favoured its use for long term monitoring.

CJC Options in Mini8 Controller Series

0 – Internal	CJC measurement at instrument terminals
1 – 0C	CJC based on external junctions kept at 0°C (Ice Point)
2 – 45C	CJC based on external junctions kept at 45°C (Hot Box)
3 – 50C	CJC based on external junctions kept at 50°C (Hot Box)
4 – External	CJC based on independent external measurement
5 – Off	CJC switched off

Sensor Break Value

The controller continuously monitors the impedance of a transducer or sensor connected to any analog input. This impedance, expressed as a percentage of the impedance which causes the sensor break flag to trip, is a parameter called 'SBrkValue'.

The table below shows the typical impedance which causes sensor break to trip for various types of input and high and low SBrk Impedance readings. The impedance values are only approximate (±25%) as they are not factory calibrated.

TC4/TC8/ET8 Input Range -77 to +77mV	SBrk Impedance – High	~ 12kΩ
	SBrk Impedance – Low	~ 3kΩ

Fallback

A Fallback strategy may be used to configure the default value for the PV in case of any issues. These may be due an out of range value, a sensor break, lack of calibration or a saturated input.

The Status parameter would indicate the nature of the issue and could be used to diagnose the problem.

Fallback has several modes and may be associated with the Fallback PV parameter

The Fallback PV may be used to configure the value assigned to the PV in case of any issue. The Fallback parameter should be configured accordingly.

The Fallback parameter may be configured so as to force a Good or Bad status when in operation. This in turn allows the user to choose to override issues or to allow them to affect the process.

User Calibration (Two Point)

All ranges of the controller have been calibrated against traceable reference standards. However in a particular application it may be necessary to adjust the displayed reading to overcome other effects within the process. A two point calibration is offered allowing offset and slope adjustment. This is most useful where the setpoints used in a process cover a wide range. The Low and High points should be set on or near the extremities of the range.
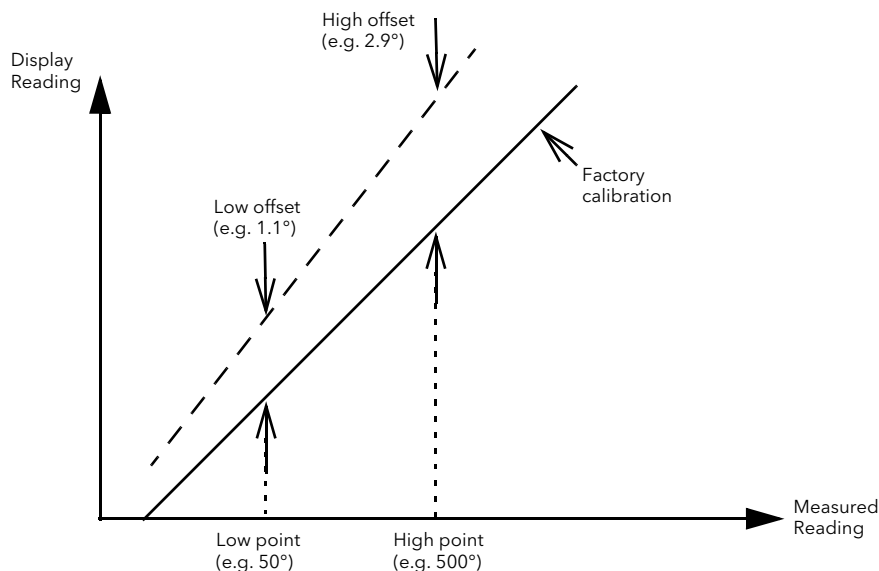
Figure 58 Two Point User Calibration

PV Offset (Single Point)

All ranges of the controller have been calibrated against traceable reference standards. This means that if the input type is changed it is not necessary to calibrate the controller. There may be occasions, however, when you wish to apply an offset to the standard calibration to take account of known issues within the process, for example, a known issue either with a sensor or its positioning. In these instances, it is not advisable to change the reference calibration, but to apply a user defined offset.

A single point offset is most useful where the process setpoint remains at nominally the same value.

PV Offset applies a single offset over the full display range of the controller and can be adjusted in Operator Mode. It has the effect of moving the curve up and down about a central point as shown in the example below:
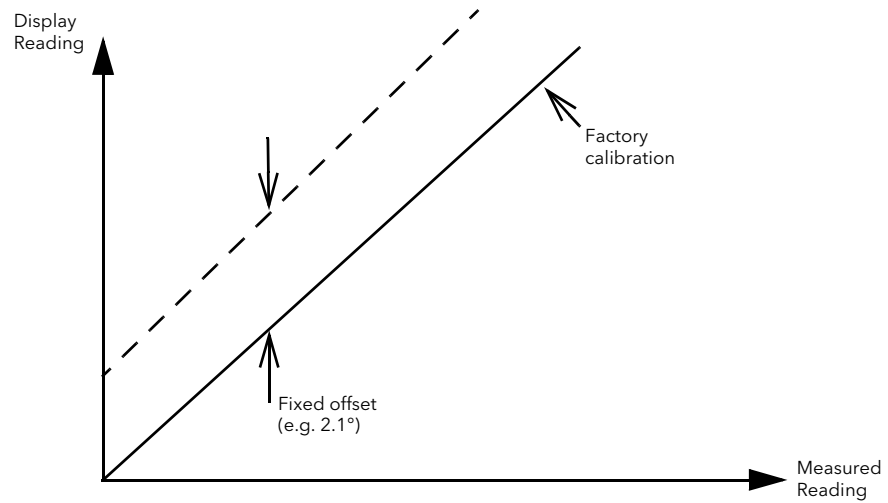
Figure 59 PV Offset Example

Example: To Apply an Offset

1. Connect the input of the controller to the source device which you wish to calibrate to.

2. Set the source to the desired calibration value. The controller will show the current measurement of the value.

3. If the value is correct, the controller is correctly calibrated and no further action is necessary. If you wish to offset the reading use the Offset parameter where:
Corrected value (PV) = input value + Offset.

Using TC4 or TC8/ET8 channel as a mV input

Example – a pressure sensor provides 0 to 33mV for 0 to 200 bar.

1. Set IO type to 'mV'.

2. Set Linearisation Type to 'Linear'

3. Set DisplayHigh to '200' (bar).

4. Set DisplayLow to '0' (bar).

5. Set RangeHigh to '33mV'

6. Set RangeLow to '0mV'.

Figure 60 Result of Configuration Settings

Note: Maximum input range is ± 70mV.

Resistance Thermometer Input

The RT4 module offers four resistance inputs which can be linear or Pt100/Pt1000.

RT Input Parameters

Folder – IO		Sub-headers: Mod .1 to .32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Channel Ident	RTinput			Read Only
IO Type	IO Type	RTD2 RTD3 RTD4	For 2-wire, 3-wire or 4-wire connections.		Conf
ResistanceRange	Resistance Range	Low	Selects a Pt100	Low	Conf
		High	Selects a Pt1000		
Lin Type	Linearization Type	See "Linearization Types and Ranges" on page 101			Conf
Units	Display units used for units conversion	See "Input Linearization Parameters" on page 202			Conf
Resolution	Resolution	XXXXX to X.XXXX	Sets scaling for digital communications using the SCADA table		Conf
SBrk Type	Sensor break type	Low	Sensor break will be detected when its impedance is greater than a 'low' value		Conf
		High	Sensor break will be detected when its impedance is greater than a 'high' value		
		Off	No sensor break		
SBrk Alarm	Sets the alarm action when a sensor break condition is detected	ManLatch	Manual latching	see also "Alarms" on page 120		Oper
		NonLatch	No latching			
		Off	No sensor break alarm			
AlarmAck	Sensor Break alarm acknowledge	No Yes		No	Oper
Fallback	Fallback Strategy See also "Fallback" on page 103.	Downscale	Meas Value = Input range Lo - 5%		Conf
		Upscale	Meas Value = Input range Hi + 5%		
		Fall Good	Meas Value = Fallback PV		
		Fall Bad	Meas Value = Fallback PV		
		Clip Good	Meas Value = Input range Hi/Lo +/- 5%		
		Clip Bad	Meas Value = Input range Hi/Lo +/- 5%		
Fallback PV	Fallback value See also "Fallback" on page 103.	Instrument range			Conf
Filter Time Constant	Input filter time. An input filter provides damping of the input signal. This may be necessary to mitigate the effects of excessive electrical noise on the PV input.	Off to 500:00 (hhh:mm) s:ms to hhh:mm		1.6 seconds	Oper
Measured Val	The current electrical value of the PV input				Read Only
PV	The current value of the PV input after linearization	Instrument range			Read Only
LoPoint	Low Point	Lower cal point (See "User Calibration (Two Point)" on page 104)		0.0	Oper
LoOffset	Low Offset	Offset at lower cal point		0.0	Oper
HiPoint	High Point	Higher cal point		0.0	Oper
HiOffset	High Offset	Offset at Higher cal point		0.0	Oper

Folder – IO		Sub-headers: Mod .1 to .32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Offset	Used to add a constant offset to the PV see "PV Offset (Single Point)" on page 104	Instrument range		0.0	Oper
SBrk Value	Sensor break Value Used for diagnostics only, and displays the sensor break trip value				Read Only
Cal State	Calibration State. Calibration of the PV Input is described in "Calibration Parameters" on page 276	Idle			Conf
Status	PV Status The current status of the PV.	0 - OK	Normal operation		Read Only
		1 - Startup	Initial startup mode		
		2 - SensorBreak	Input in sensor break		
		4 – Out of range	PV outside operating limits		
		6 - Saturated	Saturated input		
		8 – Not Calibrated	Uncalibrated channel		
		25 – No Module	No Module		
SbrkOutput	Sensor Break Output	Off /On			Read Only

Linearization Types and Ranges

Input Type		Min Range	Max Range	Units	Min Range	Max Range	Units
Pt100	100 ohm platinum bulb	-242	850	°C	-328	1562	°F
Linear	Linear	0	420	ohms			
Pt1000	1000 ohm platinum bulb	-242	850	°C	-328	1562	°F
Linear	Linear	0	4200	ohms			

Using RT4 as mA input

Wire the input with a 2.49Ω resistor as shown in "Electrical Connections for RTD" on page 45.

1. Set the Resistance Range to 'Low'.

2. Set the Linearisation Type to 'Linear'.
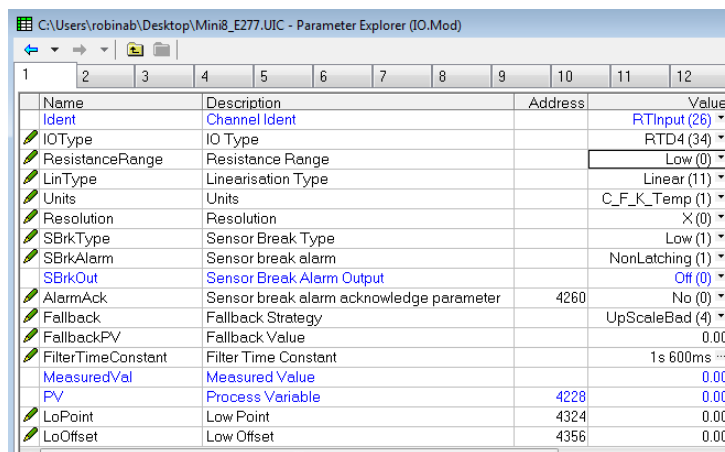
Figure 61 Result of RT4 Configuration Settings

The PV is mapped from the input using User Cal – see "User Calibration (Two Point)" on page 104.

Approximate Values for 4-20mA input with 2.49Ω resistor.

PV range	4 to 20	0 to 100
LoPoint	35.4	35.4
LoOffset	-31.4	-35.4
HiPoint	169.5	169.5
HiOffset	-149.5	-69.5

To achieve accuracy, calibrate the input against a reference. Resistor values up to 5Ω may be used.

Analog Output

The AO4 offers four channels and the AO8 module eight channels which may be configured as mA outputs. An AO4 or AO8 may only be fitted in Slot 4.

Folder – IO		Sub-folder: Mod.25 to Mod.32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Channel ident	mAout			Read Only
IO Type	To configure the output drive signal	mA	Milliamps dc		Conf
Resolution	Display resolution	XXXXX to X.XXXX	Determines scaling for SCADA communications		Conf
Disp Hi	Display high reading	-99999 to 99999 decimal points depend on resolution		100	Oper
Disp Lo	Display low reading			0	Oper
Range Hi	Electrical high input level	0 to 20		20	Oper
Range Lo	Electrical low input level			4	Oper
Meas Value	The current output value				Read Only
PV					Oper
Status	PV Status The current status of the PV.	0 - OK 1 - Startup 2 - SensorBreak 4 – Out of range 6 - Saturated 8 – Not Calibrated 25 – No Module	Normal operation Initial startup mode Input in sensor break PV outside operating limits Saturated input Uncalibrated channel No Module		Read Only

Example: 4 to 20mA Analog Output

In this example 0% (=Display Low) to 100% (=Display High) from a Loop PID Output is wired to this output channel PV input which will give a 4mA (=Range Low) to 20mA (=Range High) control signal.
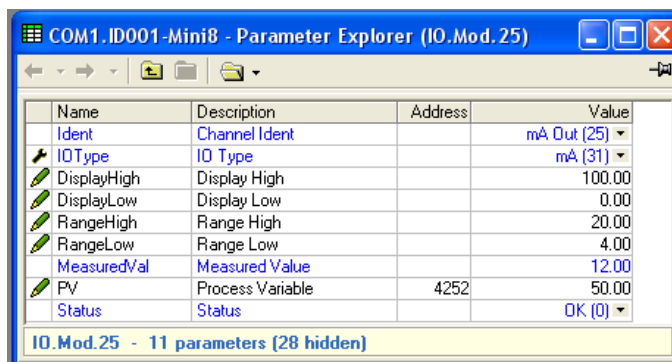
Figure 62 Result of Analog Output Configuration Settings

Here the PID demand is 50% giving a MeasuredVal output of 12mA.

Fixed IO

There are two digital inputs, designated D1 and D2.

Folder: IO		Sub-folder: Fixed IO.D1 and IO.D2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Channel Ident	LogicIn		LogicIn	Read Only
IO Type	IO Type	Input		Input	Read Only
Invert	Invert	No/Yes – input sense is inverted		No	Conf
Measured Val	Measured Value	On/Off	Value seen at the terminals	Off	Read Only
PV	Process Variable	On/Off	Value after allowing for Invert	Off	Read Only

There are two fixed relay outputs, designated A and B.

Folder: IO		Sub-folder: Fixed IO.A and IO.B			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Channel Ident	Relay		Relay	Read Only
IO Type	IO Type	OnOff		OnOff	Read Only
Invert	Invert	No/Yes = output sense is inverted.		No	Conf
Measured Val	Measured Value	On/Off	Value seen at the terminals after allowing for Invert.	Off	Read Only
PV	Process Variable	On/Off	Requested output before Invert	Off	Oper
SbyAct	Action taken by output when instrument goes into Standby Mode	Off, On	Switches On/Off	Off	Conf
		Continue	Remains in its last state		

Current Monitor

The Mini8 controller, with a CT3 card, has the capability of detecting external failures of up to 16 heater loads by measuring the current flowing through them via three current transformer inputs. The external failures that can be detected are:

'Solid State Relay (SSR) Fault'

If current is detected flowing through the heater when the controller is requesting it to be off then this indicates that the SSR is short-circuited. If current is not detected when the controller is requesting the heater to be on it indicates that the SSR is open-circuit.

'Partial Load Fault' (PLF)

If less current is detected flowing through the heater than the PLF threshold which has been set for that channel, then this indicates that the heater has a fault detected in it; in applications that use multiple heater elements in parallel then it indicates that one or more of the elements is open-circuit.

'Over Current Fault' (OCF)

If more current is detected flowing through the heater than the OCF threshold then this indicates that the heater has a fault detected in it; in applications that use multiple heater elements in parallel then it indicates that one or more of the elements has lower than expected resistance value.

Note: If the loop associated with a CT monitored output is inhibited, then that output will be excluded from the CT measurements and fault detection.

Heater failures are indicated via individual load status parameters and via four status words. In addition, a global alarm parameter will indicate when a new CT alarm has been detected, which, will also be registered in the alarm log.

Current Measurement

Individual LoadCurrent parameters indicate the current measured for each heater. The Current Monitor function block utilizes a cycling algorithm to measure the current flowing through one heater per measurement interval (default 10s, user alterable). Compensation within the control loop minimizes the disturbance to the PV when current through a load is being measured.

Name	Description	Value
Load1Status	Load1 Status	Ok (0)
Load1Current	Load1 current	4.185859
Load2Status	Load2 Status	Ok (0)
Load2Current	Load2 current	3.813231
Load3Status	Load3 Status	Ok (0)
Load3Current	Load3 current	3.821723
Ph1AllOff	Phase1 All Off Current	0.012421
Ph2AllOff	Phase2 All Off Current	0.037263
Ph3AllOff	Phase3 All Off Current	0.012328

Figure 63 Result of Current Measurement Settings

The interval between successive measurements is dependent upon the average output power required to maintain SP. The recommended absolute minimum interval can be calculated as follows:

Minimum interval (s) > 0.25 * (100/average output power to maintain SP).

For example, if average output power to maintain SP is 10%, using the above rule, the recommended minimum interval is 2.5 seconds. The interval may need to be adjusted depending upon the response of the heaters being used.

Single Phase Configurations

Single SSR triggering

With this configuration, failures of individual heater loads can be detected. For example, if the current detected flowing through Heater 3 is less than its PLF threshold then this will be indicated as Load3PLF.

Example1 – Using one CT input
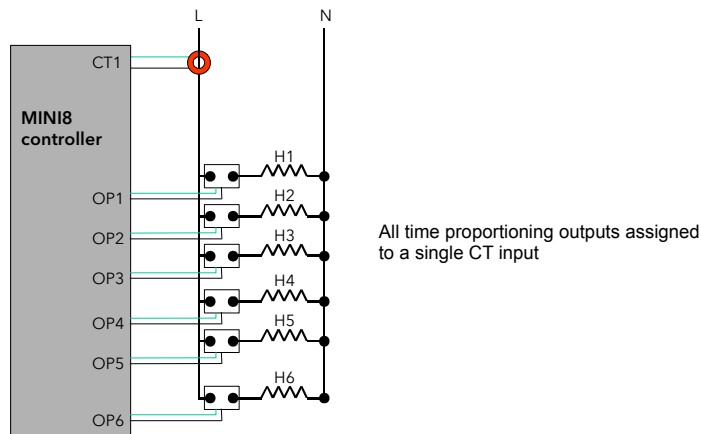
Note: Maximum of 6 Heaters can be connected to one CT input

Figure 64 Using one CT Input

Example2 – Using three CT inputs
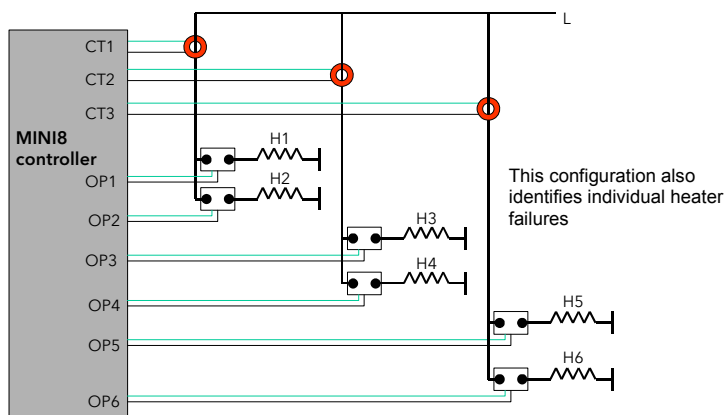
Figure 65 Using three CT Inputs

Multiple SSR triggering

With this configuration, failure of a set of heater loads can be detected. For example, if the current detected flowing through Heater Set 1 is less than the PLF threshold of Load1 then this will be indicated as Load1PLF. Further investigation will then be required to determine which heater within Set 1 has ceased to operate correctly.
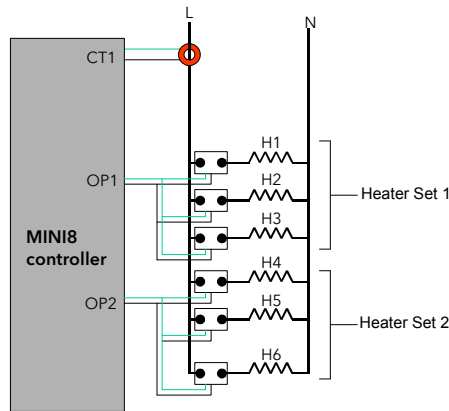
Figure 66 Multiple SSR Triggering

Split Time Proportioning Outputs

This is where a single power demand is split and applied to two time proportioning outputs, that have been scaled, allowing the loads to switch on incrementally as the output power increases. For example, Heater1 will deliver any demand from 0-50%, and Heater2 will deliver any demand from 50-100% (with Heater1 fully on).
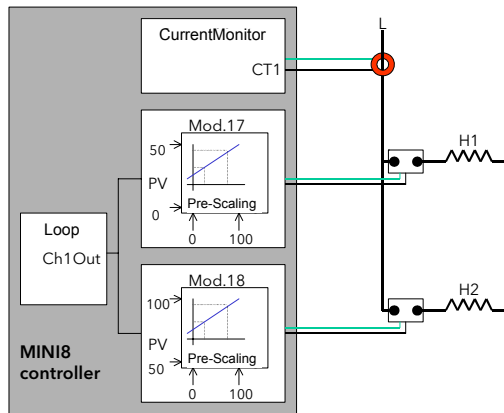
Figure 67 Split Time Proportioning Outputs

As the Mini8 controller has the capability of detecting faults with up to 16 heater loads it can handle this type of application even if all eight loops have split time proportioning outputs.

Three Phase Configuration

Configuration for Three Phase supply applications is similar to that for Single phase using three CT inputs.
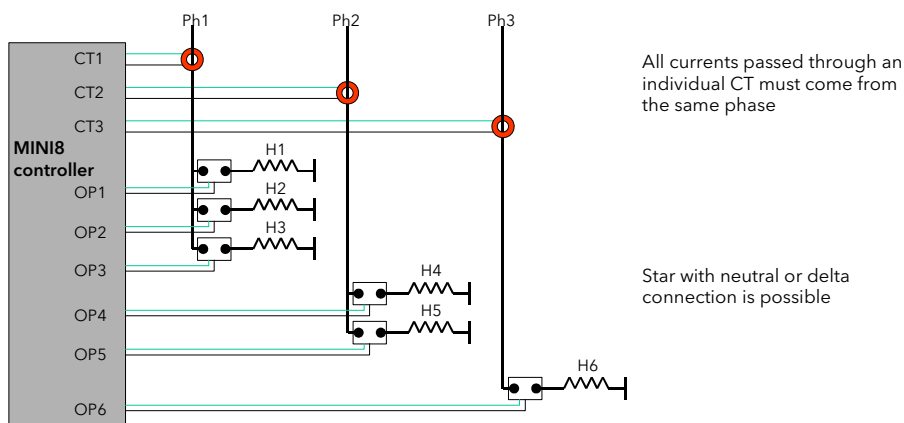
Note: Maximum of 6 Heaters can be connected to one CT input

Figure 68 Three Phase Configuration

Parameter Configuration

If Current Monitor is enabled in the folder Instrument/Options/Current Monitor then the current monitor configuration folder appears as a subfolder in IO.

Folder: IO		Sub-folder: CurrentMonitor/Config			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Commission	Commission CT	No See "Commissioning" on page 115 Auto Manual Accept Abort		No	Oper
CommissionStatus	Commission Status	Not commissioned	Not commissioned	0	Read Only
		Commissioning	Commissioning in progress		
		NoDO8orRL8cards	There are no DO8/RL8 cards installed in the instrument.		
		NoloopTPouts	The digital outputs are either not configured as time proportioning or are not wired from loop heater channels.		
		SSRfault	An SSR is detected as either short-circuit or open-circuit.		
		MaxLoadsCT1/2/3	More than six heaters have been connected to CT input 1 or 2 or 3.		
		NotAccepted	Commissioning did not succeed		
		Passed	Successfully auto commissioned		
		ManuallyConfigured	Configured manually		
Interval	Measurement Interval	1sec to 1min		10s	Oper
Inhibit	Inhibit	No – current is measured Yes –current measurement is inhibited		No	Oper
MaxLeakPh1	Max Leakage Current Phase 1	0.25 to 1A		0.25	Oper
MaxLeakPh2	Max Leakage Current Phase 2	0.25 to 1A		0.25	Oper

Folder: IO		Sub-folder: CurrentMonitor/Config			
Name	**Parameter Description**	**Value**	**Default**	**Access Level**	
MaxLeakPh3	Max Leakage Current Phase 3	0.25 to 1A	0.25	Oper	
CT1Range (see Note)	CT input 1 range	10 to 1000A (Ratio to 50mA)	10	Oper	
CT2Range (see Note)	CT input 2 range	10 to 1000A (Ratio to 50mA)	10	Oper	
CT3Range (see Note)	CT input 3 range	10 to 1000A (Ratio to 50mA)	10	Oper	
CalibrateCT1	Calibrate CT1	Idle See "Calibration" on page 117 0mA -70mA LoadFactorCal SaveUserCal	Idle	Oper	
CalibrateCT2	Calibrate CT2	As CT1	Idle	Oper	
CalibrateCT3	Calibrate CT3	As CT1	Idle	Oper	

Note: The current rating of the CT used for each of the CT input channels should cover only the single largest load current proposed for its group of heaters. e.g. if CT1 has heaters of 15A, 15A & 25A it would need a CT capable of at least 25A.

Commissioning

Auto Commission

Auto commissioning of the Current Monitor is a feature that automatically detects which time proportioning outputs drive individual heaters (or heater sets), detects which CT input individual heaters are associated with and determines the Partial Load and Over Current thresholds using a 1:8 ratio. If auto commissioning does not succeed, a status parameter indicates the reason why.

Note: For the auto commissioning to operate successfully, the process must be enabled for full operation of the heating circuit with the digital outputs configured as Time Proportioning and 'soft' wired to the appropriate loop heater channels. During auto commissioning digital outputs will switch on and off.

How to Auto Commission

1. Put instrument into Operator Mode.

2. Set Commission to 'Auto' and CommissionStatus will display 'Commissioning'.

3. If successful, CommissionStatus will display 'Passed' and configured load parameters will become available.
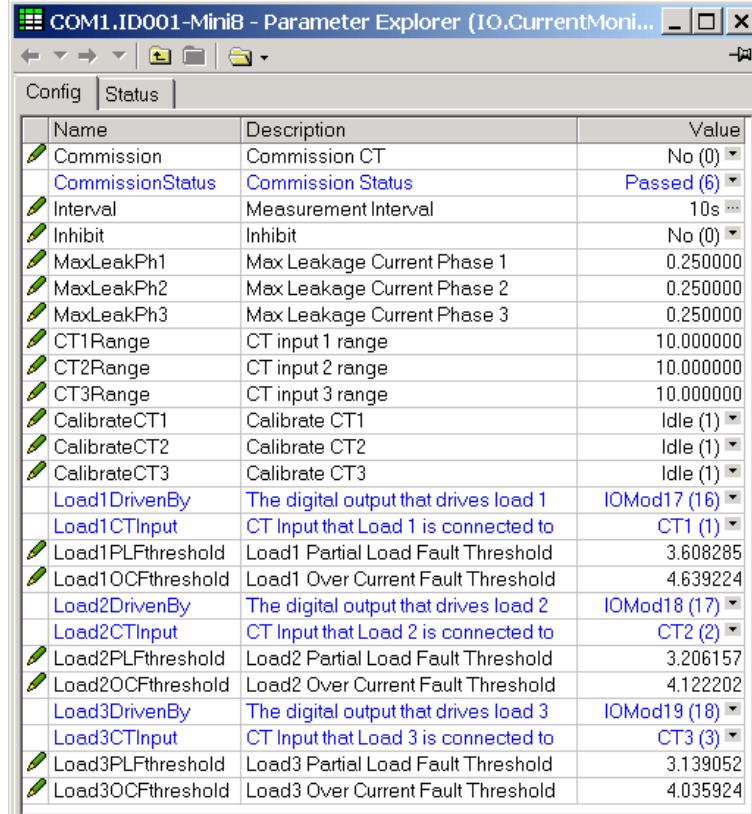
Figure 69 Result of Auto-Commissioning

If unsuccessful, CommissionStatus displays the reason:

NoDO8orRL8Cards

Indicates that there are no DO8 or RL8 cards installed in the instrument.

NoLoopTPOuts   Indicates that the digital outputs are either not configured as time proportioning or are not wired from loop heater channels.

SSRFault   Indicates that an SSR is either short-circuit or open-circuit.

MaxLoadsCT1 (or 2,3)

Indicates that more than six heaters have been connected to CT input 1 (or 2, 3)

Manual Commission

Manual Commissioning is also available for those users who want to commission the Current Monitor off-line or do not want to accept auto-commissioned settings.

How to Manual Commission

1. Set Commission to 'Manual'. CommissionStatus will display 'Commissioning' and Load1 configuration parameters will become available:
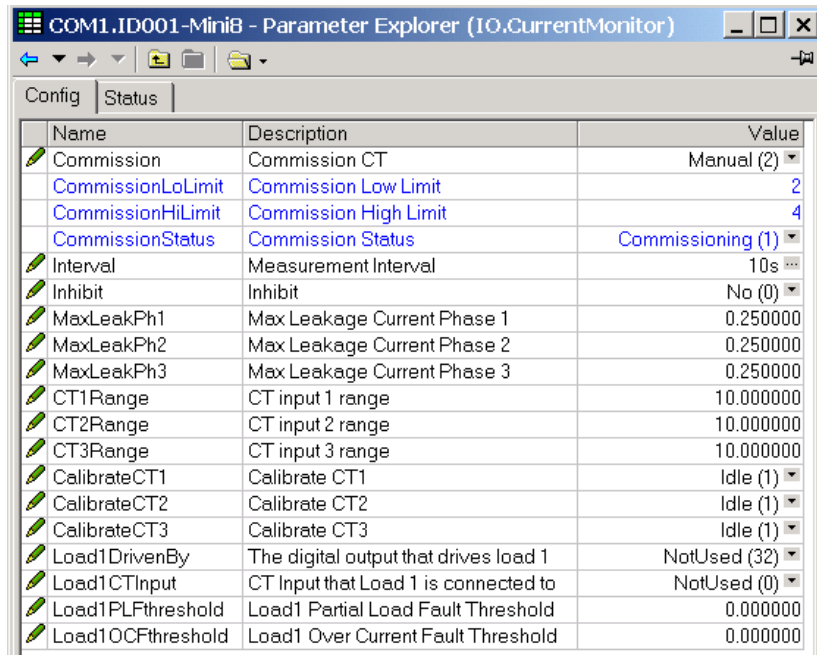
Figure 70 Load1 Parameters

2. Set Load1DrivenBy to the IO Module that is connected to the heater load.

3. Set Load1CTInput to the CT input number that is connected to the heater load.

4. Set Load1PLFthreshold and Load1OCFthreshold to appropriate values for the heater load.

5. Repeat for other loads.

6. To use the commissioned settings set Commission to 'Accept'. CommissionStatus will display 'ManuallyConfigured'.

7. To stop manual commissioning set Commission to 'Abort'. CommissionStatus will display 'NotCommissioned'.

Calibration

A Mini8 controller supplied from factory with the CT3 card already installed the CT inputs will have been factory calibrated. If the CT3 card is installed at a later date then default calibration values are automatically loaded into the instrument. However, three calibration parameters, one for each CT input, are provided to allow the inputs to be calibrated in the field.

Note: DC Current Source, capable of outputting a –70mA signal, is required to calibrate the inputs.

The three CT inputs are calibrated individually.

How to Calibrate

1. Apply the stimulus (0mA or –70mA) from the DC current source to the CT input to be calibrated.

2. Set CalibrateCT1, to reflect the stimulus being applied to the input.

3. CalibrateCT1 displays 'Confirm'. Select 'Go' to proceed with the calibration process.

4. After selecting Go, CalibrateCT1 displays 'Calibrating'.

5. If calibration was successful, CalibrateCT1 displays 'Passed'. Select 'Accept' to keep the calibration values.

6. If calibration was unsuccessful, CalibrateCT1 displays 'Failed'. Select 'Abort' to reject the calibration.

7. Select 'SaveUserCal' to save the calibration values into non-volatile memory.

8. Select 'LoadFactCal' to restore calibration values to the factory calibrated or default settings.

Note: It is possible to stop the calibration process at anytime by selecting 'Abort'.

Follow the same procedure for CT2 and CT3.

Alarms

Alarms are used to alert the system when a pre-set level has been exceeded or a particular condition has changed state. As the Mini8 controller has no display to show alarms the alarm flags are all available over communications in status words See "Alarm Summary" on page 125. They may also be wired directly or via logic to an output such as a relay.

Alarms can be divided into two main types. These are:

- Analog alarms - operate by monitoring an analog variable such as the process variable and comparing it with a set threshold.

- Digital alarms – operate when the state of a boolean variable changes, for example, sensor break.

Number of Alarms - up to 32 analog and 32 digital alarms may be configured.

Further Alarm Definitions

Hysteresis	is the difference between the point at which the alarm switches 'ON' and the point at which it switches 'OFF'. It is used to provide a definite indication of the alarm condition and to minimize alarm relay chatter.
Latch	used to hold the alarm condition once an alarm has been detected. It may be configured as:
	None (Non latching)
	A non-latching alarm will reset itself when the alarm condition is removed.
	Auto (Automatic)
	An auto-latching alarm requires acknowledgement before it is reset. The acknowledgement can occur BEFORE the condition causing the alarm is removed.
	Manual
	The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. The acknowledgement can only occur AFTER the condition causing the alarm is removed.
	Event
	Alarm output will activate.
Block	The alarm may be masked during start up. Blocking inhibits the alarm from being activated until the process has first achieved a steady state. It is used, for example, to ignore start up conditions which are not representative of running conditions. A blocking alarm is re-initiated after a setpoint change.
Delay	A short time can be set for each alarm before the output goes into the alarm state. The alarm is still detected as soon as it occurs, but if it cancels before the end of the delay period then no output is triggered. The timer for the delay is then reset. It is also reset if an alarm is changed from being inhibited to uninhibited.

Analog Alarms

Analog alarms operate on variables such as PV, output levels, and so on. They can be soft wired to these variables to suit the process.

Analog Alarm Types

Absolute High	an alarm occurs when the PV exceeds a set high threshold.
Absolute Low	an alarm occurs when the PV exceeds a set low threshold.
Deviation High	an alarm occurs when the PV is higher than the setpoint by a set threshold.
Deviation Low	an alarm occurs when the PV is lower than the setpoint by a set threshold.
Deviation Band	an alarm occurs when the PV is higher or lower than the setpoint by a set threshold.

These are shown graphically below for changes in PV plotted against time. (Hysteresis set to zero).
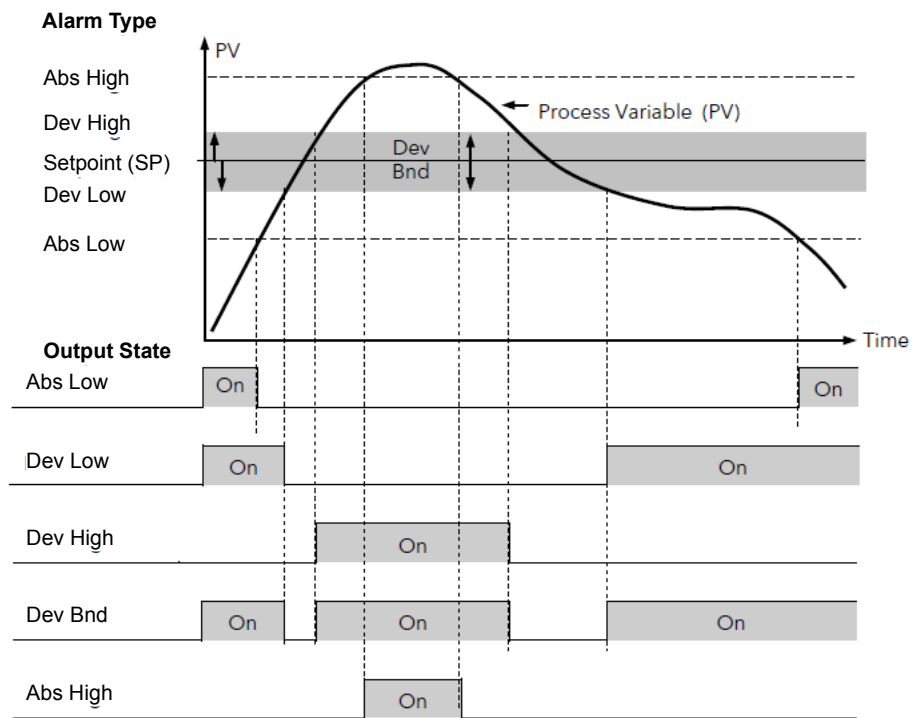
Figure 71 Analog Alarm Types

Digital Alarms

Digital alarms operate on Boolean variables. They can be soft wired to any suitable Boolean parameter such as digital inputs or outputs.

Digital Alarm Types

Pos Edge	The alarm will trigger when the input changes from a low to high condition.
Neg Edge	The alarm will trigger when the input changes from a high to low condition.
Edge	The alarm will trigger on any change of state of the input signal.
High	The alarm will trigger when the input signal is high.

Low		The alarm will trigger when the input signal is low.

Alarm Outputs

Alarms can operate a specific output (usually a relay). Any individual alarm can operate an individual output or any combination of alarms can operate an individual output. They are wired as required in configuration level.

Each source may be chosen from:-

Analog Alarms 1 to 32
Digital Alrams 1 to 32
Any alarms
New alarm/New CT Alarm
Loop break alarms

OR

No

Invert

Yes
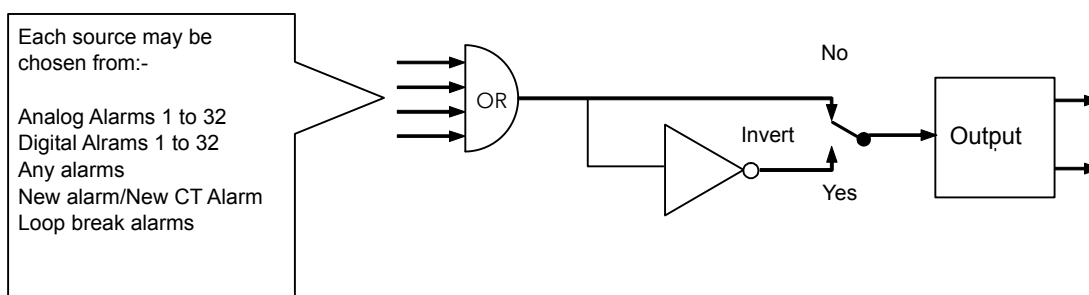
Output

Figure 72 Alarm Outputs

How Alarms are Indicated

Alarm states are all embedded in 16-bit status words. See "Alarm Summary" on page 125.

To Acknowledge an Alarm

Set the appropriate alarm acknowledge flag to acknowledge that particular alarm. Alternatively the GlobalAck in the AlmSummary folder can be used to acknowledge ALL alarms that require acknowledging in the instrument.

The action, which now takes place, will depend on the type of latching, which has been configured.

Non-Latched Alarms

If the alarm condition is present when the alarm is acknowledged, the alarm output will be continuously active. This state will continue for as long as the alarm condition remains. When the alarm condition clears the output will go off.

If the alarm condition clears before it is acknowledged the alarm output goes off as soon as the condition disappears.

Automatic Latched Alarms

The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. The acknowledgement can occur BEFORE the condition causing the alarm is removed.

Manual Latched Alarms

The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. The acknowledgement can only occur AFTER the condition causing the alarm is removed.

Alarm Parameters

Four groups of eight analog alarms are available. The following table shows the parameters to set up and configure alarms.

Folder: Alarm		Sub-folders: 1 to 32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Type	Selects the type of alarm	None	Alarm not configured		Conf
		Abs Hi	Full Scale High		
		Abs Lo	Full Scale Low		
		Dev Hi	Deviation High		
		Dev Lo	Deviation Low		
		Dv Bnd	Deviation band		
In	This is the parameter that will be monitored and compared against the threshold value to see if an alarm condition has occurred	Instrument range			Oper
Reference	The reference value is used in deviation alarms and the threshold is measured from this reference and not from its absolute value.	Instrument range			Oper
Threshold	The threshold is the value that the input is compared against to determine if an alarm has occurred.	Instrument range			Oper
Out	The output indicates whether the alarm is on or off depending on the alarm condition, latching and acknowledge, inhibiting and blocking.	Off	Alarm output deactivated		Read Only
		On	Alarm output activated		
Inhibit	Inhibit is an input to the Alarm function. It allows the alarm to be switched OFF. Typically the Inhibit is connected to a digital input or event so that during a phase of the process alarms do not activate. For Example, if the door to a furnace is opened the alarms may be inhibited until the door is closed again.	No Yes	Alarm not inhibited Inhibit function active		Oper
Hysteresis	Hysteresis is used to stop signal noise from causing the Alarm output to oscillate. Alarm outputs become active as soon as the PV exceeds the Alarm Setpoint. They return to inactive after the PV has returned to a non-Alarm value by more than the hysteresis value. Typically the Alarm hysteresis is set to a value that is greater than the oscillations seen on the instrument display	Instrument range			Oper
Latch	Determine the type of latching the alarm will use, if any. Auto latching allows acknowledgement while the alarm condition is still active, whereas manual latching needs the condition to revert back to a non-Alarm value before the alarm can be acknowledged. See also the description at the beginning of this section.	None	No latching is used		Oper
		Auto	Automatic		
		Manual	Manual		
		Event	Event		
Ack	Used in conjunction with the latching parameter. It is set when the user responds to an alarm.	No Yes	Not acknowledged Acknowledged		Oper
Block	Alarm Blocking is used to inhibit alarms from activating during start-up. In some applications, the measurement at start-up is in an alarm condition until the system has come under control. Blocking causes the alarms to be ignored until the system is under control, after this any deviations trigger the alarm.	No Yes	No blocking Blocking		Oper
Delay	This is a small delay between sensing the alarm condition and displaying it. If in the time between the two, the cause of the alarm is removed, then no alarm is shown and the delay timer is reset. It can be used on systems that are prone to electrical noise.	0:00.0 to 500 mm:ss.s hh:mm:ss hhh:mm		0:00.0	Oper

Example: To Configure Alarm 1

Change Access level to Configuration.

In this example the high alarm will be detected when the measured value exceeds 100.00.

The current measured value is 27.79 as measured by the 'Input' parameter. This parameter will normally be wired to an internal source such as a thermocouple input. In this example the alarm will set when the measured value exceeds the threshold 100.0 and will clear when the input decreases 0.50 units below the threshold level (i.e. at 99.5 units).
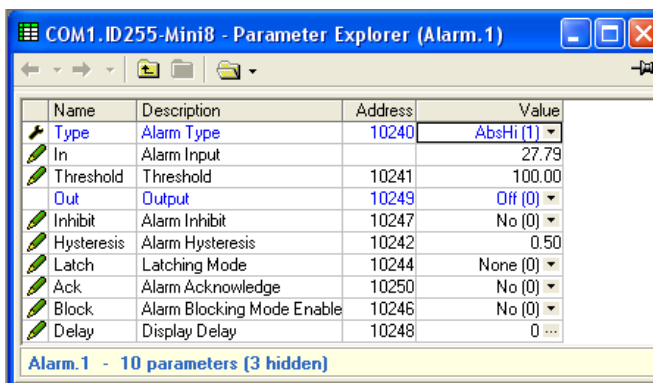
Figure 73 Configuring Alarm 1

Digital Alarm Parameters

Four groups of eight digital alarms are available. The following table shows the parameters to set up and configure alarms.

Folder: DigAlarm				Sub-folders: 1 to 32		
Name	**Parameter Description**	**Value**			**Default**	**Access Level**
Type	Selects the type of alarm	None	Alarm not configured			Conf
		PosEdge	On rising edge			
		NegEdge	On falling edge			
		Edge	On change			
		High	High (1)			
		Low	Low (0)			
In	This is the parameter that will be monitored and checked according to the AlarmType to see if an alarm condition has occurred	0 to 1				Oper
Out	The output indicates whether the alarm is on or off depending on the alarm condition, latching and acknowledge, inhibiting and blocking.	Off	Alarm output deactivated			Read Only
		On	Alarm output activated			
Inhibit	Inhibit is an input to the Alarm function. It allows the alarm to be switched OFF. Typically the Inhibit is connected to a digital input or event so that during a phase of the process alarms do not activate. For Example, if the door to a furnace is opened the alarms may be inhibited until the door is closed again.	No Yes	Alarm not inhibited Inhibit function active			Oper
Latch	Determine the type of latching the alarm will use, if any. Auto latching allows acknowledgement while the alarm condition is still active, whereas manual latching needs the condition to leave the alarm state before the alarm can be acknowledged. See also the description at the beginning of this chapter	None	No latching is used			Oper
		Auto	Automatic			
		Manual	Manual			
		Event	Event			
Ack	Used in conjunction with the latching parameter. It is set when the user responds to an alarm.	No Yes	Not acknowledged Acknowledged			Oper

Folder: DigAlarm	Sub-folders: 1 to 32				
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Block	Alarm Blocking is used to inhibit alarms from activating during start-up. In some applications, the measurement at start-up is in an alarm condition until the system has come under control. Blocking causes the alarms to be ignored until the system is under control, after this any deviations trigger the alarm	No Yes	No blocking Blocking		Oper
Delay	This is a small delay between sensing the alarm condition and displaying it. If in the time between the two, the cause of the alarm is removed, then no alarm is shown and the delay timer is reset. It can be used on systems that are prone to electrical noise.	0:00.0 to 500 mm:ss.s hh:mm:ss hhh:mm		0:00.0	Oper

Example: To Configure DigAlarm 1

Change Access level to Configuration.

In this example the digital alarm will come on if Timer 1 expires.

Timer.1.Out is wired to the alarm input. The DigAlarm.1.Out will turn on if the timer expires.
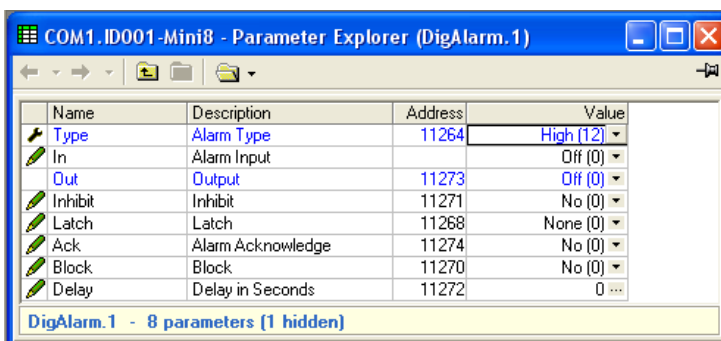
Figure 74 Configuring DigAlarm 1

Alarm Summary

This is a summary of all the alarms in the Mini8 controller. It provides global alarm and acknowledge flags as well as 16 bit status words which can be read over communications by the supervisory system.

Folder: AlmSummary	Sub-folders: General				
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
NewAlarm	A new alarm has occurred since the last reset (excludes CT alarms)	Off/On			Read Only
RstNewAlarm	Resets the NewAlarm flag	Yes / No		No	Oper
NewCTAlarm	A new Current alarm has occurred since the last reset	Off/On			Read Only
RstNewCTAlarm	Resets the NewCTAlarm flag	Yes / No		No	Oper
AnyAlarm	Any new alarm since the last reset	Off/On			Read Only
GlobalAck	Acknowledges every alarm in the Mini8 controller requiring acknowledgement. Also resets NewAlarm and NewCTAlarm flags.	No Yes	Not acknowledged Acknowledged		Oper

Folder: AlmSummary	Sub-folders: General				
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
AnAlarmStatus1	16 bit word for analog alarms 1 to 8	Bit 0	Alarm 1 active		Read Only
		Bit 1	Alarm 1 not ack'd		
		Bit 2	Alarm 2 active		
		Bit 3	Alarm 2 not ack'd		
		Bit 4	Alarm 3 active		
		Bit 5	Alarm 3 not ack'd		
		Bit 6	Alarm 4 active		
		Bit 7	Alarm 4 not ack'd		
		Bit 8	Alarm 5 active		
		Bit 9	Alarm 5 not ack'd		
		Bit 10	Alarm 6 active		
		Bit 11	Alarm 6 not ack'd		
		Bit 12	Alarm 7 active		
		Bit 13	Alarm 7 not ack'd		
		Bit 14	Alarm 8 active		
		Bit 15	Alarm 8 not ack'd		
AnAlarmStatus2	16 bit word for analog alarms 9 to 16	Same format as above			Read Only
AnAlarmStatus3	16 bit word for analog alarms 17 to 24	Same format as above			Read Only
AnAlarmStatus4	16 bit word for analog alarms 25 to 32	Same format as above			Read Only
DigAlarmStatus1	16 bit word for digital alarms 1 to 8	Bit 0	Alarm 1 active		Read Only
		Bit 1	Alarm 1 not ack'd		
		Bit 2	Alarm 2 active		
		Bit 3	Alarm 2 not ack'd		
		Bit 4	Alarm 3 active		
		Bit 5	Alarm 3 not ack'd		
		Bit 6	Alarm 4 active		
		Bit 7	Alarm 4 not ack'd		
		Bit 8	Alarm 5 active		
		Bit 9	Alarm 5 not ack'd		
		Bit 10	Alarm 6 active		
		Bit 11	Alarm 6 not ack'd		
		Bit 12	Alarm 7 active		
		Bit 13	Alarm 7 not ack'd		
		Bit 14	Alarm 8 active		
		Bit 15	Alarm 8 not ack'd		
DigAlarmStatus2	16 bit word for digital alarms 9 to 16	Same format as above			Read Only
DigAlarmStatus3	16 bit word for digital alarms 17 to 24	Same format as above			Read Only
DigAlarmStatus4	16 bit word for digital alarms 25 to 32	Same format as above			Read Only
SBrkAlarmStatus1	16 bit word for IO channels Mod.1 to 8	Bit 0	Mod.1 issue		Read Only
		Bit 1	Alarm 1 not ack'd		
		Bit 2	Mod.2 issue		
		Bit 3	Alarm 2 not ack'd		
		Bit 4	Mod.3 issue		
		Bit 5	Alarm 3 not ack'd		
		Bit 6	Mod.4 issue		
		Bit 7	Alarm 4 not ack'd		
		Bit 8	Mod.5 issue		
		Bit 9	Alarm 5 not ack'd		
		Bit 10	Mod.6 issue		
		Bit 11	Alarm 6 not ack'd		
		Bit 12	Mod.7 issue		
		Bit 13	Alarm 7 not ack'd		
		Bit 14	Mod.8 issue		
		Bit 15	Alarm 8 not ack'd		

Folder: AlmSummary	Sub-folders: General				
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
SbrkAlarmStatus2	16 bit word for IO channels Mod.9 to 16	Same format as above			Read Only
SbrkAlarmStatus3	16 bit word for IO channels Mod.17 to 24	Same format as above			Read Only
SbrkAlarmStatus4	16 bit word for IO channels Mod.25 to 32	Same format as above			Read Only
CTAlarmStatus1	16 bit word for CT alarms 1 to 5	Bit 0	Load1 SSR issue		Read Only
		Bit 1	Load1 PLF		
		Bit 2	Load1 OCF		
		Bit 3	Load2 SSR issue		
		Bit 4	Load2 PLF		
		Bit 5	Load2 OCF		
		Bit 6	Load3 SSR issue		
		Bit 7	Load3 PLF		
		Bit 8	Load3 OCF		
		Bit 9	Load4 SSR issue		
		Bit 10	Load4 PLF		
		Bit 11	Load4 OCF		
		Bit 12	Load5 SSR issue		
		Bit 13	Load5 PLF		
		Bit 14	Load5 OCF		
		Bit 15	-		
CTAlarmStatus2	16 bit word for CT alarms 6 to 10	Bit 0	Load6 SSR issue		Read Only
		Bit 1	Load6 PLF		
		Bit 2	Load6 OCF		
		Bit 3	Load7 SSR issue		
		Bit 4	Load7 PLF		
		Bit 5	Load7 OCF		
		Bit 6	Load8 SSR issue		
		Bit 7	Load8 PLF		
		Bit 8	Load8 OCF		
		Bit 9	Load9 SSR issue		
		Bit 10	Load9 PLF		
		Bit 11	Load9 OCF		
		Bit 12	Load10 SSR issue		
		Bit 13	Load10 PLF		
		Bit 14	Load10 OCF		
		Bit 15	-		
CTAlarmStatus3	16 bit word for CT alarms 11 to 15	Same format as CTAlarmStatus1			Read Only
CTAlarmStatus4	16 bit word for CT alarm 16	Same format as CTAlarmStatus1			Read Only

Alarm Log

A list of the last 32 alarms to have occurred is maintained in an Alarm Log.

Folder: AlmSummary	Sub-folder: AlmLog			
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
ClearLog	Clear Alarm Log	Yes/No	No	Oper
Entry1Ident	Most recent alarm activation	All analog alarms All digital alarms All sensor break alarms All current alarms	NoEntry	Read Only
Entry1Day	The day the first entry activated	NoEntry, Monday/Tuesday…Sunday.	NoEntry	Read Only
Entry1Time	The time the first entry activated	hh:mm:ss	0	Read Only
Entry2Ident	2nd most recent alarm activation	All analog alarms All digital alarms All sensor break alarms All current alarms	NoEntry	Read Only
Entry2Day	The day the second entry activated	NoEntry, Monday/Tuesday…Sunday.	NoEntry	Read Only
Entry2Time	The time the second entry activated	hh:mm:ss	0	Read Only
…etc				
Entry32Ident	32nd most recent alarm activation	All analog alarms All digital alarms All sensor break alarms All current alarms	NoEntry	Read Only
Entry32Day	The day the 32nd entry activated	NoEntry, Monday/Tuesday…Sunday.	NoEntry	Read Only
Entry32Time	The time the 32nd entry activated	hh:mm:ss	0	Read Only

Note: EntryDay and EntryTime parameters require the Real Time Clock to be set up (see "Real Time Clock" on page 177) to record meaningful values.

BCD Input

The Binary Coded Decimal (BCD) input function block uses a number of digital inputs and combines them to make a numeric value. A very common use for this feature is to select a setpoint program number from panel-mounted BCD decade switches.

The block uses four bits to generate a single digit.

Two groups of four bits are used to generate a two-digit value (0 to 99).

The block outputs four results:

- **Units Value**: The BCD value taken from the first four bits (range 0 – 9)

- **Tens Value**: The BCD value taken from the second four bits (range 0 – 9)

- **BCD Value**: The combined BCD value taken from all 8 bits (range 0 – 99)

- **Decimal Value**: The decimal numeric equivalent of Hexadecimal bits (range 0 – 255)

The following table shows how the input bits combine to make the output values.

Input 1			
Input 2	Units value (0 – 9)		
Input 3		BCD value (0 – 99)	Decimal value (0 – 255)
Input 4			
Input 5			
Input 6	Tens value (0 – 9)		
Input 7			
Input 8			

Since the inputs cannot all be relied upon to change simultaneously, the output will only update after all the inputs have been steady for two samples.

BCD Parameters

Folder – BCDInput		Sub-Folders: 1 and 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
In 1	Digital Input 1	On or Off	Alterable from the operator interface if not wired	Off	Oper
In 2	Digital Input 2	On or Off		Off	Oper
In 3	Digital Input 3	On or Off		Off	Oper
In 4	Digital Input 4	On or Off		Off	Oper
In 5	Digital Input 5	On or Off		Off	Oper
In 6	Digital Input 6	On or Off		Off	Oper
In 7	Digital Input 7	On or Off		Off	Oper
In 8	Digital Input 8	On or Off		Off	Oper
Dec Value	Decimal value of the inputs	0 – 255	See examples below		Read Only
BCD Value	Reads the value (in BCD) of the switch as it appears on the digital inputs	0 – 99	See examples below		
Units	Units value of the first switch	0 – 9	See examples below		Read Only
Tens	Units value of the second switch	0 – 9	See examples below		Read Only

In 1	In 2	In 3	In 4	In 5	In 6	In 7	In 8	Dec	BCD	Units	Tens
1	0	0	0	0	0	0	0	1	1	1	0
1	1	1	1	0	0	0	0	15	9	9	0
0	0	0	0	1	1	1	1	240	90	0	9
1	1	1	1	1	1	1	1	255	99	9	9

Example: To wire a BCD Input

The BCD digital input parameters may be wired to digital input terminals of the controller. A DI8 module may be used and there are also two standard digital input terminals in FixedIO, D1 and D2.
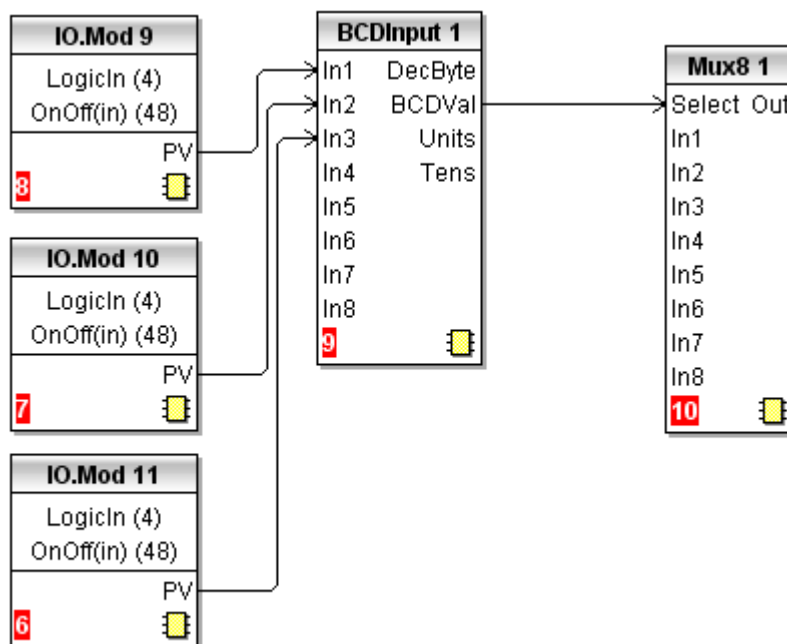
Figure 75 Example BCD Wiring

This example shows a BCD switch selecting one of eight values, In1 to In8 on the Mux8.

Digital Communications

Digital Communications (or 'comms' for short) allows the Mini8 controller to be part of a system by communicating with a PC or a programmable logic controller (PLC).

The Mini8 controller also has a configuration port for 'cloning' or saving/loading instrument configurations for future expansion of the plant or to allow you to recover a system if necessary.

Configuration Port (CC)

The configuration port is on an RJ11 socket, just to the right of the power supply connections. This will normally be connected to a PC running iTools. When connecting to iTools the instrument on this port will be found at address 255. iTools will also optimize the baud rate to suit the conditions.

Eurotherm supply a standard cable to connect a serial COM port on a computer to the RJ11 socket, part no. SubMini8/cable/config.

This port conforms to MODBUS RTU® protocol, a full description of which can be found on www.modbus.org.

Pin connections for the RJ11 connector are shown in "Configuration Port (CC)" on page 31.

This port can be used as a 'permanent' connection but it is limited to one instrument, it is an EIA-232 point to point connection.

The baud rate of the configuration port defaults to 19200bps. Set the comms port in the PC to the correct rate.

Configuration is also possible through the Field Communications port but ONLY if that port is Modbus or ModbusTCP. In that situation the Mini8 controllers can be multi-dropped to iTools.

Configuration Communications Parameters

Folder - Comms		Sub-folders: CC (Config Comms)			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Comms module identity	Modbus non-iso	Non isolated Modbus module		Read Only
Protocol	Digital communications protocol	Modbus. The CC channel only supports Modbus slave protocol.		Modbus	Read Only
Baud	Communications baud rate	4800 9600 19k2 (19200)		19200	Conf
Parity	Communications parity	None Even Odd	No parity Even parity Odd parity	None	Conf
Address	Instrument address	1 to 254		1	Oper
Wait	Rx/Tx wait states	No Yes	No delay Fixed delay. This inserts a delay between Rx and Tx to help ensure that the drivers used by intelligent EIA-232/EIA-485 converters have sufficient time to switch over.	No	Conf
SafeModeEnable	'Safe Mode' enable	Off On	If enabled, 'safe mode' will activate at power up and when the comms watchdog is latched. While in 'safe mode', all loops will be set to manual, all powers will be set to SafeModePower value and all setpoints will be set to SafeModeSP value	Off	Conf

Field Communications Port (FC)

The Mini8 controller has a number of communication options. These have to be ordered from the factory as part of the instrument build. A change of protocol is not usually possible in the field. The physical port and the connections will vary depending on the field communications protocol. These are shown in the wiring section of the manual (see "Electrical Connections – Common to All Instruments" on page 29. Mini8 controller version 1.xx offers Modbus and DeviceNet, Version 2.xx added Profibus, EtherNet Modbus-TCP, EtherNet/IP and EtherCAT. These protocols are described in the following sections.

Communications Identity

The instrument recognizes the type of communication board fitted. The identity 'Ident' is displayed to show that the instrument is built as required.

Modbus

This port conforms to MODBUS RTU® protocol a full description of which can be found on www.modbus.org.

Modbus Connections

This uses two parallel RJ45 connectors for use with shielded Cat5e patch cables. The connection is usually 2-wire but 4-wire is also available. This is selected by the top switch of the address switches below the RJ45 ports – OFF (to the left) 2-wire, ON (to the right) 4-wire.

Modbus Address Switch

On a network of instruments an address is used to specify a particular instrument. Each instrument on a network MUST have a unique address. Address 255 is reserved for configuration using the configuration port or the configuration clip.

The switch is situated at the bottom of the Comms module. The switch gives addresses from 1 to 31. If Address 0 is set the Mini8 controller will then take the address and parity settings entered in the configuration of the instrument, see "Modbus Parameters" on page 137. This allows for addresses above 31.

Sw	OFF	ON
8	3-wire	4-wire
7	NO Parity	Parity
6	Even	Odd
5	-	Address 16
4	-	Address 8
3	-	Address 4
2	-	Address 2
1	-	Address 1
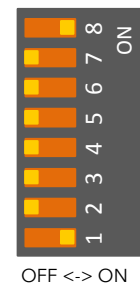
Example shows 4 wire and address 1

OFF <-> ON

Baud Rate

The baud rate of a communications network specifies the speed that data is transferred between instrument and master. A baud rate of 9600 equates to 9600 bits per second. Since a single character requires 8 bits of data plus start, stop, and optional parity, up to 11 bits per byte may be transmitted. 9600 baud equates approximately to 1000 bytes per second. 4800 baud is half the speed – approx. 500 bytes per second.

In calculating the speed of communications in your system it is often the Latency between a message being sent and a reply being started that dominates the speed of the network.

For example, if a message consists of 10 characters (10ms at 9600 Baud) and the reply consists of 10 characters, then the transmission time would be 20ms. However, if the Latency is 20ms, then the transmission time has become 40ms. Baud rate is set in the parameter list see "Modbus Parameters" on page 137.

Parity

Parity is a method of confirming that the data transferred between devices has not been corrupted.

Parity is the lowest form of integrity in the message. It indicates that a single byte contains either an even or an odd number of ones or zeroes in the data.

In industrial protocols, there are usually layers of checking to confirm that the first byte transmitted is good. Modbus applies a CRC (Cyclic Redundancy Checksum) to the data to confirm that the package is correct.

Parity is set in the parameter list see "Modbus Parameters" on page 137.

Rx/Tx Delay Time

In some systems it is necessary to introduce a delay between the instrument receiving a message and its reply. This is sometimes caused by communications converter boxes which require a period of silence on the transmission to switch over the direction of their drivers.

Modbus Broadcast Master Communications

Broadcast master communications allow the Mini8 controllers to send a single value to any slave instruments using a Modbus broadcast using function code 6 (Write single value). This allows the Mini8 controller to link through digital communications with other products without the need for a supervisory PC to create a small system solution.

Example applications include multi-zone profiling applications or cascade control using a second controller. The facility provides an alternative to analog retransmission.

NOTICE
POTENTIAL INSTRUMENT DAMAGE
When using broadcast master communications, be aware that updated values are sent many times a second. Before using this facility, check that the instrument to which you wish to send values can accept continuous writes. Note that in common with many third party lower cost units, the Eurotherm 2200 series and the 3200 series prior to version V1.10 do not accept continuous writes to the temperature setpoint. Damage to the internal non-volatile memory could result from the use of this function. If in any doubt, contact the manufacturer of the device in question for advice.
When using the 3200 series fitted software version 1.10 and greater, use the Remote Setpoint variable at Modbus address 26 if you need to write to a temperature setpoint. This has no write restrictions and may also have a local trim value applied. There is no restriction on writing to the 2400, 3500 or Mini8 controller series. **Failure to follow these instructions can result in equipment damage.**

Mini8 Controller Broadcast Master

The Mini8 controller broadcast master can be connected to up to 31 slaves if no segment repeaters are used. If repeaters are used to provide additional segments, 32 slaves are permitted in each new segment. The master is configured by selecting a Modbus register address to which a value is to be sent. The value to send is selected by wiring it to the Broadcast Value. Once the function has been enabled, the instrument will send this value out over the communications link every control cycle typically every 110ms.

Notes:

1. The parameter being broadcast must be set to the same decimal point resolution in both master and slave instruments.

2. If iTools, or any other Modbus master, is connected to the port on which the broadcast master is enabled, then the broadcast is temporarily inhibited. It will restart approximately 30 seconds after iTools is removed. This is to allow reconfiguration of the instrument using iTools even when broadcast master communications is operating.

A typical example might be a multi zone application where the setpoint of each zone is required to follow, with digital accuracy, the setpoint of a master.
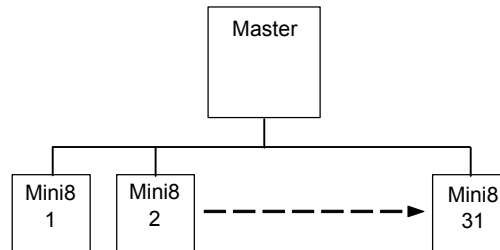
Figure 76 Broadcast Communications

Wiring Connections for Broadcast Communications are shown in "Wiring Connections for Modbus Broadcast Communications" on page 35.

Modbus Parameters

The following table shows the parameters available for Modbus.

Folder – Comms		Sub-folder: FC (Field Communications)			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Comms Module Identity	Modbus		Modbus	Read only
Protocol	Digital communications protocol	Modbus		Modbus	Read only
Baud	Communications baud rate	Modbus: 4800, 9600 or 19k2 (19200)		9600	Conf
Parity	Communications parity	None	No parity	None	Conf
		Even	Even parity		
		Odd	Odd parity		
Address	Instrument address	1 to 254 Only writeable if DIP switches are set to Off.		1	Oper
Wait	Rx/Tx delay time	No	No delay	No	Conf
		Yes	Fixed delay. This inserts a delay between Rx and Tx to allow the drivers used by intelligent EIA-232/EIA-485 converters sufficient time to switch over.		
Broadcast Enabled	To enable broadcast master communications. (See "Modbus Broadcast Master Communications" on page 135)	No	Not enabled	No	
		Yes	Enabled		
Broadcast Address	Address of the parameter being written to slaves.	0 to 32767	See "Modbus SCADA Table" on page 286 for addresses of all Mini8 controller parameters.	0	Only shown if Broadcast is enabled.
Broadcast Value	Value to be sent to instruments on the network. This would normally be wired to a parameter within the master.	Range of the parameter wired. In the case of a Boolean the value will be 0 or 1.		0.00	Only shown if Broadcast is enabled.
WDFlag	Network watchdog flag	Off	This flag is ON when the Network communications have stopped addressing this instrument for longer than the Timeout time. It will be set by the Watchdog process and may be cleared Automatically or Manually according to the value of the Watchdog Action parameter.		
		On			
WDAct	Network watchdog action. The Watchdog Flag may be cleared Automatically upon reception of valid messages or Manually by a parameter write or a wired value.	Man	The Watchdog Flag must be cleared manually - either by a parameter write or a wired value.		Conf
		Auto	The Watchdog Flag will be automatically cleared when the Network Comms resume - according to the value in the Recovery Timer.		
WDTime	Network Watchdog Timeout If the Network communications stop addressing the instrument for longer than this value, the Watchdog Flag will become active.	h:m:s:ms A value of 0 disables the watchdog			Conf

DeviceNet

Only two parameters have to be set on the Mini8 controller for use with DeviceNet - Baud rate and address. Both can be set on the hardware address switch situated under the DeviceNet connector. Each Mini8 controller must have a unique address on the DeviceNet network and all units must be set to the same Baud rate. The switch gives addresses from 0 to 63.

Sw	OFF	ON
8	Baud rate	Baud rate
7	Baud rate	Baud rate
6	-	Address 32
5	-	Address 16
4	-	Address 8
3	-	Address 4
2	-	Address 2
1	-	Address 1

Example shows 500k baud rate and address 5

OFF <-> ON

Address 0 is a valid DeviceNet address, but Mini8 controller addresses can be set via iTools, when all switches are set to 0.

Sw	Baud rate		
	125k	250k	500k
8	OFF	OFF	ON
7	OFF	ON	OFF

Note: Use a Baud rate of 500k unless the total length of the DeviceNet network is longer than 100m (328ft).

Enhanced DeviceNet Interface

See also "Electrical Connections for Enhanced DeviceNet Interface" on page 40. In this version of DeviceNet the slider switch is replaced by rotary BCD switches to set Node ID (address) and Baud Rate.

Address Switch

The Node ID (address) is set via two BCD rotary switches, one for each digit.

For example, an address of 13 is configured by setting the MSD to 1 and LSD to 3.

Valid DeviceNet address range is 0 - 63. If the switches are set in the range 64 - 99 the value will be ignored and the node address will be configured by the Mini8 controller via iTools.

When the address is changed the DeviceNet interface will automatically restart.

Baud Switch
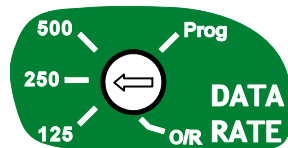
The baud rate is selected by a single BCD rotary switch, and can be set to 125K, 250K or 500K.

The 'Prog' position is selected when it is required to upgrade the Mini8 controller firmware.

The O/R position is selected when it is required to set Baud Rate using iTools configuration software.

When the baud rate is changed or the 'Prog' position is selected power cycle the instrument to activate the change.

Check that the switch is set to valid positions as marked on the panel.

Switch Position in iTools

The value of the Baud Rate and Address is returned so that it can be read by iTools.

Note: If the DeviceNet network is unpowered for any reason, any changes to the Baud Rate and Address will NOT be seen in iTools even though the Mini8 controller is powered and communicating normally via the CC port or config clip.

DeviceNet Parameters

Folder – Comms		Sub-folder: FC (Field Communications)			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Comms Module Identity	DeviceNet DeviceNet Enhanced		DeviceNet	Read only
Protocol	Digital communications protocol	DeviceNet		DeviceNet	Read only
Baud	Communications baud rate	125k, 250k, 500k		125k	Conf
Address	Instrument address	0 to 63 Only writeable if DIP switches are set to Off.		1	Oper
Status	Comms network status	Offline	Network Offline		Read only
		Init	Network Initialising		
		Ready	Network ready to accept connection		
		Running	Network connected and running		
		Online	The device is on line and has connections in the Established state.		
		IO Timeout	One or more IO connections have timed out.		
		Link fail	Critical link issue: a comms issue has been detected, making the module incapable of communicating.		
		Comms fault	Comms port is in the 'faulted' condition and has accepted an 'Identify Comms Fault' Request		
WDFlag	Network watchdog flag	Off	This flag is ON when the Network communications have stopped addressing this instrument for longer than the Timeout time. It will be set by the Watchdog process and may be cleared Automatically or Manually according to the value of the Watchdog Action parameter.		
		On			
WDAct	Network watchdog action. The Watchdog Flag may be cleared Automatically upon reception of valid messages or Manually by a parameter write or a wired value.	Man	The Watchdog Flag must be cleared manually - either by a parameter write or a wired value.		Conf
		Auto	The Watchdog Flag will be automatically cleared when the Network Comms resume - according to the value in the Recovery Timer.		
WDTime	Network Watchdog Timeout If the Network communications stop addressing the instrument for longer than this value, the Watchdog Flag will become active.	h:m:s:ms A value of 0 disables the watchdog			Conf
SafeMode Enable	'Safe Mode' Enable	Off On	If enabled, 'safe-mode' will activate at power up and when the comms watchdog is latched. While in 'safe-mode', all loops will be set to manual, all powers will be set to SafeModePower value and all SPs will be set to SafeModeSP value.	Off	Conf
SafeModePower	'Safe Mode' power		When in 'safe-mode', the power output level of all loops will be set to this value.	0	Conf
SafeModeSP	'Safe Mode' setpoint		While in 'safe-mode', the Setpoint of all loops will be set to this value. It will be set immediately with no ramp or servo action.		Conf
Devicenet Shutdown	DeviceNet Shutdown Enable	Enable Disable	If an unrecoverable issue occurs on the internal DeviceNet port, the module is able to send a Devicenet Shutdown message. Some Masters are unable to process this message, so this parameter gives the ability for it to be disabled.	Enable	Conf

Profibus

Up to 127 Nodes can be connected to a Profibus Network and the address is set via the comms DIP switches. The Baud Rate is auto-detected and set by the master.

A further description of Profibus is given in the Profibus Communications Handbook Part No HA026290.

Profibus Parameters

Folder – Comms		Sub-folder: FC (Field Communications			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Comms Module Identity	Profibus RJ45 Profibus D-type		Profibus	Read Only
Protocol	Digital communications protocol	Profibus		Profibus	Conf
Address	Instrument address	0 to 126 Only writeable if DIP switches are set to 0.		1	Oper
Network Status	Network Status	See section "DeviceNet Parameters" on page 140 for the list			Read Only
WDFlag	Network watchdog flag	Off	This flag is ON when the Network communications have stopped addressing this instrument for longer than the Timeout time. It will be set by the Watchdog process and may be cleared Automatically or Manually according to the value of the Watchdog Action parameter.		
		On			
WDAct	Network watchdog action. The Watchdog Flag may be cleared Automatically upon reception of valid messages or Manually by a parameter write or a wired value.	Man	The Watchdog Flag must be cleared manually - either by a parameter write or a wired value.		Conf
		Auto	The Watchdog Flag will be automatically cleared when the Network Comms resume - according to the value in the Recovery Timer.		
WDTime	Network Watchdog Timeout If the Network communications stop addressing the instrument for longer than this value, the Watchdog Flag will become active.	h:m:s:ms A value of 0 disables the watchdog			Conf

EtherNet (Modbus TCP)

Instrument setup

It is recommended that you setup the communications settings for each instrument before connecting it to any EtherNet network. This is not essential but network conflicts may occur if the default settings interfere with equipment already on the network. By default, the instruments are set to a fixed IP address of 192.168.111.222 with a default SubNet Mask setting of 255.255.255.0.

IP Addresses are usually presented in the form "xxx.xxx.xxx.xxx". In the instrument Comms folder each element of the IP Address is shown and configured separately.

"IP address 1" relates to the first set of three digits, IP address 2 to the second set of three digits and so on. This also applies to the SubNet Mask, Default Gateway and Preferred master IP Address.

Each EtherNet module contains a unique MAC address, normally presented as a 12-digit hexadecimal number in the format "aa-bb-cc-dd-ee-ff".

In the Mini8 controllers MAC addresses are shown as six separate decimal values in iTools. MAC1 shows the first pair of digits in decimal, MAC2 shows the second pair of digits and so on.

Unit Identity

The Modbus TCP Specification includes the 'normal' Modbus address as part of the packaged Modbus message – where it is called the Unit Identifier. If such a message is sent to an EtherNet / Serial gateway, the Unit Ident is essential to identify the slave instrument on the serial port. When a stand alone EtherNet instrument is addressed however, the Unit Ident is surplus to requirements since the IP address fully identifies the instrument. To allow for both situations the Unit Ident Enable parameter is used to enable or disable checking of the Unit Ident received from TCP. The enumerations produce the following actions:

'**Instr**':   the received Unit Ident must match the Modbus address in the instrument or there will be no response.

'**Loose**':   the received Unit Ident value is ignored, thus causing a reply regardless of the received Unit Ident.

'**Strict**':   the received Unit Ident value must be 0xFF or there will be no reply.

Dynamic Host Configuration Protocol (DHCP) Settings

IP addresses may be 'fixed' – set by the user, or dynamically allocated by a DHCP server on the network.

This is set by Switch 8 on the DIL address switch.

If the IP Addresses are to be dynamically allocated the server uses the instrument MAC address to uniquely identify it.

For fixed IP Addresses set the IP address as well as the SubNet Mask. These must be configured into the instrument using iTools. Remember to note the allocated addresses.

Fixed IP Addressing

Address Switch 8 OFF. In the "Comms" folder of the instrument the "DHCP enable" parameter will be set to "Fixed". Set the IP address and SubNet Mask as required.

Dynamic IP Addressing

Address Switch 8 ON. In the "Comms" folder of the instrument the "DHCP enable" parameter will be set to "Dynamic". Once connected to the network and powered, the instrument will acquire its "IP address", "SubNet Mask" and "Default gateway" from the DHCP Server and display this information within a few seconds.

Default Gateway

The "Comms" tab also includes configuration settings for "Default Gateway", these parameters will be set automatically when Dynamic IP Addressing is used. When fixed IP addressing is used these settings are only required if the instrument needs to communicate wider than the local area network i.e. over the Internet.

Preferred Master

The "Comms" tab also includes configuration settings for "Preferred Master". Setting this IP address to the IP Address of a particular PC will reserve one of the four available EtherNet sockets for that PC (reducing the number of available sockets for anonymous connections to three).

Sw	OFF	ON
8	DHCP fixed	DHCP dynamic
7	Not used	-
6	Not used	-
5	-	Modbus Address 16
4	-	Modbus Address 8
3	-	Modbus Address 4
2	-	Modbus Address 2
1	-	Modbus Address 1

Example shows dynamic DHCP and Modbus address 5

OFF <-> ON

iTools Setup

iTools configuration package, version V5.60 or later, may be used to configure EtherNet communications.

The following instructions configure EtherNet.

To include a Host Name/Address within the iTools scan:

1. Ensure iTools is NOT running before taking the following steps.

2. Within Windows, click 'Start', the 'Settings', then 'Control Panel'.

3. In control panel select 'iTools'.

4. Within the iTools configuration settings select the 'TCP/IP' tab.

5. Click the 'Add' button to add a new connection.

6. Enter a name for this TCP/IP connection.

7. Click the 'Add' button to add the IP address of the instrument in the 'Host Name/ Address' section.

8. Click 'OK' to confirm the new IP Address you have entered.

9. Click 'OK' to confirm the new TCP/IP port you have entered.

10. You should now see the TCT/IP port you have configured within the TCP/IP tab of the iTools control panel settings.

iTools is now ready to communicate with an instrument at the IP Address you have configured.

EtherNet Parameters

These are listed in the 'Comms' > 'FC' list in iTools.

Folder - Comms		Sub-folder: FC			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Identifies that the EtherNet comms module is fitted.	EtherNet		EtherNet	Read only
Protocol	Digital communications protocol	EtherNet		EtherNet	Read only
Address	Comms Address	1 to 253		1	Oper
WDFlag	Network watchdog flag	Same as previous protocols – see "Modbus Parameters" on page 137 for example.			
WDAct	Network watchdog action				
WDTime	Network watchdog timeout				
UnitID Enable	Unit Identity Enable Enable/disable checking of the ModbusTCP Unit Identity field.	Strict	Disable - Unit ID must be 0xFF (255)	Strict	Conf
		Loose	Disable - Unit ID ignored		
		Instr	Enable - Unit ID must be instrument address		
DHCP enable	DHCP Type Select whether IP address / subnet mask etc are as configured (Fixed) or supplied from EtherNet server (Dynamic).	Fixed	Manually set IP addresses (Address Switch 8 = OFF)		Read only
		Dynamic	IP addresses set by DCHP server (Address Switch 8 = ON)		
IP Address 1	1st Byte IP address	IP address format is xxx.xxx.xxx.xxx. 1st Byte. 2nd Byte. 3rd Byte. 4th Byte. Range 0 to 255		192	Conf
IP Address 2	2nd Byte IP address			168	
IP Address 3	3rd Byte IP address			111	
IP Address 4	4th Byte IP address			222	
Subnet Mask 1	1st Byte Subnet Mask	Subnet mask format is xxx.xxx.xxx.xxx. 1st Byte. 2nd Byte. 3rd Byte. 4th Byte. Range 0 to 255		255	Conf
Subnet Mask 2	2nd Byte Subnet Mask			255	
Subnet Mask 3	3rd Byte Subnet Mask			255	
Subnet Mask 4	4th Byte Subnet Mask			0	
Default Gateway 1	1st Byte Default Gateway	Default gateway format is xxx.xxx.xxx.xxx. 1st Byte. 2nd Byte. 3rd Byte. 4th Byte. Range 0 to 255		0	Conf
Default Gateway 2	2nd Byte Default Gateway				
Default Gateway 3	3rd Byte Default Gateway				
Default Gateway 4	4th Byte Default Gateway				

Folder - Comms		Sub-folder: FC			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Pref mstr IP 1	1st Byte Preferred Master IP address	Preferred master IP address format is xxx.xxx.xxx.xxx. 1st Byte. 2nd Byte. 3rd Byte. 4th Byte. Range 0 to 255		0	Conf
Pref mstr IP 2	2nd Byte Preferred Master IP address				
Pref mstr IP 3	3rd Byte Preferred Master IP address				
Pref mstr IP 4	4th Byte Preferred Master IP address				
MAC1	MAC address 1	A unique MAC address is allocated to every EtherNet device MAC addresses are six bytes in length and are shown in HEX format, for example: AA-BB-CC-DD-EE-FF 1st Byte 2nd Byte 3rd Byte 4th Byte 5th Byte 6th Byte		0	Read only
MAC2	MAC address 2				
MAC3	MAC address 3				
MAC4	MAC address 4				
MAC5	MAC address 5				
MAC6	MAC address 6				
EtherNet Status	EtherNet network status	Running	Network connected and working		Read only
		Offline	Network not connected or working		
		Init	Network initialising		
		Ready	Network ready to accept connection		

EtherNet/IP

EtherNet/IP (EtherNet/Industrial Protocol) is a communication system suitable for use in industrial environments. It allows industrial devices to exchange time-critical application information. These devices include simple I/O devices such as sensors/actuators, as well as more complex control devices such as robots or PLCs.

EtherNet/IP makes use of the CIP (Common Industrial Protocol), common network, transport and application layers currently implemented by DeviceNet and ControlNet. EtherNet/IP then makes use of the standard EtherNet and TCP/IP technology to transport CIP communications packets. The result is a common, open application layer on top of open and highly popular EtherNet and TCP/IP protocols.

EtherNet/IP provides a producer-consumer model for exchange of time-critical control data. The producer-consumer model allows the exchange of application information between a sending device (producer) and many other receiving devices (consumers) without the need to send data multiple times to multiple destinations.

A gateway communications option card is installed in the Mini8 controller to implement the EtherNet/IP server (Adapter).

Feature Switch

An eight-pole lever operated DIP switch is used to set the DHCP feature to off or on, and to force start up in the boot mode for software upgrades.

Switch 8 is used to switch DHCP mode ON (Dynamic) or OFF (Fixed).

All other switches are normally in the OFF state.

The boot mode requires all switches to be ON.

Example shows Fixed DHCP

OFF **<->** ON
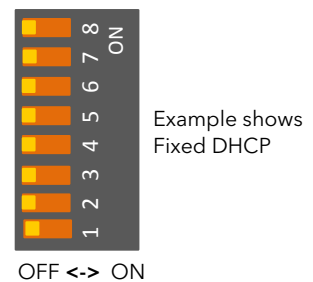
Configuration using iTools

iTools configuration package, version V8.68 or later, may be used to configure EtherNet communications.

Using the RJ11 configuration port (CC), connect the Mini8 controller to the serial comms port of a PC running iTools.

Check that the Feature switch is set as shown in the diagram above and scan for the instrument in the normal way.

Explicit Messaging Inactivity Timeout

The encapsulation message (TCP packet) maximum size is 300 bytes. If a received message length is greater than 300 bytes then the TCP connection is closed.

EtherNet/IP Parameters

EtherNet/IP parameters are shown under 'Comms' > 'FC' as shown in Figure 77.
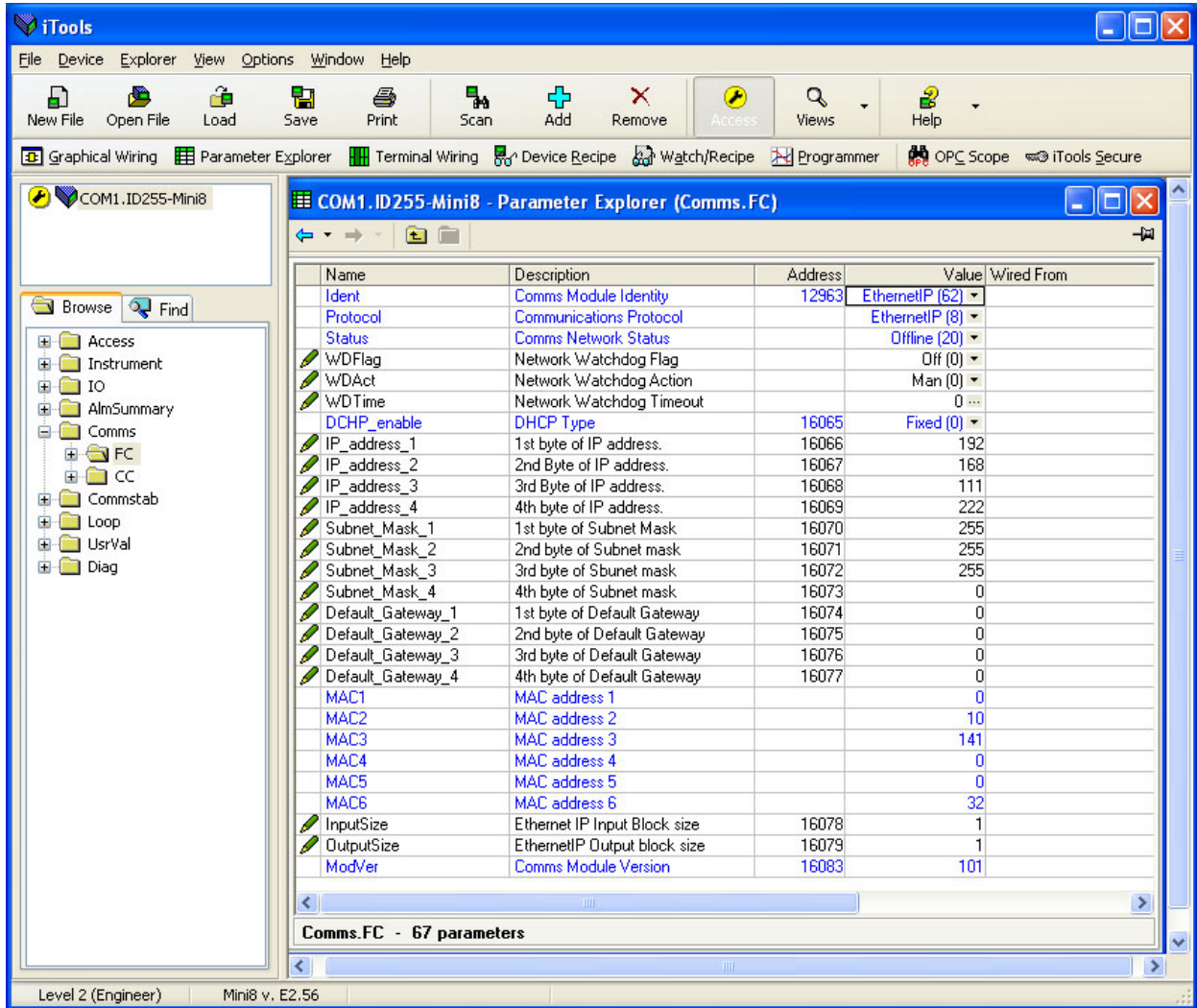
Figure 77 EtherNet/IP Parameters

The parameter list is similar to the EtherNet TCP (see "EtherNet/IP Parameters" on page 147) without the Preferred Master IP addresses (PrefMstr). There are three additional parameters:

Folder - Comms		Sub-folder: FC		
Name	**Parameter Description**	**Value and enumeration**	**Default**	**Access Level**
InputSize	Ethernet/IP Input Block Size	Range 1 to 100 See Input Definition Table below	1	Conf
OutputSize	EtherNet/IP Output Block Size	Range 1 to 100 See Output Definition Table below	1	Conf
ModVer	Module firmware version	This is an integer value where the least two significant digits are the minor version. For example:. A value of 201 indicates 2.01 – major revision 2, minor revision 01.		Read Only

The definitions are shown in the following two sections.

Input Definition Table

The following table shows the Default Input parameter list:

Item	Description	Modbus Address decimal / (HEX)	Notes
1	Loop.1.Main.PV	15360 / (3C64)	The default Input Block Size value (Comms.InputSize) matches this list.
2	Loop.1.Main.WorkingSP	15361 / (3C01)	
3	Loop.1.Main.ActiveOut	15362 / (3C02)	
4	Loop.2.Main.PV	15363 / (3C03)	All of this area may be redefined by use of the CommsTab Function Block, remember to set the Input Block Size value for the configured number of parameters.
5	Loop.2.Main.WorkingSP	15364 / (3C04)	
6	Loop.2.Main.ActiveOut	15365 / (3C05)	
7	Loop.3.Main.PV	15366 / (3C06)	
8	Loop.3.Main.WorkingSP	15367 / (3C07)	
9	Loop.3.Main.ActiveOut	15368 / (3C08)	
10	Loop.4.Main.PV	15369 / (3C09)	The Commstab Data Format option **must** be set to "Integer" to work with EtherNet/IP
11	Loop.4.Main.WorkingSP	15370 / (3C0A)	
12	Loop.4.Main.ActiveOut	15371 / (3C0B)	
13	Loop.5.Main.PV	15372 / (3C0C)	
14	Loop.5.Main.WorkingSP	15373 / (3C0D)	
15	Loop.5.Main.ActiveOut	15374 / (3C0E)	
16	Loop.6.Main.PV	15375 / (3C0F)	
17	Loop.6.Main.WorkingSP	15376 / (3C10)	
18	Loop.6.Main.ActiveOut	15377 / (3C11)	
19	Loop.7.Main.PV	15378 / (3C12)	
20	Loop.7.Main.WorkingSP	15379 / (3C13)	
21	Loop.7.Main.ActiveOut	15380 / (3C14)	
22	Loop.8.Main.PV	15381 / (3C15)	
23	Loop.8.Main.WorkingSP	15382 / (3C16)	
24	Loop.8.Main.ActiveOut	15383 / (3C17)	
25	AlmSummary.General.AnAlarmStatus1	15384 / (3C18)	
26	AlmSummary.General.AnAlarmStatus2	15385 / (3C19)	
27	AlmSummary.General.AnAlarmStatus3	15386 / (3C1A)	
28	AlmSummary.General.AnAlarmStatus4	15387 / (3C1B)	
29	AlmSummary.General.SBrkAlarmStatus1	15388 / (3C1C)	
30	AlmSummary.General.SBrkAlarmStatus2	15389 / (3C1D)	
31	AlmSummary.General.SBrkAlarmStatus3	15390 / (3C1E)	
32	AlmSummary.General.SBrkAlarmStatus4	15391 / (3C1F)	
33	AlmSummary.General.CTAlarmStatus1	15392 / (3C20)	
34	AlmSummary.General.CTAlarmStatus2	15393 / (3C21)	
35	AlmSummary.General.CTAlarmStatus3	15394 / (3C22)	
36	AlmSummary.General.CTAlarmStatus4	15395 / (3C23)	
37	AlmSummary.General.NewAlarm	15396 / (3C24)	
38	AlmSummary.General.AnyAlarm	15397 / (3C25)	
39	AlmSummary.General.NewCTAlarm	15398 / (3C26)	
40	Programmer.Run.ProgStatus	15399 / (3C27)	
41 to 100	These parameters are undefined by default	15400 to 15459 / (3C28-3C63)	
	Total Length 100 words = 200 bytes		

Output Definition Table

The following table shows the Default Output parameter list:

Item	Description	Modbus Address / (HEX)	Notes
1	Loop.1.Main.TargetSP	15460 / (3C64)	The default Output Block Size value (Comms.OutputSize) matches this list.
2	Loop.1.Main.AutoMan	15461 / (3C65)	
3	Loop.1.OP.ManualOutVal	15462 / (3C66)	
4	Loop.2.Main.TargetSP	15463 / (3C67)	
5	Loop.2.Main.AutoMan	15464 / (3C68)	All of this area may be redefined by use of the CommsTab Function Block, remember to set the Output Block Size value for the configured number of parameters.
6	Loop.2.OP.ManualOutVal	15465 / (3C69)	
7	Loop.3.Main.TargetSP	15466 / (3C6A)	
8	Loop.3.Main.AutoMan	15467 / (3C6B)	
9	Loop.3.OP.ManualOutVal	15468 / (3C6C)	
10	Loop.4.Main.TargetSP	15469 / (3C6D)	
11	Loop.4.Main.AutoMan	15470 / (3C6E)	The Commstab Data Format option **must** be set to "Integer" to work with EtherNet/IP
12	Loop.4.OP.ManualOutVal	15471 / (3C6F)	
13	Loop.5.Main.TargetSP	15472 / (3C70)	
14	Loop.5.Main.AutoMan	15473 / (3C71)	
15	Loop.5.OP.ManualOutVal	15474 / (3C72)	
16	Loop.6.Main.TargetSP	15475 / (3C73)	
17	Loop.6.Main.AutoMan	15476 / (3C74)	
18	Loop.6.OP.ManualOutVal	15477 / (3C75)	
19	Loop.7.Main.TargetSP	15478 / (3C76)	
20	Loop.7.Main.AutoMan	15479 / (3C77)	
21	Loop.7.OP.ManualOutVal	15480 / (3C78)	
22	Loop.8.Main.TargetSP	15481 / (3C79)	
23	Loop.8.Main.AutoMan	15482 / (3C7A)	
24	Loop.8.OP.ManualOutVal	15483 / (3C7B)	
25 to 100	These parameters are undefined by default	15484 to 15559 / (3C7B-3CC7)	
	TOTAL LENGTH 100 words = 200 bytes.		

Requested Packet Interval

The EtherNet/IP module can support Requested Packet Interval (RPI) values down to 100ms. However, depending upon the size of Input/Output blocks, the maximum rate at which a new value will be produced/consumed is every 500ms. RPI values less than 500ms will, therefore, repeat previously produced values.

To minimize network traffic, it is recommended to set the RPI to as large a value as is reasonable for the application.

Example - Connect Mini8 Controller to Allen-Bradley PLC via EtherNet/IP

Installation

1. Install the PLC software according to the instructions supplied with the PLC. For this particular PLC, once installation is complete, the 'RSLinx Classic' and 'RSLogix 5000' software items (amongst others) must be present. RSLinx classic is used to provide a link between the PLC network and Windows, and RSLogix 5000 is configuration and programming software for the PLC.

2. Use a cross-over type serial cable to connect one of the PC ports to the serial port (typically a 9-way D-Type connector) of the PLC.

3. Connect an EtherNet cable between the EtherNet port on the PLC (typically an RJ45 socket) and the Mini8 controller. For a connection via a switch, a hub or directly to a Master, a Cat5e (straight through or cross-over) cable can be used.

4. Power up the PLC and the controller. Switch the PLC to 'Programmer' mode.

Setting Up The Link Between Windows and the PLC Network

5. Click on Start/All Programs/Rockwell software/RSLinx/RSLinx Classic. The 'RSLinx Classic' window opens.

6. Click on 'Communications' and select 'Configure Drivers'. When the 'Configure Drivers' window opens, select 'RS232 DF1 devices' in the 'Available Drive Types' pull-down menu (Figure 78).
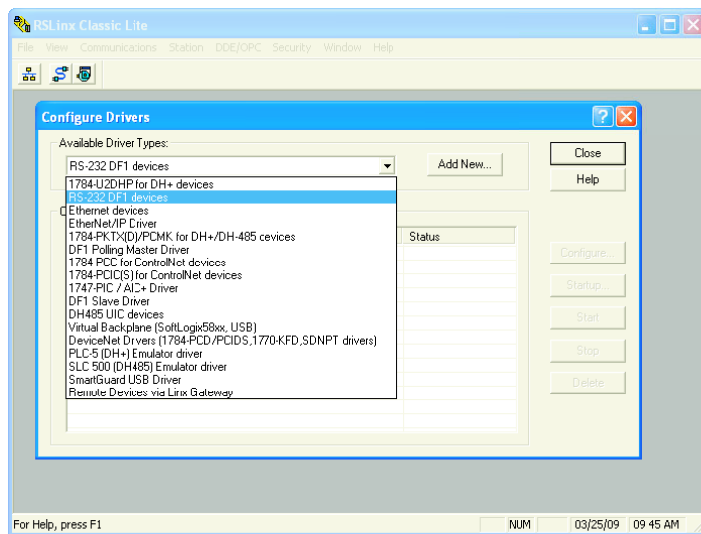
Figure 78 Configure Drivers

7. Click on 'Add New' and enter a suitable Driver Name in the pop-up window that then appears. Click on 'OK'. The 'Configure RS-232 DF1 devices' window opens (Figure 79).
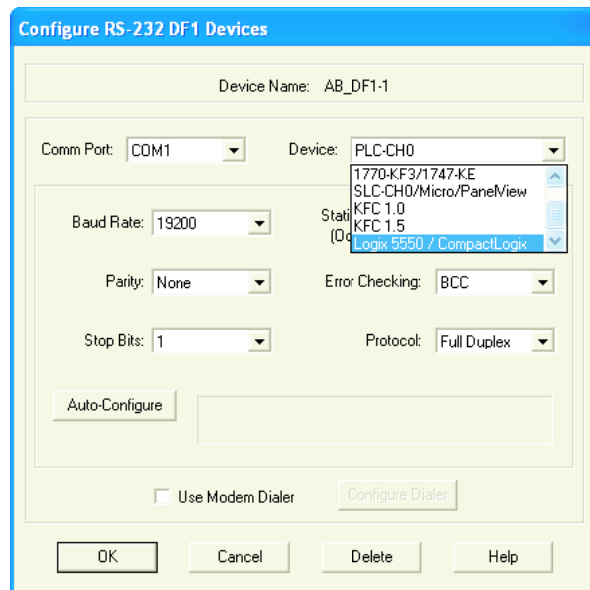
Figure 79 Configure RS232 DFI Devices

8. In the 'Device:' field pull-down menu, select the relevant device name. Select the PC COM port, and the relevant Baud Rate, Parity etc. (normally the defaults are acceptable). Click on 'Auto-Configure'.

9. When the Auto-Configure process is complete, click on 'OK', to close the 'Configure Drivers' window, and then minimize the 'RSLinx Classic window.

10. Start the RSLogix 5000 program (from 'Start/All programs/... /RSLogix 5000). When the 'Quick Start' window opens, close it.

11. At the top of the RSLogix 5000 window, click on the 'Who active' icon or click on 'Who Active' in the 'Communications' drop down menu. The 'Who Active' window opens.

Updating Firmware

NOTICE
POTENTIAL INSTRUMENT DAMAGE
Power must be maintained during the Update process (which may take some tens of minutes). Loss of power during update may render the instrument inoperative.
Failure to follow these instructions can result in equipment damage.

1. Select the relevant instrument (Figure 80) and click on 'Update Firmware'. In the 'Choose Firmware Revision' window, select the latest version. Click on 'Update'.

2. Click on 'Yes' or 'OK' as appropriate to accept all the messages, and wait for the process to complete and to be validated.

3. When the update process is complete, close the 'Who Active' window.
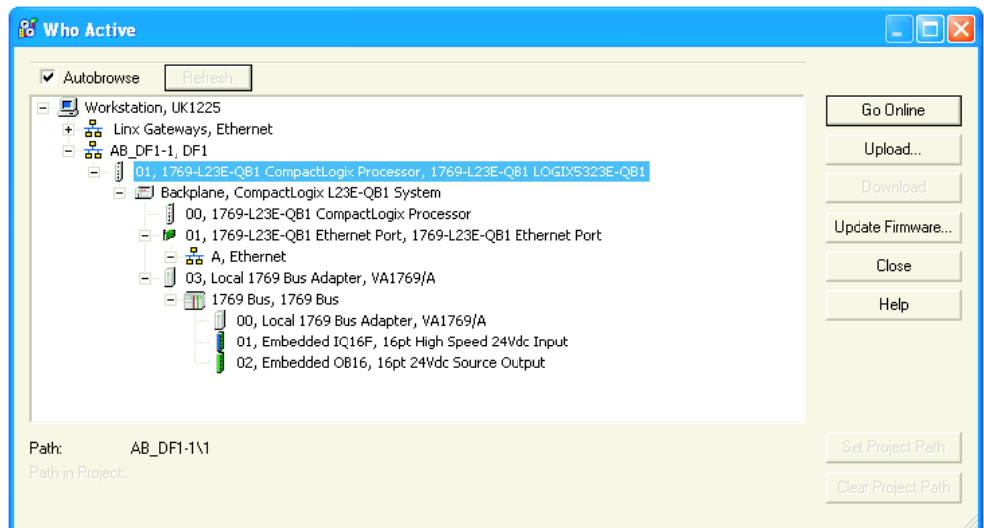
Figure 80 Who Active Window

Completing the Link

1. In the 'File' menu select 'New', or click on the 'New Tool' icon. The 'New Controller' window opens (Figure 81).
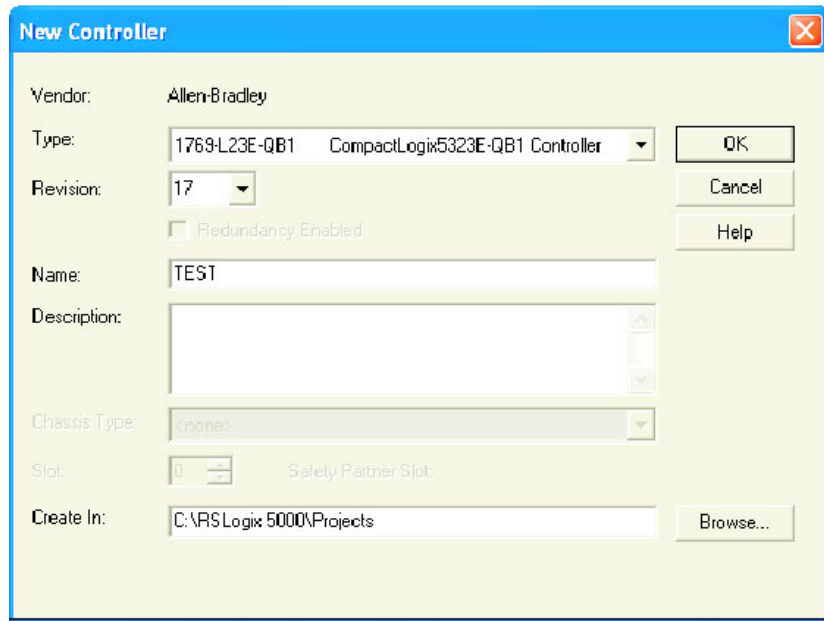
Figure 81 New Controller

2. Select the relevant PLC from the drop-down menu. Enter a name, if required and click on 'OK'. After some seconds, the selected controller's window opens.

3. Open the 'Who active' window. This is found under the Communications menu or the ⊞ icon. Select the relevant instrument from the hierarchy. At this point it is possible to download the project to the controller (PLC). Click on 'Download'.

4. When the download is complete, right click on the relevant EtherNet port in the left pane 'tree', and select 'Properties' (Figure 82).
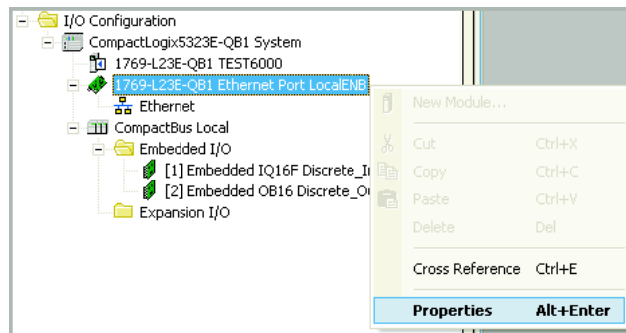
Figure 82 Properties

5. The Module Properties window opens. Select the 'Port Configuration' tab (shown if the configuration is being done through the serial port). For fixed IP Address applications, 'uncheck' the 'Enable BootP' check box, and enter an appropriate IP address and Subnet mask for the PLC.

6. Click on 'Set', and click on 'OK' on the message displays.

7. Click on 'OK' to close the Properties window.

8. Left-click on the 'Program' icon (Figure 83) and select 'Go OffLine' from the menu which appears.
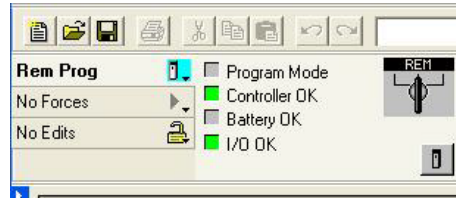
Figure 83 'Go OffLine' 'Go OnLine'

This view is shown if the local switch is set to PROG.

9. Connect the PLC to the EtherNet port (RJ45) of the PC.

10. Restore the RSLinxClassic window. To configure the PLC as an EtherNet driver, in the 'Communications' menu select 'Configure Drivers' then 'EtherNet/IP Driver'.

11. Click on 'Add New' and enter a name for the driver.

12. Select 'Browse local subnet' if this is not already selected.

13. Click on the relevant Network Card and Click on 'OK'.

14. Minimize the RSLinx window.

Note: Steps 11 to 13 associate the software drivers with the physical hardware.

Creating a Network Scanner

1. In the left pane tree-view of the RSLogix 5000 window, right-click on the EtherNet symbol and select 'New Module...' from the menu (Figure 84).
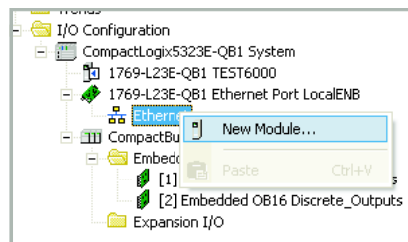
Figure 84 New Module

2. Expand the communications list (click on the + symbol).
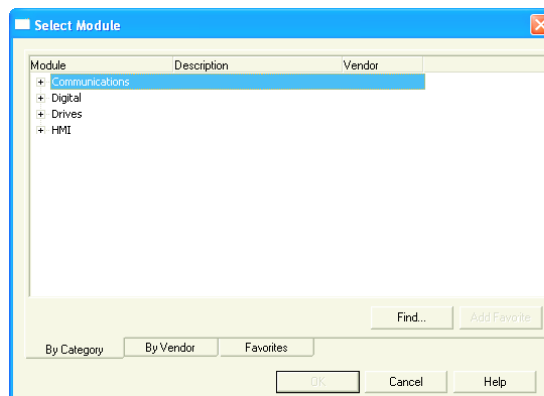
Figure 85 Select Module

3. Using the scroll bar as necessary, click on the 'Generic EtherNet Module' item and click on 'OK' (or double-click on the selected item).
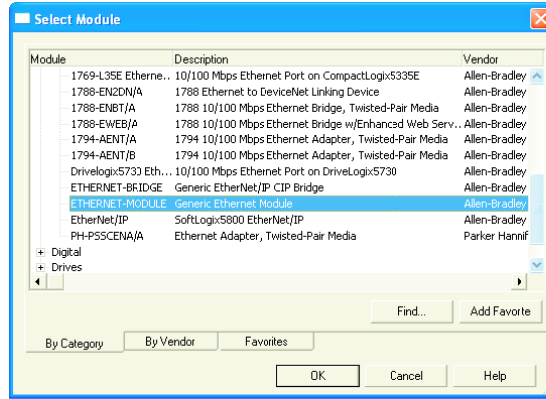
Figure 86 Generic EtherNet Module

4. In the New Module page that appears (Figure 87), enter a name for the module, and set Connection Parameter values:
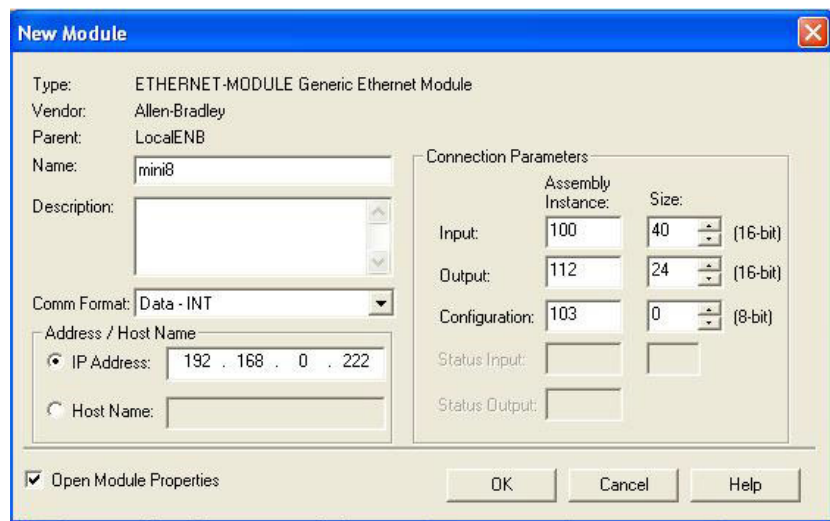
Figure 87 New Module

Enter data for the Mini8 controller as follows:

1. Select the Comm Format first as: Data – INT – the Size is then defined as a 16-bit number.

Note: This box is grayed when the module has been established.

2. Address/Host name: The IP address of the Mini8 controller (this can be found in iTools, Comms menu > IP address).

3. Input: 100;   Size: 40   (see Note, below)

4. Output: 112;   Size: 24   (see Note, below)
(Size MUST match the Input Output definitions shown in iTools Comms menu)

5. Configuration: 103;   Size 0   (see Note, below)

6. Tick (click on) the 'Open Module Properties' checkbox if it is not already ticked.

7. Click 'OK"

The 'Module Properties' window is now shown (Figure 88).
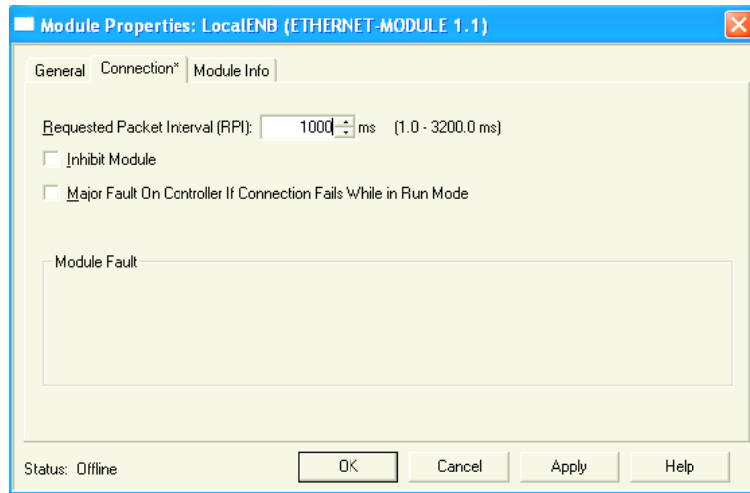
Figure 88 Module Properties

8.   Set the Requested Packet Interval (RPI) to 1000 (1 second) and click 'OK'.

See also "Requested Packet Interval" on page 149.

At this point the PLC is configured.

It is then necessary to create or load a pre-determined application for the Mini8 controller application using iTools, go to "Create or Load a Mini8 Controller Configuration" on page 156.

Note: The above values can be found using the EZ-EDS tool, as follows:

The Connection Parameters are fixed for a Mini8 controller, but may be found from the EDS file relevant to the Mini8 controller in use. The figure below shows an example of the EDS file for the Input Assembly Instance. Click Create/Decode Path button to show the 'Path' pop up window. The instance is shown in Hex as 64. In the New Module selection (Figure 77) it is entered in decimal as 100.

A similar page is available for the Output Assembly Instance.
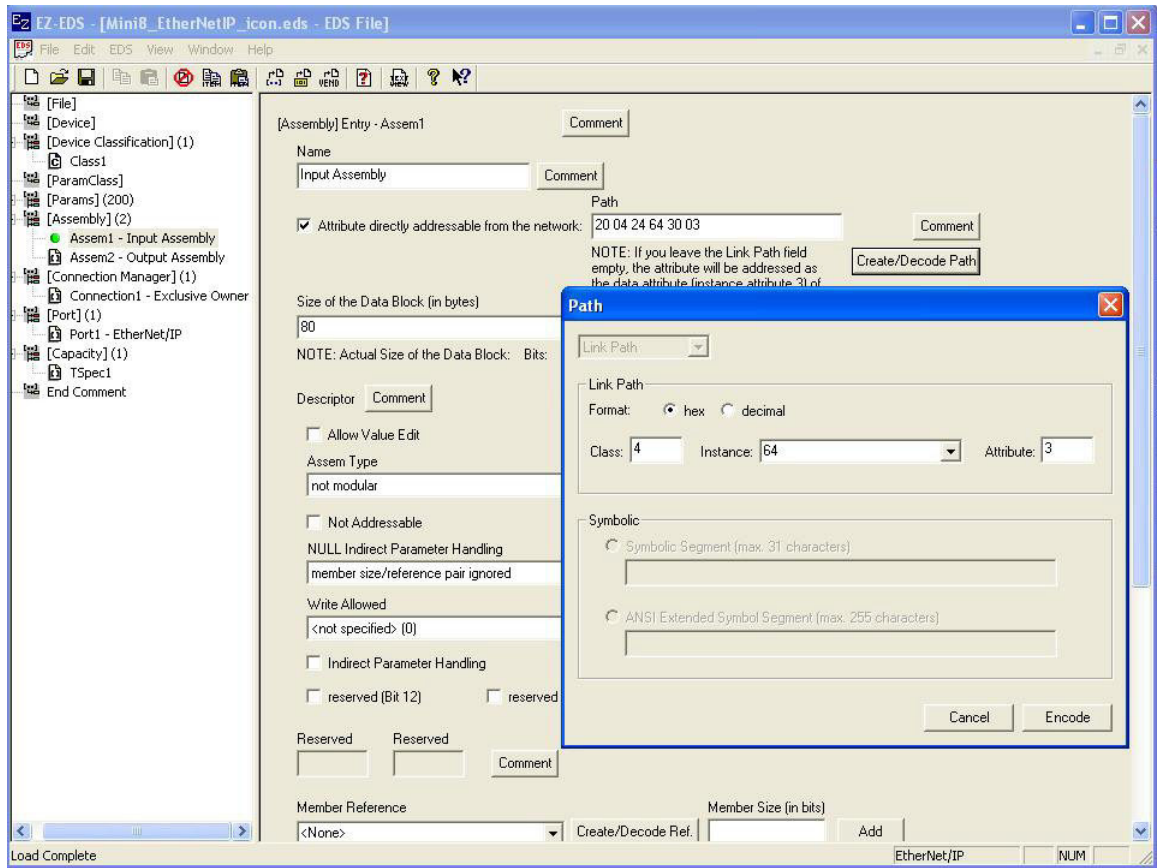
Figure 89 EZ-EDS

Create or Load a Mini8 Controller Configuration

1. Ensure an EtherNet/IP comms module is fitted and recognized by the instrument.

2. Configure the Mini8 controller using iTools. In the example below the all eight loops in the Mini8 controller slave have been setup for temperature control as shown for Loop 1 in the iTools Graphical Wiring (Figure 90).
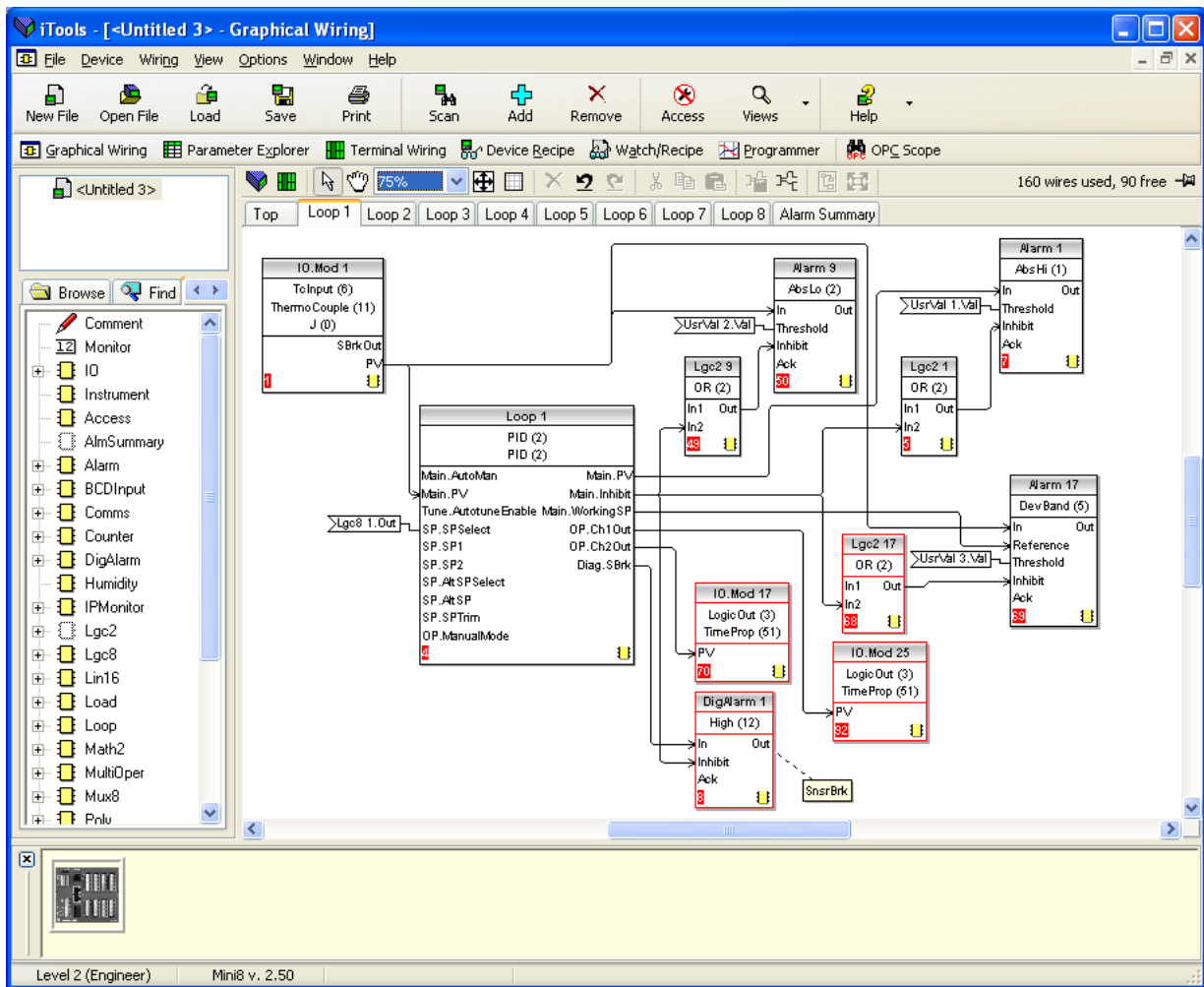
Figure 90 Mini8 Controller Graphical Wiring

Run Mode

1. Set the PLC into either 'Remote' or 'Run' mode. This can be done using the key switch on the PLC or in the RSLogix5000 menu.

2. Set the PLC online.

At this point you may be asked to download the file if it is different.
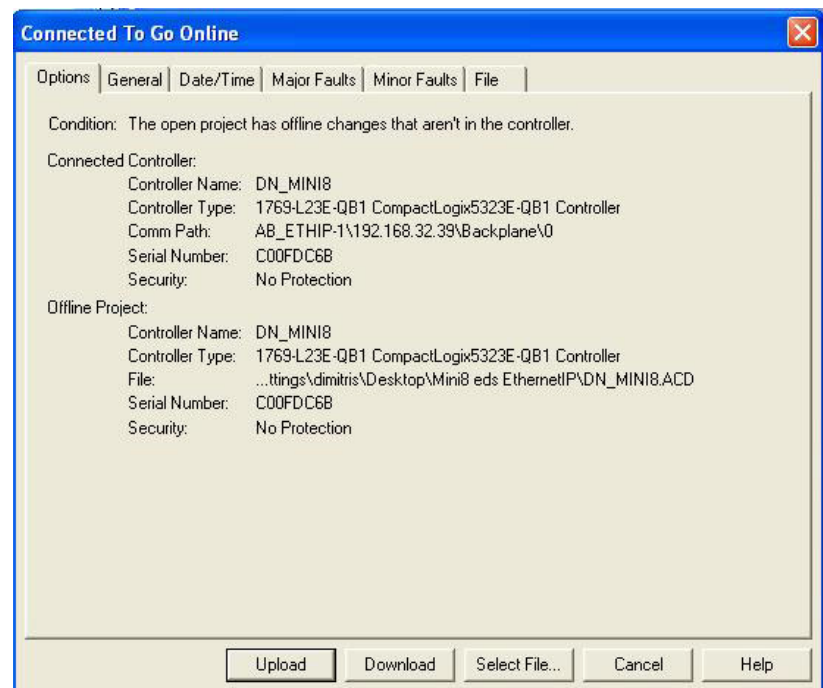
Figure 91 Go online

Monitor Parameters

It is possible to check that the PLC is communicating with the Mini8 controller using the 'Tags' display to write values to the Mini8 controller and to receive values from it. Once it is proved that the link is working, the PC may be disconnected from the PLC.

1. In the left pane tree-view of the RSLogix 5000 window, double-click on the Controller Tags symbol.

2. Set the PLC online.

3. Expand the Name list (click on the + symbol) to view parameter values. Some non-zero values should appear next to input data.
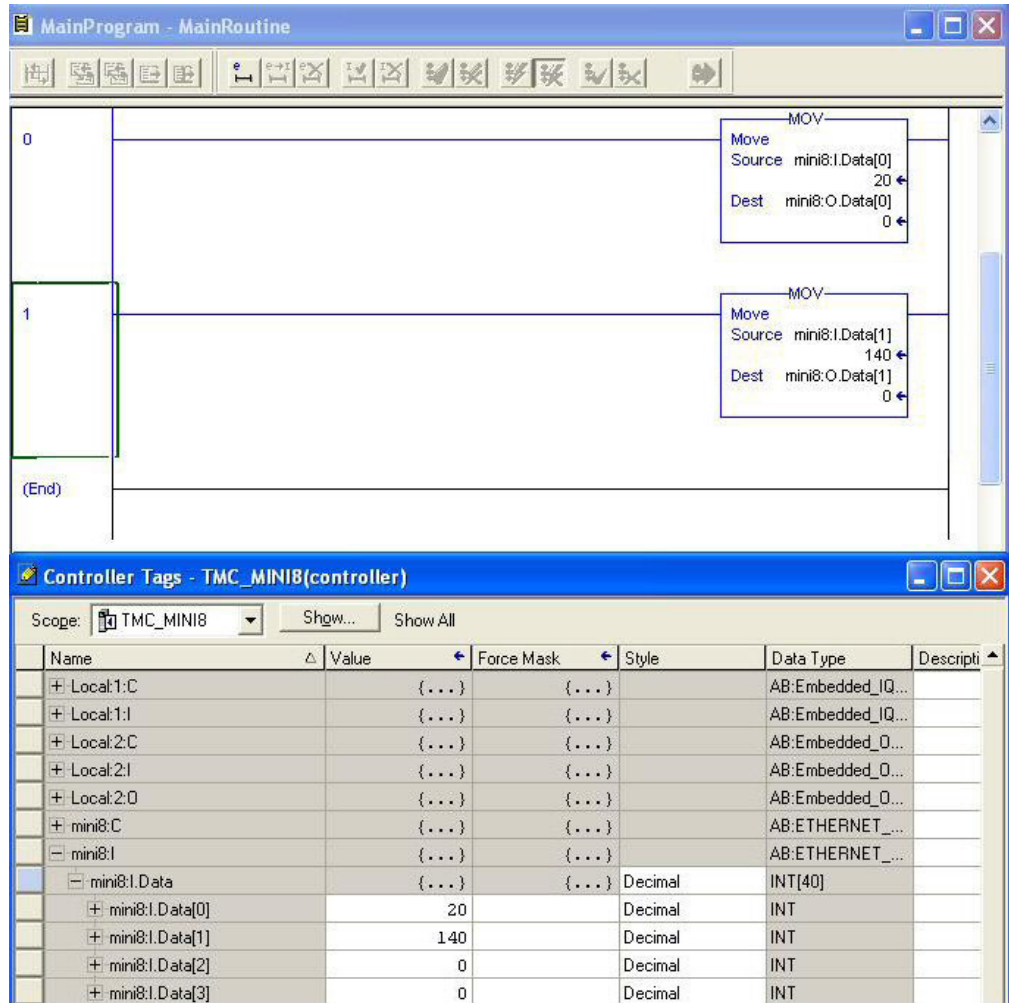
Figure 92 Monitor Inputs and Outputs via Controller Tags

Status Indicators

The status indicators at the top left corner of the RSLogix 5000 Page show the status of the link between the PC and the PLC.
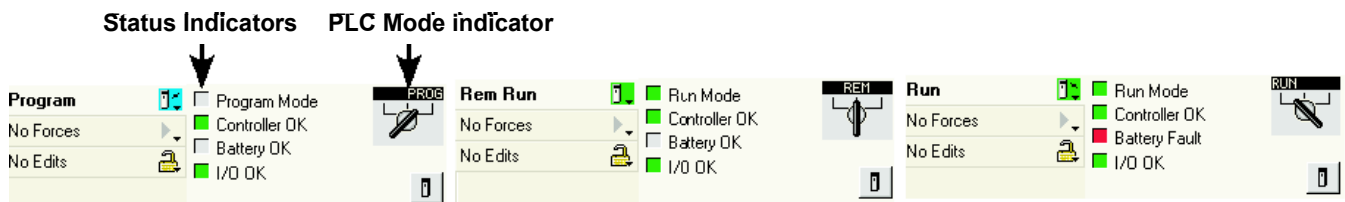
Figure 93 Status Indicators

Mini8 Controller on an Ethernet/IP Network

To obtain a graphical representation of the network configuration (if required) proceed as follows:

1. Start the RSNetWorx for EtherNet/IP program (from 'Start/All programs/... /RSNetWorx for EtherNet/IP).

2. In the 'Tools' menu select EDS Wizard.

3. Locate the EDS file in the Hardware list. In the Vendor list select InvensysEurothermMini8 and register the Mini8 controller EDS file and icon. The EDS file is available from Eurotherm. After successful registration, an entry will appear in the Generic Device list.

4. Drag and Drop devices from the registered Hardware list to create your network. Figure 95 shows an example of two Mini8 controllers on a network together with a nanodac controller.
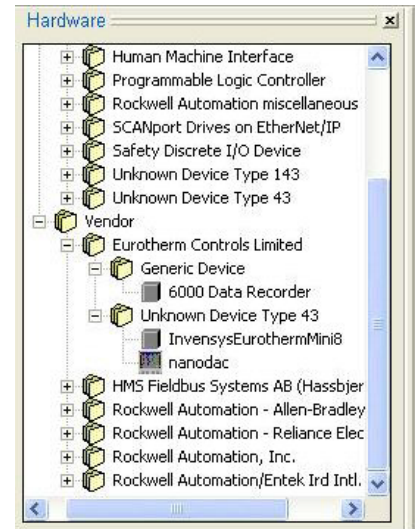
Figure 94 Hardware List
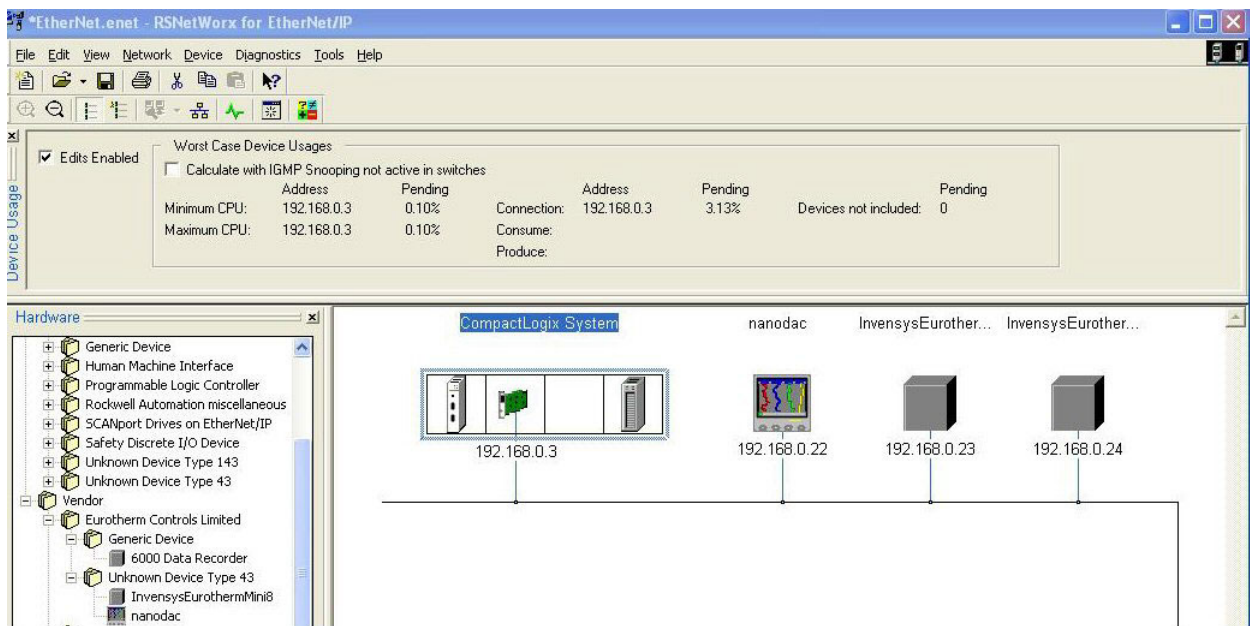
Figure 95 Example of Eurotherm Products on an EtherNet/IP Network

Implicit (Cyclic) Messaging

Using the RSLogix 5000, the user can write a Ladder program to read (get) and write (set) Implicit (Cyclic) messages between the PLC master and Mini8 controller slave.

Explict (Acyclic) Messaging

Using the RSNetWorx for EtherNet/IP, in the 'Device' menu, select Class Instance Editor, to read (get) and write (set) Explicit (Acyclic) messages to the Mini8 controller. The target controller MUST be selected.

Troubleshooting

Check that:

1. Instruments are Powered On and Online and the PLC is set to RUN mode.

2. The instrument indicators are all normal.

3. An EtherNet/IP comms module is fitted and recognized by the instrument.

4. All instruments have unique EtherNet/IP addresses.

5. Subnet Mask is not prohibiting connections.

6. Input and Output Size of EtherNet Module match exactly the Input and output Definitions (see Figure 87).

7. Assembly Instance values are supported by the Mini8 controller (see Figure 87).

8. EtherNet cables are not disconnected or damaged.

9. The instrument is responding when using PING command from a PC with a similar IP address.

10. Any user program running on PLC is not performing illegal operations.

EtherCAT

EtherCAT (Ethernet for Control Automation Technology) is an open real-time technology that realizes the specific transfer of data. It offers real-time performance and is aimed to maximize the utilization of high-speed full-duplex Ethernet data transfer through a twisted pair cable for industrial process control needs.

EtherCAT is based on the Ethernet technology and possesses advantages such as ease of implementation, cost of ownership and standardization. This makes it an excellent solution for industrial applications, to maximize the performance of control systems.

Medium access control employs the Master/Slave principle, where the Master node (typically the control system) sends the Ethernet frames to the slave nodes, which extract data from and insert data into these frames on the fly. A complete range of topologies can be used for EtherCAT applications.

An EtherCAT segment is a single Ethernet device, from an Ethernet point of view, which receives and sends standard ISO/IEC 802-3 Ethernet frames. This Ethernet device may consist of a large number of EtherCAT slave devices, which process the incoming frames directly and extract the relevant user data, or insert data and transfer the frame to the next EtherCAT slave device. The last EtherCAT slave device within the segment sends the fully processed frame back, so that it is returned by the first slave device to the Master as a response frame.

This procedure utilizes the full duplex mode of Ethernet, which allows communication in both directions independently. Direct communication without a switch between a Master device and an EtherCAT segment consisting of one or several slave devices may be established.

EtherCAT slave (adapter) is implemented as a Mini8 gateway communications option card.

NOTICE
POTENTIAL BROADCAST STORM
EtherCAT slave controllers will reflect any frame back onto the network, therefore, it should not be connected to an office network as this may result in a broadcast storm.
Failure to follow these instructions can result in equipment damage.

EtherCAT-to-Modbus Interface

The card can be considered a 3-port "black box", supporting an internal Modbus RTU port and two external EtherCAT slave ports, with an active circuit between, acting as a "translator", converting the information in EtherCAT packets to and from Modbus messages:
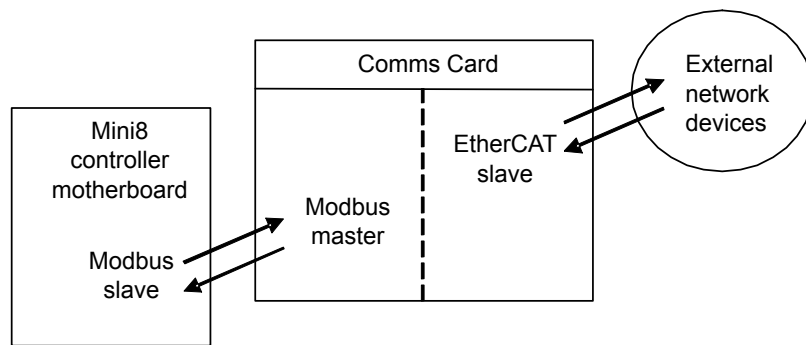
Figure 96 EtherCAT to Modbus Interface

From the Mini8 controller point of view the Comms card looks like a Modbus Master. For the external network, the Mini8 controller Comms card looks like an EtherCAT Slave (adapter) at a maximum of 100Base-T.

EtherCAT Feature Switch
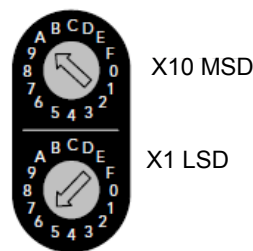
Figure 97 EtherCAT Feature Switch

The feature switch consists of two HEX rotary switches. The upper switch is the most significant digit and the lower the least significant digit.

There are three conditions where the switches can be set:

- 0xFF: Boot mode

- 0x01 to 0xFE: Master will use this value as the "Requesting ID". The example shown in the diagram sets the Explicit Device ID of A6 (166), configured by setting the MSD to A and LSD to 6.

- 0x00: Invalid setting

EtherCAT Parameters

Folder – Field Comms (FC)					
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ident	Identification of the module fitted.	EtherCAT. Used to set the Program being accessed via the comms channel.			Conf
Protocol	Digital communications protocol	EtherCAT			Read Only
Device ID	EtherCAT device ID	As selected by the module switches			Read Only
WDFlag	Network watchdog flag	Off		Off	Oper
		On	The Network communications have stopped addressing the instrument for longer than the Timeout time. Set by the Watchdog process. For EtherCAT,the watchdog will time out if the ECStatus is not "Op".		
WDAct	Network watchdog action	Man	The Watchdog Flag must be cleared manually - either by a parameter write or a wired value.	Man	Conf
		Auto	The Watchdog Flag will be automatically cleared when the Network Comms resume - according to the value in the Recovery Timer.		
WDTime	Network watchdog timeout	h:m:s:ms	If the Network communications stop addressing the instrument for longer than the set value, the Watchdog Flag will become active.	0:0:0:0	Conf
SafeModeEnable	'Safe Mode' enable	On Off	'Safe-mode' will activate at power up and when the comms watchdog is latched. While in 'safe-mode', all loops will be set to manual, all powers will be set to the last received values and all SPs will be set to SafeModeSP value.	Off	Conf
SafeModePower	'Safe Mode' power		When in 'safe-mode', the power output level of all loops will be set to this value.	0	
SafeModeSP	'Safe Mode' setpoint		While in 'safe-mode', the Setpoint of all loops will be set to this value. It will be set immediately with no ramp or servo action.		
ECModVer	EtherCAT Module Version	This is a 16-bit hex integer value where the top byte indicates the major revision and the bottom byte the minor revision.			Read Only
ECStatus	EtherCAT Network Status	Init	No data transferred to/from EtherCAT master.	Init	Read Only
		Preop	Only acyclic (SDO) communications to/from EtherCAT master		
		Safeop	Acyclic and cyclic communications are available but Outputs are ignored.		
		Op	Full communication is established		
CloneLiteEn	Enable clone Lite process	Disable Enable	The clone Lite process enables a simplified clone file to be sent to the Mini8 via EtherCAT using the File over EtherCAT process, FoE. See also "File Over EtherCAT" on page 165	Disable	Conf

Note: All output parameters controlled by EtherCAT will retain the last value transmitted in EtherCAT OPERATIONAL mode.

Parameter Pick List and IO Mapping

The EtherCAT protocol shares the 200 address parameter area with Ethernet/IP at 15360 to 15559. These are listed in "Input Definition Table" on page 148 and "Output Definition Table" on page 149.

For Ethernet/IP this is divided into Input and Output parameters and this remains the default setting. However, EtherCAT does not need to maintain this organization as the IO Mapping blocks determine the Input and Output block contents and size.

Each entry in the IOMapping blocks identifies a parameter index into the pick list. As such, valid indexes are 0 to 199. The module will treat any value >=200 as an end of block marker.

The Default Input block for Ethernet/IP is configured from 15360 to 15399 giving a block size of 40. To match this in EtherCAT, the default values for MapIn0 to MapIn39 returns 0 to 39; MapIn40 returns 0xFF at address 15400.

Similarly, the Default Output block, for Ethernet/IP, is from 15460 to 15483 giving a block size of 24. Default MapOut0 to MapOut23 returns 100 to 123; MapOut24 returns 0xFF at address 15484.

File Over EtherCAT

Clone Mini8 Controller

The master may be used to clone Mini8 controllers over EtherCAT. A special file must be passed to the EtherCAT master for sending via File over EtherCAT. This file can be produced using iCloneLite available in iTools and has the file extension .uid.

iCloneLite is, by definition, a lightweight version of iTools cloning. It is not a replacement for instrument cloning using iTools as described in "Cloning" on page 65.

The iCloneLite engine imposes the following limitations and assumptions:

- Single Pass cloning process

- Limited reporting of unsuccessful parameter writes (if any)

- Cannot cope with cloning from vastly different device configuration (e.g. cross-coupled range limits)

    ○ Example – Range High/Low change from 100/0 to -100/-200

- Assumes the target device is of a known configuration (e.g. cold-started or default/standard configuration)

- Requires compatible hardware module configuration

- Requires compatible software features configuration (or superset)

- Requires exact device firmware

- Custom Linearization data will not be cloned

- iTools GWE (Graphical Wiring Editor) layout data will not be cloned

- Following successful clone, the Mini8 will be placed into Operator Mode (IM=0). If the clone does not succeed, the Mini8 will be left in Config Mode (IM=2).

- If iTools cannot successfully clone the device in a single pass, then iCloneLite will most likely be unsuccessful too.

So that cloning over EtherCAT has the optimum chance of success, the following procedure should be employed when preparing a UID Clone Lite file:

1. Connect a target Mini8 controller, which has exact matching firmware and hardware configuration for the clone file selected, to iTools.

2. Using iTools:

    a. Load the required UIC Clone File (for example mini8_1.uic) into the target device

        i.   Correct any issues reported

    b. Ensure the device is in Configuration Mode

    c. Save the configuration to a new UIC Clone File (for example mini8_2.uic)

    d. Cold-Start the target device

    e. Issue an iTools Re-synchronize request for the device (or delete device, re-add device)

    f. Load the new UIC Clone File (mini8_2.uic)

i. Ensure the clone completes with zero (0) issues, ideally using a single clone pass. If ANY issues are reported, adjust/correct configuration, then repeat steps (b) onwards. If issues persist or more than a single clone pass is required, consider generating an intermediate base configuration which can be pre-loaded into devices using iTools prior to using iCloneLite.

3. Use UIC-To-UID converter (iCloneLite Convertor) to convert the UIC Clone File (from step c above) to a UID file.

4. Cold-Start the device

5. Use the iCloneLite tool to send the UID file to the device

   a. Ensure the clone succeeds with zero issues

6. Using iTools:

   a. Connect to the device

   b. Save the configuration to a new UIC Clone File (for example mini8_3.uid)

   c. Perform a difference (WinMerge) between the newly saved UIC Clone File and the clone file saved in stage 1.c (mini8_2.uic)

      i. Verify that differences can be accounted for (e.g. configuration values match, any differences are in runtime values such as PV)

If all is well, the uid file should now transfer successfully over EtherCAT using File over EtherCAT.

To produce a UID File

Open iCloneLite as follows:

Start > All Programs > Eurotherm > iTools Advanced > iCloneLite Tools > Clone File to iCloneLite Convertor
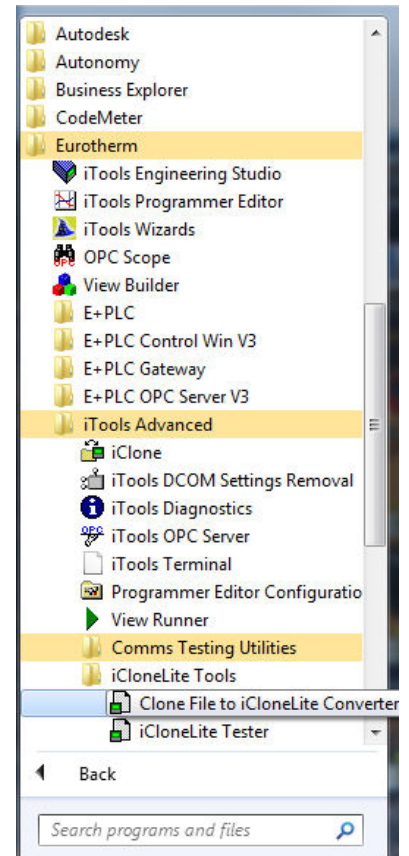
Figure 98 Opening iCloneLite

iCloneLite starts with the opening page shown below:
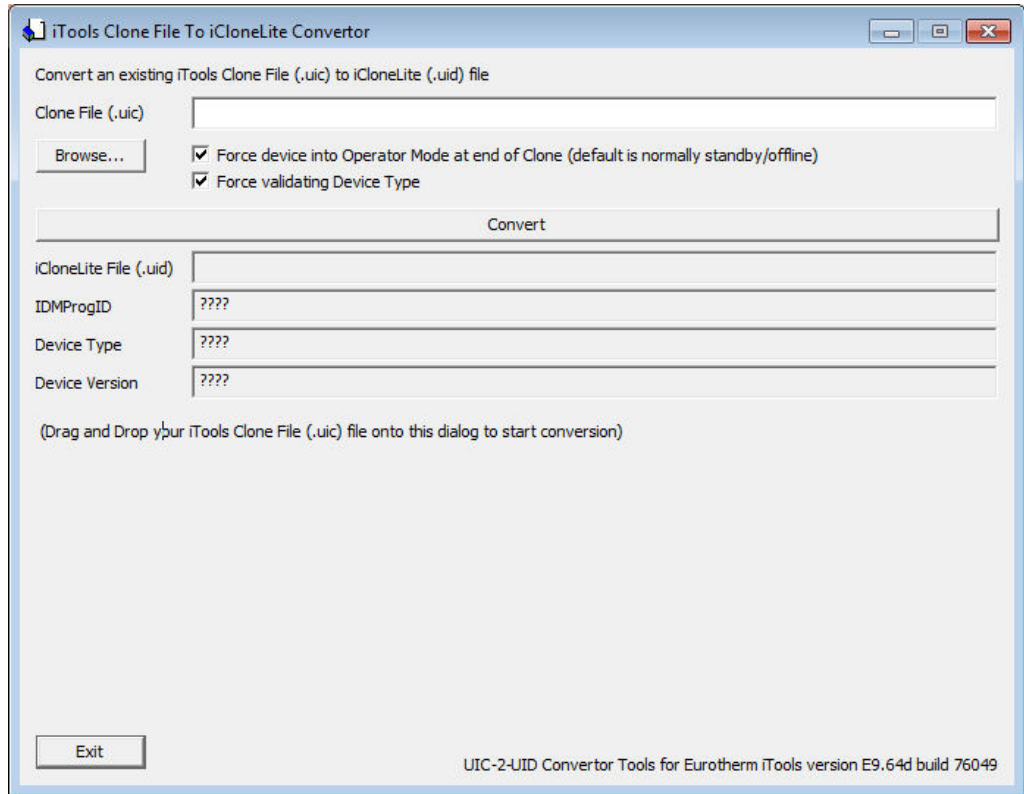
Figure 99 iCloneLite Start Page

Browse to a previously produced UIC file (in this example mini8_2.uic) and press Convert.

The file mini8_2.uid is produced in the same folder as the .uic file.
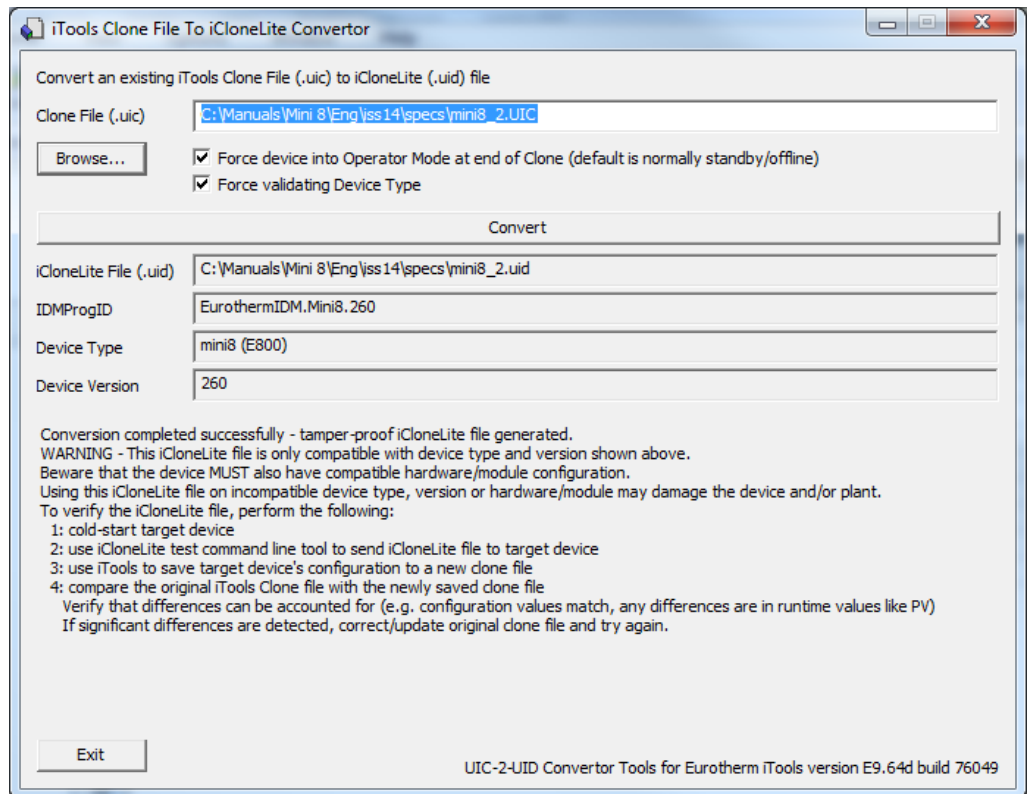
Figure 100 iCloneLite File Converter

This file may now be used by the EtherCAT master.

Precautions

- iTools should not be connected to the instrument via either the RJ11 socket on the front of the controller or the configuration clip at the back at the same time as EtherCAT is operating as this may make EtherCAT operations slower.

- iTools should not be connected while loading a clone file or downloading firmware using FoE.

Trademark

Terms of trademark for EtherCAT

- English: "EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany."

- German: „EtherCAT® ist eine eingetragene Marke und patentierte Technologie lizensiert durch die Beckhoff Automation GmbH, Deutschland."

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- Korean: „EtherCAT® 독일 Beckhoff Automation GmbH의 허가를 받은 등록 상표이자 특허 기술입니다."

- Chinese: „EtherCAT®是注册商标和专利技术，由德国倍福自动化有限公司授权。"

Counters, Timers, Totalizers, and RT Clock

A series of function blocks are available which are based on time/date information. These may be used as part of the control process.

Counters

Up to two counters are available. They provide a synchronous edge triggered event counter.
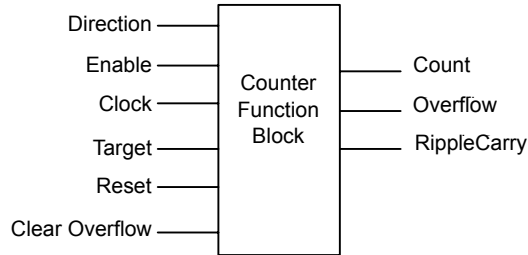
Figure 101 Counter Function Block

When configured as an Up counter, Clock events increment Count until reaching the Target. On reaching Target RippleCarry is set true. At the next clock pulse, Count returns to zero. Overflow is latched true and RippleCarry is returned false.

When configured as a down counter, Clock events decrement Count until it reaches zero. On reaching zero RippleCarry is set true. At the next clock pulse, Count returns to the Target count. Overflow is latched true and RippleCarry is reset false.

Counter blocks can be cascaded as shown in the diagram below.
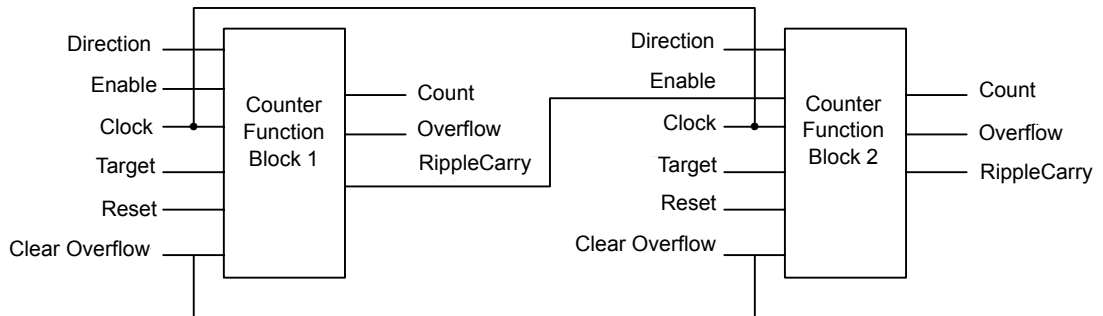
Figure 102 Cascading Counters

The RippleCarry output of one counter acts as an enabling input for the next counter. In this respect the next counter in sequence can only detect a clock edge if it was enabled on the previous clock edge. This means that the Carry output from a counter must lead its Overflow output by one clock cycle. The Carry output is, therefore, called a RippleCarry as it is NOT generated on an Overflow (i.e. Count > Target) but rather when the count reaches the target (i.e. Count = Target). The timing diagram in Figure 103 illustrates the principle for the Up Counter.
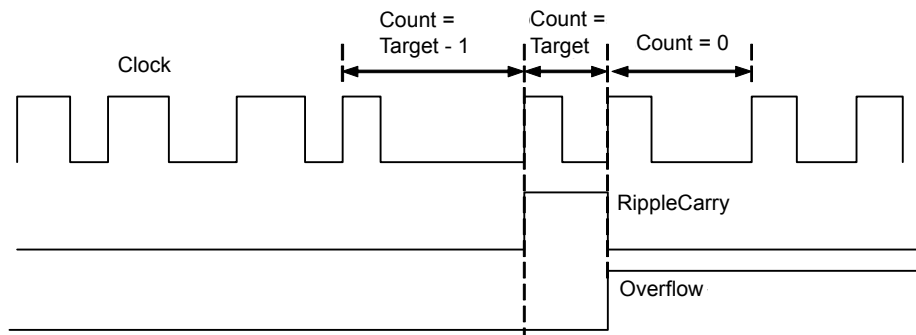
Figure 103 Timing Diagram for an Up Counter

Counter Parameters

Folder - Counter		Sub-folders: 1 to 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Enable	Counter enable. Counter 1 or 2 is enabled in the Instrument Options folder but they can also be turned on or off in this list	Yes No	Enabled Disabled	No	Oper
Direction	Defines count up or count down. This is not intended for dynamic operation (i.e. subject to change during counting). It can only be set in configuration level.	Up Down	Up counter Down counter	Up	Conf
Ripple Carry	Ripple carry to act as an enabling input to the next counter. It is turned On when the counter reaches the target set	Off			Read Only
Overflow	Overflow flag is turned on when the counter reaches zero				Read Only
Clock	Tick period to increment or decrement the count. This is normally wired to an input source such as a digital input.	0 1	No clock input Clock input present	0	Read Only if wired
Target	Level to which the counter is aiming	0 to 99999		9999	Oper
Count	Counts each time a clock input occurs until the target is reached.	0 to 99999			Read Only
Reset	Resets the counter	No Yes	Not in reset Reset	No	Oper
Clear Overflow	Clear overflow flag	No Yes	Not cleared Cleared	No	Oper

Timers

Up to eight timers can be configured. Each one can be configured to a different type and can operate independently of one another.

Timer Types

Each timer block can be configured to operate in four different modes. These modes are explained below.

On Pulse Timer Mode

This timer is used to generate a fixed length pulse from an edge trigger.

- The output is set to On when the input changes from Off to On.

- The output remains On until the time has elapsed.

- If the 'Trigger' input parameter recurs while the Output is On, the Elapsed Time will reset to zero and the Output will remain On.

- The triggered variable will follow the state of the output.

The diagram illustrates the behavior of the timer under different input conditions.
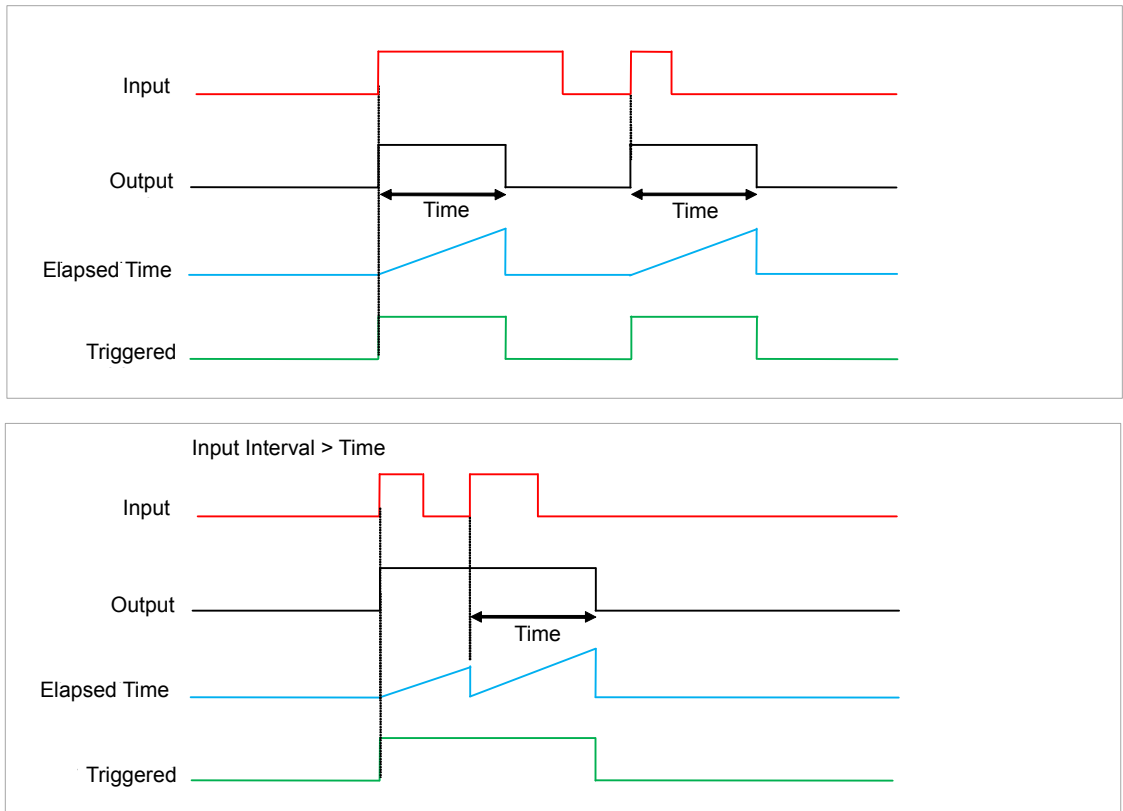
Figure 104 On Pulse Timer Under Different Input Conditions

On Delay Timer Mode

This timer provides a delay between the trigger event and the Timer output. If the input pulse is less than the set delay time there is no output pulse.

- The Output is set to Off when the Input changes from Off to On.

- The Output remains Off until the Time has elapsed.

- If the Input returns to Off before the time has elapsed, the Timer will cease and there will be no output.

- If the Input remains on until the Time has elapsed, the Output will be set to On.

- The Output will remain On until the Input is cleared to Off.

- The Triggered variable will be set to On by the Input changing from Off to On. It will remain On until both the Time has elapsed and the Output has reset to Off.

The diagram illustrates the behavior of the timer under different input conditions.
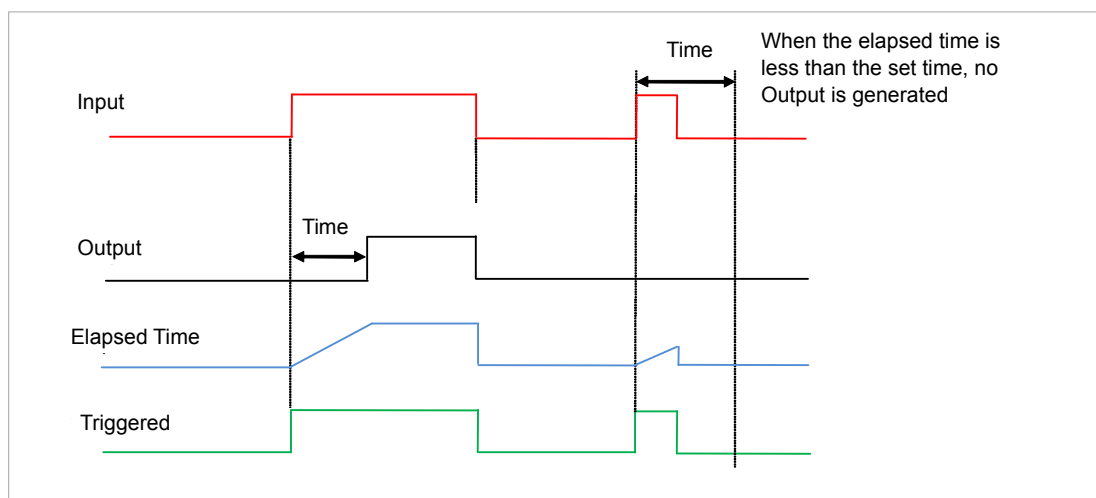
Figure 105 On Delay Timer under Different Input Conditions

This type of timer is used to make certain that the output is not set unless the input has been valid for a pre-determined period of time, thus acting as a kind of input filter.

One Shot Timer Mode

This timer behaves like a simple oven timer.

- When the Time is edited to a non-zero value the Output is set to On.

- The Time value is decremented until it reaches zero. The Output is then cleared to Off.

- The Time value can be edited at any point to increase or decrease the duration of the On time.

- Once set to zero, the Time is not reset to a previous value, it must be edited by the operator to start the next On-Time.

- The Input is used to gate the Output. If the Input is set, the time will count down to zero. If the Input is cleared to Off, then the Time will hold and the Output will switch Off until the Input is next set.

Note: Since the Input is a digital wire, it is possible for the operator to NOT wire it, and set the Input value to On which permanently enables the timer.

- The Triggered variable will be set to On as soon as the Time is edited. It will reset when the Output is cleared to Off.

The behavior of the timer under different input conditions is shown below.
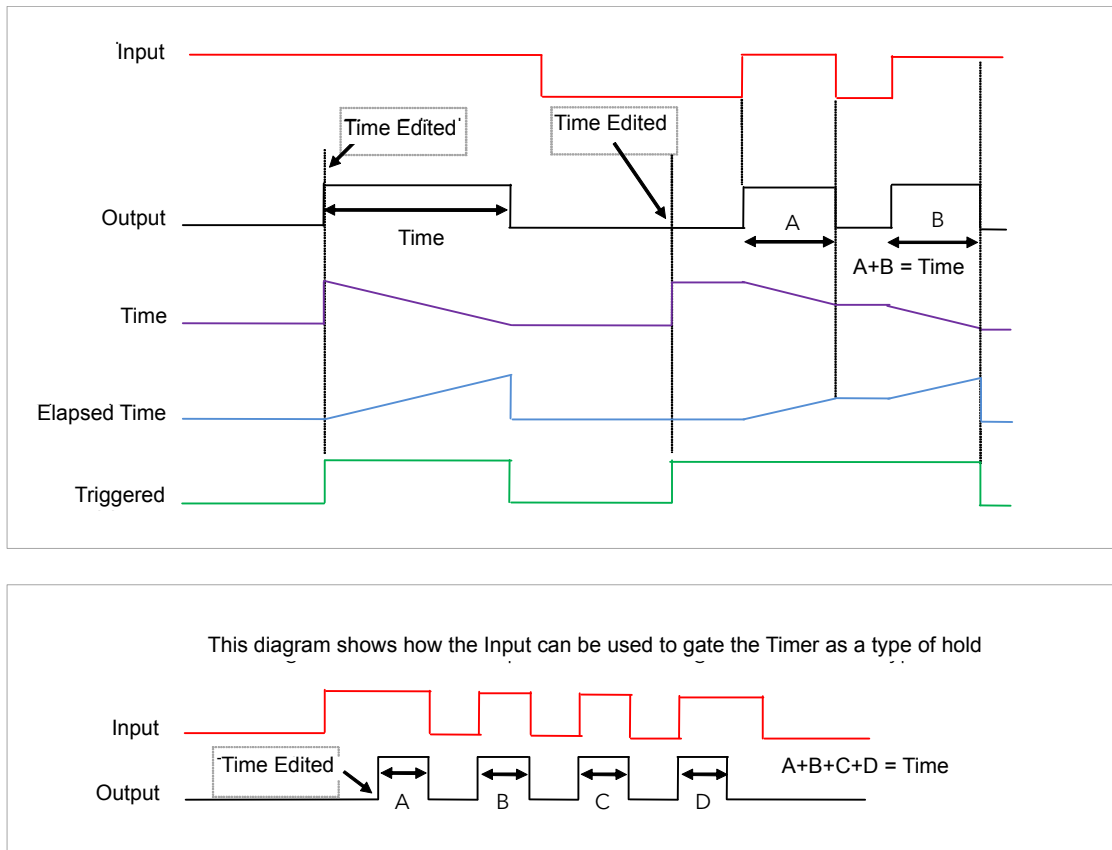
Figure 106 One Shot Timer

Minimum On Timer or Compressor Mode

This type of timer may also be known as an 'Off Delay' function where the output goes 'on' when the input goes active and remains on for a specified period after the input goes inactive.

It may be used, for example, to help prevent a compressor being cycled excessively.

- The output will be set to On when the Input changes from Off to On.

- When the Input changes from On to Off, the elapsed time will start incrementing towards the set Time.

- The Output will remain On until the elapsed time has reached the set Time. The Output will then switch Off.

- If the Input signal returns to On while the Output is On, the elapsed time will reset to 0, ready to begin incrementing when the Input switches Off.

- The Triggered variable will be set while the elapsed time is >0. It will indicate that the timer is counting.

The diagram illustrates the behavior of the timer under different input conditions.
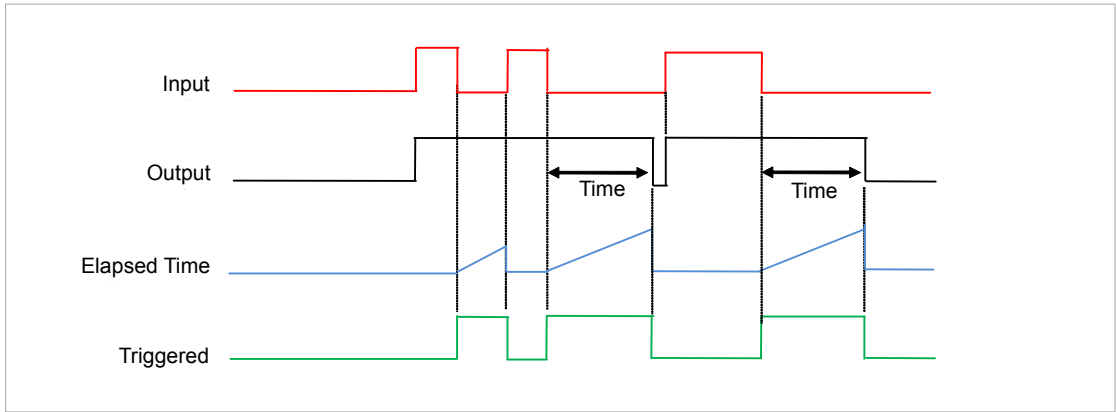
Figure 107 Minimum On Timer under Different Input Conditions

Timer Parameters

Folder – Timer		Sub-folders: 1 to 4			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Type	Timer type	Off	Timer not configured	Off	Conf
		On Pulse	Generates a fixed length pulse from an edge trigger		
		Off Delay	Provides a delay between input trigger event and timer output		
		One Shot	Simple oven timer which reduces to zero before switching off		
		Min-On Ti	Compressor timer keeps the output ON for a time after the input signal has been removed		
Time	Duration of the timer. For re-trigger timers this value is entered once and copied to the time remaining parameter whenever the timer starts. For pulse timers the time value itself is decremented.	0:00.0 to 99:59:59		0:00.0	Oper
Elapsed Time	Timer elapsed time	0:00.0 to 99:59:59			R/O
In	Trigger/Gate input. Turn On to start timing	Off / On	Off / Start timing	Off	Oper
Out	Timer output	Off / On	Output off / Timer has timed out		R/O
Triggered	Timer triggered (timing). This is a status output to indicate that the timers input has been detected	Off / On	Not timing / Timer timing		R/O

The above table is repeated for Timers 2 to 4.

Totalizers

There are two totalizer function blocks which are used to measure the total quantity of a measurement integrated over time. A totalizer can, by soft wiring, be connected to any measured value. The outputs from the totalizer are its integrated value and an alarm state. The user may set a setpoint which causes the alarm to activate once the integration exceeds the setpoint.

The totalizer has the following attributes:

Run/Hold/Reset

In **Run** the totalizer will integrate its input and continuously test against an alarm setpoint.

In **Hold** the totalizer will stop integrating its input but will continue to test for alarm conditions.

In **Reset** the totalizer will be zeroed, and alarms will be reset.

Alarm Setpoint

If the setpoint is a positive number, the alarm will activate when the total is greater than the setpoint.

If the setpoint is a negative number, the alarm will activate when the total is lower (more negative) than the setpoint.

If the totalizer alarm setpoint is set to 0.0, the alarm will be off. It will not detect values above or below.

The alarm output is a single state output. It may be cleared by resetting the totalizer, or by changing the alarm setpoint.

Limits

The total is limited to a maximum of 9,999,999,999 and a minimum of -9,999,999,999.

Resolution

The totalizer maintains resolution when integrating small values onto a large total.

Totalizer Parameters

Folder – Total		Sub-Folders: 1 to 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
TotalOut	The totalized value	±9,999,999,999			Read Only
In	The value to be totalized	-9999.9 to 9999.9. Note:- the totalizer stops accumulating if the input is 'Bad'.			Oper
Units	Totalizer units	None AbsTemp V, mV, A, mA, pH, mmHg, psi, Bar, mBar, %RH, %, mmWG, inWG, inWW, Ohms, PSIG, %O2, PPM, %CO2, %CP, %/sec, RelTemp mBar/Pa/T sec, min, hrs,			Conf
Resolution	Totalizer resolution	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX		XXXXX	Conf
Alarm SP	Sets the totalized value at which an alarm will occur	±9,999,999,999			Oper
AlarmOut	This is a read-only value which indicates the alarm output On or Off. The totalized value can be a positive number or a negative number. If the number is positive the alarm occurs when Total > + Alarm Setpoint If the number is negative the alarm occurs when Total > - Alarm Setpoint	Off On	Alarm inactive Alarm output active	Off	Oper
Run	Runs the totalizer	No Yes	Totalizer not running Select Yes to run the totalizer	No	Oper
Hold	Holds the totalizer at its current value Note: The Run & Hold parameters are designed to be wired to (for example) digital inputs. Run must be 'on' and Hold must be 'off' for the totalizer to operate.	No Yes	Totalizer not in hold Hold totalizer	No	Oper
Reset	Resets the totalizer	No Yes	Totalizer not in reset Totalizer in reset	No	Oper

Real Time Clock

A real time clock (day of week and time only) is used to provide a daily and weekly scheduling facility and provides two corresponding outputs. The configuration for an output is an On-Day and an On-Time and an Off-Day and an Off-Time.

The Real Time Clock also provides the time stamping in the AlarmLog (see "Alarm Log" on page 128).

The day options supported are:

Day Option	Description
Never	Disables the output feature
Monday	Output will only be available on a Monday
Tuesday	Output will only be available on a Tuesday
Wednesday	Output will only be available on a Wednesday
Thursday	Output will only be available on a Thursday
Friday	Output will only be available on a Friday
Saturday	Output will only be available on a Saturday
Sunday	Output will only be available on a Sunday
Mon-Fri	Output will only be available between Monday to Friday
Mon-Sat	Output will only be available on between Monday to Saturday
Sat-Sun	Output will only be available on between Saturday to Sunday
Everyday	Output always available

For example, it is possible to configure an output to be activated at 07:30 on Monday and deactivated at 17:15 on Friday.

The output from the Real Time Clock outputs may be used to place the instrument in standby or to sequence a batch process.

The Real Time Clock function will set/clear the outputs only at the configured time. Therefore it is possible to override the outputs manually, by editing the output to On/Off between output activations.

The Real Time Clock does not display date or year.

Real Time Clock Parameters

Folder – RTClock		Sub Folders: None			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Mode	This parameter can be used to set the clock	Running	Normal operation	Stopped	Oper
		Edit	Allows the clock to be set		
		Stopped	Clock stopped (extends battery life)		
Day	Displays the day or allows the day to be set when in Edit mode	Monday to Sunday			Oper
Time	Displays the time or allows the time to be set when in Edit mode	00:00:00 to 23:59:59			Oper
On Day1 On Day2	Days when output 1 and 2 are activated	See table above			Oper
On Time1 On Time2	Time of day when output 1 and 2 are activated	00:00:00 to 23:59:59			Oper
Off Day1 Off Day2	Days when output 1 and 2 are de-activated	See table above			Oper
Off Time1 Off Time2	Time of day when output 1 and 2 are de-activated	00:00:00 to 23:59:59			Oper
Out1 Out2	Output 1 and 2	Off	Output not activated		Oper
		On	Output activated		

Applications

Humidity

Overview

Humidity (and altitude) control is a standard feature of the Mini8 controller. In these applications the controller may be configured to generate a setpoint profile (see "Setpoint Programmer" on page 238).

Also the controller may be configured to measure humidity using either the traditional Wet/Dry bulb method or it may be interfaced to a solid state sensor.

The controller output may be configured to turn a refrigeration compressor on and off, operate a bypass valve, and possibly operate two stages of heating and/or cooling.

Temperature Control of an Environmental Chamber

The temperature of an environmental chamber is controlled as a single loop with two control outputs. The heating output time proportions electric heaters, usually via a solid state relay. The cooling output operates a refrigerant valve which introduces cooling into the chamber. The controller automatically calculates when heating or cooling is required.

Humidity Control of an Environmental Chamber

Humidity in a chamber is controlled by adding or removing water vapour. Like the temperature control loop two control outputs are required, i.e. Humidify and Dehumidify.

To humidify the chamber, water vapour may be added by a boiler, an evaporating pan or by direct injection of atomized water.

If a boiler is being used, adding steam increases the humidity level. The humidify output from the controller regulates the amount of steam from the boiler that is allowed into the chamber.

An evaporating pan is a pan of water warmed by a heater. The humidify output from the controller humidity regulates the temperature of the water.

An atomization system uses compressed air to spray water vapour directly into the chamber. The humidify output of the controller turns on or off a solenoid valve.

Dehumidification may be accomplished by using the same compressor used for cooling the chamber. The dehumidify output from the controller may control a separate control valve connected to a set of heat exchanger coils.

Humidity Parameters

List Folder – Humidity		Sub-folder: None			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Resolution	Resolution of the relative humidity	XXXXX XXXX.X XXX.XX XX.XXX X.XXXX			Conf
Psychro Const	The psychrometric constant at a given pressure (6.66E-4 at standard atmospheric pressure). The value is dependent on the speed of air-flow across the wet bulb, and hence the rate of evaporation. 6.66E-4 is for the ASSMANN ventilated Psychrometer.	0.0 to 10.0		6.66	Oper
Pressure	Atmospheric Pressure	0.0 to 2000.0		1013.0 mbar	Oper
WetTemp	Wet Bulb Temperature	Range units			
WetOffset	Wet bulb temperature offset	-100.0 to 100.0		0.0	Oper
DryTemp	Dry Bulb Temperature	Range units			
RelHumid	Relative Humidity is the ratio of actual water vapour pressure (AVP) to the saturated water vapour pressure (SVP) at a particular temperature and pressure	0.0 to 100.0		100	Read Only
DewPoint	The dew point is the temperature to which air would need to cool (at constant pressure and water vapour content) in order to reach saturation	-999.9 to 999.9			Read Only
Sbrk	Indicates that one of the probes is broken.	No Yes	No sensor break detection Sensor break detection enabled		Conf

Zirconia (Carbon Potential) Control

A Mini8 Controller has a Zirconia function block which may be used to control Carbon potential. The controller is often a programmer which generates carbon potential profiles. In this section it is assumed that a programmer is used.

Calculation of PV: The Process Variable can be Carbon Potential, Dewpoint or Oxygen concentration. The PV is derived from the probe temperature input, the probe mV input and remote gas reference input values. Various probe makes are supported. In the Mini8 Controller Carbon Potential and Dewpoint can be displayed together.

The following definitions may be useful:

Temperature Control

The sensor input of the temperature loop may come from the Zirconia probe but it is common for a separate thermocouple to be used. The controller provides a heating output which may be connected to gas burners or thyristors to control electrical heating elements. In some applications a cooling output may also be connected to a circulation fan or exhaust damper.

Carbon Potential Control

The Zirconia probe generates a millivolt signal based on the ratio of oxygen concentrations on the reference side of the probe (outside the furnace) to the amount of oxygen in the furnace.

The controller uses the temperature and carbon potential signals to calculate the actual percentage of carbon in the furnace. This second loop generally has two outputs. One output is connected to a valve which controls the amount of an enrichment gas supplied to the furnace. The second output controls the level of dilution air.

Sooting Alarm

In addition to other alarms which may be detected by the controller, the Mini8 Controller can trigger an alarm when the atmospheric conditions are such that carbon will be deposited as soot on all surfaces inside the furnace. The alarm may be connected to an output (e.g. relay) to initiate an external alarm.

Automatic Probe Cleaning

The Zirconia function block has a probe clean and recovery strategy that can be programmed to occur between batches or which can be manually requested. At the start of the cleaning process a 'snapshot' of the probe mV is taken, and a short blast of compressed air is used to remove any soot and other particles that may have accumulated on the probe. A minimum and maximum cleaning time can be set by the user. If the probe mV has not recovered to within 5% of the snapshot value within the maximum recovery time set then an alarm is given. This indicates that the probe is ageing and replacement or refurbishment is due. During the cleaning and recovery cycle the PV is frozen, thereby maintaining continuous furnace operation. A flag 'PvFrozen' is set which can be used in an individual strategy, for example to hold the integral action during cleaning.

Endothermic Gas Correction

A gas analyzer may be used to determine the CO concentration of the endothermic gas. If a 4-20mA output is available from the analyzer, it can be fed into the Mini8 Controller to automatically adjust the calculated % carbon reading. Alternatively, this value can be entered manually.

Clean Probe

As these sensors are used in furnace environments they require regular cleaning. Cleaning (Burn Off) is performed by forcing compressed air through the probe. Cleaning can be initiated either manually or automatically using a timed period. During cleaning the PV output is frozen.

Probe Status

After cleaning an alarm output, MinCalcT, is generated if the PV does not return to 95% of its previous value within a specified time. This indicates that the probe is deteriorating and should be replaced.

Zirconia Parameters

Folder - Zirconia		Sub-folders: None			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Probe Type	Configures the type of probe to be used	Drayton	Drayton		Oper
		Accucarb	Accucarb		
		SSI	SSI		
		MacDhui	MacDhui		
		%O2	Oxygen		
		LogO2	Log Oxygen		
		BoschO2	Bosch Oxygen		
		ZircoDew	Dewpoint.		
		ProbeMV	Probe mV		
		BoschCarb	Bosch Carbon		
		BarberC	Barber-Colman		
		MMICarb	MMI Carbon		
		AACC	AACC		
Resolution	Resolution of the calculated result	X		X	Oper
		X.X			
		X.XXX			
		X.XXX			
		X.XXXX			
Parameters shown in shaded rows below are not applicable to O2 probes					
GasRef	Gas reference value	-9999.9 to 9999.9		20.0	Oper
RemGasRef	Remote gas reference value	-9999.9 to 9999.9		0.0	Oper
RemGasEn	Enable the remote gas reference. This can be an internal value from the user interface or from an external source	0	Internal	0	Oper
		1	External		
MinCalTemp	Minimum calculation temperature	-99999 to 99999		720	Oper
OxygenExp	The exponent units of the log oxygen type calculation				
Tolerance	Tolerance of the sooting	-9999.9 to 9999.9		1.0	Oper
CleanFreq	Frequency of the cleaning process	0:00:00 to 99:59:59 or 100:00 to 500:00		4:00:00	Oper
CleanTime	Sets the duration of the clean	0:00:00 to 99:59:59 or 100:00 to 500:00		0:00:00	Oper
MinRcovTime	Minimum recovery time after purging	0:00:00 to 99:59:59 or 100:00 to 500:00		0:00:00	Oper
MaxRcovTime	Maximum recovery time after purging	0:00:00 to 99:59:59 or 100:00 to 500:00		0:10:00	Oper
TempInput	Zirconia probe temperature input value	Temp range			Oper
TempOffset	Sets a temperature offset for the probe	-99999 to 99999		0	Oper
ProbeInput	Zirconia probe mV input				Oper
ProbeOffset	Zirconia probe mV offset	-99999 to 99999		0	Oper
Oxygen	Calculated oxygen			0	
CarbonPot	Calculated carbon potential			0	Read Only
DewPoint	Zirconia control process value. The O2 or dew point value derived from temperature and remote gas reference inputs			0	Read Only
SootAlm	Probe sooting alarm output	No	No alarm output	No	Read Only
		Yes	In alarm		
ProbeFault	Probe issue	No		No	Oper
		Yes			
PvFrozen	This is a Boolean which freezes the PV during a purging cycle. It may have been wired, for example, to disable control output during purging	No		No	Read Only
		Yes			

Folder - Zirconia		Sub-folders: None			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
CleanValve	Enable the clean valve.	No Yes		No	Read Only
CleanState	The burn off state of the Zirconia probe	Waiting Cleaning Recovering			Read Only
CleanProbe	Enable clean probe. This may be wired to initiate automatically or if un-wired can be set by the user	No Yes	Do not clean probe Initiate probe clean	No	Oper
Time2Clean	Time to next clean.	0:00:00 to 99:59:59 or 100:00 to 500:00		0	Read Only
ProbeStatus	Indicates the status of the probe.	OK mVSbr TempSbr MinCalcT	Normal working Probe input in sensor break Temperature input in sensor break Probe deteriorating		Read Only

Input Monitor

Description

There are two Input monitors. Each input monitor may be wired to any variable in the controller. It then provides three functions:

- Maximum detect

- Minimum detect

- Time above threshold

Maximum Detect

This function continuously monitors the input value. If the value is higher than the previously recorded maximum, it becomes the new maximum.

This value is retained following a power interruption.

Minimum Detect

This function continuously monitors the input value. If the value is lower than the previously recorded minimum, it becomes the new minimum.

This value is retained following a power interruption.

Time Above Threshold

This function increments a timer whenever the input is above a threshold value. If the timer exceeds 24 hours per day, a counter is incremented. The maximum number of days is limited to 255. A time alarm can be set on the timer so that once the input has been above a threshold for a period, an alarm output is given.

Applications include:

- Service interval alarms. This sets an output when the system has been running for a number of days (up to 255 days).

- Material stress alarms - if the process cannot tolerate being above a level for a period. This is a style of 'policeman' for processes where the high operating point reduces the life of the machine.

- In internal wiring applications in the controller.

Input Monitor Parameters

Folder - IPMonitor		Sub-Folders: 1 or 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
In	The input value to be monitored.	May be wired to an input source. The range will depend on the source.			Oper Read Only if wired
Max	The maximum measured value recorded since the last reset.	As above			Read Only
Min	The minimum measured value recorded since the last reset.	As above			Read Only
Threshold	The input timer accumulates the time the input PV spends above this trigger value.	As above			Oper
Days Above	Accumulated days the input has spent above threshold since the last reset.	Days is an integer count of the 24 hour periods only. The Days value should be combined with the Time value to make the total time above threshold.			Read Only
Time Above	Accumulated time above the 'Threshold' since last reset.	The time value accumulates from 00:00.0 to 23:59.9. Overflows are added to the days value.			Read Only
AlarmDays	Days threshold for the monitors time alarm. Used in combination with the Alarm Time parameter. The 'Out' is set to true if the inputs accumulated time above threshold is higher than the timer high parameters.	0 to 255		0	Oper
AlarmTime	Time threshold for the monitors time alarm. Used in combination with the Alarm Days parameter. The 'Out' is set to true if the inputs accumulated time above threshold is higher than the timer high parameters.	0:00.0 to 99:59:59		0:00.0	Oper
Out	Set true if the accumulated time that the input spends above the trigger value is higher than the alarm threshold.	Off On	Normal operation Time above setpoint exceeded		Read Only
Reset	Resets the Max and Min values and resets the time above threshold to zero.	No Yes	Normal operation Reset values	No	Oper
In Status	Monitors the status of the input.	Good Bad	Normal operation The input may be incorrectly wired		Read Only Oper

Logic and Maths Operators

Logic Operators

Logic Operators allow the controller to perform logical calculations on two input values. These values can be sourced from any available parameter including Analog Values, User Values and Digital Values.

The parameters to use, the type of calculation to be performed, use of logical NOT on the input value and 'fallback' value are determined in Configuration level.

There are 24 separate calculations – they do not have to be in sequence. When logic operators are enabled a Folder 'Lgc2' exists where the '2' denotes two input logic operators.
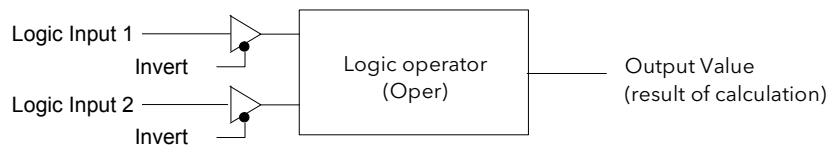
Figure 108 Two-Input Logic Operators

Logic Operators are found under the folder 'Lgc2'. Note that the logic operators can also be enable by dragging a block onto the graphical wiring screen in iTools.

Logic 8

Logic 8 operators can perform logic calculations on up to eight inputs. The calculations are limited to AND, OR, and XOR. Up to two eight-input operators can be enabled. The folder is labeled 'Lgc8' to denote eight-input logic operators.
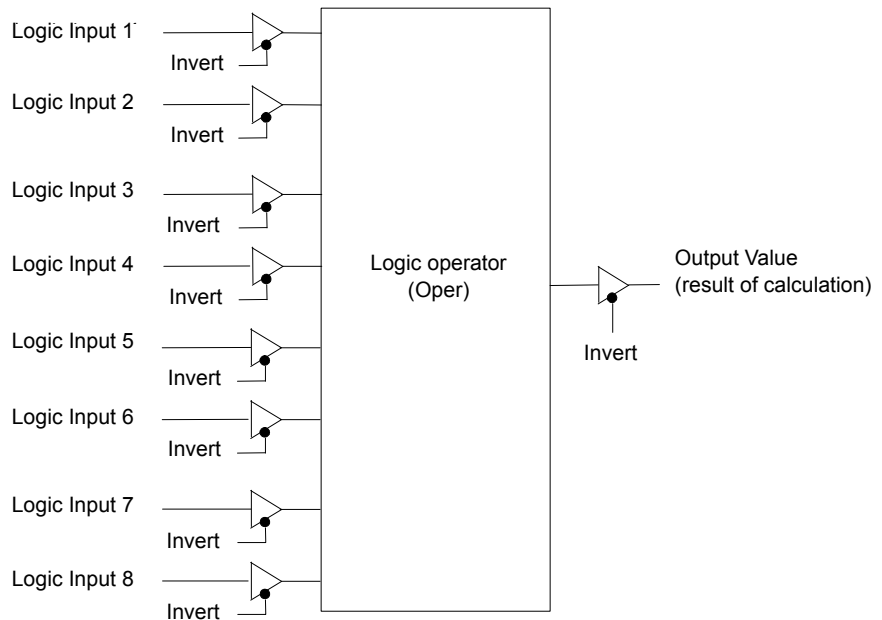
Figure 109 Eight-Input Logic Operators

Two-input Logic Operations

The following calculations can be performed:

Oper	Operator description	Input 1	Input 2	Output Invert = None
0: OFF	The selected logic operator is turned off			
1: AND	The output result is ON when both Input 1 and Input 2 are ON	0	0	Off
		1	0	Off
		0	1	Off
		1	1	On
2: OR	The output result is ON when either Input 1 or Input 2 is ON	0	0	Off
		1	0	On
		0	1	On
		1	1	On
3: XOR	Exclusive OR. The output result is true when one and only one input is ON. If both inputs are ON the output is OFF.	0	0	Off
		1	0	On
		0	1	On
		1	1	Off
4: Latch	Input 1 sets the latch, Input 2 resets the latch.	0	0	
		1	0	
		0	1	
		1	1	
5: Equal (==)	The output result is ON when Input 1 = Input 2	0	0	On
		1	0	Off
		0	1	Off
		1	1	On
6: Not equal (<>)	The output result is ON when Input 1 does not equal Input 2	0	0	Off
		1	0	On
		0	1	On
		1	1	Off
7: Greater than (>)	The output result is ON when Input 1 > Input 2	0	0	Off
		1	0	On
		0	1	Off
		1	1	Off
8: Less than (<)	The output result is ON when Input 1 < Input 2	0	0	Off
		1	0	Off
		0	1	On
		1	1	Off
9: Equal to or Greater than (=>)	The output result is ON when Input 1 $\geq$ Input 2	0	0	On
		1	0	On
		0	1	Off
		1	1	On
10: Less than or Equal to (<=)	The output result is ON when Input 1 $\leq$ Input 2	0	0	On
		1	0	Off
		0	1	On
		1	1	On

Notes:

1. The numerical value is the value of the enumeration.

2. For options 1 to 4 an input value of less than 0.5 is considered FALSE and greater than or equal to 0.5 as TRUE.

Logic Operator Parameters

Folder – Lgc2 (2 Input Operators)		Sub-Folders: 1 to 24			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Oper	To select the type of operator	See previous table		None	Conf
In1	Input 1	Normally wired to a logic, analog or user value. May be set to a constant value if not wired.		0	Oper
In2	Input 2				
FallbackType	The fallback state of the output if one or both of the inputs is bad	0: FalseBad	The output value is FALSE and the status is BAD.		Conf
		1: TrueBad	The output value is TRUE and the status is BAD		
		2: FalseGood	The output value is FALSE and the status is GOOD		
		3: TrueGood	The output value is TRUE and the status is GOOD.		
Invert	The sense of the input value, may be used to invert one or both of the inputs	0: None	Neither input inverted		Conf
		1: Input1	Invert input 1		
		2: Input2	Invert input 2		
		3: Both	Invert both inputs		
Out	The output from the operation is a boolean (true/false) value.	On	Output activated		Read Only
		Off	Output not activated		
Status	The status of the result value	Good			Read Only
		Bad			

Eight-Input Logic Operators

The eight-input logic operator may be used to perform the following operations on eight inputs.

Oper	Operator description
0: OFF	The selected logic operator is turned off
1: AND	The output result is ON when ALL eight inputs are ON
2: OR	The output result is ON when one or more of the eight inputs are ON
3: XOR	Exclusive OR – the output is true if an odd number of inputs are true. $(In1 \oplus In2) \oplus (In3 \oplus In4) \oplus (In5 \oplus In6) \oplus (In7 \oplus In8)$

Eight Input Logic Operator Parameters

Folder – Lgc8 (8 Input Operators)		Sub-Folders: 1 to 4			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Oper	To select the type of operator	0: OFF 1: AND 2: OR 3: XOR	Operator turned off Output ON when all inputs are ON Output ON when one input is ON Exclusive OR	OFF	Conf
NumIn	This parameter is used to configure the number of inputs for the operation	1 to 8		2	Conf
InInvert	Used to invert selected inputs prior to operation. This is a status word with one bit per input, the left hand bit inverts input 1.	The invert parameter is interpreted as a bitfield where: 1 (0x1) - input 1 2 (0x2) - input 2 4 (0x4) - input 3 8 (0x8) - input 4 16 (0x10) - input 5 32 (0x20) - input 6 64 (0x40)- input 7 128 (0x80)- input 8 (e.g. 255 = all eight)		0	Oper
Out Invert	Invert the output	No Yes	Output not inverted Output inverted	No	Oper
In1 to In8	Input state 1 to 8	Normally wired to a logic, analog or user value. When wired to a floating point, values less than or equal to –0.5 or greater than or equal to 1.5 will be rejected (e.g. the value of the lgc8 block will not change). Values between –0.5 and 1.5 will be interpreted as ON when greater than or equal to 0.5 and OFF when less than 0.5. May be set to a constant value if not wired.		Off	Oper
Out	Output result of the operator	On Off	Output activated Output not activated		Read Only

Maths Operators

Maths Operators (sometimes known as Analog Operators) allow the controller to perform mathematical operations on two input values. These values can be sourced from any available parameter including Analog Values, User Values and Digital Values. Each input value can be scaled using a multiplying factor or scalar.

The parameters to use, the type of calculation to be performed and the acceptable limits of the calculation are determined in Configuration level. In normal operation the values of each of the scalars may be changed via communications or iTools.

There are 24 separate calculations – they do not have to be in sequence. When maths operators are enabled (in Instrument/Options folder) a Folder 'Math2' exists (where the '2' denotes two-input maths operators).
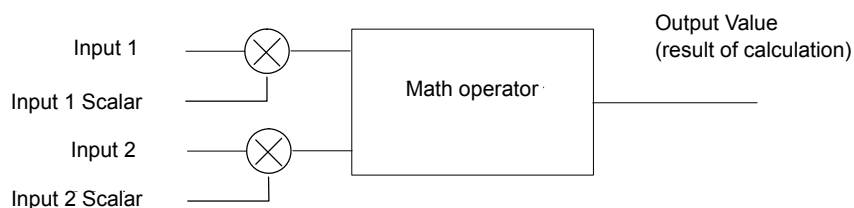
Figure 110 Two-Input Math Operators

Eight-input multiplexers are also available and are described in "Eight-Input Analog Multiplexers" on page 198.

Math Operations

The following operations can be performed:

0: Off	The selected analog operator is turned off
1: Add	The output result is the addition of Input 1 and Input 2
2: Subtract (Sub)	The output result is the difference between Input 1 and Input 2 where Input 1 > Input 2
3: Multiply (Mul)	The output result is the Input 1 multiplied by Input 2
4: Divide (Div)	The output result is Input 1 divided by Input 2
5: Absolute Difference (AbsDif)	The output result is the absolute difference between Input 1 and 2
6: Select Max (SelMax)	The output result is the maximum of Input 1 and Input 2
7: Select Min (SelMin)	The output result is the minimum of Input 1 and Input 2
8: Hot Swap (HotSwp)	Input 1 appears at the output provided input 1 is 'good'. If input 1 is 'bad' then input 2 value will appear at the output. An example of a bad input occurs during a sensor break condition.
9: Sample and Hold (SmpHld)	Normally input 1 will be an analog value and input B will be digital. The output tracks input 1 when input 2 = 1 (Sample). The output will remain at the current value when input 2 = 0 (Hold). If input 2 is an analog value then any non zero value will be interpreted as 'Sample'.
10: Power	The output is the value at input 1 raised to the power of the value at input 2. I.e. input $1^{input\ 2}$
11: Square Root (Sqrt)	The output result is the square root of Input 1. Input 2 has no effect.
12: Log	The output is the logarithm (base 10) of Input 1. Input 2 has no effect
13: Ln	The output is the logarithm (base n) of Input 1. Input 2 has no effect
14: Exp	The output result is the exponential of Input 1. Input 2 has no effect
15: 10 x	The output result is 10 raised to the power of Input 1 value. I.e. $10^{input\ 1}$. Input 2 has no effect
51: Select	Select input is used to control which Analog Input is switched to the output of the Analog Operator. If the select input is true input 2 is switched through to the output. If false input 1 is switched through to the output. See example below: Select input An input 1 → Select Logic 1 → If Select Input = 1, then An input 2 is selected An input 2 → If Select Input = 0, then An input 1 is selected An Op 1

When Boolean parameters are used as inputs to analog wiring, they will be cast to 0.0 or 1.0 as appropriate. Values <= -0.5 or >= 1.5 will not be wired. This provides a way to stop a Boolean updating. Analog wiring (whether simple re-routing or involving calculations) will always output a real type result, whether the inputs were booleans, integers or reals.

Note: The numerical value is the value of the enumeration.

Math Operator Parameters

Folder – Math2 (2 Input Operators)		Sub-Folders: 1 to 24			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Oper	To select the type of operator	See previous table		None	Conf
In1Mul	Scaling factor on input 1	Limited to max float*		1.0	Oper
In2 Mul	Scaling factor on input 2	Limited to max float*		1.0	Oper
Units	Units applicable to the output value	None AbsTemp V, mV, A, mA, PH, mmHg, psi, Bar, mBar, %RH, %, mmWG, inWG, inWW, Ohms, PSIG, %O2, PPM, %CO2, %CP, %/sec, RelTemp mBar/Pa/T sec, min, hrs,		None	Conf
Resolution	Resolution of the output value	XXXXX. XXXX.X, XXX.XX, XX.XXX, X.XXXX			Conf
LowLimit	To apply a low limit to the output	Max float* to High limit (decimal point depends on resolution)			Conf
HighLimit	To apply a high limit to the output	Low limit to Max float* (decimal point depends on resolution)			Conf
Fallback	The state of the Output and Status parameters in case of a detected fault condition. This parameter could be used in conjunction with fallback value	Clip Bad Clip Good Fall Bad Fall Good Upscale DownScale	Descriptions, see "Fallback" on page 103		Conf
Fallback Val	Defines (in accordance with Fallback) the output value during detected fault conditions.	Limited to max float* (decimal point depends on resolution)			Conf
In1	Input 1 value (normally wired to an input source – could be a User Value)	Limited to max float* (decimal point depends on resolution)			Oper
In2	Input 2 value (normally wired to an input source – could be a User Value)	Limited to max float* (decimal point depends on resolution)			Oper
Out	Indicates the analog value of the output	Between high and low limits			Read Only
Status	This parameter is used in conjunction with Fallback to indicate the status of the operation. Typically, status is used to flag detected fault conditions and may be used as an interlock for other operations.	Good Bad			Read Only

* Max float in this instrument is ±9,999,999,999

Sample and Hold Operation

The diagram below shows the operation of the sample and hold feature.
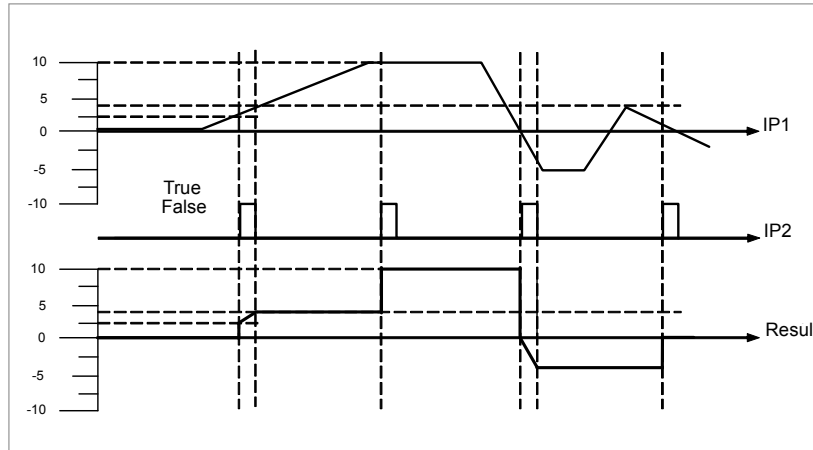
Figure 111 Sample and Hold

Multiple Input Operator Block

The Multiple Input Operator Block simultaneously outputs the Sum, Average, Minimum and Maximum values of up to eight valid inputs. The outputs will be clipped to user-defined limits or be replaced by a fallback value based on the selected fallback strategy.
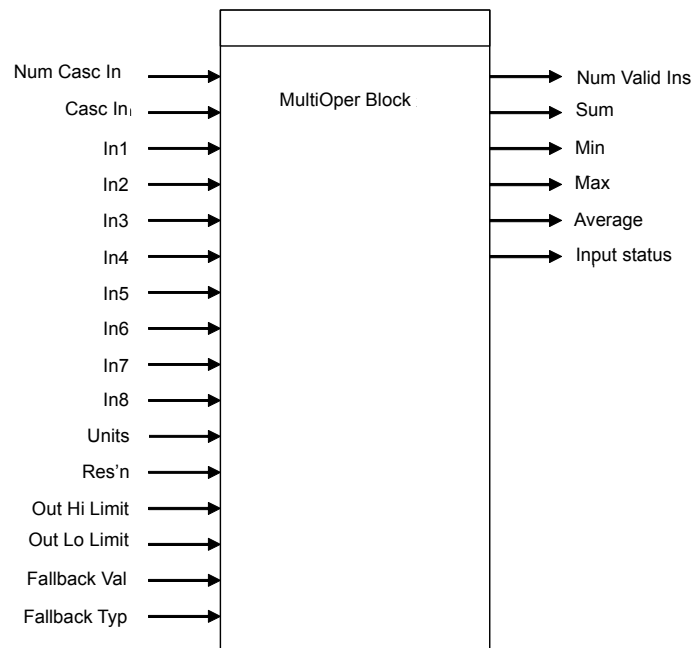
Figure 112 Multi Operator Function Block

'Num In' determines the number of inputs made available for use. This is settable by the user and is defaulted to two. Be careful not to set this number to a value higher than the desired number of inputs as any unused inputs are seen as valid inputs to the block (zero value by default). Num Casc In and Casc In will always be available.

'Input Status' gives an indication of the status of the inputs in priority order. Casc In has the highest priority, In1 the next highest up to In8 the lowest. If more than one input is bad then the input with the highest priority is shown as 'bad'. When the highest priority bad status is cleared the next highest priority bad status is shown. When all inputs are OK a status of OK is shown.

'Number of valid inputs' provides a count of the number of inputs used to perform the calculation within the block. This is required for cascaded operation and is detailed below.

Cascaded Operation

Multiple input operator blocks may be cascaded to allow operations on more than eight inputs (33 max for four instances of the block). Figure 113 shows how two blocks should be configured to find the average of more than eight inputs. If required the second block could then be cascaded to a third to provide up to eight more inputs.
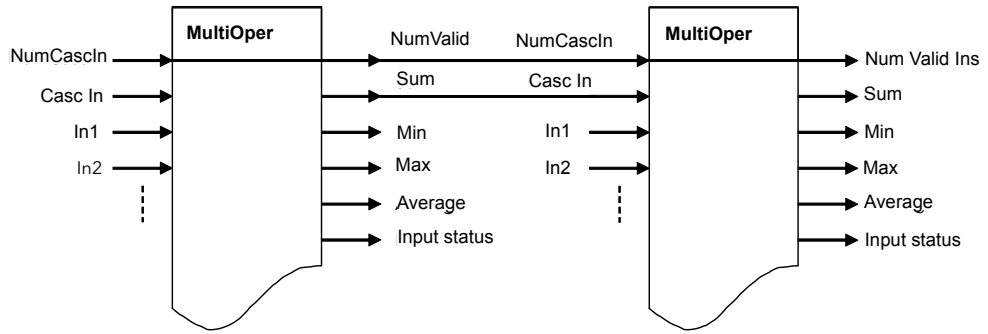
Figure 113 Cascaded Multi Operator Function Blocks

If 'CascIn' is has Good status, and 'NumCascIn' is not equal to zero we can assume that the block is in cascade and these values are used for calculations within the block, and the value given by 'NumCascIn' is added to 'NumValidIns'. When in cascade the sum, min, max and average outputs treat Casc In as an additional input to the block. For example if Casc In is greater than any number on the rest of the inputs then its value will be output as the max.

Fallback Strategy

The user is able to select the fallback strategy during configuration. The options are:

Clip Good

• The status of the outputs is always good.

• If an output is out of range then it is clipped to limits.

• If all inputs are bad, all outputs = 0 (Or clipped to limits if 0 is not within the output range).

Clip Bad

• The status of all outputs is bad if one or more of the inputs are bad.

• If an output is out of range then it is clipped to limits and the status of that output is set to bad.

• If all inputs are bad, all outputs = 0 and all status' are set to bad (or clipped to limits if 0 is not within the output range).

Fall Good

• The status of the outputs is always good.

- If an output is out of range then it is set to the fallback value.

- If all inputs are bad, all outputs = fallback value.

Fall Bad

- The status of all outputs is bad if one or more of the inputs are bad.

- If an output is out of range then it is set to the fallback value and the status is set to bad.

- If all inputs are bad, all outputs are set to the fallback value and all statuses are set to bad.

Multiple Input Operator Block Parameters

Folder – MultiOper (Multi Operator)		Sub-folders: 1 to 4			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
NumIn	Number of inputs selected to use.	2 to 8		2	Conf
CascNumIn	Number of cascaded inputs from the previous block	0 to 255		0	Read Only
CascIn	The cascaded input from a previous block	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only
In 1 to In 8	Input 1	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only
Units	Selected units for the I/O	Unit8 (nvol)		None	Conf
Resolution	Selected resolution of the Outputs	X to X.XXX		X	Conf
OutHi Limit	Upper limit of the outputs.	-99999 to 99999 (decimal point depends on Resolution). Minimum setting is limited by 'OutLoLimit'.		0	Conf
OutLo Limit	Lower limit of the outputs.	-99999 to 99999 (decimal point depends on Resolution). Maximum setting is limited by 'OutHiLimit'.		0	Conf
Fallback Val	Value to be output depending on Input status and fallback type selected.	-99999 to 99999 (decimal point depends on Resolution)		0	Conf
Fallback Typ	Fallback Type selected.	Clip Bad Clip Good Fall Bad Fall Good Upscale DownScale	See "Fallback Strategy" on page 196.	Clip Good	Conf
NumValidIn	Number of inputs used in the calculated outputs (Output)	2 to 8		0	Read Only
Sum Out	Sum of the valid inputs (Output)	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only
Max Out	Maximum value of the valid inputs (Output)	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only
Min Out	Minimum value of the valid inputs (Output)	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only
Average Out	Average value of the valid inputs (Output)	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only
Input Status	Status of the inputs (Output)	-99999 to 99999 (decimal point depends on Resolution)		0	Read Only

Eight-Input Analog Multiplexers

The eight-input analog multiplexers may be used to switch one of eight inputs to an output. It is usual to wire inputs to a source within the controller that selects that input at the appropriate time or event.

Multiple Input Operator Parameters

Folder – Mux8 (8 Input Multiplexers)		Sub-folders: 1 to 4			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
LowLimit	The low limit for all inputs and the fall back value.	-99999 to High limit (decimal point depends on resolution)			Conf
HighLimit	The high limit for all inputs and the fall back value.	Low limit to 99999 (decimal point depends on resolution)			Conf
Fallback	The state of the Output and Status parameters in case of a detected fault condition. This parameter could be used in conjunction with Fallback Val.	Clip Bad Clip Good Fall Bad Fall Good Upscale DownScale	Descriptions see "Fallback Strategy" on page 196.		Conf
Fallback Val	Used (in accordance with Fallback) to define the output value during detected fault conditions	-99999 to 99999 (decimal point depends on resolution)			Conf
Select	Used to select which input value is assigned to the output.	Input1 to Input8			Oper
In1 to 8	Input values (normally wired to an input source)	-99999 to 99999 (decimal point depends on resolution)			Oper
Out	Indicates the analog value of the output	Between high and low limits			Read Only
Status	Used in conjunction with Fallback to indicate the status of the operation. Typically, status is used to flag detected fault conditions and may be used as an interlock for other operations.	Good Bad			Read Only

Fallback

The fallback strategy will come into effect if the status of the input value is bad or if the input value is outside the range of Input Hi and Input Lo.

In this case the fallback strategy may be configured as:

Fall Good   If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the 'Fallback' value, and the 'Status' is set to 'Good'.

Fall Bad   If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the 'Fallback' value, and the 'Status' is set to 'Bad'.

Clip Good   If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and 'Status' is set to 'Bad'. If the input signal is within the limits, but its status is bad, the output is set to the 'Fallback' value.

Clip Bad   If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and 'Status' is set to 'Good'. If the input signal is within the limits, but its status is bad, the output is set to the 'Fallback' value.

Upscale   If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the 'High Limit'.

Downscale   If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the 'Low Limit'.

Input Characterization

Input Linearization

The Lin16 function block converts an input signal into an output PV using a series of up to 15 straight lines to characterize the conversion.

The function block provides the following behavior.

- The Input values must be monotonic and constantly rising.

- To convert the MV to the PV, the algorithm will search the table of inputs until the matching segment is found. Once found, the points either side will be used to interpolate the output value.

- If during the search, a point is found which is not above the previous (below for inverted) then the search will be terminated and the segment taken from the last good point to the extreme (In Hi-Out Hi) see following diagram.
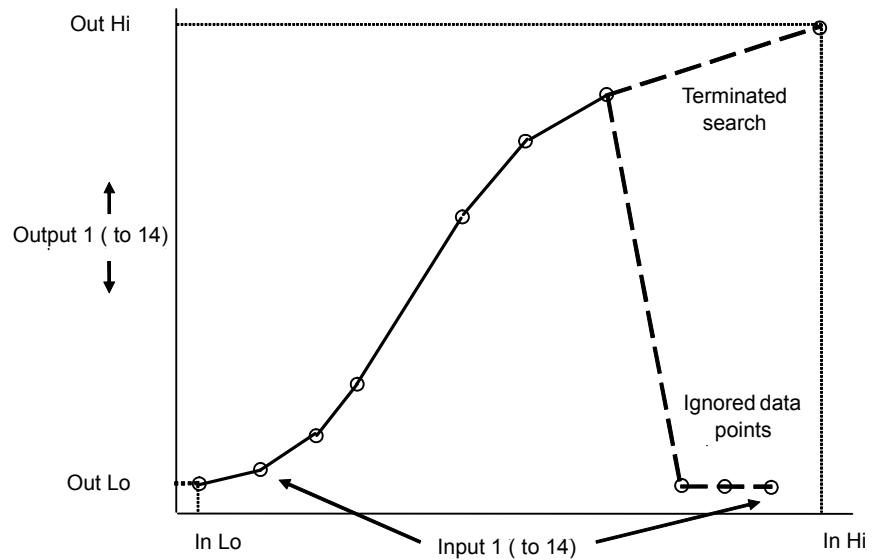
Figure 114 Linearization Example

Notes:

1. The linearization block works on rising inputs/rising outputs or rising inputs/falling outputs. It is not suitable for outputs which rise and fall on the same curve.

2. Input Lo/Output Lo and Input Hi/Output Hi are entered first to define the low and high points of the curve. It is not necessary to define all 15 intermediate points if the accuracy is not required. Points not defined will be ignored and a straight line fit will apply between the last point defined and the Input Hi/Output Hi point. If the input source has a bad status (sensor break, or over-range) then the output value will also have a bad status.
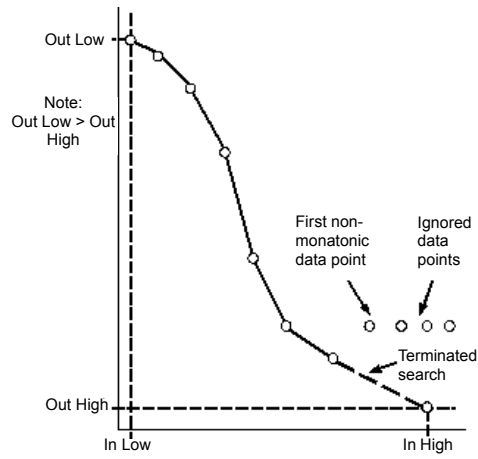
Figure 115 How an Inverted Curve will Terminate its search when it detects non-monatonic data

- If the input value is outside the translated range then the output status will indicate Bad, and the value will be limited to the nearest output limit.

- The units and resolution parameters will be used for the output values. The input values resolution and units will be specified by the source of the wire.

- If the 'Out Low' is higher than the 'Out High' then the translation will be inverted.

Compensation for Sensor Non-Linearities

The custom linearization feature can also be used to compensate for deviations in the sensor or measurement system. The intermediate points are, therefore, available in Level 1 so that known discontinuities in the curve can be calibrated out. The diagram below shows an example of the type of discontinuity which can occur in the linearization of a temperature sensor.
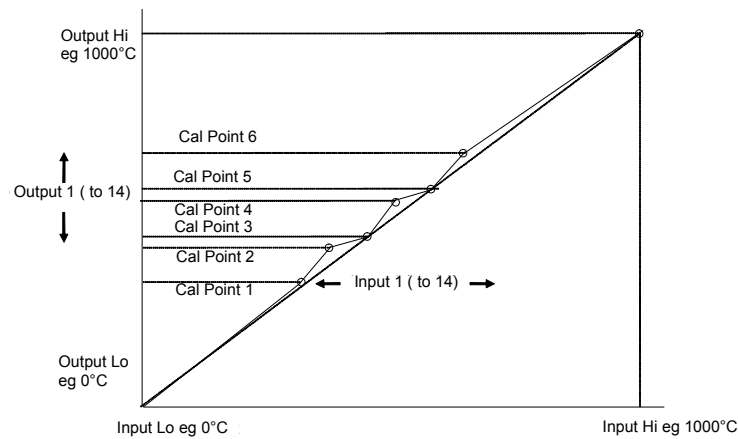
Figure 116 Compensation for Sensor Discontinuities

The calibration of the sensor uses the same procedure as described above. Adjust the output (displayed) value against the corresponding input value to compensate for any deviations in the standard linearization of the sensor.

Note: Do not exceed the range of the instrument when choosing the compensation range. For example, whereas type K tables show mV values up to -270°C (-454°F) the instrument range is limited to -200°C (-328°F) so that mis-readings may occur in the mid range if -200°C (-328°F) is exceeded.

Input Linearization Parameters

List Folder – Lin16		Sub-folders: 1 to 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Units	Units of the linearized output	None AbsTemp V, mV, A, mA, PH, mmHg, psi, Bar, mBar, %RH, %, mmWG, inWG, inWW, Ohms, PSIG, %O2, PPM, %CO2, %CP, %/sec, RelTemp mBar/Pa/T sec, min, hrs,			Conf
Resolution	Resolution of the output value	XXXXX. XXXX.X, XXX.XX, XX.XXX, X.XXXX			Conf
In	Input measurement to linearize. Wire to the source for the custom linearization	Between InLowLimit and InHighLimit		0	Oper
FallbackType	Fallback Type The fallback strategy will come into effect if the status of the input value is bad or if the input value is outside the range of input high scale and input low scale. In this case the fallback strategy may be configured as shown:	Clip Bad	If the input is outside a limit the output will be clipped to the limit and the status will be BAD	ClipBad	Oper
		Clip Good	If the input is outside a limit the output will be clipped to the limit and the status will be GOOD		
		Fall Bad	The output value will be the fallback value and the output status will be BAD		
		Fall Good	The output value will be the fallback value and the output status will be GOOD		
		Upscale	The output value will be output high scale and the output status will be BAD		
		DownScale	The output value will be the output low scale and the output status will be BAD		
Fallback Value	In the event of a bad status, the output may be configured to adopt the fallback value. This allows the strategy to dictate a 'safe' output in the event of a detected fault.			0	Oper
Out	Linearization Result	Between OutLowLimit and OutHighLimit			Read Only
InLowLimit	Adjust to the low input value	-99999 to InHighLimit		0	Conf
OutLowLimit	Adjust to correspond to the low input value	-99999 to OutHighLimit		0	Conf
InHighLimit	Adjust to the high input value	InLowLimit to 99999		0	Conf
OutHighLimit	Adjust to correspond to the high input value	OutLowLimit to 99999		0	Conf
In1	Adjust to the first break point			0	Oper
Out1	Adjust to correspond to input 1			0	Oper
…etc up to				0	
In14	Adjust to the last break point			0	Oper
Out14	Adjust to correspond to input 14			0	Oper
Status	Status of the block. A value of zero indicates a healthy conversion.	Good	Within operating limits		Read Only
		Bad	A bad output may be caused by a bad input signal (perhaps the input is in sensor break) or an output which is out of range		

The 16 point linearization does not require you to use all 16 points. If fewer points are required, then the curve can be terminated by setting the first unwanted value to be less than the previous point.

Conversely if the curve is a continuously decreasing one, then it may be terminated by setting the first unwanted point above the previous one.

Polynomial

Folder – Poly		Sub-Folders: 1 to 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
LinType	To select the input type. The linearization type selects which of the instruments linearization curves is applied to the input signal. The instrument contains a number of thermocouple and RTD linearizations as standard. In addition there are a number of custom linearizations that may be downloaded using iTools to provide linearizations of non-temperature sensors.	J, K, L, R, B, N, T, S, PL2, C, PT100, PT1000, Linear, SqRoot		J	Conf
Units	Units of the output	None AbsTemp V, mV, A, mA, PH, mmHg, psi, Bar, mBar, %RH, %, mmWG, inWG, inWW, Ohms, PSIG, %O2, PPM, %CO2, %CP, %/sec, RelTemp mBar/Pa/T sec, min, hrs,		None	Conf
Resolution	Resolution of the output value	XXXXX. XXXX.X, XXX.XX, XX.XXX, X.XXXX		XXXXX	Conf
In	Input Value The input to the linearization block	Range of the input wired from			Oper
Out	Output value	Between Out Low and Out High			Read Only
InHighScale	Input high scale	In Low to 99999		0	Oper
InLowScale	Input low scale	-99999 to In High		0	Oper
OutHighScale	Output high scale	Out Low to 99999		0	Oper
OutLowScale	Output low scale	-99999 to Out High		0	Oper

Folder – Poly		Sub-Folders: 1 to 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Fallback Type	Fallback Type The fallback strategy will come into effect if the status of the input value is bad or if the input value is outside the range of input high scale and input low scale. In this case the fallback strategy may be configured as:	Clip Bad	If the input is outside a limit the output will be clipped to the limit and the status will be BAD		Conf
		Clip Good	If the input is outside a limit the output will be clipped to the limit and the status will be GOOD		
		Fall Bad	The output value will be the fallback value and the output status will be BAD		
		Fall Good	The output value will be the fallback value and the output status will be GOOD		
		Upscale	The output value will be output high scale and the output status will be BAD		
		Down-Scale	The output value will be the output low scale and the output status will be BAD		

Folder – Poly		Sub-Folders: 1 to 2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
FallbackValue	Value to be adopted by the output in the event of Status = Bad				Oper
Status	Indicates the status of the linearized output:	Good	Good indicates the value is within range and the input is not in sensor break.		Read Only
		Bad	Indicates the Value is out of range or the input is in sensor break. **Note:** This is also effected by the configured fallback strategy		

Load

The load simulation block provides styles of load which can be used to allow an instrument configuration to be tested before connection to the process plant. In the current issue of firmware the simulated loads available are Oven and Furnace.

Load Parameters

Folder – Load			Sub-Folders: None			
Name	**Parameter Description**		**Value**		**Default**	**Access Level**
Type	The type of load simulation to use. Oven is a simple load of three first order lags, providing a single process value for connection to the control loop. Furnace consists of 12 interactive first order lags giving a slave PV, followed by six interactive first order lags giving a master PV.		Oven	Simulates the characteristics of a typical oven	Oven	Conf
			Furnace	Simulates the characteristics of a typical furnace		
Resolution	The display resolution of the resultant PV Out.					Conf
Units	The Units of the resultant PV.					Conf
Gain	The gain of the load, the input power is multiplied by gain, before use by the load.					Oper
TimeConst1	The time constant of lag 1 in the Oven load and slave lags (1-12) of the Furnace load. The time constant has units of seconds.					Oper
TimeConst2	The time constant of lag 2/3 of the Oven load and master lags (13-18) of the furnace load.					Oper
Attenuation (Furnace load only)	Attenuation Between PV1 and PV2 Stages. Used in the advanced furnace load and defines an attenuation factor between the slave and master lags					Oper
Ch 2 Gain	Defines the relative gain when cooling is requested, applied to the input power when the power requested is < 0.					Oper
PVFault	The load simulation function block provides two PV outputs, a simulated sensor issue can be used to generate a simulated issue condition on these PVs such that the bad status is passed along a wire to be consumed by another block such as the loop. This simulated sensor issue can be configured as:		None	No simulated issue conditions.		Oper
			PVOut1	Simulated issue on the first output.		
			PVOut2	Simulated issue on the second output.		
			Both	A simulated issue both the first and second outputs.		
PV Out1	First Process Value The PV in Process Value an Oven load or the Slave PV in a furnace load.					Read Only
PV Out2 (Furnace load only)	Second Process Value Second process value, lagged from PVOut1, used as a cascade master input. The Master PV in the Furnace load.					Read Only
LoopOutCh1	Loop output channel 1 input. The output of the loop as wired to the load simulation, this is the power requested of the load. This can be used as the heat demand.					Oper
LoopOutCh2	Loop output channel 2 input. The output of the loop as wired to the load simulation, this is the power requested of the load. This can be used as the cool demand.					Oper
Noise	Electrical Noise Added to PV This is used to make the PV of the load appear electrically noisy, and hence more like a real measurement.		Off 1 to 99999	The amount of electrical noise is specified in engineering units.	Off	Oper

Folder – Load		Sub-Folders: None		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Offset	Process offset Used to configure an offset in the process. In a temperature application this could represent the ambient operating temperature of the plant.			Oper

Control Loop Setup

The Mini8 controller has up to 16 loops of control. Each Loop has two outputs, Channel 1 and Channel 2, each of which can be configured for PID or On/Off.

The control function block is divided into a number of sections the parameters of which are all listed under the Folder 'Loop'.

The 'Loop' folder contains sub-folders for each section as shown diagrammatically below.

What is a Control Loop?

An example of a heat-only temperature control loop is shown below:
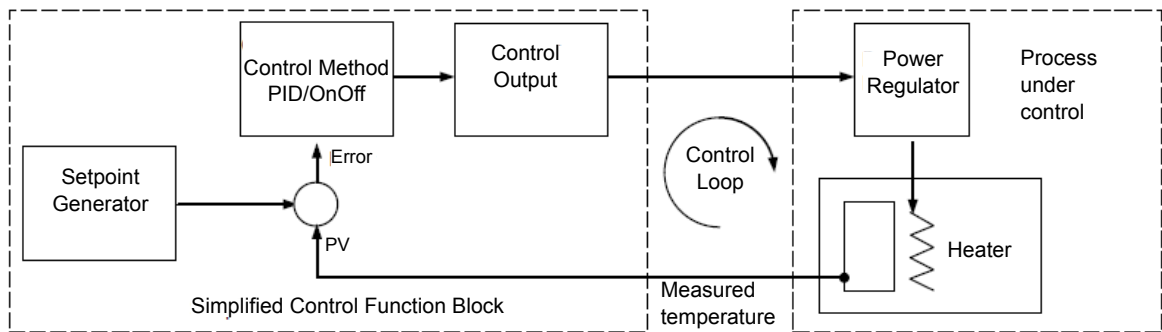
Figure 117 Single Loop Single Channel

The actual temperature measured at the process (PV) is connected to the input of the controller. This is compared with a setpoint (or required) temperature (SP). If there is a deviation between the set and measured temperature the controller calculates an output value to call for heating or cooling. The calculation depends on the process being controlled but normally uses a PID algorithm. The output(s) from the controller are connected to devices on the plant which cause the heating (or cooling) demand to be adjusted which in turn is detected by the temperature sensor. This is referred to as the control loop.

Loop Parameters – Main

Folder – Loop.1 to Loop.16		Sub-Folder: Main			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
AutoMan	To select Auto or Manual operation.	Auto	Automatic (closed loop) operation	Auto	Oper
		Man	Manual (output power adjusted by the user) operation		
PV	The process variable input value. This is typically wired from an analog input.	Range of the input source			Oper
Inhibit	Used to stop the loop controlling. If enabled the loop will stop control and the output of the loop will be set to the 'safe' output value. On exit from Inhibit the transfer will be bumpless. This may be wired to an external source	No Yes	Inhibit disabled Inhibit enabled	No	Oper
TargetSP	The value of setpoint at which the control loop is aiming. It may come from a number of different sources, such as internal SP and remote SP.	Between setpoint limits			Oper
WorkingSP	The current value of the setpoint being used by the control loop. It may come from a number of different sources, such as internal SP and Remote SP. The working setpoint is always read-only as it is derived from other sources.	Between setpoint limits			Read Only
ActiveOut	The actual output of the loop before it is split into the channel 1 and channel 2 outputs.				Read Only
IntHold	Stops Integral action			No	Oper

Loop Set up

These parameters configure the type of control.

Folder – Loop.1 to Loop.16		Sub-folder: Setup			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Ch1 ControlType	Selects the channel 1 control algorithm. You may select different algorithms for channels 1 and 2. In temperature control applications, Ch1 is usually the heating channel, Ch2 is the cooling channel.	Off OnOff PID	Channel turned off On/off control 3-term or PID control	PID	Conf
Ch2 ControlType	Control type for channel 2				
Control Action	Control Action	Rev	Reverse acting. The output increases when the PV is below SP. This is the recommended setting for heating control.	Rev	Conf
		Dir	Direct acting. The output increases when the PV is above SP. This is the recommended setting for cooling control		
PB Units	Proportional band units.	EngUnits	Engineering units eg C or F	Eng	Conf
		Percent	Per cent of loop span (range Hi - Range Lo)		
Derivative Type	Selects whether the derivative acts only on PV changes or on 'Control Error' (either PV or Setpoint changes).	PV	Only changes in PV cause changes to the derivative output.	PV	Conf
		Error	Changes to either PV or SP will cause a derivative output.		
The above two parameters appear if either Ch1 or Ch2 are configured for PID control					

Types of Control Loop

On/Off Control

On/Off control simply turns heating power on when the PV is below setpoint and off when it is above setpoint. If cooling is used, cooling power is turned on when the PV is above setpoint and off when it is below. The outputs of such a controller will normally be connected to relays – hysteresis may be set as described in "Alarms" on page 120 to remove relay chatter or to provide a delay in the control output action.

PID Control

PID control, also referred to as 'Three Term Control', is a technique used to achieve steady straight line control at the required setpoint. The three terms are:

P = Proportional band

I = Integral time

D = Derivative time

The output from the controller is the sum of the contributions from these three terms. The combined output is a function of the magnitude and duration of the deviation, and the rate of change of the process value. It is possible to turn off integral and derivative terms independently and control on only proportional, proportional plus integral or proportional plus derivative.

PID Control

The PID controller consists of the following parameters:

Parameter	Meaning or Function
Proportional Band 'PB'	The proportional term, in display units or %, delivers an output that is proportional to the size of the deviation.
Integral Time 'Ti'	Removes steady state control offsets by ramping the output up or down in proportion to the amplitude and duration of the deviation.
Derivative Time 'Td'	Determines how strongly the controller will react to the rate of change in the measured value. It is used to reduce overshoot and undershoot and to restore the PV rapidly if there is a sudden change in demand.
High Cutback 'CBH'	The number of display units, above setpoint, at which the controller will increase the output power, in order to reduce undershoot on cool down.
Low Cutback 'CBL'	The number of display units, below setpoint, at which the controller will cutback the output power, in order to reduce overshoot on heat up.
Relative Cool Gain 'R2G'	Only present if cooling has been configured. Sets the cooling proportional band, which equals the heat proportional band value divided by the cool gain value.

Proportional Band

The proportional band, or gain, delivers an output which is proportional to the size of the deviation. It is the range over which the output power is continuously adjustable in a linear fashion from 0% to 100% (for a heat-only controller). Below the proportional band (PB) the output is full on (100%), above the proportional band the output is full off (0%) as shown in Figure 118.

The width of the proportional band determines the magnitude of the response to the deviation. If it too narrow (high gain) the system oscillates by being over responsive. If it is too wide (low gain) the control is sluggish. The ideal situation is when the proportional band is as narrow as possible without causing oscillation.
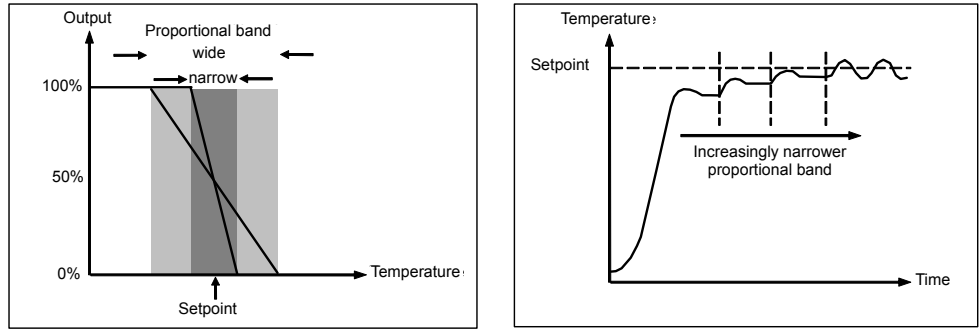
Figure 118 Proportional Action

Figure 118 also shows the effect of narrowing proportional band to the point of oscillation. A wide proportional band results in straight line control but with an appreciable initial deviation between setpoint and actual temperature. As the band is narrowed the temperature gets closer to setpoint until finally becoming unstable.

The proportional band may be set in engineering units or as a percentage of the controller range.

Integral Term

In a proportional-only controller, a deviation between setpoint and PV has to exist for the controller to deliver power. Integral is used to achieve zero steady state control.

The integral term slowly shifts the output level as a result of a deviation between setpoint and measured value. If the measured value is below setpoint, the integral action gradually increases the output in an attempt to correct the deviation. If it is above setpoint integral action gradually decreases the output or increases the cooling power to correct the deviation.

Figure 119 shows the result of introducing integral action.
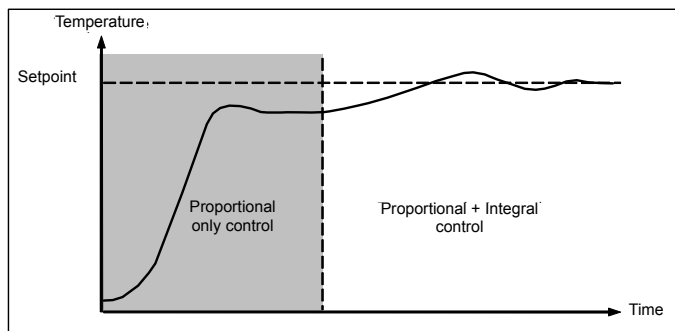
Figure 119 Proportional + Integral Control

The units for the integral term are measured in time (1 to 99999 seconds in Mini8 controllers). The longer the integral time constant, the more slowly the output is shifted and results in a sluggish response. Too small an integral time will cause the process to overshoot and even oscillate. The integral action may be disabled by setting its value to Off.

Derivative Term

Derivative action, or rate, provides a sudden shift in output as a result of a rapid change in deviation, whether or not this is caused by PV alone (derivative on PV) or on SP changes as well (derivative on deviation selection). If the measured value falls quickly derivative provides a large change in output in an attempt to correct the perturbation before it goes too far. It is most beneficial in recovering from small perturbations.
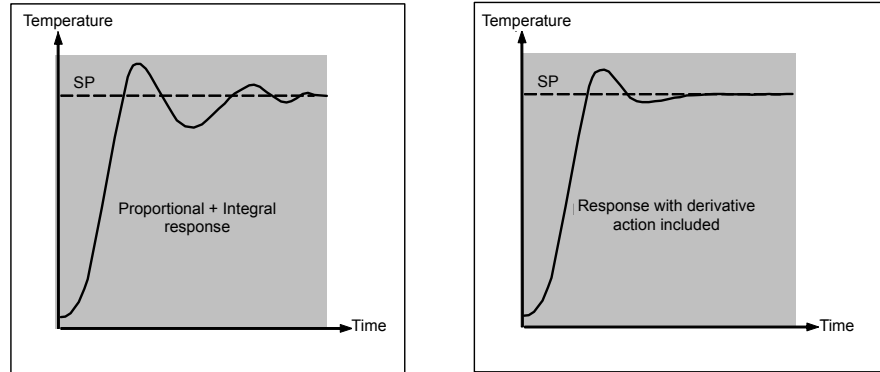
Figure 120 Proportional + Integral + Derivative Action

The derivative modifies the output to reduce the rate of change of deviationr. It reacts to changes in the PV by changing the output to remove the transient. Increasing the derivative time will reduce the settling time of the loop after a transient change.

Derivative is often mistakenly associated with overshoot inhibition rather than transient response. In fact, derivative should not be used to curb overshoot on start up since this will inevitably degrade the steady state performance of the system. Leave overshoot inhibition to the approach control parameters, High and Low Cutback, see "High and Low Cutback" on page 212.

Derivative is generally used to increase the stability of the loop, however, there are situations where derivative may be the cause of instability. For example, if the PV is noisy, then derivative can amplify that and cause excessive output changes, in these situations it is often better to disable the derivative and re-tune the loop.

If set to Off(0), no derivative action will be applied.

Derivative can be calculated on change of PV or change of deviation. If configured on deviation, then changes in the setpoint will be transmitted to the output. For applications such as furnace temperature control, it is common practice to select Derivative on PV to reduce thermal shock caused by a sudden change of output as a result of a change in setpoint.

High and Low Cutback

Cutback high 'CBH' and Cutback low 'CBL' are values that modify the amount of overshoot, or undershoot, that occurs during large step changes in PV (for example, under start-up conditions). They are independent of the PID terms which means that the PID terms can be set for optimal steady state response and the cutback parameters used to modify any overshoot which may be present.

Cutback involves moving the proportional band towards the cutback point nearest the measured value whenever the latter is outside the proportional band and the power is saturated (at 0 or 100% for a heat-only controller). The proportional band moves downscale to the lower cutback point and waits for the measured value to enter it. It then escorts the measured value with full PID control to the setpoint. In some cases it can cause a 'dip' in the measured value as it approaches setpoint as shown in Figure 121, but generally decreases the time to needed to bring the process into operation.

The action described above is reversed for falling temperature.

If cutback is set to Auto the cutback values are automatically configured to 3*PB.
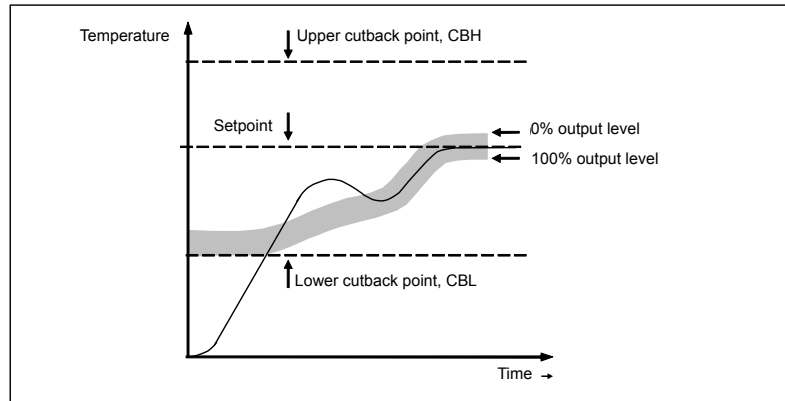
Figure 121 High and Low Cutback

Integral action and manual reset

In a full three-term controller (that is, a PID controller), the integral term automatically removes steady state deviations from the setpoint. If the controller is set as a PD controller, the integral term will be set to 'OFF'. Under these conditions the measured value may not settle precisely at setpoint. The Manual Reset parameter (MR) represents the value of the power output that will be delivered when the deviation is zero. Set this value manually to remove the steady state deviation.

Relative Cool Gain

The gain of channel 2 control output, relative to the channel 1 control output.

Relative Ch2 Gain compensates for the different quantities of energy needed to heat, as opposed to that needed to cool, a process. For example: water cooling applications might require a relative cool gain of 4 (cooling is four times faster than the heat-up process).

This parameter is set automatically when Autotune is used. A nominal setting of around 4 is often used.

Loop Break

The loop is considered to be broken if the PV does not respond to a change in the output in a given time. Since the time of response will vary from process to process the Loop Break Time (LBT – PID list) parameter allows a time to be set before a Loop Break Alarm (Lp Break - Diag list) is initiated.

The Loop Break Alarm attempts to detect a loss of restoring action in the control loop by checking the control output, the process value and its rate of change. This is not to be confused with 'Load Failure' and 'Partial Load Failure'. The loop break algorithm is purely software detection.

Occurrence of a loop break causes the Loop Break Alarm parameter to be set. It does not affect the control action unless it is wired (in software or hardware) to affect the control specifically.

It is assumed that, so long as the requested output power is within the output power limits of a control loop, the loop is operating in linear control and is therefore not in a loop break condition.

However, if the output becomes saturated then the loop is operating outside its linear control region.

Furthermore if the output remains saturated at the same output power for a significant duration, then this could indicate a break in the control loop. The source of this loop break is not important, but the resulting loss of control could be catastrophic.

Since the worst case time constant for a given load is usually known, a worst case time can be calculated over which the load should have responded with a minimum movement in temperature.

By performing this calculation the corresponding rate of approach towards setpoint can be used to determine if the loop can no longer control at the chosen setpoint. If the PV was drifting away from the setpoint or approaching the setpoint at a rate less than that calculated, the loop break condition would be met.

Loop Break and Autotune

If an autotune is performed the loop break time is automatically set to Ti*2 for a PI or PID loop or 12*Td for a PD loop.

For an On/Off controller, loop break detection is also based on loop break time with the PV threshold of 0.1*SPAN where SPAN = Range High – Range Low. Therefore, if the output is at limit and the PV has not moved by 0.1*SPAN in the loop break time a loop break will occur.

For all control configurations other than On/Off (i.e. where the Proportional Band is a valid parameter), if the output is in saturation and the PV has not moved by >0.5*Pb in the loop break time, a loop break condition is considered to have occurred.

If the loop break time is 0 (off) the loop break time is not set.

Cooling Algorithm

The method of cooling may vary from application to application.

For example, an extruder barrel may be cooled by forced air (from a fan), or by circulating water or oil around a jacket. The cooling effect will be different depending on the method. The cooling algorithm may be set to linear where the controller output changes linearly with the PID demand signal, or it may be set to water, oil or fan where the output changes non-linearly against the PID demand. The algorithm provides optimum performance for these methods of cooling.

Gain Scheduling

Gain scheduling is the automatic transfer of control between one set of PID values and another. It may be used in very non-linear systems where the control process exhibits large changes in response time or sensitivity, see diagram below. This may occur, for example, over a wide range of PV, or between heating and cooling where the rates of response may be significantly different. The number of sets depends on the non-linearity of the system. Each PID set is chosen to operate over a limited (approximately linear) range.

In the Mini8 controller, this is done at a preset strategy defined by the parameter 'Scheduler Type'. The choices are:

No.	Type	Description
0	Off	Just one fixed set of PID values
1	Set	The PID set can be selected manually or from a digital input
2	SP	The transfer between one set and the next depends on the value of the SP
3	PV	The transfer between one set and the next depends on the value of the PV
4	'Error'	The transfer between one set and the next depends on the value of the deviation ('control error')
5	OP	The transfer between one set and the next depends on the value of the OP demand
6	Rem Sched IP	The transfer between one set and the next depends on the value from a remote source for example, a digital input

The Mini8 controller has three sets of PID values for each loop – the maximum number, which you may wish to use, is set by 'Num Sets' parameter.
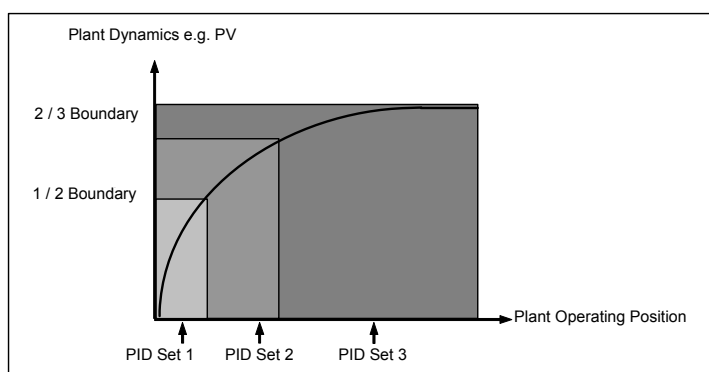
Figure 122 Gain Scheduling in a Non-Linear System

PID Parameters

Control loops must be specifically ordered – Order Code MINI8 – 4LP, 8LP or 16LP.

To enable a loop place one of the Loop function blocks on the graphical wiring page.

Folder – Loop		Sub-folders: Loop1.PID to Loop16.PID			
Name	Parameter Description	Value		Default	Access Level
SchedulerType	To choose the type of gain scheduling	Off Set SP PV Error OP Rem	See above for explanation Parameters displayed will vary depending on type of scheduling selected.	Off	Oper
Num Sets	Selects the number of PID sets to present. Allows the lists to be reduced if the process does not require the full range of PID sets.	1 to 3		1	Oper
Scheduler RemoteInput	Scheduler Remote Input	1 to 3 (if SchedulerType is 'Remote')		1	Read Only
Active Set	Currently working set	Set1 Set2 Set3		Set1	Read Only except type 'Set'
Boundary 1-2	Sets the level at which PID set 1 changes to PID set 2	Range units		0	Oper
Boundary 2-3	Sets the level at which PID set 2 changes to PID set 3	Range units		0	Oper
ProportionalBand1, 2, 3	Proportional band Set1/Set2/Set3	0 to 99999 Eng units		300	Oper
IntegralTime 1, 2, 3	Integral term Set1/Set2/Set3			360s	Oper
DerivativeTime 1, 2, 3	Derivative term Set1/Set2/Set3			60s	Oper
RelCh2Gain 1, 2, 3	Relative cool gain Set1/Set2/Set3			1	Oper
CutbackHigh 1, 2, 3	Cutback high Set1/Set2/Set3			Auto	Oper
CutbackLow 1, 2, 3	Cutback low Set1/Set2/Set3			Auto	Oper
ManualReset 1, 2, 3	Manual reset Set1/Set2/Set3. This must be set to 0.0 when the integral term is set to a value			0.0	Oper
LoopBreakTime 1, 2, 3	Loop break time Set1/Set2/Set3			100	Oper
OutputHi 1, 2, 3	Output High Limit Set1/Set2/Set3			100	Oper
OutputLo 1, 2, 3	Output Low Limit Set1/Set2/Set3			-100	

Tuning Function Block

Tuning involves setting the following parameters.

Proportional Band 'PB', Integral Time 'Ti', Derivative Time 'Td', Cutback High 'CBH', Cutback Low 'CBL', and Relative Cool Gain 'R2G' (applicable to heat/cool systems only).

The controller is shipped with these parameters set to default values. In many cases the default values will give adequate straight line control, however, the response of the loop may not be ideal. Because the process characteristics are fixed by the design of the process it is necessary to adjust the control parameters in the controller to achieve optimal control. To determine the optimum values for any particular loop or process it is necessary to carry out a procedure called loop tuning. If significant changes are later made to the process which affect the way in which it responds it may be necessary to retune the loop.

Users have the choice of tuning the loop automatically or manually. Both procedures require the loop to oscillate and both are described in the following sections.

Loop Response

If we ignore the situation of loop oscillation, there are three categories of loop performance:

Under Damped	In this situation the terms are set to reduce oscillation but do lead to an overshoot of the Process Value followed by decaying oscillation to finally settle at the Setpoint. This type of response can give a minimum time to Setpoint but overshoot may cause problems in certain situations and the loop may be sensitive to sudden changes in Process Value. This will result in further decaying oscillations before settling once again.
Critically Damped	This represents an ideal situation where overshoot to small step changes does not occur and the process responds to changes in a controlled, non-oscillatory manner.
Over Damped	In this situation the loop responds in a controlled but sluggish manner which will result in a loop performance which is non-ideal and unnecessarily slow.

The balancing of the P, I and D terms depends totally upon the nature of the process to be controlled.

In a plastics extruder, for example, a barrel zone will have a different response to a die, casting roll, drive loop, thickness control loop or pressure loop. To achieve optimal performance from an extrusion line, all loop tuning parameters must be set to their optimum values.

Gain scheduling is provided to allow specific PID settings to be applied at the different operating points of the process.

Initial Settings

In addition to the tuning parameters listed in "Tune Parameters" on page 220, there are a number of other parameters which can have an effect on the way in which the loop responds. Set these before either manual or automatic tuning is initiated. Parameters include, but are not limited to:

Setpoint	Before starting a tune the loop conditions should be set as closely as practicable to the actual conditions which will be met in normal operation. For example, in a furnace or oven application a representative load should be included, an extruder should be running, and so on.
Heat/Cool Limits	The minimum and maximum power delivered to the process may be limited by the parameters 'Output Lo' and 'Output Hi' both of which are found in the Loop OP list, see "Output Function Block" on page 232. For a heat only controller the default values are 0 and 100%. For a

heat/cool controller the defaults are -100 and 100%. Although it is expected that most processes will be designed to work between these limits there may be instances where it is desirable to limit the power delivered to the process. For example, if driving a 220V heater from a 240V source the heat limit may be set 80% so that the heater does not dissipate more than its maximum power.

Remote Output Limits

'RemOPL' and 'RemOPHi' (Loop OP List). If these parameters are used they should be set within the Heat/Cool Limits above.

Heat/Cool Deadband

In controllers fitted with a second (cool) channel a parameter 'Ch2 DeadBand' is also available in the Loop OP folder, see "Output Function Block" on page 232, which sets the distance between the heat and cool proportional bands. The default value is 0% which means that heating will turn off at the same time as cooling turns on. The deadband may be set so that there is no possibility of the heat and cool channels being on together, particularly when cycling output stages are installed.

Minimum On Time   If either or both of the output channels is fitted with a relay or logic output, the parameter 'MinOnTime' will appear in the relevant output folder – "I/O Folder" on page 96. This is the cycling time for a time proportioning output and should be set correctly before tuning is started.

Input Filter Time Constant

The parameter 'Filter Time Constant' is found in the IO folder "Thermocouple Input Parameters" on page 100.

Output Rate limit   Output rate limit is active during tuning and may affect the tuning results. The parameter 'Rate' is found in the Loop OP folder.

Other Considerations

- If a process includes adjacent interactive zones, each zone should be tuned independently.

- It is always better to start a tune when the PV and setpoint are far apart. This allows start up conditions to be measured and cutback values to be calculated more accurately.

- If the two loops are connected for cascade control, the inner loop may be tuned automatically but the outer should be tuned manually.

- In a programmer/controller tuning should only be attempted during dwell periods and not during ramp stages. If a programmer/controller is tuned automatically put the controller into Hold during each dwell period whilst autotune is active. It may be worth noting that tuning, carried out in dwell periods which are at different extremes of temperature may give different results owing to non-linearity of heating (or cooling). This may provide a convenient way to establish values for Gain Scheduling (see "Gain Scheduling" on page 215).

☺ Tip:

If an auto tune is initiated there are two further parameters which need to be set. These are 'OutputHigh Limit' and 'OutputLow Limit'. These are found in the 'Tune' folder, see also "Tune Parameters" on page 220.

Multi-zone applications

The tuning of one loop can be unduly influenced by the controlling effect of adjacent zone(s). Ideally the zone either side of the one being tuned should be turned OFF, or put in manual with the power level set to keep its temperature at about the usual operating level.

Automatic Tuning

Auto Tune automatically sets the following parameters:

Proportional Band '**PB'**	
Integral Time '**Ti'**	If '**Ti**' and/or '**Td**' is set to OFF, because you wish to use PI, PD or P only control, these terms will remain off after an autotune.
Derivative Time '**Td'**	
Cutback High '**CBH'**	If CBH and/or CBL is set to '**Auto'** these terms will remain at Auto after an autotune, i.e. 3*PB.
Cutback Low '**CBL'**	For autotune to set the cutback values, CBH and CBL must be set to a value (other than Auto) before autotune is started.
	Autotune will never return cutback values which are less than 1.6*PB.
Relative Cool Gain '**R2G'**	R2G is only calculated if the controller is configured as heat/cool.
	Following an autotune, '**R2G'** is always limited to between 0.1 and 10. If the calculated value is outside this limit a 'Tune Fail' alarm is given. In software releases up to and including 2.30, if the calculated value is outside this limit, R2G remains at its previous value but all other tuning parameters are changed.
Loop Break Time '**LBT'**	Following an autotune, '**LBT**' is set to 2*Ti (assuming the integral time is not set to OFF). If 'Ti' is set to OFF then 'LBT' is set to 12*Td.

Auto tune uses the 'one-shot' tuner which works by switching the output on and off to induce an oscillation in the process value. From the amplitude and period of the oscillation, it calculates the tuning parameter values. The autotune sequence for different conditions is described in "Autotune from Below SP – Heat/Cool" on page 222 to "Autotune at Setpoint – Heat/Cool" on page 224.

Tune Parameters

Folder – Loop.Loop.1 to Loop.16		Sub-folder: Tune			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
AutoTune Enable	To start self tuning	Off	Stop	Stop	Oper
		On	Start		
OutputHigh Limit	Set this to limit the maximum output power level which the controller will supply during the tuning process. If the high output power limit set in the output list is lower the autotune high limit will be clipped to this value.	Between Low Output and 100.0		100.0	Oper
OutputLow Limit	Set this to limit the minimum % output power level which the controller will supply during the tuning process. If the low output power limit set in the output list is higher the autotune low limit will be clipped to this value.	Between High Output and 0.0		0.0	Oper
State	Shows if self tuning is in progress	Off	Not running	Off	Read Only
		Ready			
		Running	In progress		
		Complete	Auto tune completed successfully		
		Timeout	Issue conditions, see "Unsuccessful Autotune Modes" on page 224.		
		TI_Limit			
		R2G_Limit			
Stage	Shows the progress of the self tuning	Reset		Reset	Read Only
		Settling	Displayed during the first minute		
		To SP	Heat (or cool) output on		
		Wait Min	Power output off		
		Wait Max	Power output on		
		Timeout	Issue conditions, see "Unsuccessful Autotune Modes" on page 224.		
		TI Limit			
		R2G Limit			
Stage Time	Time in the particular stage				Read Only

To Auto Tune a Loop - Initial Settings

Set parameters listed in "Initial Settings" on page 217.

'Output High Limit' and 'Output Low Limit' ('OP' List "Output Function Block" on page 232) set the overall output limits. These limits apply at all times during tuning and during normal operation.

Set 'OutputHigh Limit' and 'Output Low Limit' ('Tune' list "Tune Parameters" on page 220). These parameters set the output power limits during Autotune.

☺ Tips:

The 'tighter' power limit will always apply. For example if 'OutputHigh Limit' (Tune List) is set to 80% and 'Output High Limit' (OP List) is set to 70% then the output power will be limited to 70%.

The measured value must oscillate to some degree for the tuner to be able to calculate values. The limits must be set to allow oscillation about the setpoint.

To Start Autotune

1. Select the loop to be tuned,

2. Set AutoTune Enable to On.

A One-shot Tune can be performed at any time, but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), it may be necessary to tune again for the new conditions.

The autotune algorithm reacts in different ways depending on the initial conditions of the plant. The explanations given in this section are for the following conditions:

• Initial PV is below the setpoint and, therefore, approaches the setpoint from below for a heat/cool control loop.

• Initial PV is below the setpoint and, therefore, approaches the setpoint from below for a heat only control loop.

• Initial PV is at the same value as the setpoint. That is, within 0.3% of the range of the controller if 'PB Units' (Setup list) is set to 'Percent' or +1 engineering unit (1 in 1000) if the 'PB Units' is set to 'Eng'. Range is defined as 'Range Hi' – 'Range Lo' for process inputs or the full temperature range defined for the relevant temperature input "Linearization Types and Ranges" on page 101.

☺   Tip:

If the PV is just outside the range stated above the autotune will attempt a tune from above or below SP.

Autotune and Sensor Break

When the controller is autotuning and sensor break occurs, the autotune will abort and the controller will output the sensor break output power 'Sbrk OP' set up in the OP List. Autotune must be re-started when the sensor break condition is no longer present.

Autotune and Inhibit

If the controller is in autotune when inhibit is asserted the tune goes to the OFF state (Stage = Reset). On inhibit being released the controller will re-start autotune.

Autotune and Gain Scheduling

When gain scheduling is enabled and an autotune is performed, the calculated PID values will be written into the PID set that is active on completion of the tune. Therefore, the user may tune within the boundaries of a set and the values will be written into the appropriate PID set. When the schedule type is PV or OP and the boundaries between sets are close, the PID values may not be written to the correct set at the completion of the tune, since the range of the loop is not large. In this situation the scheduler ('SchedulerType') should be switched to 'Set' and the 'Active Set' chosen manually.

Autotune from Below SP – Heat/Cool

The point at which Automatic tuning is performed (Tune Control Point) is designed to operate just below the setpoint at which the process is normally expected to operate (Target Setpoint). This is so the process is not significantly overheated or overcooled. The Tune Control Point is calculated as follows:

Tune Control Point = Initial PV + 0.75(Target Setpoint – Initial PV).

The Initial PV is the PV measured at 'B' (after a 1 minute settling period)

Examples:

If Target Setpoint = 500°C and Initial PV = 20°C, then the Tune Control Point will be 380°C.

If Target Setpoint = 500°C and Initial PV = 400°C, then the Tune Control Point will be 475°C.

This is because the overshoot is likely to be less as the process temperature is already getting close to the target setpoint.

The sequence of operation for a tune from below setpoint for a heat/cool control loop is described below:
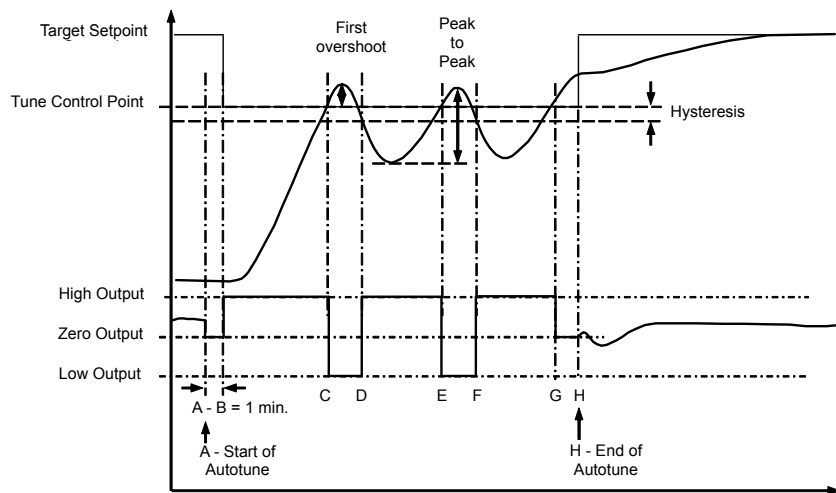
Figure 123 Autotune - Heat/Cool Process

Period	Action
A	Start of Autotune
A to B	Both heating and cooling power remains off for a period of 1 minute to allow the algorithm to establish steady state conditions.
B to D	First heat/cool cycle to establish first overshoot. '**CBL**' is calculated on the basis of the size of this overshoot (assuming it is not set to Auto in the initial conditions).
B to F	Two cycles of oscillation are produced from which the peak to peak response and the true period of oscillation are measured. **PID** terms are calculated.
F to G	An extra heat stage is provided and all heating and cooling power is turned off at G allowing the plant to respond naturally. Measurements made during this period allow the relative cool gain '**R2G**' to be calculated. '**CBH**' is calculated from CBL*R2G.
H	Autotune is turned off at and the process is allowed to control at the target setpoint using the new control terms.

Autotune can also occur when the initial PV is above SP. The sequence is the same as tuning from below setpoint except that the sequence begins with full cooling applied at 'B' after the first one minute settling time.

Autotune From Below SP – Heat Only

The sequence of operation for a heat only loop is the same as that previously described for a heat/cool loop except that the sequence ends at 'F' since there is no need to calculate 'R2G'.

At 'F' autotune is turned off and the process is allowed to control using the new control terms.

Relative cool gain, 'R2G', is set to 1.0 for heat-only processes.
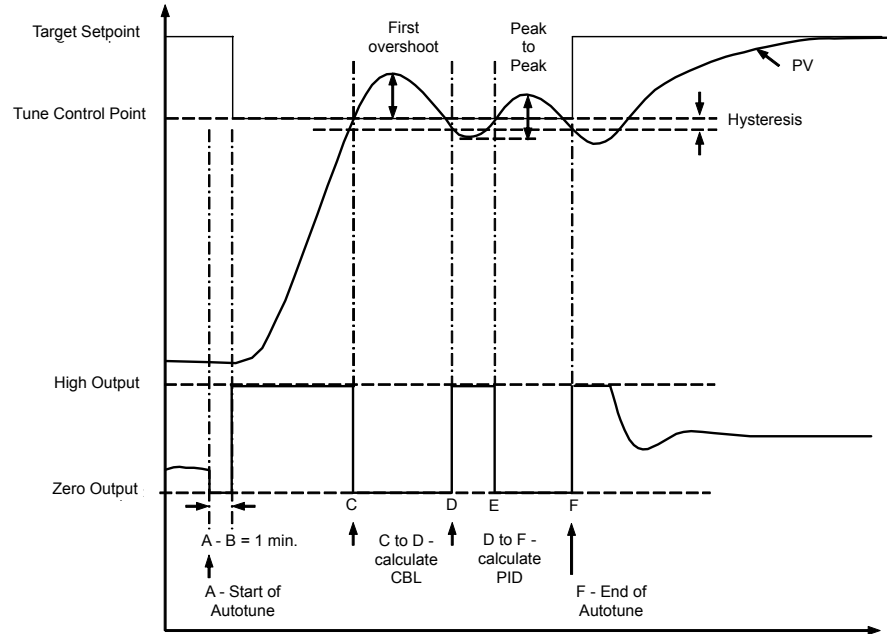
Figure 124 Autotune from below SP – Heat Only

For a tune from below setpoint 'CBL' is calculated on the basis of the size of the overshoot (assuming it was not set to Auto in the initial conditions). CBH is then set to the same value as CBL.

Note: As with the heat/cool case, Autotune can also occur when the initial PV is above SP. The sequence is the same as tuning from below setpoint except that the sequence starts with natural cooling applied at 'B' after the first one minute settling time.

In this case CBH is calculated – CBL is then set to the same value as CBH.

Autotune at Setpoint – Heat/Cool

It is sometimes necessary to tune at the actual setpoint being used. This is allowable in Mini8 Controller and the sequence of operation is described below.
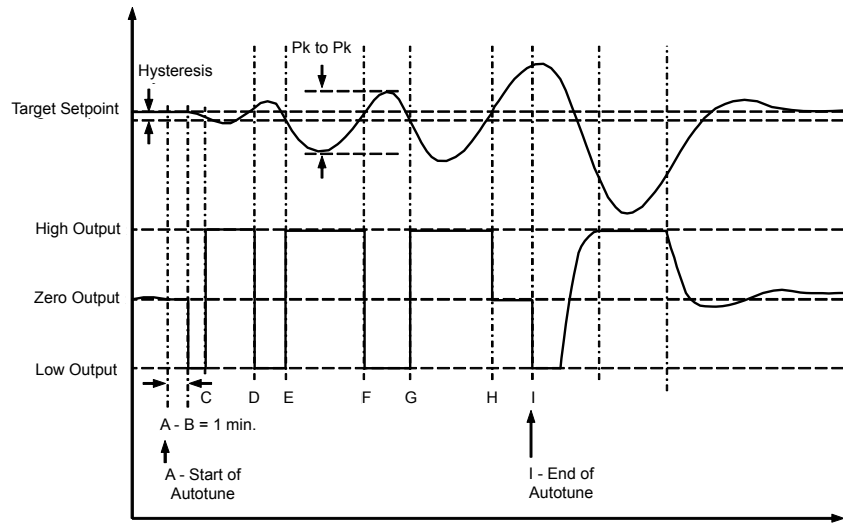
Figure 125 Autotune at Setpoint

Period	Action
A	Start of Autotune. A test is done at the **start of autotune** to establish the conditions for a tune at setpoint. The conditions are that the SP must remain within 0.3% of the range of the controller if '**PB Units**' (Setup list) is set to '**Percent**'. If '**PBUnits'** is set to '**Eng'** then the SP must remain within ± 1 engineering unit (1 in 1000). Range is defined as 'Range Hi' – 'Range Lo' for process inputs or the range defined in "Linearization Types and Ranges" on page 101 for temperature inputs.
A to B	The output is **frozen at the current value** for one minute and the conditions are continuously monitored during this period. If the conditions are met during this period autotune at setpoint is initiated at B. If at any time during this period the PV drifts outside the condition limits a tune at setpoint is abandoned. Tuning is then resumed as a tune from above or below setpoint depending on which way the PV has drifted. Since the loop is already at setpoint there is no need to calculate a Tune Control Setpoint – the loop is forced to oscillate around the Target Setpoint
C to G	Initiate oscillation - the process is forced to oscillate by switching the output between the output limits. From this the **period of oscillation** and the **peak to peak** response is measured. **PID** terms are calculated.
G to H	An extra heat stage is provided and all heating and cooling power is turned off at H allowing the plant to respond naturally. Measurements made during this period allow the relative cool gain '**R2G**' to be calculated.
I	Autotune is turned off and the process is allowed to control at the target setpoint using the new control terms.

For a tune at setpoint, autotune does not calculate cutback since there was no initial start up response to the application of heating or cooling. The exception is that the cutback values will never be returned less than 1.6*PB.

Unsuccessful Autotune Modes

The conditions for performing an autotune are monitored by the parameter 'State' (Tune folder). If autotune is not successful, the following conditions are read by this parameter:

Timeout	This will occur if any one stage is not completed within one hour. It could be due to the loop being open or not responding to the demands from the controller. Very heavily lagged systems may produce a timeout if the cooling rate is very slow.
TI Limit	This will be displayed if Autotune calculates a value for the integral term greater than the maximum allowable integral

	setting i.e. 99999 seconds. This may indicate that the loop is not responding or that the tune is taking too long.
R2G Limit	The calculated value of R2G is outside the range 0.1 and 10.0. In versions up to and including V2.3, R2G is set to 0.1 but all other PID parameters are updated.

R2G limit may occur if the gain difference between heating and cooling is too large. This could also occur if the controller is configured for heat/cool but the cooling medium is turned off or not working correctly. It could similarly occur if the cooling medium is on but heating is off or not working correctly.

Manual Tuning

If for any reason automatic tuning gives unsatisfactory results, you can tune the controller manually. There are a number of standard methods for manual tuning. The one described here is the Ziegler-Nichols method.

1. Adjust the setpoint to its normal running conditions (it is assumed this will be above the PV so that heat only is applied).

2. Set the Integral Time 'Ti' and the Derivative Time 'Td' to 'OFF'.

3. Set High Cutback 'CBH' and Low Cutback 'CBL' to 'Auto'.

4. Ignore the fact that the PV may not settle precisely at the setpoint.

If the PV is un-deviating, reduce the proportional band so that the PV just starts to oscillate. Allow enough time between each adjustment for the loop to stabilize. Record the proportional band value 'PB' and the period of oscillation 'T'. If PV is already oscillating, measure the period of oscillation 'T', then increase the proportional band until it just stops oscillating. Record the value of the proportional band at this point.

Set the proportional band, integral time and derivative time parameter values according to the calculations given in the table below:

Type of control	Proportional band (PB)	Integral time (Ti) seconds	Derivative time (Td) seconds
Proportional only	2xPB	OFF	OFF
P + I control	2.2xPB	0.8xT	OFF
P + I + D control	1.7xPB	0.5xT	0.12xT

Manually Setting Relative Cool Gain

If the controller is fitted with a cool channel this should be enabled before the PID values, calculated from the table above, are entered.

Observe the oscillation waveform and adjust R2G until a symmetrical waveform is observed.

Then enter the values from the table.
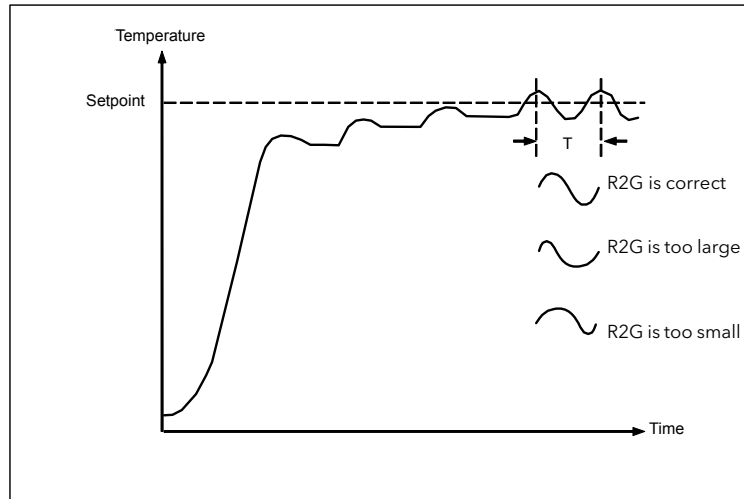
Figure 126 Setting Relative Cool Gain

Manually Setting the Cutback Values

Enter the PID terms calculated from the table in "Manual Tuning" on page 225 before setting cutback values.

The above procedure sets up the parameters for optimum steady state control. If unacceptable levels of overshoot or undershoot occur during start-up, or for large step changes in PV, then manually set the cutback parameters.

Proceed as follows:

1. Initially set the cutback values to one proportional bandwidth converted into display units. This can be calculated by taking the value in percentage that has been installed into the parameter 'PB' and entering it into the following formula:

    PB/100 * Span of controller = Cutback High and Cutback Low

    For example, if PB = 10% and the span of the controller is 0 -1200°C, then

    Cutback High and Low = 10/100 * 1200 = 120

2. If overshoot is observed following the correct settings of the PID terms increase the value of 'CBL' by the value of the overshoot in display units. If undershoot is observed increase the value of the parameter 'CBH' by the value of the undershoot in display units.
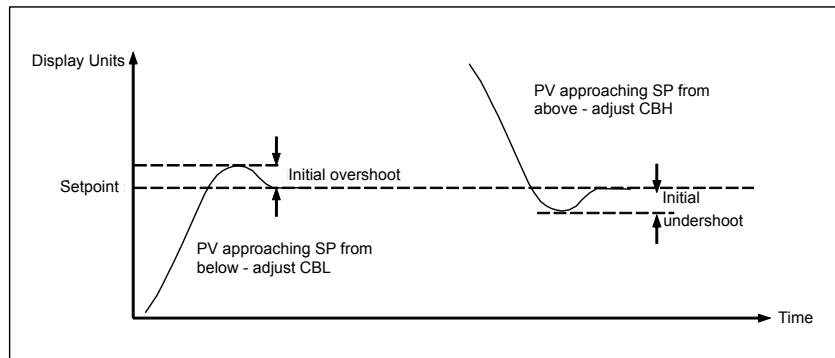
Figure 127 Manual Setting of Cutback

Setpoint Function Block

For each of the 16 loops, the controller setpoint is the Working Setpoint that may come from a number of alternative sources. This is the value ultimately used to control the process variable in each loop.

The working setpoint may be derived from:

- SP1 or SP2, both of which are individually set, can be selected by an external signal or via the SPSelect parameter over communications.

- From an external (remote) analog source

- The output of a programmer function block and will, therefore, vary in accordance with the program in use.

The setpoint function block also provides the facility to limit the rate of change of the setpoint before it is applied to the control algorithm. It will also provide upper and lower limits. These are defined as setpoint limits for the local setpoints and instrument range high and low for other setpoint sources. All setpoints are ultimately subject to a limit of range hi and range lo.

User configurable methods for tracking are available, such that the transfer between setpoints and between operational modes will not cause a bump in the setpoint.

Setpoint Function Block
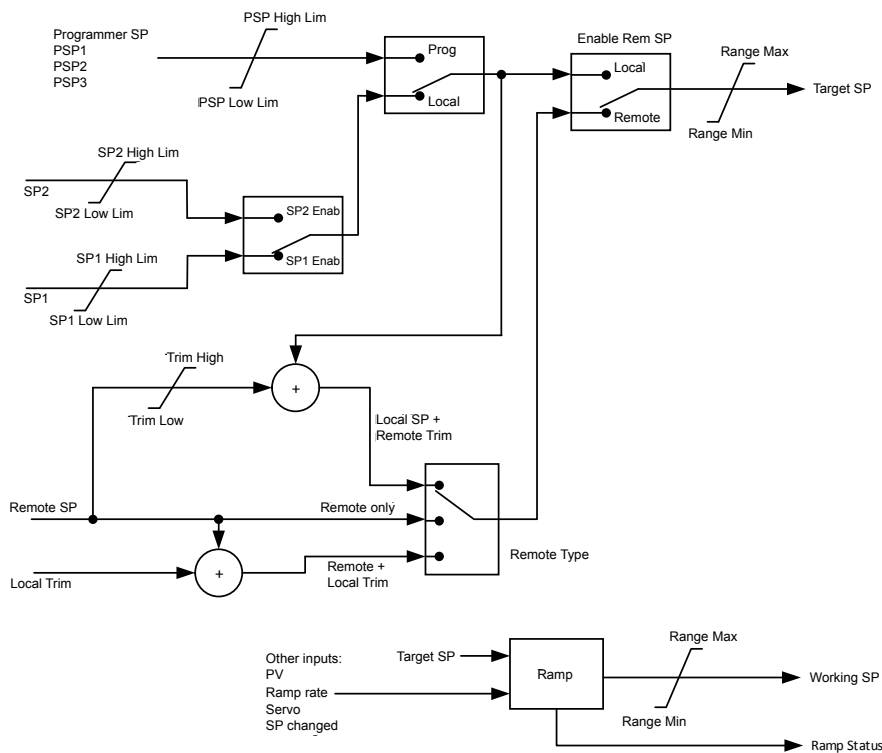
Figure 128 Setpoint Function Block

SP Tracking

When setpoint tracking is enabled and the local setpoint is selected, the local setpoint is copied to 'TrackSP'. Tracking now dictates that the alternate SP follows or tracks this value. When the alternate setpoint is selected it initially takes on the tracked value so that no bump takes place. The new setpoint is then adopted gradually. A similar action takes place when returning to the local setpoint.

Manual Tracking

When the controller is operating in manual mode the currently selected SP tracks the PV. When the controller resumes automatic control there will be no step change in the resolved SP.

Rate Limit

Rate limit will control the rate of change of setpoint. It is enabled by the 'Rate' parameter. If this is set to Off then any change made to the setpoint will be effective immediately. If it is set to a value then any change in the setpoint will be effected at the value set in units per minute. Rate limit also acts on SP2 and when switching between SP1 and SP2.

When rate limit is active the 'RateDone' parameter will display 'No'. When the setpoint has been reached this parameter will change to 'Yes'.

When 'Rate' is set to a value (other than Off) an additional parameter 'SPRate Disable' is displayed which allows the setpoint rate limit to be turned off and on without the need to adjust the 'Rate' parameter between Off and a value.

Setpoint Parameters

Folder – Loop.1 to Loop.16		Sub-folder: SP			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Range High	The Range limits provide a set of absolute maximums and minimums for setpoints within the control loop.	Full range of the input type			Conf
Range Low					Conf
	Any derived setpoints are ultimately clipped to be within the Range limits.				
	If the Proportional Band is configured as % of Span, the span is derived from the Range limits.				
SP Select	Select local or alternate setpoint	SP1	Setpoint 1	SP1	Oper
		SP2	Setpoint 2		
SP1	Primary setpoint for the controller	Between SP high and SP low limits			Oper
SP2	Setpoint 2 is the secondary setpoint of the controller. It is often used as a standby setpoint.				Oper
SP HighLimit	Maximum limit allowed for the local setpoints	Between Range Hi and Range Lo			Oper
SP LowLimit	Minimum limit allowed for the local setpoints				Oper
Alt SP Select	To enable the alternative setpoint to be used. This may be wired to a source such as the programmer Run input.	No	Alternative setpoint disabled		Oper
		Yes	Alternative setpoint enabled		
Alt SP	This may be wired to an alternative source such as the programmer or remote setpoint				Oper
Rate	Limits the maximum rate at which the working setpoint can change.	Off or 0.1 to 9999.9 engineering units per minute		Off	Oper
	The rate limit may be used to protect the load from thermal shock which may be caused by large step changes in setpoint.				
RateDone	Flag which indicates when the setpoint is changing or completed	No	Setpoint changing		Read Only
		Yes	Complete		
Rate Disable	Setpoint rate disable	No	Enabled		Oper
		Yes	Disabled		
ServoToPV	Servo to PV Enable	No	Disabled	No	Conf
	When Rate is set to any value other than Off and Servo to PV is enabled, changing the active SP will cause the working SP to servo to the current PV before ramping to the new target SP.	Yes	Enabled		Read Only in L3
SP Trim	Trim is an offset added to the setpoint. The trim may be either positive or negative, the range of the trim may be restricted by the trim limits.	Between SP Trim Hi and SP Trim Lo			Oper
	Setpoint trims may be used in a retransmission system. A master zone may retransmit the setpoint to the other zones, a local trim may be applied to each zone to produce a profile along the length of the machine.				
SPTrim HighLimit	Setpoint trim high limit				Oper
SPTrim LowLimit	Setpoint trim low limit				Oper
ManualTrack	To enable manual tracking. When the loop is switched from Manual to Auto, the Setpoint is set to the current PV. This is useful if the load is started in Manual Mode, then later switched to Auto to maintain the operating point.	Off	Manual tracking disabled		Read Only
		On	Manual tracking enabled		

Mini8 Controller

Folder – Loop.1 to Loop.16		Sub-folder: SP			
Name	Parameter Description	Value		Default	Access Level
SP Track	Setpoint tracking faciliates bumpless transfer in setpoint when switching between a local and an alternate setpoint such as the programmer. This enables the tracking interface provided by TrackPV and TrackVal, which is used by the programmer and other setpoint providers external to the control loop.	Off On	Setpoint tracking disabled Setpoint tracking enabled		Conf
Track PV	The programmer tracks the PV when it is servoing or tracking.				Read Only
Track SP	Manual Tracking Value. The SP to track for manual tracking.				Read Only
SPIntBal	SP Integral Balance This is also known as debump in some instances. It forces the integral to be balanced upon changes in target setpoint.	Off On		Off	L3 Read Only Alterable in Conf

Setpoint Limits

The setpoint generator provides limits for each of the setpoint sources as well as an overall set of limits for the loop. These are summarized in the diagram below.
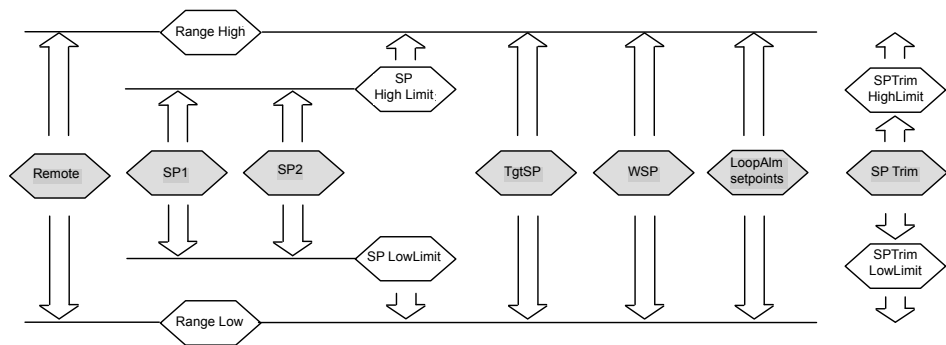
Figure 129 Setpoint Limits

☺ Tip:

'Range High' and 'Range Low' provide the range information for the control loop. They are used in control calculations to generate proportional bands. Span = Range High – Range Low.

Setpoint Rate Limit

Allows the rate of change of setpoint to be controlled. This removes step changes in the setpoint. It is a simple symmetrical rate limiter and is applied to the working setpoint which includes setpoint trim. It is enabled by the 'Rate' parameter. If this is set to Off then any change made to the setpoint will be effective immediately. If it is set to a value then any change in the setpoint will be effected at the value set in units per minute. Rate limit applies to SP1, SP2 and Remote SP.

When rate limit is active the 'RateDone' flag will display 'No'. When the setpoint has been reached this parameter will change to 'Yes'. This flag will be cleared if the target setpoint subsequently changes.

When 'Rate' is set to a value (other than Off) an additional parameter 'Rate Disable' is displayed which allows the setpoint rate limit to be turned off and on without the need to adjust the 'Rate' parameter between Off and a value.

If the PV is in sensor break, the rate limit is suspended and the working setpoint takes the value of 0. On sensor break being released the working setpoint goes from 0 to the selected setpoint value at the rate limit.

Setpoint Tracking

The setpoint used by the controller may be derived from a number of sources. For example:

- Local setpoints SP1 and SP2. These may be selected using the parameter 'SP Select' in the SP folder, through digital communications or by configuring a digital input which selects either SP1 or SP2. This might be used, for example, to switch between normal running conditions and standby conditions. If Rate Limit is switched off the new setpoint value is adopted immediately when the switch is changed.

- A programmer generating a setpoint which varies over time, see "Setpoint Programmer" on page 238. When the programmer is running the 'Track SP' and 'Track PV' parameters update continuously so that the programmer can perform its own servo (see also "Servo" on page 247). This is sometimes referred to as 'Program Tracking'.

- From a Remote analog source. The source could be an external analog input into an analog input module wired to the 'Alt SP' parameter or a User Value wired to the 'Alt SP' parameter. The remote setpoint is used when the parameter 'Alt SP Select' is set to 'Yes'.

Setpoint tracking (sometimes referred to as Remote Tracking) helps ensure that the Local setpoint adopts the Remote setpoint value when switching from Local to Remote to maintain bumpless transfer from Remote to Local. Bumpless transfer does not take place when changing from Local to Remote.

Note: If Rate Limit is applied the setpoint will change at the rate set when changing from Local to Remote.

Manual Tracking

When the controller is operating in manual mode the currently selected SP (SP1 or SP2) tracks the PV. When the controller resumes automatic control there will be no step change in the resolved SP. Manual tracking does not apply to the remote setpoint or programmer setpoint.

Output Function Block

The output function block allows you to set up output conditions from the control block, such as output limits, hysteresis, output feedforward, behavior in sensor break, and so on.

Folder – Loop.1 to Loop.16		Sub-folder: OP			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Output High Limit	Maximum output power delivered by channels 1 and 2. By reducing the high power limit, it is possible to reduce the rate of change of the process, take care however, as reducing the power limit will reduce the controllers ability to react to disturbance.	Between Output Lo and 100.0%		100.0	Oper
Output Low Limit	Minimum (or maximum negative) output power delivered by channels 1 and 2.	Between Output Hi and -100.0%		-100.0	
Ch1 Out	Channel 1 (Heat) output. The Ch1 output is the positive power values (0 to Output Hi) used by the heat output. Typically this is wired to the control output (time proportioning or DC output).	Between Output Hi and Output Lo			R/O
Ch2 Out	The Ch2 output is negative portion of the control output (0 – Output Lo) for heat/cool applications. It is inverted to be a positive number so that it can be wired into one of the outputs (time proportioning or DC outputs).	Between Output Hi and Output Lo			R/O
Ch2 DeadBand	Ch1/Ch2 Deadband is a gap in percent between output 1 going off and output 2 coming on and vice versa. For on/off control this is taken as a percentage of the hysteresis.	Off to 100.0%		Off	Oper
Rate	Limits the rate at which the output from the PID can change in % change per minute. Output rate limit is useful in stopping rapid changes in output from damaging the process or the heater elements.	Off to 9999.9 percent per minute		Off	Oper
Rate Disable	Output rate disable	No Yes	Enabled Disabled		Oper
Ch1 OnOff Hysteresis	Channel hysteresis only shown when channel 1 is configured as OnOff.	0.0 to 200.0		10.0	Oper
Ch2 OnOff Hysteresis	Hysteresis sets the difference between output on and output off to reduce (relay) chatter.	0.0 to 200.0		10.0	Oper
SensorBreak Mode	Defines the action taken if the Process Variable is bad, i.e. a sensor break has occurred. This can be configured as hold, in which case the output of the loop is held at its last good value. Alternatively the output can switch to a 'safe' output power defined at configuration.	Safe Hold	To select the level set by 'Safe OP' To hold the current output level at the point when sensor break occurs	Safe	Oper
Safe OP Val	Sets the output level to be adopted when loop is inhibited.	Between Output Hi and Output Lo		0	Oper
SbrkOp	Sets the output level to be adopted when in sensor break condition.	Between Output Hi and Output Lo		0	Oper

Folder – Loop.1 to Loop.16		Sub-folder: OP			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Manual Mode	Selects the mode of manual operation.	Track	In auto the manual output tracks the control output such that a change to manual mode will not result in a bump in the output.		Oper
		Step	On transition to manual the output will be the manual op value as last set by the operator.		
ManualOutVal	The output when the loop is in manual. Note: In manual mode the controller will still limit the maximum power to the power limits, however, it is recommended that the instrument is not left unattended at a high power setting. It is important that the over range alarms are configured to protect your process. *We recommend that all processes are fitted with an independent over range "policeman"*	Between Output Hi and Output Lo			Read Only
ForcedOP	Forced manual output value. When 'Man Mode' = 'Step' the manual output does not track and on transition to manual the target output will step from its current value to the 'ForcedOP' value.	-100.0 to 100.0		0.0	Oper
Cool Type	Selects the type of cooling channel characterization to be used. Can be configured as water, oil or fan cooling.	Linear Oil Water Fan	These are set to match the type of cooling medium applicable to the process		Conf
FeedForward Type	Feedforward type The following four parameters appear if FF Type ≠ None	None	No signal fed forward	None	Conf
		Remote	A remote signal fed forward		
		SP	Setpoint fed forward		
		PV	PV fed forward		
FeedForward Gain	Defines the gain of the feedforward value, the feed forward value is multiplied by the gain.				Conf
FeedForward Offset	Defines the offset of the feedforward value this is added to the scaled feedforward.				Oper
FeedForward Trim Limit	Feedforward trim limits the effect of the PID output. Defines symmetrical limits around the PID output, such that this value is applied to the feedforward signal as a trim.				Oper
FF_Rem	Remote Feedforward signal. Allows an another signal to be used as Feedforward.	This is not affected by FeedForward Gain or Offset			Read Only
FeedForward Val	The calculated Feedforward Value.				Read Only
TrackOutVal	Value for the loop output to track when OP Track is Enabled.				
Track Enable	When enabled, the output of the loop will follow the track output value. The loop will bumplessly return to control when tracking is turned off.	Off On	Disabled Enabled		Oper
RemOPL	Remote output low limit. Can be used to limit the output of the loop from a remote source or calculation. This must always be within the main limits.	-100.0 to 100.0			Oper
RemOPH	Remote output high limit	-100.0 to 100.0			Oper

Output Limits

The diagram shows where output limits are applied.
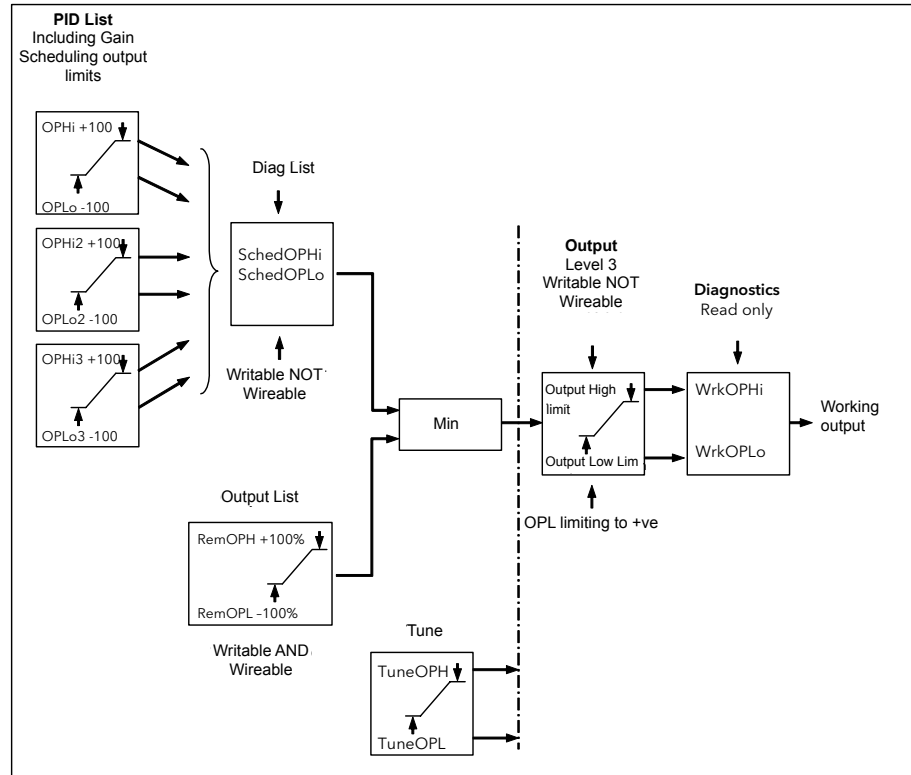
Figure 130 Output Limits

- Individual output limits may be set in the PID list for each set of PID parameters when gain scheduling is used.

- The parameters 'SchedOPHi' and 'SchedOPHLo', found the Diagnostics folder, may be set to values which override the gain scheduling output values.

- A limit may also be applied from an external source. These are 'RemOPH' and 'RemOPLo' (Remote output high and low) found in the Output folder. These parameters are wireable. For example they may be wired to an analog input module so that a limit may applied through some external strategy. If these parameters are not wired +100% limit is applied every time the instrument is powered up.

- The tightest set (between Remote and PID) is connected to the output where an overall limit is applied using parameters 'Output High Limit' and 'Output Low Limit' settable in Oper Level.

- 'Wrk OPHi' and 'Wrk OPHLo' found in the Diagnostics folder are read-only parameters showing the overall working output limits.

The tune limits are a separate part of the algorithm and are applied to the output during the tuning process. The overall limits 'Output High Limit' and 'Output Low Limit' always have priority.

Output Rate Limit

The output rate limiter is a simple rate of change limiter which will stop the control algorithm demanding step changes in output power. It may be set in percent per minute.

The rate limit is performed by determining the direction in which the output is changing, and then incrementing or decrementing the Working Output ('ActiveOut' in the Main folder) until 'ActiveOut' = the required output.

The amount by which to increment or decrement will be calculated based on the sampling rate of the algorithm (i.e. 110ms) and the rate limit that has been set. If the change in output is less than the rate limit increment the change will take effect immediately.

The rate limit direction and increment will be calculated on every execution of the rate limit. Therefore, if the rate limit is changed during execution, the new rate of change will take immediate effect. If the output is changed whilst rate limiting is taking place, the new value will take immediate effect on the direction of the rate limit and in determining whether the rate limit has completed.

The rate limiter is self-correcting such that if the increment is small and is lost in the floating point resolution, the increment will be accumulated until it takes effect.

The output rate limit will remain active even if the loop is in manual mode.

Sensor Break Mode

Sensor break is detected by the measurement system and a flag is passed to the control block which indicates sensor break. On the loop being informed that a sensor break has occurred it may be configured using 'SensorBreak Mode' to respond in one of two ways. The output may go to a pre-set level or remain at its current value.

The pre-set value is defined by the parameter 'SbrkOP'. If rate limit is not configured the output will step to this value otherwise it will ramp to this value at the rate limit.

If configured as 'Hold' the output of the loop will stay at its last good value. If Output Rate Limit (Rate) has been configured a small step may be seen as the working output will limit to the 2 second old value.

On exit from sensor break the transfer is bumpless – the power output will ramp from its pre-set value to the control value.

Forced Output

This feature enables the user to specify what the output of the loop should do when moving from automatic control to manual control. The default is that the output power will be maintained and is then editable by the user. If forced manual is enabled, two modes of operation can be configured. The forced manual step setting means the user can set a manual output power value and on transition to manual the output will be forced to that value. If 'Track Enable' is enabled the output steps to the forced manual output and then subsequent edits to the output power are tracked back into the manual output value.

The parameters associated with this feature are 'ForcedOP' and 'ManualMode' = 'Step'.

Feedforward

Feedforward is a value, which is scaled and added to the PID output, before any limiting. It can be used for the implementation of cascade loops or constant head control. Feedforward is implemented such that the PID output is limited to trim limits and acts as a trim on a FeedForward Value. The FeedForward Val is derived either from the PV or setpoint by scaling the PV or SP by the 'FeedForward Gain' and 'FeedForward Offset'. Alternatively, a remote value may be used for the FeedForward Val, this is not subject to any scaling. The resultant FeedForward Val is added to the limited PID OP and becomes the PID output as far as the output algorithm is concerned. The feedback value then generated must then have the FF contribution removed before being used again by the PID algorithm. The diagram below shows how feedforward is implemented.
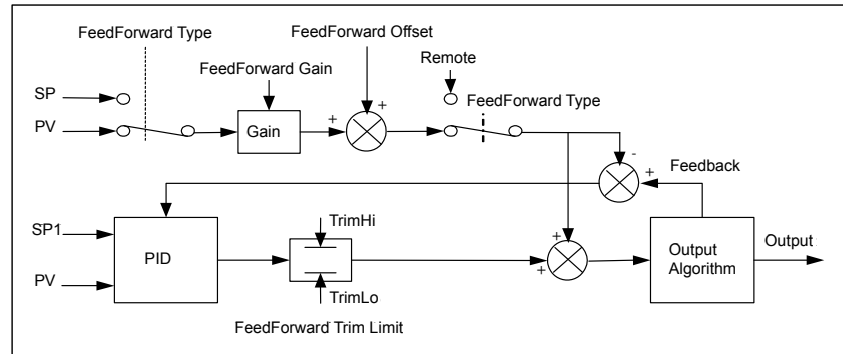
Figure 131 Implementation of Feedforward

Effect of Control Action, Hysteresis and Deadband

For temperature control 'Loop.1.Control Action' will be set to 'Reverse'. For a PID controller this means that the heater power decreases as the PV increases. For an on/off controller output 1 (usually heat) will be on (100%) when PV is below the setpoint and output 2 (usually cool) will be on when PV is above the setpoint.

Hysteresis applies to on/off control only. It defines the difference in temperature between the output switching off and switching back on again. The examples below show the effect in a heat/cool controller.

Deadband (Ch2 DeadB) can operate on both on/off control or PID control where it has the effect of widening the period when no heating or cooling is applied. However, in PID control its effect is modified by both the integral and derivative terms. Deadband might be used in PID control, for example, where actuators take time to complete their cycle, to stop heating and cooling being applied at the same time. Deadband is likely to be used, therefore, in on/off control only. The second example below adds a deadband of 20 to the above example.
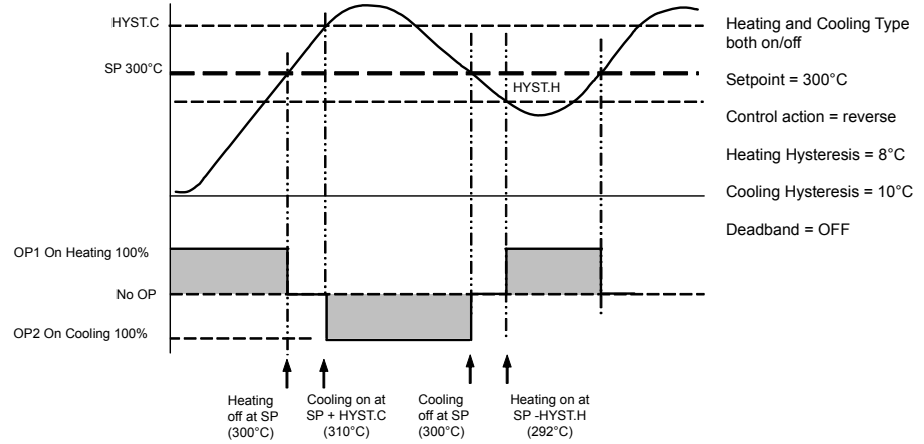
Figure 132 Deadband OFF
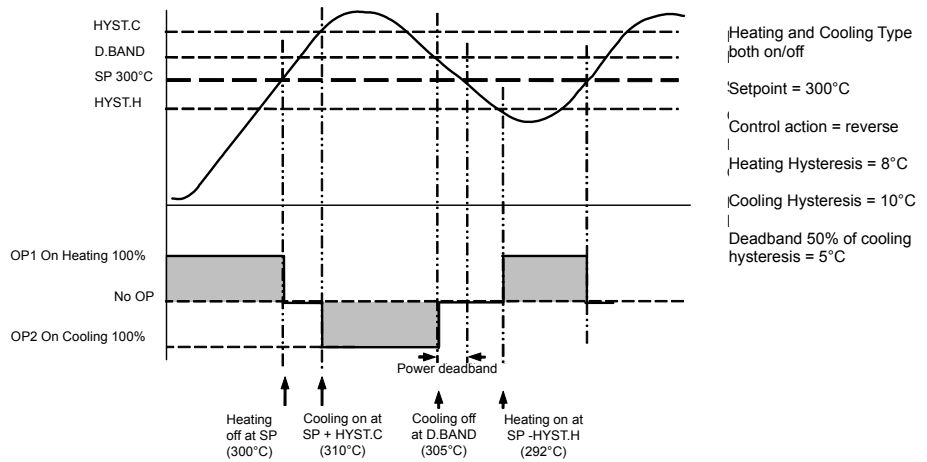
Figure 133 Deadband ON set at 50% of Cooling. Hysteresis = 5°C

Setpoint Programmer

Introduction to Setpoint Programmer

In a setpoint programmer you can set up a profile in the controller in which the setpoint varies in a pre-determined way over a period of time. Temperature is a very common application where it is required to 'ramp' the process value from one level to another over a set period of time.

The program is divided into a flexible number of segments - each being of a single time duration.

It is often necessary to switch external devices at particular times during the program. Up to eight digital 'event' outputs can be programmed to operate during those segments.

An example of a program and two event outputs is shown below.
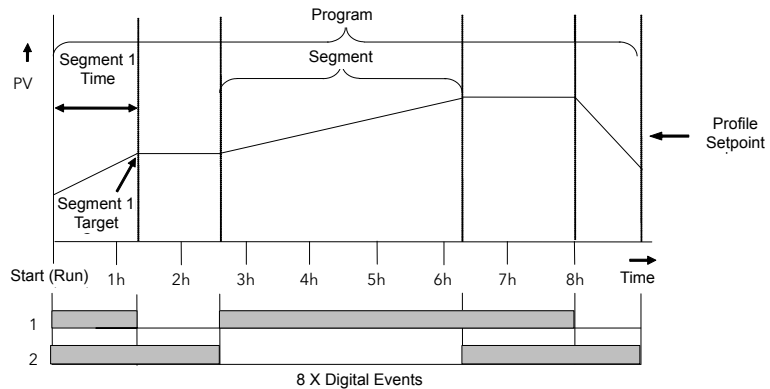
Figure 134 A Setpoint Program

Time to Target Programmer

Each segment consists of a single duration parameter and a set of target values for the profiled variables.

- The duration specifies the time that the segment takes to change the profiled variables from their current values to the new targets.

- A dwell type segment is set up by leaving the target setpoint at the previous value.

- A Step type segment is set up by setting the segment time to zero.

A program with all segments configured as Time-to-Target is shown below.
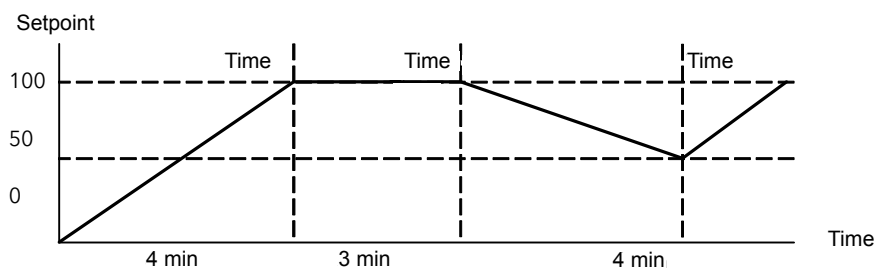
Figure 135 Time-to-Target Programmer

Ramp Rate Programmer

A ramp rate programmer specifies its ramp segments as maximum setpoint changes per time unit.

Each segment can be specified by the operator as Ramp Rate, Dwell or Step.

Ramp Rate	The setpoint changes at a rate in units/time.
Dwell	The time period is set – there is no need to set the target value as this is inherited from the previous segment.
Step	Specify target setpoint only – the controller will use that setpoint when the segment is reached.

The diagram below shows an example of a ramp rate programmer.
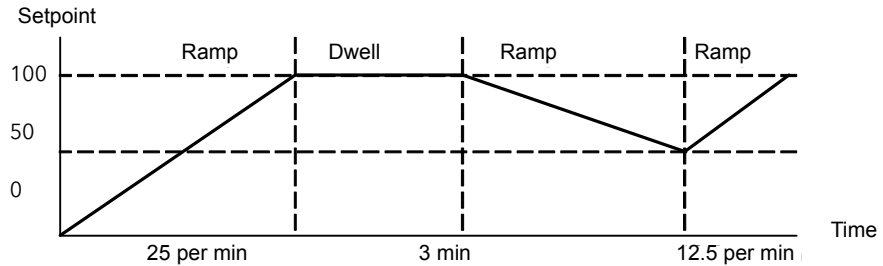
Figure 136 Ramp Rate Programmer

Mini8 Controller Programmer Block(s)

Mini8 Controller Version 2.xx have eight programmer blocks available. Each of these blocks has one program of up to 16 segments. One block may be wired to all 16 loops or up to eight loops may have their own programmer block. In this situation Loop 1, Programmer block 1 and program 1 are associated together, Loop 2, Programmer block 2 and program 2 are associated together, and so on up to Loop 8, Programmer block 8 and program 8 being associated together.

Mini8 Controller Version 1.xx have a single programmer block. The total number of segments available is 200 or 50 per program and it is possible to store up to 50 separate programs. Parameter tables of this version are included in "Version 1.xx Programmer" on page 344.

Note: Version 1.xx Mini8 controller clone files with programs included will not load correctly into a version 2.xx Mini8.

Segment Types

Depending on the type of program configured, a segment may be set as:

Ramp

A Ramp segment provides a controlled change of setpoint from an original to a target setpoint. The duration of the ramp is determined by the rate of change specified. Two styles of ramp are possible in the range, Ramp-Rate or Time-To-Target.

The segment is specified by the target setpoint and the desired ramp rate. The ramp rate parameter is presented in engineering units (°C, °F, Eng.) per real time units (seconds, minutes or hours). If the units are changed, all ramp rates are re-calculated to the new units and clipped if necessary.

Dwell

The setpoint remains constant for a specified period at the specified target. The operating setpoint of a dwell is inherited from the previous segment.

Step

The setpoint changes instantaneously from its current value to a new value at the beginning of a segment. A Step segment has a minimum duration of 1 second.

Time

A Time segment defines the duration of the segment. In this case the target setpoint is defined and the time taken to reach this value. A dwell period is set by making the target setpoint the same value as the previous setpoint.

GoBack

Go Back allows segments in a program to be repeated a set number of times. The diagram shows an example of a program which is required to repeat the same section a number of times and then continue the program.
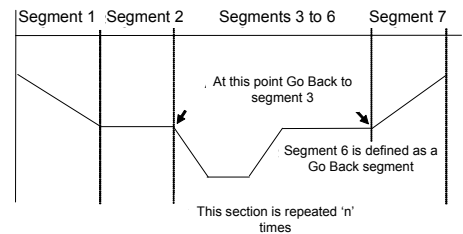
When planning a program it is advisable to ensure that the start and end setpoints of the program are the same otherwise it will step to the different levels. A 'Go Back' segment is defined when editing a program.

'Goback Seg' specifies the segment to go back to.

'Goback Cycles' specifies the number of times the goback loop is executed.

Overlapping Goback loops are disallowed.
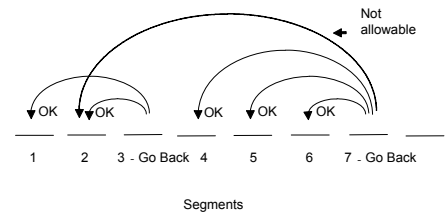
Figure 137 Go Back

Figure 137 Go Back Loops

Notes:

1. If a second or more 'Go Back' segments are created, they cannot return to a segment before the previous 'Go Back' segment as shown.
2. In this diagram a 'Go Back' segment can be created from 3 to 2 or 1. Go Back segments can also be created from 7 to 6 or 5 or 4 but not from 7 to 2 or 1.

Wait

Wait specifies the criterion for which a segment cannot proceed to the next segment. Any segment can be defined as 'Wait' in the 'Program Edit' page. The next parameter is then 'Wait For' and here you define the criterion.

'Wait For' criteria:

None	No action
PrgIn1	Wait until Input 1 is true
PrgIn2	Wait until Input 2 is true
PrgIn1n2	Wait until Input 1 AND Input 2 are true
PrgIn1or2	Wait until Input 1 OR Input 2 is true
PVWaitIP	Wait until PV has met the criteria against the parameter 'WaitVal' as shown:

'Wait For' set to 'PVWaitIP' PSP = 100 'WaitVal' = 5	
PVWait	Segment will wait until
Abs Hi	PVWaitIP >= 5
Dev Lo	PVWaitIP >= 95
Abs Lo	PVWaitIP <= 5
Dev Hi	PVWaitIP <= 105

Example where the temperature must have reached 550°C before the program continues:
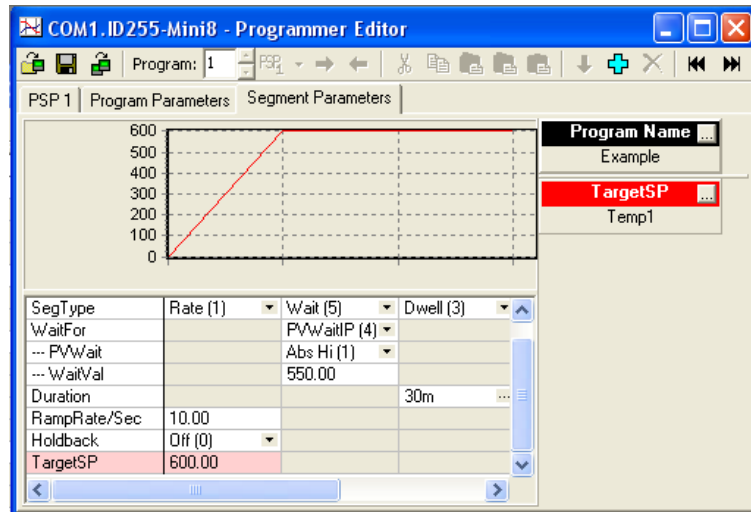
Figure 138 Example use of 'Wait'

This and subsequent screenshots are from the Programmer editor in iTools.

Wait segments do not have Events or Holdback.

End

A program may contain one End segment. This allows the program to be truncated to the number of segments required.

The end segment can be configured to have an indefinite dwell at the last target setpoint or to reset to the start of the program or to go to a defined level of power output (SafeOP). This is selectable by the user.

If a number of program cycles are specified for the program, then the End segment is not executed until the last cycle has completed.

Output Events

Program segments have configurable events. 'Wait' 'GoBack' and 'End' segments do not have events.

There are up to eight digital events, PV Events and Time Events.

Digital Events

These are digital flags which can be set on or off for each of the segments.

These are enabled by setting Programmer.n.Setup.MaxEvents to the required maximum number of events (>0 and <=8).

Figure 139 Digital Events

Clicking the icon on the right in an 'EventOuts' cell opens digital events window:

Figure 140 EventOuts Window

In this example Programmer.n.Setup.MaxEvents has been set to 4. Tick the boxes of the outputs that are required. The value shown is the bit mask for the outputs (10 = 2 + 8 i.e. outputs 2 and 4)

The EventOuts row above shows this setup for each segment.

PV Event & User Value

PV Events are essentially a simplified analog alarm per segment based on the programmer PV input. For this feature the Programmer.n.Setup.EnablePVEvent must be set to 'Yes'. The PV Event Output (PVEventOP) may be used to trigger the required response.

- Each Segment has one PV Event Type (Off, Hi, Lo, Dev Hi, Dev Lo, Dev Band*)

- Each Segment has one PV Threshold

* Dev refers to deviation of the PV parameter from Programmer Setpoint (i.e. there is no reference input).

If the PVEvent type is set to None in a segment then the User value may be used as a general-purpose analog value per segment. For this feature the Programmer.n.Setup.EnableUValue must be set to 'Yes'. By default, the parameter is named 'UserVal' – it may be renamed in Programmer.n.Setup.UValName.

	1	2	3
SegType	Rate (1)	Wait (5)	Dwell (3)
WaitFor		PVWaitIP (4)	
--- PVWait		None (0)	
Duration			30m
RampRate/Sec	10.00		
Holdback	Off (0)		
TargetSP	600.00		
PVEvent	None (0)		Dv Band (5)
--- PVThreshold			0.00
UserVal	0.00		

Figure 141 PV Event and User Value

In segment 1 there is no PVEvent so the UserVal may be set but in segment 3 the PVEvent type is not 'None' so only the PVThreshold may be set.

The event output is Programmer.n.Setup.PVEventOP, the UserVal output is Programmer.n.Setup.UserValOP.

Time Event

Digital events can simply be the turning on of a digital output for the duration of a segment. An extension of this is the Time Event. For this feature Programmer.n.Setup.MaxEvents must be > 0 and the Programmer.n.Setup.EnableTimeEvent must be set to 'Yes'. In this case the first digital event Event1 can have a delay (On Time) and an (Off Time) specified. 'On Time' defines when the digital output will turn on after the beginning of the segment and 'Off Time' defines when the digital output will turn off. The reference point for the On and Off times is the start of the segment.

- Only the first digital event Event1 may be configured as a Time Event.

- Each segment has one Time Event parameter (OFF, Event1).

- The first digital event cannot be set (read only if TimeEvent is not OFF).

The following example of a timed event in segment 3 shows that Programmer.n.Setup.EventOut1 will be on for 10 minutes during segment 3 starting 10 minutes after segment 3 begins.

	1	2	3
SegType	Rate (1) ▾	Wait (5) ▾	Dwell (3) ▾
WaitFor		PVWaitIP (4) ▾	
--- PVWait		None (0) ▾	
Duration			30m ...
RampRate/Sec	10.00		
Holdback	Off (0) ▾		
TargetSP	600.00		
TimeEvent	Off (0) ▾		Event1 (1) ▾
--- OnTime			10m ...
--- OffTime			20m ...
EventOuts	..:. ...		....

Figure 142 Example Timed Event

Editing of the Time Events follows a number of simple rules to make programming easier for the operator - these are shown in the three diagrams below:
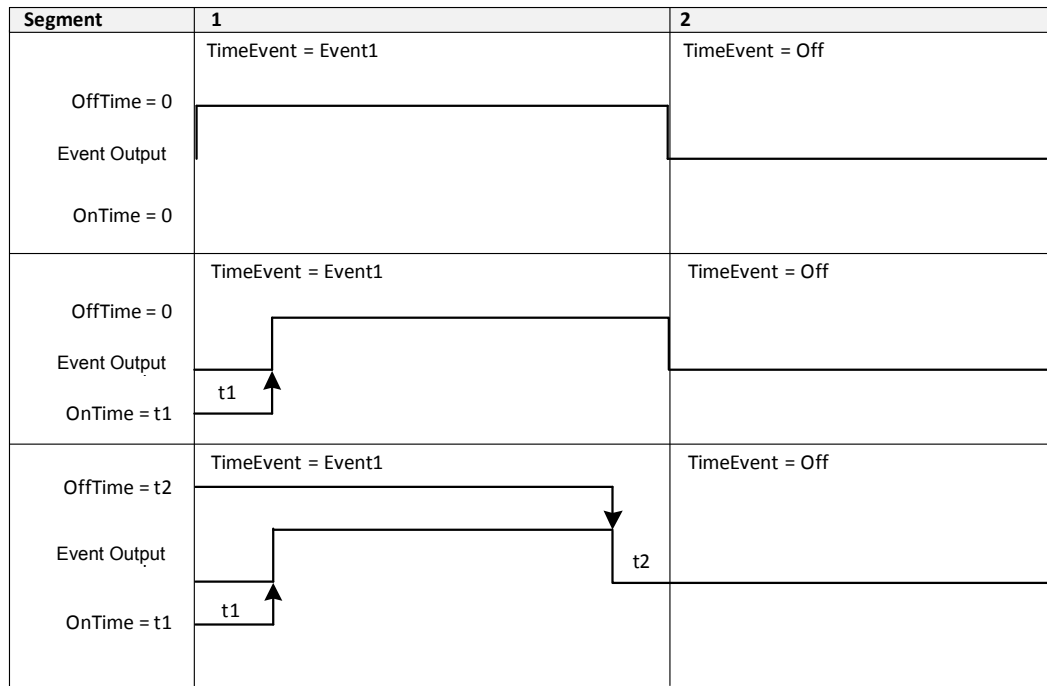
Figure 143 Editing of Time Events (1)
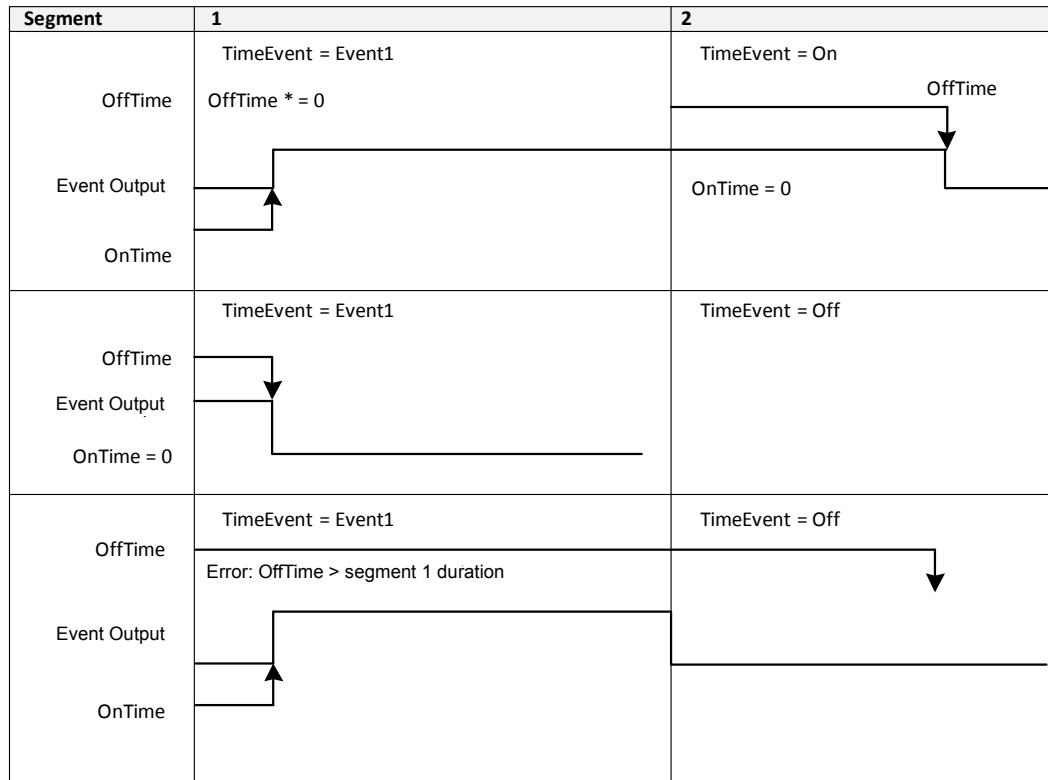
Figure 144 Editing of Time Events (2)

To configure an event which straddles two segments configure T_{on} (OnTime) in Segment n and T_{off} (OffTime) in segment n+1.
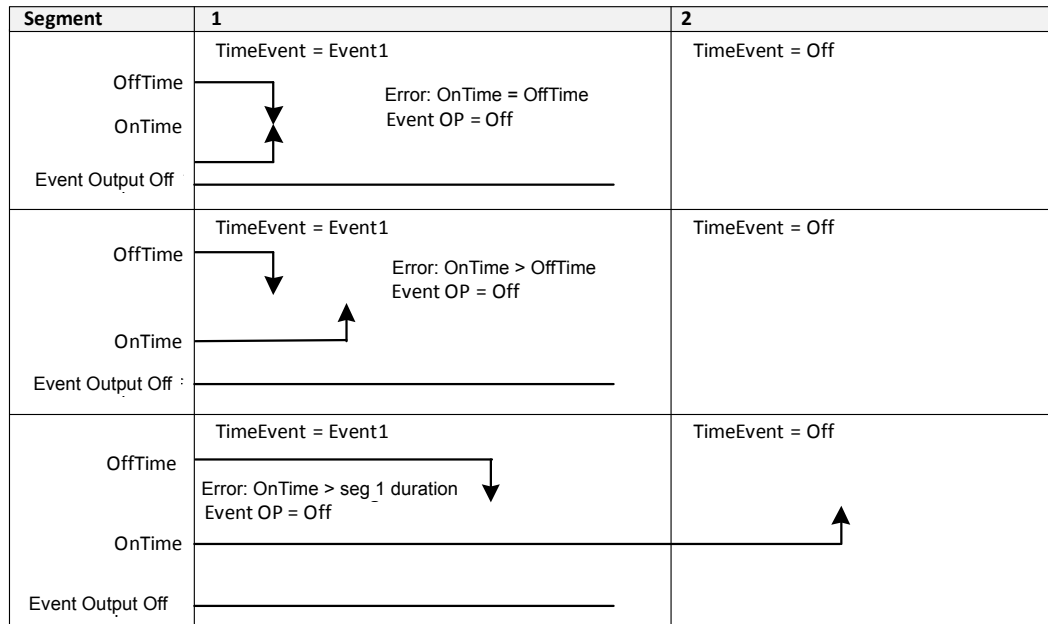
Figure 145 Editing of Time Events (3)

OnTime and OffTime are extended by G.Soak periods. If OnTime = 0, the output goes Hi at the start of the segment but OffTime is not decremented while Gsoak Wait is applied. Timed event outputs are on a total of Gsoak Wait + (OffTime – OnTime).

In the event of a power interruption, time events timing will be unaffected.

Holdback

Holdback freezes the program if the process value (PV) does not track the setpoint (SP) by more than a user-defined amount. The programmer will remain in HOLDBACK until the PV returns to within the requested deviation from setpoint.

In a Ramp it indicates that the PV is lagging the SP by more than the set amount and that the program is waiting for the process to catch up.

Holdback maintains the correct soak period for the product – see "'Guaranteed Soak'" on page 246.

Each program can be configured with a holdback value. Each segment determines the holdback function.

Holdback will cause the execution time of the program to extend, if the process cannot match the demanded profile.

Holdback state will not change access to the parameters. The parameters will behave as if in the RUN state.

The diagram below demonstrates that the demanded setpoint (SP) will only change at the rate specified by the program when the PV's deviation is less than the holdback value. When the deviation between the setpoint and PV is greater than the holdback value (HBk Val) the setpoint ramp will pause until the deviation returns to within the band.

The next segment will not start until the deviation between Setpoint and PV is less than the holdback value.

Four types of Holdback are available:-

None	Holdback is disabled for this segment.
High	Holdback is entered when the PV is greater than the Setpoint plus HBk Val.
Low	Holdback is entered when the PV is lower than the Setpoint minus HBk Val.
Band	Holdback is entered when the PV is either greater than the Setpoint plus HBk Val or lower than the Setpoint minus HBk Val.

'Guaranteed Soak'

'Guaranteed Soak' (the time a workpiece stays at SP within a specified tolerance) is achieved in the previous single programmer version by using Holdback Band during a dwell segment. Since only one holdback value per program is available, this imposes a limitation where different tolerance values are required to specify the soak.

In 2.xx Mini8 controller Holdback Type in Dwell segments is replaced by a 'Guaranteed Soak' Type (G.Soak) which can be set as Off, Lo, Hi or Band. A 'Guaranteed Soak' Value (G.Soak Val) is available in Dwell segments and this provides the ability to set different values in any Dwell segment.
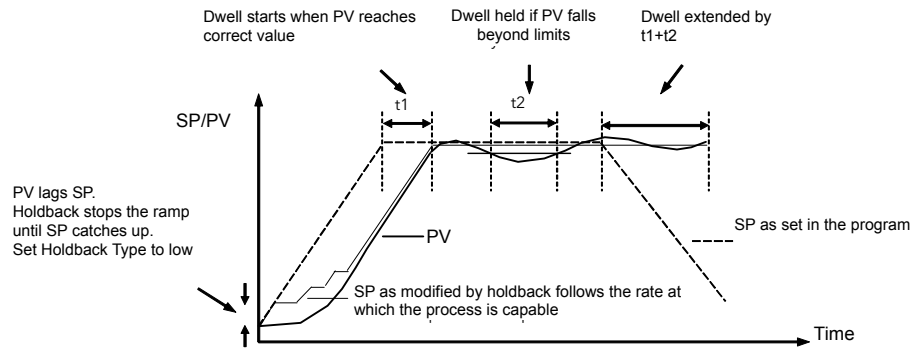
Figure 146 'Guaranteed Soak'

PID Select

It is possible to set up three sets of PID values, see "Gain Scheduling" on page 215. Any one of these sets may be activated in any segment of the program, except if the segment is configures as Wait, Goback or End. For this feature Programmer.n.Setup.EnablePIDSched must be set to 'Yes'. The last PID set in the program (SET1 by default) will be applied during these segments. When reset the usual PID strategy for the loop takes over.

In the following example the ramp uses PID set 1 and the dwell uses PID set 2.

It also shows that the segment 2 dwell specifies that the PV will be above 595°C for the full 30 minutes.

	1		2		3	
SegType	Rate (1)	▾	Dwell (3)	▾	Step (4)	▾
Duration			30m	···		
RampRate/Sec	10.00					
Holdback	Off (0)	▾			Off (0)	▾
TargetSP	600.00				0.00	
GSoakType			Low (1)	▾		
--- GSoakVal			5.00			
PIDSet	Set1 (1)	▾	Set2 (2)	▾	Set1 (1)	▾
EventOuts	....	···	....	···	....	···

Figure 147 PID Select

Program Cycles

If the Program Cycles parameter is chosen as greater than 1, the program will execute all its segments, then repeat from the beginning. The number of cycles is determined by the parameter value. The Program Cycles parameter has a range of 0 to 999 where 0 is enumerated to CONTinuous.

Servo

Servo can be set in configuration so that when a program is run the setpoint can start from the initial controller setpoint or from the current process value. Whichever it is, the starting point is called the servo point. This can be set in the program.

Servo to PV will produce a smooth and bumpless start to the process.

Servo to SP may be used in a Ramp Rate programmer to specify the time period of the first segment.

Note: In a Time to Target programmer the segment duration will always be determined by the setting of the Segment Duration parameter.

Power Interruption Recovery

In the event of power interruption to the Mini8 controller, a strategy may be set in configuration level, which defines how the controller behaves on restoration of the power.

The action on power interruption is selected using Programmer.n.Setup.PowerFailAct and offers:

Ramp	This will servo the program setpoint to the measured value (the PV Input parameter value), then return to the target setpoint at the current (or previous) ramp rate. (Default). The setpoint is not allowed to step change the program setpoint. The outputs will take the state of the segment which was active before power was interrupted. See examples below.
Reset	The process is aborted by resetting the program. All event outputs will take the reset state.
Continue	The program setpoint returns immediately to its last value prior to the power down. This may cause full power to be applied to the process for a short period to heat the process back to its value prior to the power interruption.

Ramp (Power interruption during Dwell segments)

If the interrupted segment was a Dwell, then the ramp rate will be determined by the previous ramp segment.

On achieving the Dwell setpoint, the dwell will continue from the point at which the power was interrupted.

Note: If a previous ramp segment does not exist, that is, the first segment of a program is a dwell, then the Dwell will continue at the "servo to PV" setpoint.
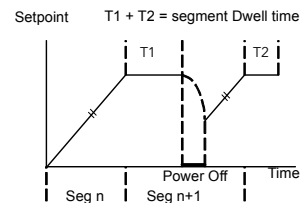
Figure 148 Ramp (Power interruption during Dwell)

Ramp (Power interruption during Ramp segments)

If the interrupted segment was a ramp, then the programmer will servo the program setpoint to the PV, then ramp towards the target setpoint at the previous ramp rate. Previous ramp rate is the ramp rate at power interruption.
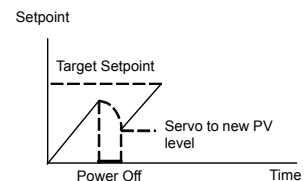
Figure 149 Ramp (Power interruption during Ramp)

Ramp (Power interruption during Time-to-target segments)

If the programmer was defined as a Time-to-Target programmer then when the power is returned the previous ramp rate will be recovered. The Time remaining will be recalculated. The rule is to maintain RAMP RATE, but alter TIME REMAINING.
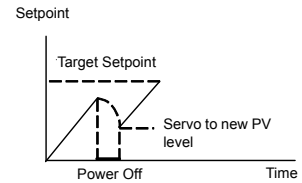
Figure 150 Ramp (Power interruption during Time-to-Target)

To Run, Hold or Reset a Program

The program is operated via parameters found in the Program Setup lists, Programmer.n.Setup.ProgRun, ProgReset, ProgHold, ProgRunReset and ProgRunHold. These parameters can be wired to digital inputs or written to over comms.

The status of the program is in Program.n.Run.ProgStatus.

Run

A program will always run – non-configured programs will default to a single Dwell end segment. In run the programmer working setpoint varies in accordance with the profile set in the active program. Parameters are Programmer.n.Setup.ProgRun or Programmer.n.Setup.ProgRunReset.

ProgRun runs the program when input goes from FALSE to TRUE.

ProgRunReset runs the program if TRUE, resets it if FALSE.

Reset

In reset the programmer is inactive and the controller behaves as a standard controller. It will:

1. Continue to control with the setpoint determined by the next available source, SP1, SP2, Alternative Setpoint.
2. Allow edits to all segments.
3. Return all controlled outputs to the configured reset state.

Parameters are Programmer.n.Setup.ProgReset or Programmer.n.Setup.ProgRunReset.

ProgReset resets the program when input goes from FALSE to TRUE.

ProgRunReset resets the program if FALSE, runs it if TRUE.

Hold

A programmer may only be placed in Hold from the Run or Holdback state. In Hold the setpoint is frozen at the current programmer setpoint and the time remaining parameter frozen at its last value. In this state you can make temporary changes to program parameters such as a target setpoint, ramp rates and times. These changes will only remain effective until the end of the currently running segment, when they will be overwritten by the stored program values.

Parameters are Programmer.n.Setup.ProgHold or Programmer.n.Setup.ProgRunHold.

ProgHold holds the program when input goes from FALSE to TRUE.

ProgRunHold runs the program if TRUE, holds it if FALSE.

Skip segment

Skip jumps immediately to the beginning of next segment and starts that segment from the current setpoint value.

Parameter is Programmer.n.Setup.SkipSeg and will skip to next segment when input goes from FALSE to TRUE.

Advance segment

Advance sets the program setpoint equal to the target setpoint and moves to the next segment.

Parameter is Programmer.n.Setup.AdvSeg and will advance to next segment when input goes from FALSE to TRUE.

Fast

Executes the program at 10x the normal speed. It is provided so that programs can be tested but the process should not be run in this state.

Parameter is Programmer.n.Run.FastRun.

PV Start

When Run is initiated PV start (for each channel) allows the program to automatically advance to the correct point in the profile which corresponds to the current PV. For example, if the process is already at PV3 when run is initiated then the program will start from the third segment as shown in the diagram below.
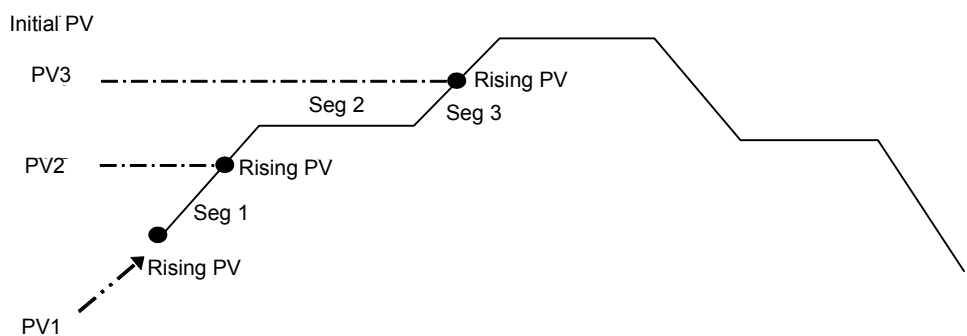
Figure 151 PV Start - Rising PV

The user may specify the start point based on a Rising PV as shown in the diagram above or on a Falling PV as shown below depending on type of profile being run.
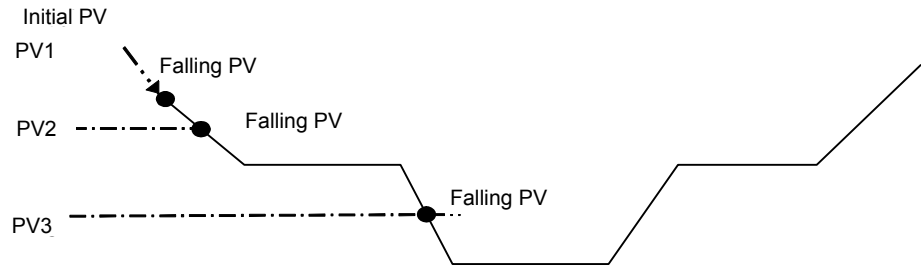
Figure 152 PV Start - Falling PV

When PV Start is used, the program always servos to PV (i.e. servo to SP will be ignored).

PV Start is enabled by setting parameter Instrument.Options.ProgPVstart to 'Yes'.

Configuring the Programmer

Programmer.n.Setup contains the general configuration settings for the Programmer Block and the parameters used to operate the programmer.

Programs are created and stored in the Program Folder.

The Programmer status can be viewed using the parameters in the Programmer.n.Run folder.

The program can also be operated by setting the Programmer.n.Run.ProgStatus parameter to the required state.

Folder – Programmer.1 to .8		Sub-folder: Setup			
Name	Parameter Description	Value		Default	Access Level
SyncIn	The synchronize input is a way of synchronizing programs. At the end of a segment the programmer will inspect the sync. input, if it is True (1) then the programmer will advance to the next segment. It is typically wired from the end of segment output of another programmer.	0 1	This will normally be wired to the 'End of Seg' parameter.		Oper
Units	Units of the Output			None	Conf
Resolution	Programmer Output resolution	X to X.XXXX		X	Conf
RateResolution	Ramp Rate Resolution	X to X.XXXX		X.X	Conf
PVIn	The programmer uses the PV input for a number of functions In holdback, the PV is monitored against the setpoint, and if a deviation occurs the program is paused. The programmer can be configured to start its profile from the current PV value (servo to PV). The programmer monitors the PV value for Sensor Break. The programmer holds in sensor break.	The PV Input is normally wired from the loop TrackPV parameter. Note: This input is automatically wired when the programmer and loop are enabled and there are no existing wires to track interface parameters. Track interface parameters are Programmer.Setup, PVInput, SPInput, Loop.SP, AltSP, Loop.SP, AltSPSelect.			Conf
SPIn	The programmer needs to know the working setpoint of the loop it is trying to control. The SP input is used in the servo to setpoint start type.	SP Input is normally wired from the loop Track SP parameter as the PV input.			Conf
Servo	The transfer of program setpoint to PV Input (normally the Loop PV) or the SP Input (normally the Loop setpoint).	PV SP	See also "Servo" on page 247.		Conf

Folder – Programmer.1 to .8		Sub-folder: Setup			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
PowerFailAct	Power interruption recovery strategy.	Ramp Reset Cont	See "Power Interruption Recovery" on page 248.		Conf
Max Events	To set the maximum number of output events required for the program. This is for convenience to avoid having to scroll through unwanted events when setting up each segment.	1 to 8			Conf
EnablePVevent	Enable PV Event provides an alarm facility on Programmer's PVInput. PV Event Type and Threshold are defined in each Segment.	No		No	Conf
		Yes	PV Event parameters are listed in the Program Edit page.		
EnableTime Event	Enables the first Event Output to be configured as a Time Event - each segment may then specify an on and an off time, with respect to the start of the segment, for the event.	No		No	Conf
		Yes	Time Event parameters are listed in the Program Edit page		
EnableUserVal	Enables a single analog value to be set in every segment. It is only available if Ch1/Ch2Event = None in the Program Edit page.	No	User value not shown	No	Conf
		Yes	User value shown in every segment		
UValName	User Value Name			UserVal	Conf
EnableGsoak	Enable 'Guaranteed Soak' to keep the work piece at the specified dwell setpoint for a minimum of the specified duration. This parameter is only shown for SyncStart programmers.	No	No 'GuaranteedSoak'	No	Conf
		Yes	'Guaranteed Soak' parameters are listed in the Program Edit page for all Dwell segments.		
Enable DelayedStart	Enables a time period to be set between starting Run and the program actually running.	No	The program will run immediately	No	Conf
		Yes	Delayed start is listed in the Program Status page. It is also listed in the pop up associated with the RUN/HOLD key.		
Enable PID Set	Enables PID set. The setting configured in each segment will automatically select the relevant PID Set for the loop wired to the Programmer. Upon completion of the program, PID setting of the loop will be reset to values prior to execution of the program.	No	Each segment uses the same PID values	No	Conf
EnableImmPSP	Enable immediate PSP			No	
Prog Reset	Resets program on transition to true	No/Yes	Can be wired from logic inputs to provide remote program control	Yes	Oper
Prog Run	Runs program on transition to true	No/Yes		No	Oper
Prog Hold	Holds program on transition to true	No/Yes		No	Oper
ProgRunHold	Program runs if true Program holds if false	No/Yes		No	Oper
ProgRunReset	Program runs if true Program holds if false	No/Yes		No	Oper
AdvSeg	Set output to target setpoint and advance to next segment.	No/Yes			Oper
SkipSeg	Skip to the next setpoint and start the segment at the current output value.	No/Yes			Oper
PrgIn1 & 2	Programmer Digital Input 1 and 2 These are events and can be wired to any parameter. They are used in 'wait' segments to stop the program continuing until the event becomes true.	Off/On	Used in Wait segment	Off	

Folder – Programmer.1 to .8		Sub-folder: Setup			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
EventOut1 to 8	Flags showing event states	No/Yes			Read Only
End of Seg	Flag showing end of segment state	No/Yes			Read Only
ProgError	Program Issue	0 Normal 1 Sensor Break 2 Empty Program 3 Overrange			Read Only

Programmer Run Status

The 'Run' folder shows the current program status. The program can also be operated by setting the ProgStatus parameter to the required state.

Folder – Programmer.1 to .8		Sub-folder: Run		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
CurProg	Current Program Number	1	1	Read Only
DelayedStart	Time for Delayed start. Enabled in Programmer.n.Setup.EnableDelayedStart	hh:mm:ss	0	Oper
CurrSeg	Current Running Segment	1 to 255	1	Read Only
ProgStatus	Program Status	Reset Run Hold Holdback End		Oper
CurSegType	Current Segment type	End Rate Time Dwell Step Call	End	Read Only
PSP	Programmer Setpoint		0	Read Only
CyclesLeft	Number of Cycles Remaining	0 to 1000	0	Read Only
SegTimeLeft	Segment Time Remaining	Hr Min Sec Millisec	0	Read Only
SegDuration	Time remaining to end of segment			Read Only
SegTarget	Current Target Setpoint Value			Read Only
SegRate	Segment Ramp Rate	0.1 to 9999.9	0	Read Only
ProgTimeLeft	Program Time Remaining	Hrs Min Sec Millisec	0	Read Only
CyclesLeft	Number of cycles remaining			Read Only
Goback CyclesLeft	Number of go back cycles left			Read Only
FastRun	Fast Run	No (0) Normal Yes (1) Program executes at 10 times real time	No	Oper
EndOutput	End Output	Off (0) Program not in End On (1) Program at End	Off	Read Only
EventsOut	Event Outputs	0 to 255, each bit represents an output.	0	Read Only
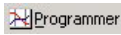
Folder – Programmer.1 to .8		Sub-folder: Run			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
ResetEventOuts	Reset Event Outputs	0 to 255, each bit resets its corresponding output		0	Oper
ResetUVal	Reset User Value				

Creating a Program

A folder exists for each Program containing a few key parameters listed below. This folder would normally be viewed via the iTools Program Editor under the Program Parameters tab. The Program Editor is used to create the segments of Program itself using the Segment Editor tab.

Folder – Program		Sub-folder: 1 to 50			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Name	Program Name	Up to eight characters		Null	Oper
Holdback Value	Deviation between SP and PV at which holdback is applied. This value applies to the whole program.	Minimum setting 0		0	Oper
Ramp Units	Time units applied to the segments	Sec	Seconds	sec	Oper
		Min	Minutes		
		Hour	Hours		
Cycles	Number of times the whole program repeats	Cont (0)	Repeats continuously	1	Oper
		1 to 999	Program executes once to 999 times		

Program Editor

The Program Editor in iTools provides the method of entering and editing programs directly in the controller. Setpoint programs can be created graphically, stored and downloaded into the controller. From the iTools menu select 'Program Editor OR

Press ![Programmer] to create/edit a Program.
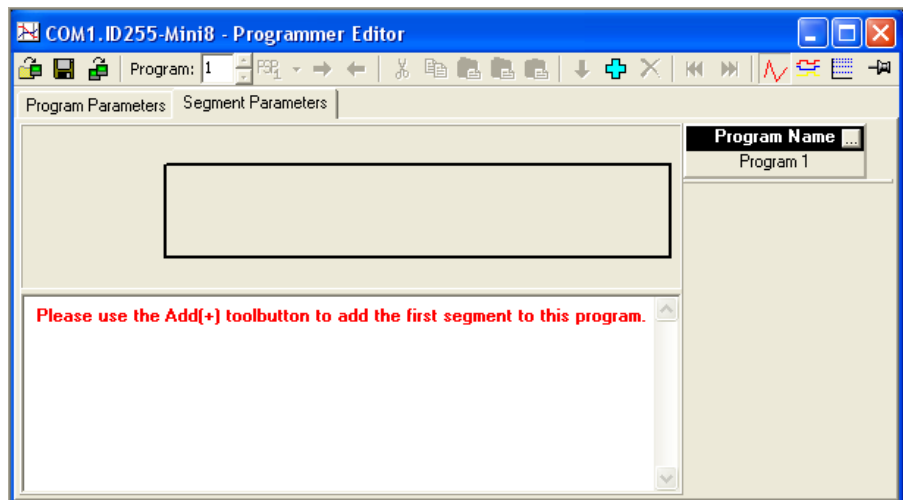
Figure 153 Blank Programmer editor – use + or Right Click to add segment

Analog View

This view is used for editing the analog setpoints.

1. Select a program number using -1 in this example.

2. Double-click ▮ Program Name ▮ and enter a name for the program - "Example".

3. Double-click ▮ TargetSP ▮ and enter a name for the TargetSP - "Temperature".

4. Right-click in the blank area and choose 'Add Segment'.

Segment Type	Description	Parameters	Values
End	Ends Program	Reset	Reset – returns to Loop setpoint
			Dwell – remains at final setpoint
			SafeOP – goes to SafeOP value
Rate	Ramp at a rate	Target SP	SP range
		Ramp rate	0.1 – 9999.9
Time	Ramp to a target over an interval	Target SP	SP range
		Duration	hh:mm:ss
Dwell	Soak at a fixed SP	Duration	hh:mm:ss
Wait	Waits for an event	Wait For	In 1 PrgIn1
			In 2 PrgIn2
			In1 AND In 2 PrgIn1n2
			In1 OR In 2 PrgIn1or2
			PV wait PVWaitIP

5. Use the drop-down to select segment type. Each segment type has the necessary parameters to suit.

6. Right-click to insert more segments. End with an 'End' segment.
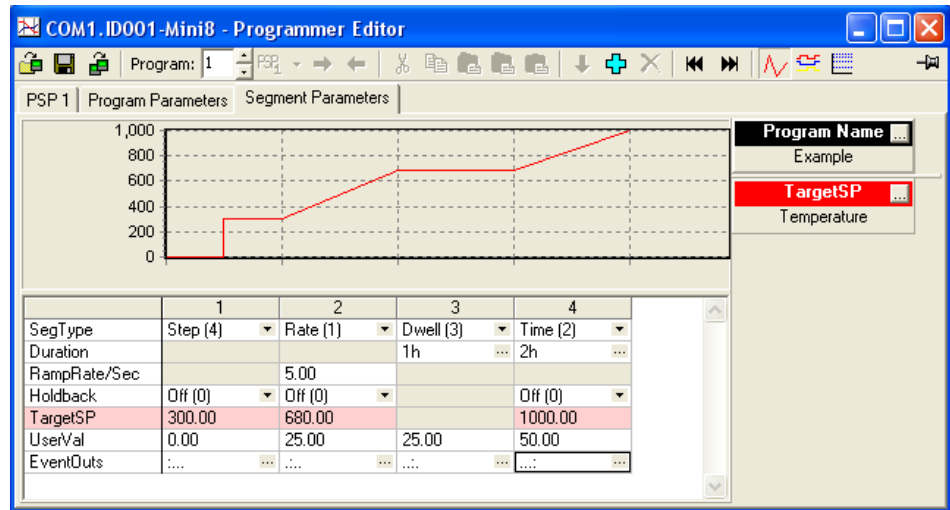
Figure 154 Spreadsheet Editor with four different segment types

Note: PSP1 tab shown in Config mode.

This tab displays all the parameters in Programmer.1.Setup folder.

With eight Programmers enabled, eight PSP tabs would be shown.
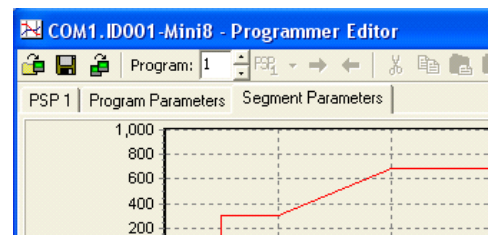
Figure 155 PSP tabs

7. Click on 'EventOuts' to set up the event outputs for each segment.

Note: Only four events have been enabled.
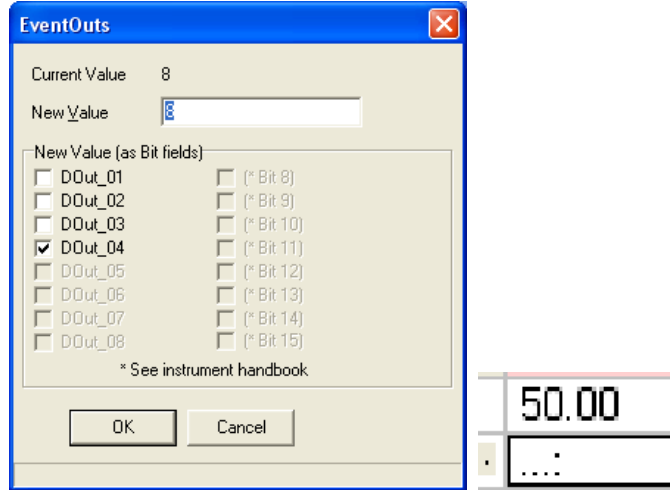
Figure 156 EventOuts with Out 4 set

In the Example program, the dots in EventOuts show which are on in each segment – O/P 1 in segment 1, O/P in segment 2, and so on.

Digital View

Alternatively, click the [icon] icon (or press Ctrl-D) and the Digital Editor is shown.
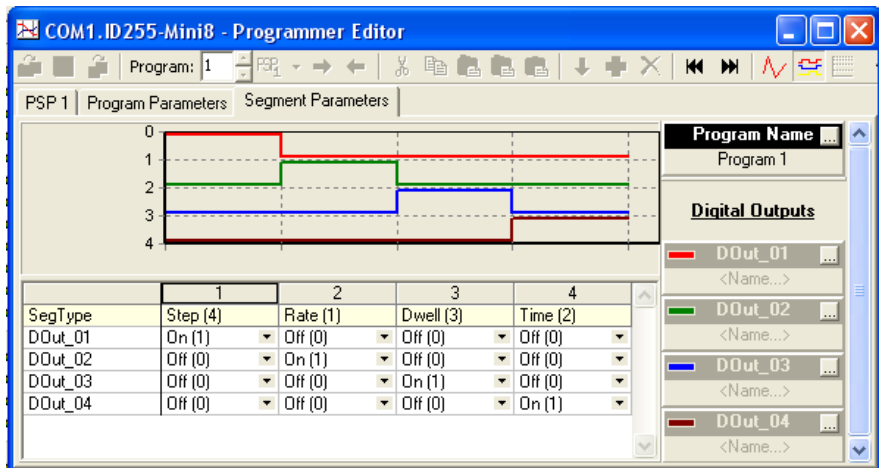
Figure 157 Digital Editor showing event outputs

8. Once the program is complete it may be saved to file, or loaded to another programmer in this Mini8 controller or in any other Mini8 also connected.

Saving & Loading Programs

If you are online to an instrument the program is already 'loaded'. Use 🖫 to save it to file. This example would be saved as 'Example.uip' and the programs for ALL the enabled programmer blocks will be saved to this file.
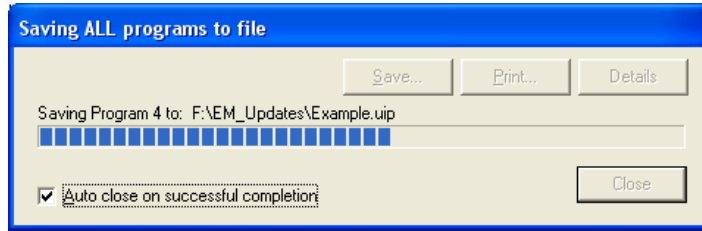
Figure 158 Saving Programs to File

Use 📂 to load a set of programs from disk to ALL the programmer blocks.
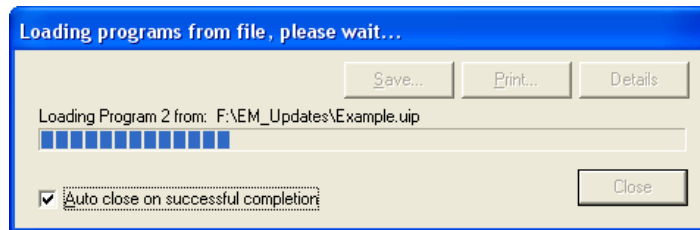
Figure 159 Loading Programs from File

Use 📂 to copy a program from one programmer to another. For this to succeed the source and destination programmer blocks must have the same features enabled – i.e. EventsOut, UserVal, and so on.

Firstly select the instrument on the network, COM1.ID001-Mini8 (or any other Mini8 controller on the network).
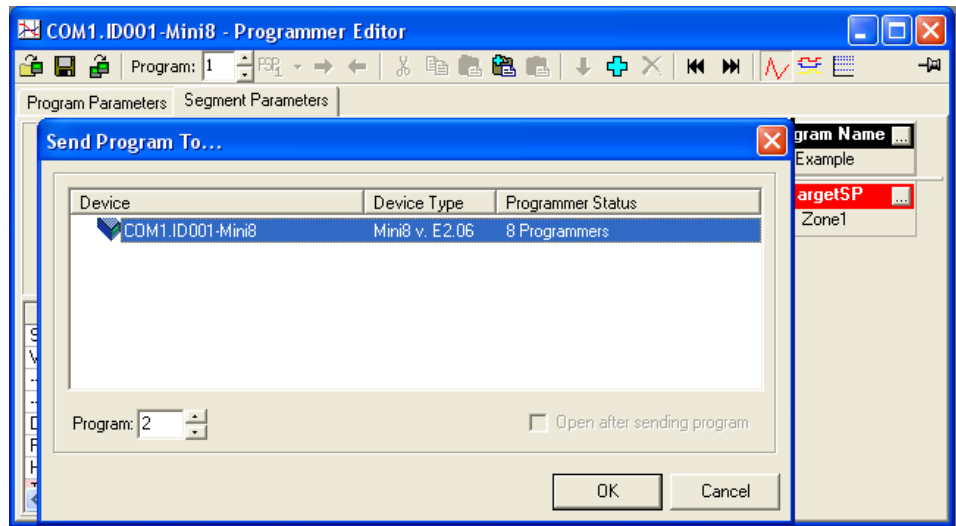
Figure 160 Send Program to...

Then set the target programmer number and click OK. In this case the program in Programmer 1 will be sent to Programmer 2.

Note: It could be sent to a programmer block in any instrument on the network.

Printing a Program

☺ Tip:

If you select all segments, Ctrl-A (or right click 'Select All') and copy spreadsheet cells they are put on the clipboard as tab-separated values which can be pasted into Microsoft Excel.

There is no direct printing support in the Programmer Editor, but you can generate a report using Microsoft Excel as follows:

1. Right-click on the graph and choose 'Copy Chart'.

2. Open a new spreadsheet in Excel and paste the chart, position as required.

3. Go back to the Programmer Editor and Choose 'Edit|Select All' followed by 'Edit|Copy'.

4. Switch to Excel, choose the top left cell for the segment data and then choose 'Edit|Paste'.

5. Optionally delete any columns that have no settings and format the cells.

6. Print the spreadsheet.

The program is listed down rather than across the page so long programs can be printed.

Wiring the Programmer Function Block

The Programmer block is invariably used with the Loop blocks. When a programmer block is placed on the graphical wiring editor it will automatically make the required connections between itself and its associated Loop block. That is, Programmer 1 with Loop1, and so on.

These connections make sure that the program setpoint goes to the loop and that 'servo' and other program options work correctly.

Note: For eight loops and eight programmers at least 60 wires are required.
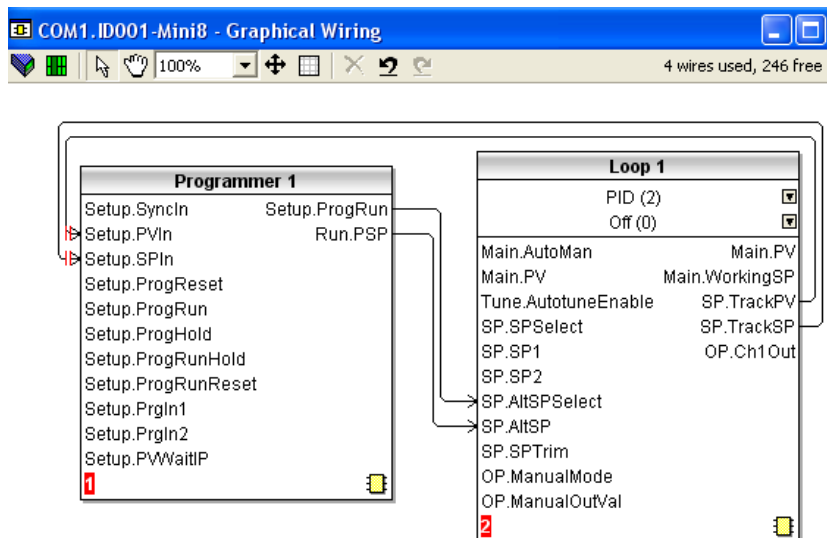
Figure 161 Wiring Programmer to Loop Block

When placing a loop block and a programmer block on the graphical wiring editor, if they are the same number (i.e. Loop.1 and Programmer.1), they will automatically wire themselves together as shown. Use this if you require up to eight loops, each with their own programmer.

In the situation where there are multiple programmer blocks, it is possible to synchronize the programmer blocks by wiring the AND of all the 'Programmer.n.Setup.EndOfSeg' outputs to all the 'Programmer.n.Setup.SyncIn' Inputs.
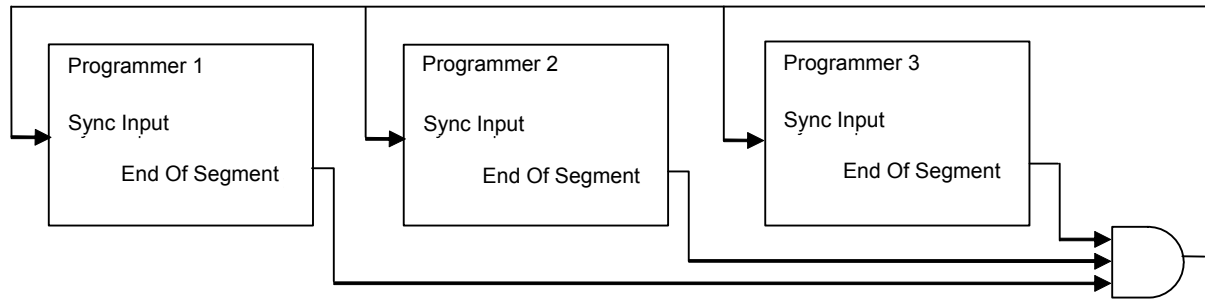
Figure 162 Synchronization of programmer blocks

If a single programmer block is used, wired to several loops then a plan has to be made about the SP & PV feedback to the programmer block. In the design below the AVERAGE PV of the three loops has been used for the PV but for the Setpoint Loop1 has been selected as the 'master' and the programmer SP feedback just taken from Loop 1.
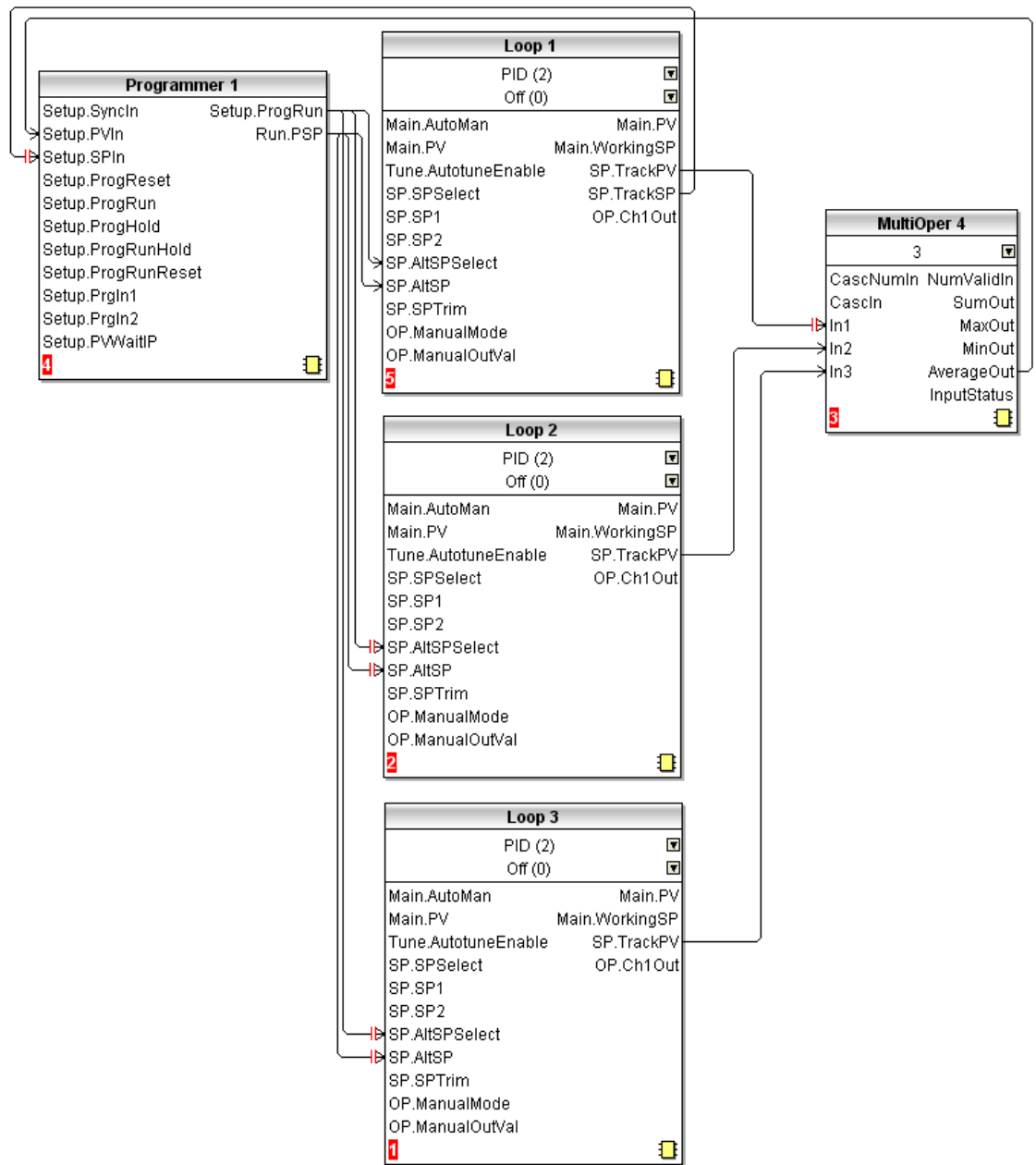
Figure 163 Single Programmer with three loops

Switch Over

This facility is commonly used in temperature applications which operate over a wide temperature range. A thermocouple may be used to control at lower temperatures and a pyrometer then controls at very high temperatures. Alternatively two thermocouples of different types may be used.

The diagram below shows a process heating over time with boundaries which define the switching points between the two devices. The higher boundary (2 to 3) is normally set towards the top end of the thermocouple range and this is determined by the 'Switch High' parameter. The lower boundary (1 to 2) is set towards the lower end of the pyrometer (or second thermocouple) range using the parameter 'Switch Low'. The controller calculates a smooth transition between the two devices.

Input 1
Low temperature
thermocouple

Mini8 Module

Input 2
High temperature
thermocouple

↑
Temperature

Controller operates entirely
on the higher temperature
device

Boundary 2/3
Boundary 1/2

Controller operates on a
combination of both devices ;

Controller operates entirely
on the lower temperature
device
↓

Time →
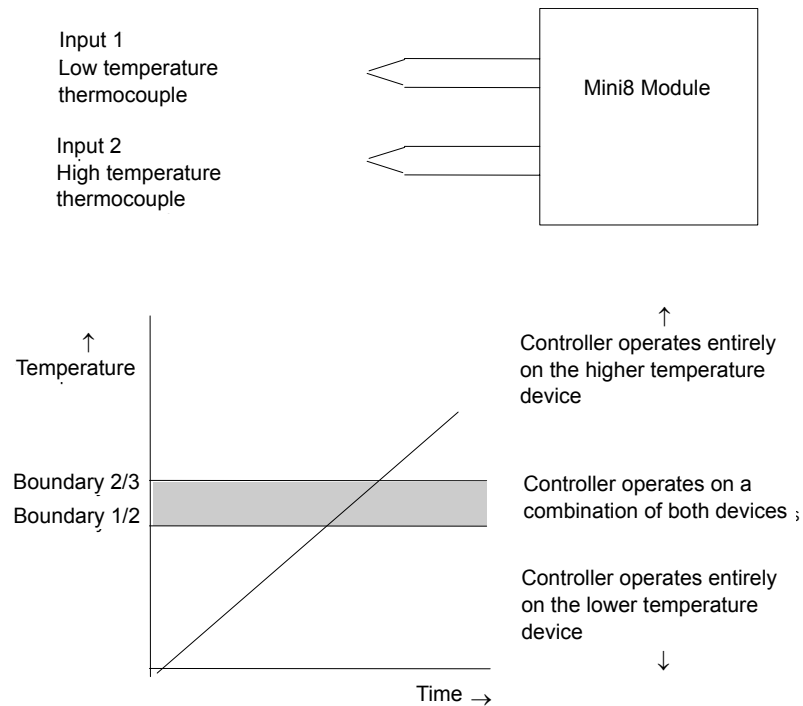
Figure 164 Thermocouple to Pyrometer Switching

Example: To Set the Switch Over Levels

Set Access to configuration level

1. Open the 'SwitchOver' Folder.

2. Set 'SwitchHigh' to a value which is suitable for the pyrometer (or high temperature thermocouple) to take over the control of the process.

3. Set 'SwitchLow' to a value which is suitable for the low temperature thermocouple to control the process.

Switch Over Parameters

Folder – SwitchOver		Sub-folders: .1			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
InHigh	Sets the high limit for the switch over block. It is the highest reading from input 2 since it is the high range input sensor.	Input range			Oper
InLow	Sets the low limit for the switch over block. It is the lowest reading from input 1 since it is the low range input sensor.				Oper
Switch High	Defines the high boundary of the switchover region.	Between Input Hi and Input Lo			Oper
Switch Low	Defines the low boundary of the switchover region.				Oper
In1	The first input value. This must be the low range sensor.	These will normally be wired to the thermocouple/pyrometer input sources via the PV Input or Analog Input Module. The range will be the range of the input chosen.			Read Only if wired
In2	The second input value. This must be the high range sensor.				Read Only if wired
Fallback Value	In the event of a bad status, the output may be configured to adopt the fallback value. This allows the strategy to dictate a 'safe' output in the event of an issue being detected.	Between Input Hi and Input Lo		0.0	Oper
Fallback Type	Fall back type	Clip Bad Clip Good Fall Bad Fall Good Upscale Downscale		Clip Bad	Conf
SelectIn	Indicates which input is currently selected	Input 1	0: Input 1 has been selected 1: Input 2 has been selected		Read Only
		Input 2	2: Both inputs are used to calculate the output		
ErrMode	The action taken if the selected input is BAD	UseGood	0: Assumes the value of a good input If the currently selected input is BAD the output will assume the value of the other input if it is GOOD	Use Good	Conf
		ShowBad	1: If selected input is BAD the output is BAD		
Out	Output produced from the two-input measurements				Read Only
Status	Status of the switchover block	Good Bad			Read Only

Transducer Scaling

The Mini8 controller includes two transducer calibration function blocks. These are software function blocks that provide a method of offsetting the calibration of the input when compared to a known input source. Transducer scaling is often performed as a routine operation on a machine to take out system deviations. For this reason it can be carried out in operator mode.

Transducer scaling can be applied to any TC8/ET8 input set up as a linear PV input. They can be wired to the transducer scaling inputs.

Three types of calibration are explained in this chapter:

- Auto-tare

- Load Cell Calibration

- Comparison Calibration

Auto-Tare Calibration

The auto-tare function is used, for example, when it is required to weigh the contents of a container but not the container itself.

The procedure is to place the empty container on the weighbridge and 'zero' the controller. Since it is likely that following containers may have different tare weights the auto-tare feature is always available.

Further parameters are available which are used to pre-configure the tare measurement or for interrogation purposes. Tare calibration may be carried out no matter what type of transducer is in use.
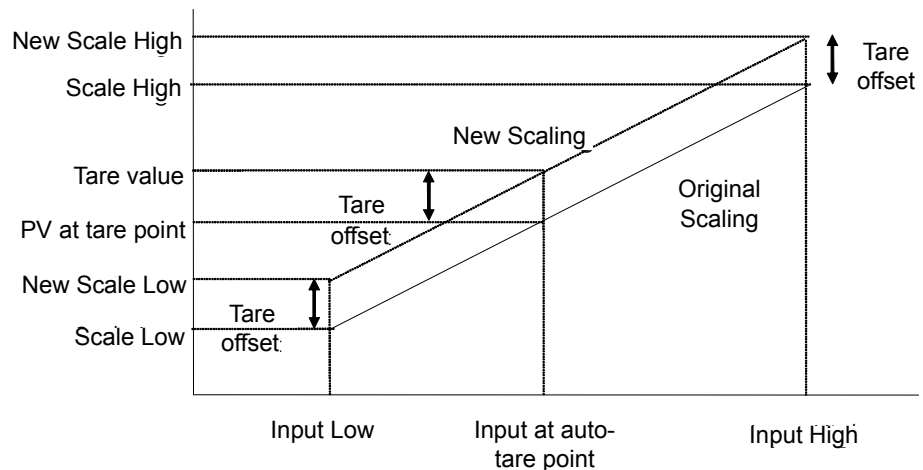
Figure 165 Effect of Auto Tare

Load Cell

A load cell provides a mV analog output which may be connected to a linear TC8/ET8 input. When no load is placed on the cell the output is normally zero. However, in practice there may be a residual output and this can be calibrated out in the controller. The high end is calibrated by placing a reference weight on the load cell and performing a high-end calibration in the controller.

Comparison Calibration

Comparison calibration is used to calibrate the controller against a second reference instrument.

The load is removed (or taken to a minimum) from the reference device. The controller low-end calibration is done using the 'Cal Enable' parameter and entering the reading from the reference instrument.

Add a weight and when the reading has stabilized, select the 'Cal Hi Enable' parameter then enter the new reading from the reference instrument.

Transducer Scaling Parameters

Folder – Txdr		Sub-folders: .1 or .2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Cal Type	Used to select the type of transducer calibration to perform See descriptions at the beginning of this section.	0: Off	Transducer type unconfigured	Off	Conf
		1: Shunt	Shunt calibration		
		2: Load Cell	Load Cell		
		3: Compare	Comparison		
Cal Enable	To make the transducer ready for calibration. Must be set to Yes to allow calibration to be done at L1. This includes Tare Cal.	No Yes	Not ready Ready	No	Conf
Range Max	The maximum permissible range of the scaling block	Range min to 99999		1000	Conf
Range Min	The minimum permissible range of the scaling block	-19999 to Range max		0	Conf
Start Tare	Begin tare calibration	No Yes	 Start tare calibration	No	Oper if 'Cal Enable' = 'Yes'
Start Cal	Starts the Calibration process. Note: for Load Cell and Comparison calibration 'Start Cal' starts the first calibration point.	No Yes	 Start calibration	No	Oper if 'Cal Enable' = 'Yes'
Start HighCal	For Load Cell and Comparison calibration the 'Start High Cal' must be used to start the second calibration point.	No Yes	 Start high calibration	No	Oper if 'Cal Enable' = 'Yes'
Clear Cal	Clears the current calibration constants. This returns the calibration to unity gain	No Yes	 To delete previous calibration values	No	Conf
Tare Value	Enter the tare value of the container				Conf
InHigh	Sets the scaling input high point				Oper
InLow	Sets the scaling input low point				Oper
Scale High	Sets the scaling output high point. Usually the same as the 'Input Lo'				Oper
Scale Low	Sets the scaling output low point. Usually 80% of 'Input Hi'				Oper
Cal Band	The calibration algorithms use the threshold to determine if the value has settled. When switching in the shunt resistor, the algorithm waits for the value to settle to within the threshold before starting the high calibration point.				Conf
CalAdjust	The adjust is used in the Comparison Calibration method.	When edited, the Adjust parameter can be set to the desired value. On confirm, the new adjust value is used to set the scaling constants			Oper

Folder – Txdr		Sub-folders: .1 or .2			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
ShuntOut	Indicates when the internal shunt calibration resistor is switched in. Only appears if 'Cal Type' = 'Shunt'	Off On	Resistor not switched in Resistor switched in		Oper
Cal Active	Indicates calibration taking place	Off On	Inactive Active		Read Only
InVal	The input value to be scaled.	-9999.9 to 9999.9			Oper
OutVal	The Input Value is scaled by the block to produce the Output Value				Oper
Status	The status of the output accounting for sensor break signals passed to the block and the state of the scaling.	Good Bad			Conf
Cal Status	Indicates the progress of calibration	0: Idle 1: Active 2: Passed 3: 'Failed'	No calibration in progress Calibration in progress Calibration Passed Calibration Unsuccessful		L1 Read Only

Parameter Notes

Enable Cal This may be wired to a digital input for an external switch. If not wired, then the value may be changed.

When enabled the transducer parameters may be altered as described in the previous sections. When the parameter has been turned On it will remain on until turned off manually even if the controller is power cycled.

Start Tare This may be wired to a digital input for an external switch. If not wired, then the value may be changed.

Start Cal This may be wired to a digital input for an external switch. If not wired, then the value may be changed.

It starts the calibration procedure for:
Shunt Calibration
The low point for Load Cell Calibration
The low point for Comparison Calibration

Start Hi Cal This may be wired to a digital input for an external switch. If not wired, then the value may be changed.

It starts:
The high point for Load Cell Calibration
The high point for Comparison Calibration

Clear Cal This may be wired to a digital input for an external switch. If not wired, then the value may be changed.

When enabled the input will reset to default values. A new calibration will overwrite the previous calibration values if Clear Cal is not enabled between calibrations.

Tare Calibration

The Mini8 controller has an auto-tare function that is used, for example, when it is required to weigh the contents of a container but not the container itself.

The procedure is to place the empty container on the weighbridge and 'zero' the controller. The procedure is as follows:

1. Place container on weighbridge.
2. Go to Txdr.1 (or 2) Folder.

3. Transducer calibration Type must be 'Load Cell'.

4. CalEnable must be set to 'Yes'.

5. Set StartTare to 'Yes'.

6. The controller automatically calibrates to the tare weight which is measured by the transducer and stores this value.

7. During this measurement Cal Status will show progress. If the calibration is unsuccessful it is probably an 'out-of-range' problem.

Load Cell

A load cell output must be within the range 0 to 77mV to go into a TC8/ET8 input. Use a shunt for mA inputs, mV can possibly go direct, Volt inputs must use a potential divider.

To calibrate a load cell:

1. Remove all load from the transducer to establish a zero reference.

2. Go to Txdr.1 (or 2) Folder.

3. Transducer calibration Type must be 'Load Cell'.

4. CalEnable must be set to 'Yes'.

5. Set Start Cal to 'Yes'

6. The controller will calibrate the low point.

7. Set StartHighCal to 'Yes'

8. The controller will calibrate the high point.

Cal Status advises progress and result.

Comparison Calibration

Comparison calibration is used to calibrate the input against a second reference instrument. Typically this might be a local display on the weighing device itself.

To calibrate against a known reference source:

1. Add a load at the low end of the scale range.

2. Go to Txdr.1 (or Txdr.2) Folder.

3. Transducer calibration Type must be 'Comparision'.

4. CalEnable must be set to 'Yes'.

5. Enter the reading from the reference instrument into 'Cal Adjust'.

6. Add a load at the high end of the scale.

7. Set StartHighCal to 'yes'

8. The controller will calibrate the high point.

Cal Status advises progress and result.

User Values

User values are registers provided for use in calculations. They may be used as constants in equations or temporary storage in extended calculations. Up to 32 User Values are available. They are arranged in four groups of eight. Each User Value can then be set up in the 'UserVal' folder.

User Value Parameters

Folder – UsrVal		Sub-Folders: .1 to .32		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Units	Units assigned to the User Value	None Abs Temp ^{o}C/^{o}F/K, V, mV, A, mA, pH, mmHg, psi, Bar, mBar, %RH, %, mmWG, inWG, inWW, Ohms, PSIG, %O2, PPM, %CO2, %CP, %/sec, RelTemp ^{o}C\$^{o}$F\K(rel), Custom 1, Custom 2, Custom 3, Custom 4, Custom 5, Custom 6, sec, min, hrs,		Conf
Resolution	Resolution of the User Value	XXXXX to X.XXXX		Conf
High Limit	The high limit may be set for each user value so that the value cannot be set to an out-of-bounds value.			Oper
Low Limit	The low limit of the user value may be set so that the user value cannot be edited to an illegal value. This is important if the user value is to be used as a setpoint.			Oper
Val	To set the value within the range limits	See Note		Oper
Status	Can be used to force a good or bad status onto a user value. This is useful for testing status inheritance and fallback strategies.	Good Bad See Note		Oper

Note: If 'Val' is wired into but 'Status' is not, then, instead of being used to force the Status, it will indicate the status of the value as inherited from the wired connection to 'Val'.

Calibration

In this chapter calibration refers to calibration of the inputs of the TC4/TC8/ET8 modules and the RT4 module. Calibration is accessed using the 'Cal State' parameter that is only available in configuration level. Since the controller is calibrated during manufacture to traceable standards for every input range, it is not necessary to calibrate the controller when changing ranges.

However, it is recognized that, for operational reasons, it may be a requirement to check or re-calibrate the controller. This new calibration is saved as a User Calibration. It is always possible to revert to the factory calibration if necessary.

☺   Tip:

Consider using the 'Offset' parameter for User Cal (e.g. Mod.1.Offset). This can be set to correct any measured difference between the Mini8 controller given PV and a calibration value obtained from another source. This is useful where the process setpoint remains at about the same value during use.

Alternatively, if the setpoint range is wide use the two point calibration with the 'LoPoint', 'LoOffset', and 'HiPoint', 'HiOffset' parameters.

TC4/TC8 User Calibration

Set Up

No pre-calibration warm-up is required.

As calibration is a single-point on eight channels, quick enough (a few minutes) to avoid self-heating effects, there are no special environmental, mounting position or ventilation requirements for calibration.

Calibration should be performed at a reasonable ambient temperature (15°C to 35°C, 59°F to 95°F). Calibration outside these limits will compromise the expected working accuracy.

Every channel of every TC8/ET8 card must be individually connected to the calibrator source using thick copper wire (so the sensor-break voltage drop in the wires and source impedance is minimal).

The voltage source, monitor DVM and the target Mini8 controller should be at the same temperature (to remove added series EMF due to thermocouple effects).

Calibration of Mini8 requires the use of iTools.

The Mini8 controller must be in Configuration Mode.

Zero Calibration

No "zero" calibration point is required for TC4 or TC8 input channels.

Voltage Calibration

The iTools view below is shown for Module 1.
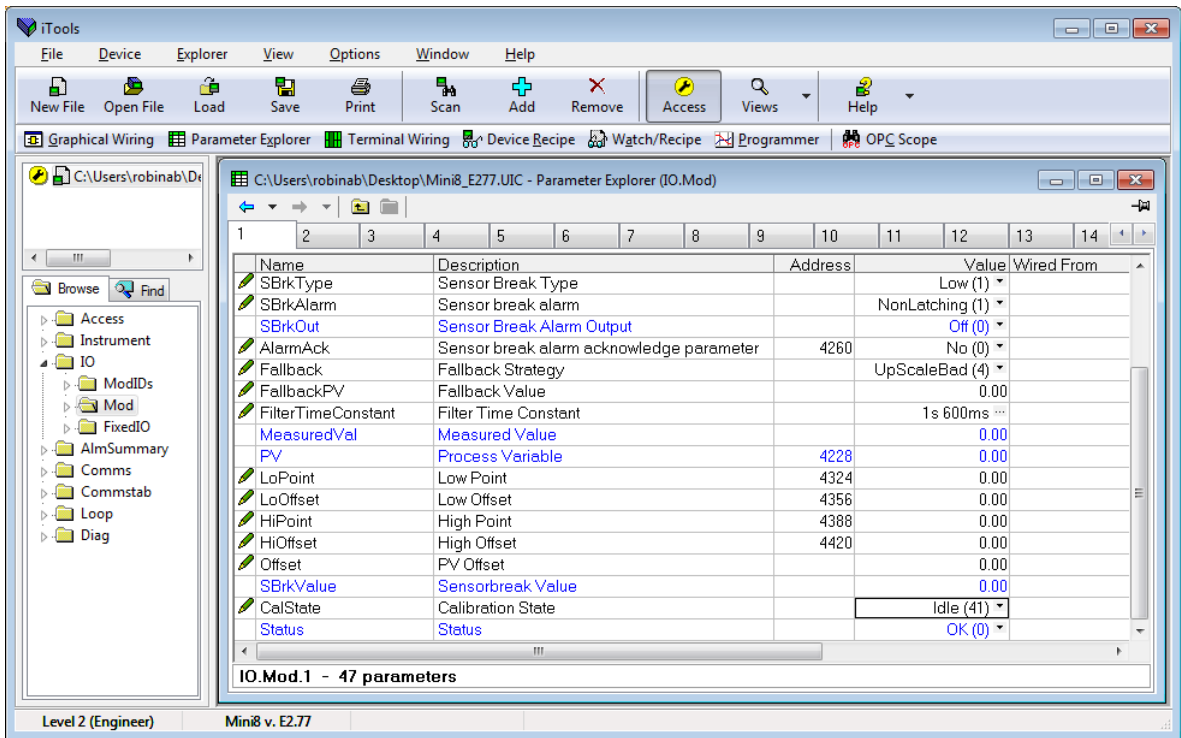
Figure 166 Voltage Calibration - Module 1

1. Set the Calibrator voltage source to an accurate 50.000mV.

2. Connect the 50mV to channel 1.

3. Set 'CalState' to 'HiCal' and then select 'Confirm'.

4. When complete set 'CalState' to 'SaveUser'.

5. Exit configuration mode.

CJC Calibration

No CJC calibration required; the sampled values are ratiometric, providing uncalibrated uncertainty of ±1°C.

Sensor-Break Limit Check

Apply a 900Ω resistor to each channel in turn, 'Sensor Break Type' to 'Low', filter to off. Verify the SBrkValue is greater than 24.0 and less than 61.0.

ET8 User Calibration

The ET8 requires four calibration phases:

- Hi_50mV Calibration

- Lo_50mV Calibration

- Hi_1V Calibration

- Lo_0V Calibration

Hi_50mV Calibration

Proceed as follows:

1. Set the Calibrator voltage source to an accurate 50.00mV.

2. For each ET8 channel, set the IOType to Thermocouple(11), apply the 50mV reference to each channel in turn.

3. Set the CalState parameter to Hi_50mV (123). The following sequence of CalState enumerations should occur:

   – Confirm? - select: Go (201)

   – Busy(212) - wait about 10 seconds until

   – Passed(220) - select: Accept (221)

   – Idle(121)

Lo_50mV Calibration

Proceed as follows:

1. For each ET8 channel, IOType should remain set to Thermocouple(11), apply a short-circuit to each channel.

2. Set the CalState parameter to Lo_50mV (122). The following sequence of CalState enumerations should occur:

   – Confirm? - select: Go (201)

   – Busy(212) - wait about 10 seconds

   – Passed - select: Accept (221)

   – Idle(121)

When all eight channels have been successfully calibrated then save the coefficients to EEPROM by performing a "Save User" command: change the "CalState" parameter of Channel 1 (for the card) to SaveUser(125).

Hi_1V Calibration

Proceed as follows:

1. Set the Calibrator voltage source to an accurate 1.00V.

2. For each ET8 channel, set the IOType to ET8Cal(18), apply this 1V reference to each channel in turn.

3. Set the CalState parameter to Hi_1V (13). The following sequence of CalState enumerations should occur:

   – Confirm? - select: Go (201)

   – Busy(212) - wait about 10 seconds

   – Passed - select: Accept (221)

   – Idle(121)

Lo_0V Calibration

Proceed as follows:

1. For each ET8 channel, the IOType should remain set to ET8Cal(18), apply a short-circuit to each channel.

2. Set the CalState parameter to Lo_0V (12). The following sequence of CalState enumerations should occur:

   – Confirm? - select: Go (201)

   – Busy(212) - wait about 10 seconds

   – Passed - select: Accept (221)

   – Idle(121)

3. Channel "Status" should change from "not calibrated" to "OK".

When all calibration phases have been successfully calibrated then save the coefficients to EEPROM by performing a "Save User" command: change the "CalState" parameter of Channel 1 (for the card) to SaveUser(125).

Note: To return to normal working, set the IOType parameter to Thermocouple(11) or mV(13) for each channel.

To Return to TC4/TC8/ET8 Factory Calibration

To clear the User calibration and restore the calibration from the factory:

1. Put Mini8 controller into Configuration Mode.

2. Set the 'Calibration State' to 'LoadFact'.

3. Return Instrument to Operating Mode.

RT4 User Calibration

Set Up

No pre-calibration warm-up is required.

There are no special environmental, mounting position or ventilation requirements for calibration.

Calibration should be performed at a reasonable ambient temperature (15°C to 35°C -59°F to 95°F). Calibration outside these limits will compromise the expected working accuracy.

Each channel of the RT4 card must be individually connected to the calibrated resistance box using the four-wire connection.

The Mini8 controller must be in Configuration Mode.

Calibration

1. Set the Resistance Range to Low or High as required.

2. Wire the resistance box to channel 1 using the four-wire connection.

3. Set the resistance box to 150.0Ω ±0.02% for Low Resistance calibration or 1500Ω ±0.02% for High Resistance calibration.

4. Set 'CalState' to' LoCal' and then select 'Confirm' followed by 'Go'.

5. The instrument will show 'Busy' followed by 'Passed', assuming the calibration is successful, or 'Failed' if not. If 'Failed', check that the correct calibration resistance has been selected.

6. When complete set 'CalState' to' SaveUser'.

7. Set the Resistance box to 400.0Ω ±0.02% for Low Resistance calibration or 4000Ω ±0.02% for High Resistance calibration.

8. Set 'CalState' to 'HiCal' and then select 'Confirm' followed by 'Confirm' followed by 'Go'.

9. The instrument will show 'Busy' followed by 'Passed', assuming the calibration is successful, or 'Failed' if not. If 'Failed' check that the correct calibration resistance has been selected.

10. When complete set 'CalState' to 'SaveUser'. This will enable the new calibration data to be used following a power down of the instrument. If the data is not saved it will be lost at power down.

11. Exit configuration mode.

To Return to RT4 Factory Calibration

To clear the User calibration and restore the calibration from the factory for RTDs it is necessary to set the Resistance Range to the one in use – Low or High.

For Pt100

1. Put Mini8 controller into Configuration Mode.

2. For Low Resistance select 'Resistance Type' = 'Low'. This selects the previously saved (SaveUser) calibration data for Pt100.

3. Set the 'Calibration State' to 'LoadFact'.

4. After a few seconds the 'CalSate' parameter returns to 'Idle'. The Factory calibration data is now restored, overwriting the previously stored User Calibration.

5. Return Instrument to Operating Mode.

For Pt1000

1. Put Mini8 controller into Configuration Mode.

2. For High Resistance select 'Resistance Type' = 'High'. This selects the previously saved (SaveUser) calibration data for Pt1000.

3. Set the 'Calibration State' to 'LoadFact'.

4. After a few seconds the 'CalSate' parameter returns to 'Idle'. The Factory calibration data is now restored, overwriting the previously stored User Calibration.

5. Return Instrument to Operating Mode.

Calibration Parameters

List Header - IO		Sub-headers: Mod.1 to Mod.32			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Cal State	Calibration state of the input	Idle	Normal operation	Idle	Conf
		Hi-50mV	High input calibration for mV ranges		
		Load Fact	Restore factory calibration values		
		Save User	Save the new calibration values		
		Confirm	To start the calibration procedure when one of the above has been selected		
		Go	Starting the automatic calibration procedure		
		Busy	Calibration in progress		
		Passed	Calibration successful		
		'Failed'	Calibration unsuccessful		
Status	PV Status The current status of the PV.	0	Normal operation		Read Only
		1	Initial startup mode		
		2	Input in sensor break		
		3	PV outside operating limits		
		4	Saturated input		
		5	Uncalibrated channel		
		6	No Module		

The above list shows the values of CalState, which appear during a normal calibration procedure. The full list of possible values follows – the number is the enumeration for the parameter.

1: Idle

2: Low calibration point for Volts range

3: High calibration point for Volts range

4: Calibration restored to factory default values

5: User calibration stored

6: Factory calibration stored

11: Idle

12: Low calibration point for HZ input

13: High calibration point for the HZ input

14: Calibration restored to factory default values

15: User calibration stored

16: Factory calibration stored

20: Calibration point for factory rough calibration

21: Idle

22: Low calibration point for the mV range

23: Hi calibration point for the mV range

24: Calibration restored to factory default values

25: User calibration stored

26: Factory calibration stored

30: Calibration point for factory rough calibration

31: Idle

32: Low calibration point for the mV range

33: High calibration point for the mV range

34: Calibration restored to factory default values

35: User calibration stored

36: Factory calibration stored

41: Idle

42: Low calibration point for RTD calibration (150Ω for Low Resistance range, 1500Ω for High Resistance range)

43: High calibration point for RTD calibration (400Ω for Low Resistance range, 4000Ω for High Resistance range)

44: Calibration restored to factory default values

45: User calibration stored

46: Factory calibration stored

51: Idle

52: CJC calibration used in conjunction with Term Temp parameter

54: Calibration restored to factory default values

55: User calibration stored

56: Factory calibration stored

200: Confirmation of request to calibrate

201: Used to start the calibration procedure

202: Used to abort the calibration procedure

210: Calibration point for factory rough calibration

212: Indication that calibration is in progress

213: Used to abort the calibration procedure

220: Indication that calibration completed successfully

221: Calibration accepted but not stored

222: Used to abort the calibration procedure

223: Indication that calibration was unsuccessful

OEM Security

Introduction

OEM security allows users, typically OEMs or distributors, to be able to protect their intellectual property by preventing unauthorized cloning of controller configurations.

OEM security is only available as a special order and is identified by special number EU0725 which appears on the label showing the order code.

The feature provides the user with the ability to enter an OEM Security Password, after which, unless the password is entered, iTools is inhibited from communicating with the controller in its normal way.

Notes:

1. It will still be possible to access communication parameters via the SCADA table.

2. If features such as OPC Scope are required then Custom Tags may be used to access the SCADA area.

Using OEM Security

The OEM Security feature enables three new addresses to become active in the SCADA region. These are:-

- Address 16116, 'Locked': this is a read only Boolean parameter that returns 1 (TRUE) when the instrument is OEM secured.

- Address 16117, 'Lock Code': this is a write only parameter which will read back as 0. When the instrument is unlocked, a value entered here will lock the instrument and defines the code needed to unlock. The code and locked status will be saved in non-volatile memory.

- Address 16118, 'Unlock Code': this is a write only parameter which will read back as 0. When the instrument is locked, a value entered here will be compared with the lock code. If it is the same, the instrument will be unlocked. If the value is different, this parameter will become unavailable for a time period. This time will increase for each unsuccessful attempt.

These addresses are not available by default in iTools. It is, therefore, necessary to create Custom Tags in iTools to be able to write or read these parameters. The following procedure shows how to do this and how to use the OEM security features.

Step 1 – View iTools OPC Server

With iTools open and connected to the target instrument, open the iTools OPC server using Options>Advanced>Show Server.
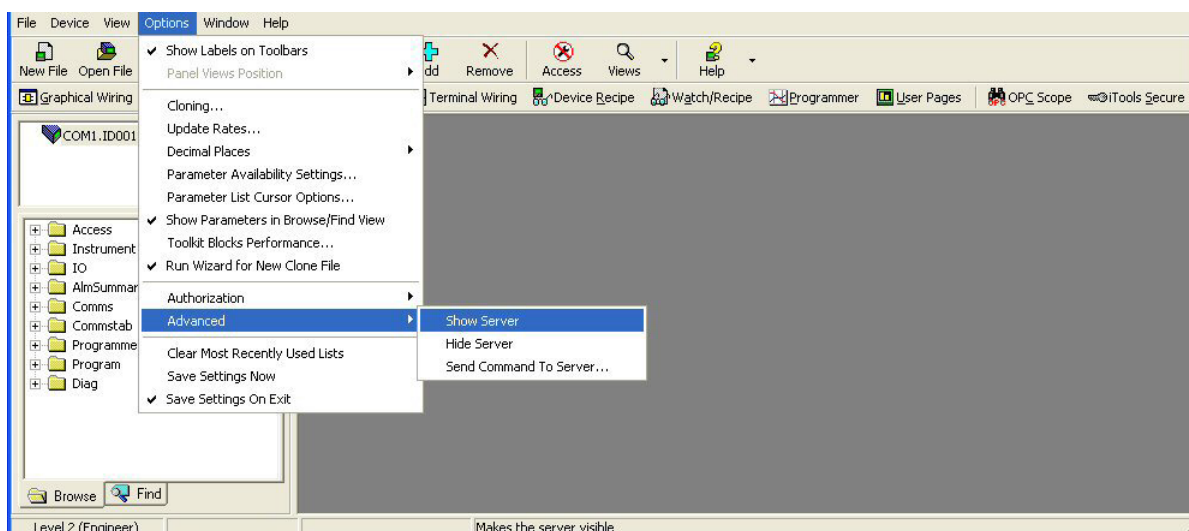
Figure 167 iTools - Show Server

Click on the OPC Server application on the Windows Taskbar to view the server.
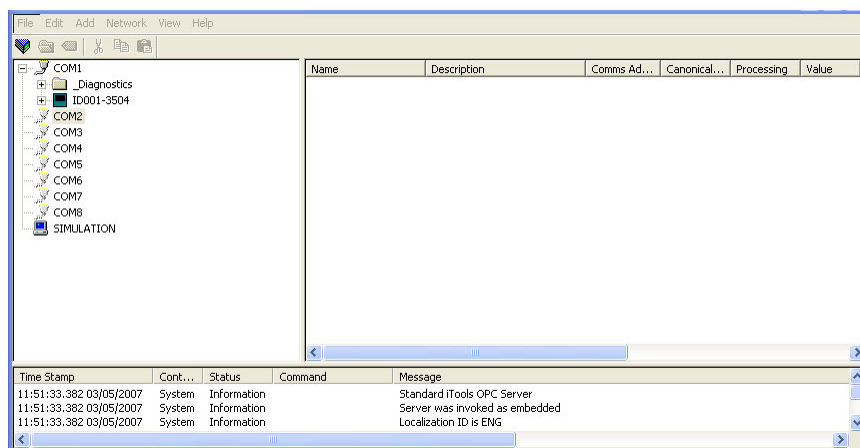
Figure 168 View Server

Step 2 – Create Custom Tags

Expand the connected instrument to show all folders. Close to the bottom of the tree you will find a folder called CustTags.
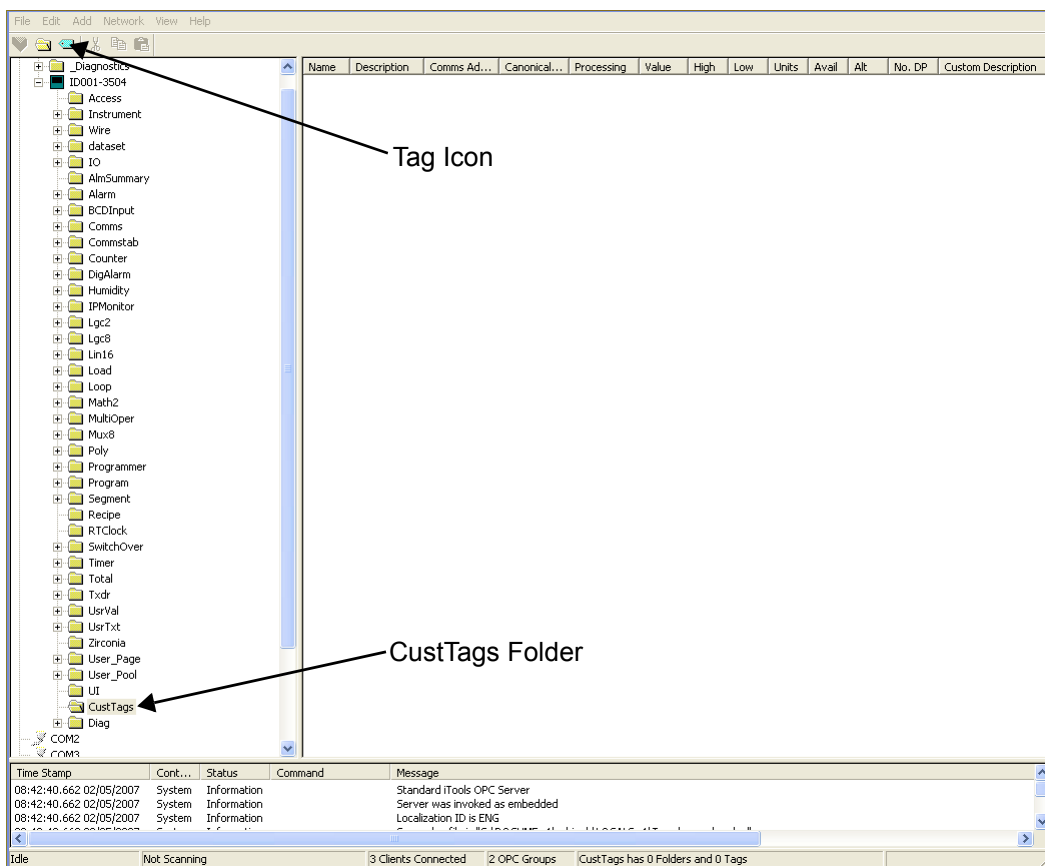
Figure 169 CustTags folder

Click on CustTags then click on the Tag icon on the Toolbar. Enter the name of the Tag as 'Locked' and its address as 16116 then press OK. Repeat for the 'Lock' and 'Unlock Code' addresses.
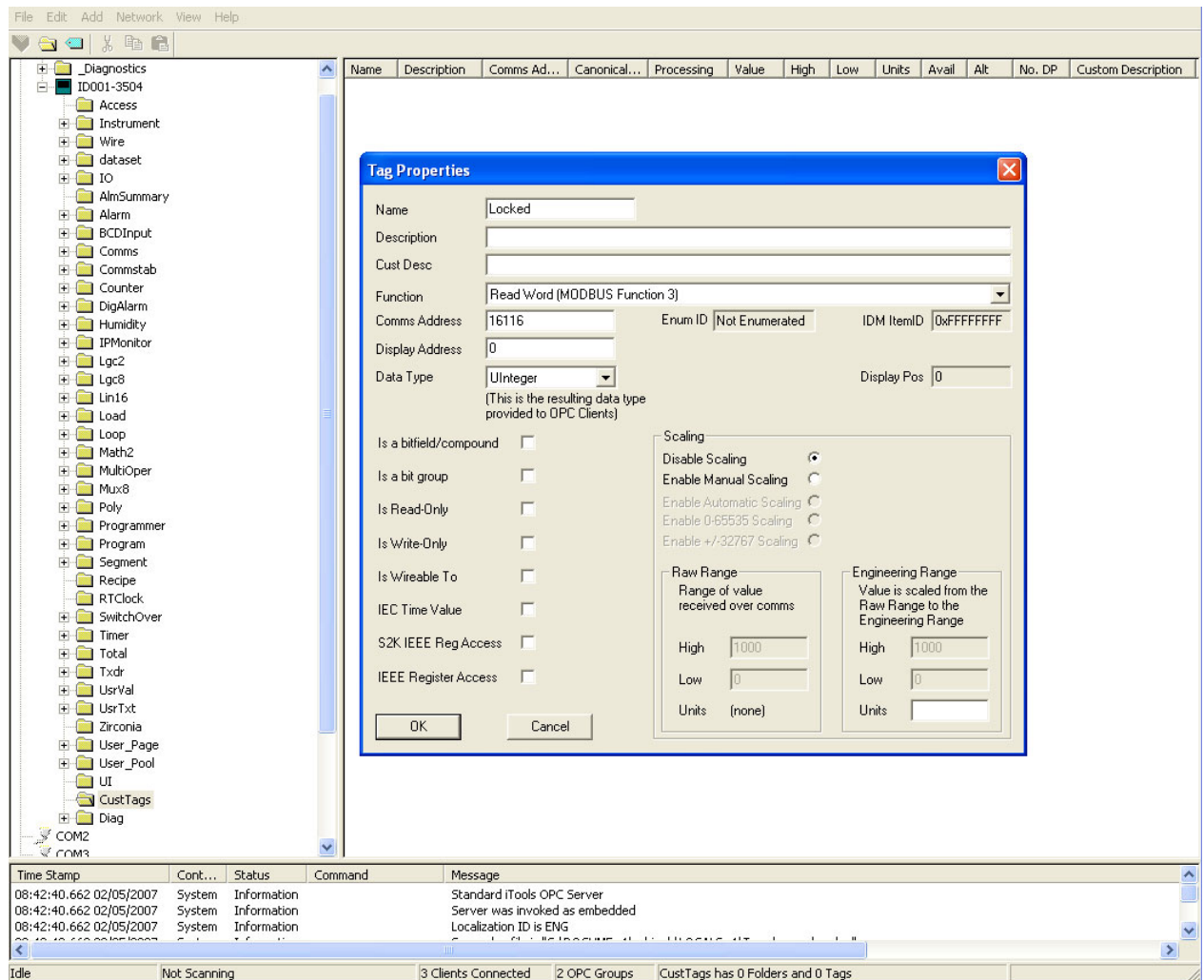
Figure 170 Tag Properties

When all three Tags are created you will see the following:
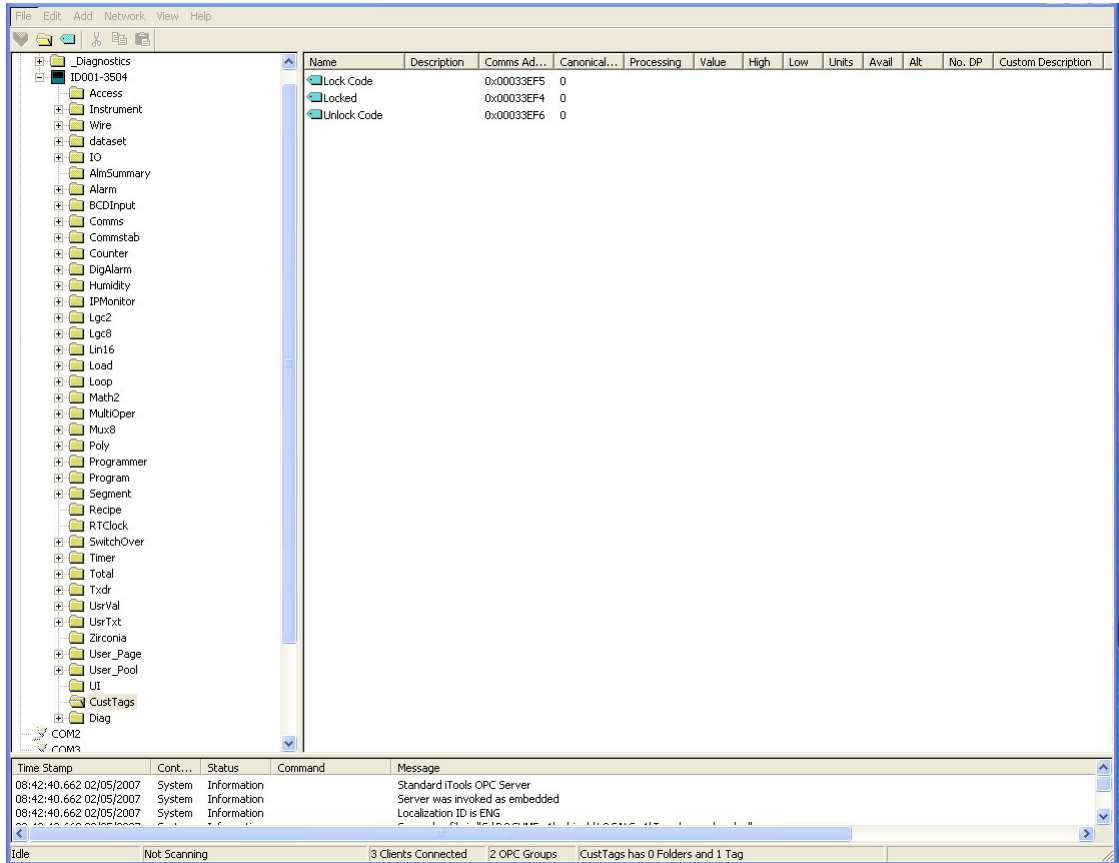
Figure 171 Three Tags Created

Minimize (do not close) the OPC Server to the taskbar and return to iTools. You can now select CustTags on the connected instrument by double-clicking on the folder when in the browse tab.
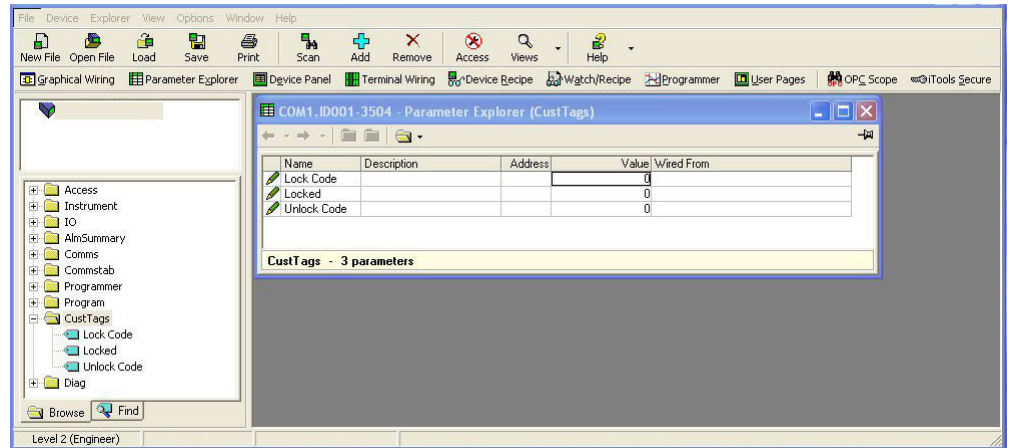
Figure 172 iTools - CustTags

Step 3 – Activate OEM Security

At the same time as viewing the CustTag parameters, double-click on another folder and position it so that you can see parameters from both.
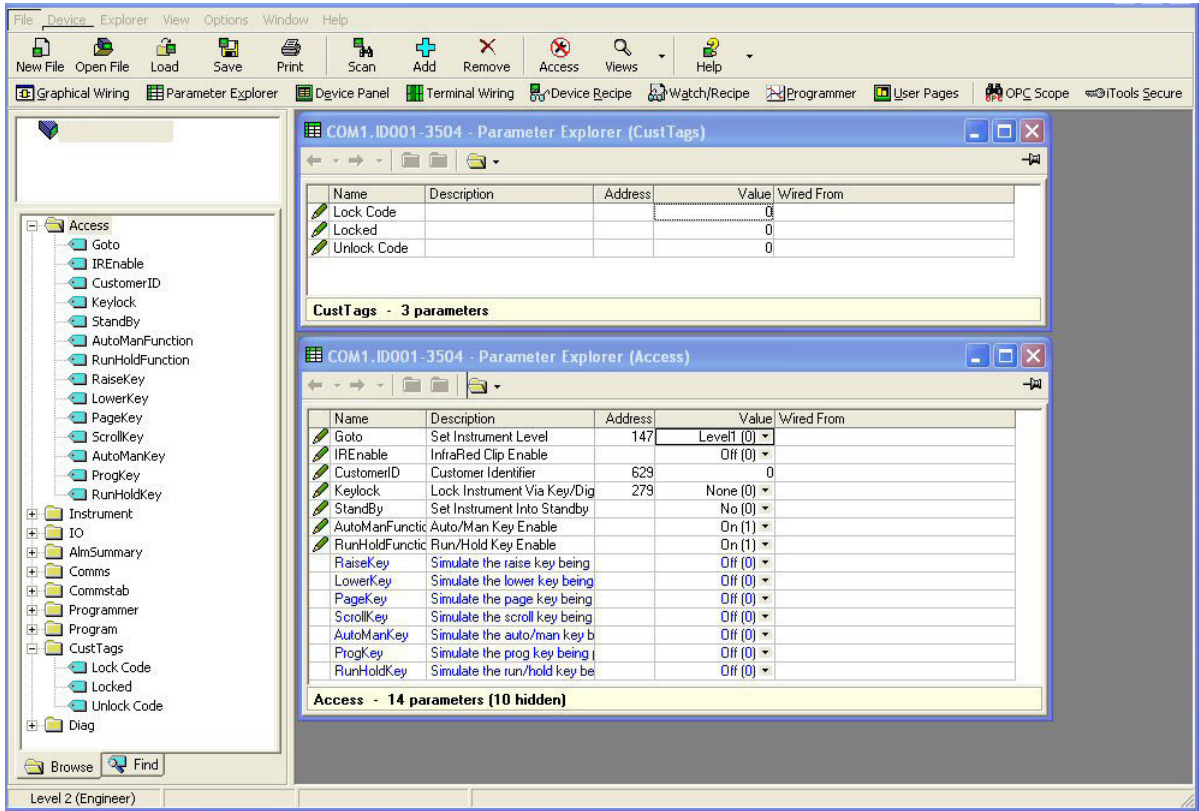
Figure 173 Viewing Second Folder

Enter a numerical code for the parameter 'Lock Code'.The 'Locked' parameter now shows true(1) and the parameters in the other folder now show question marks indicating that iTools is no longer reading them.
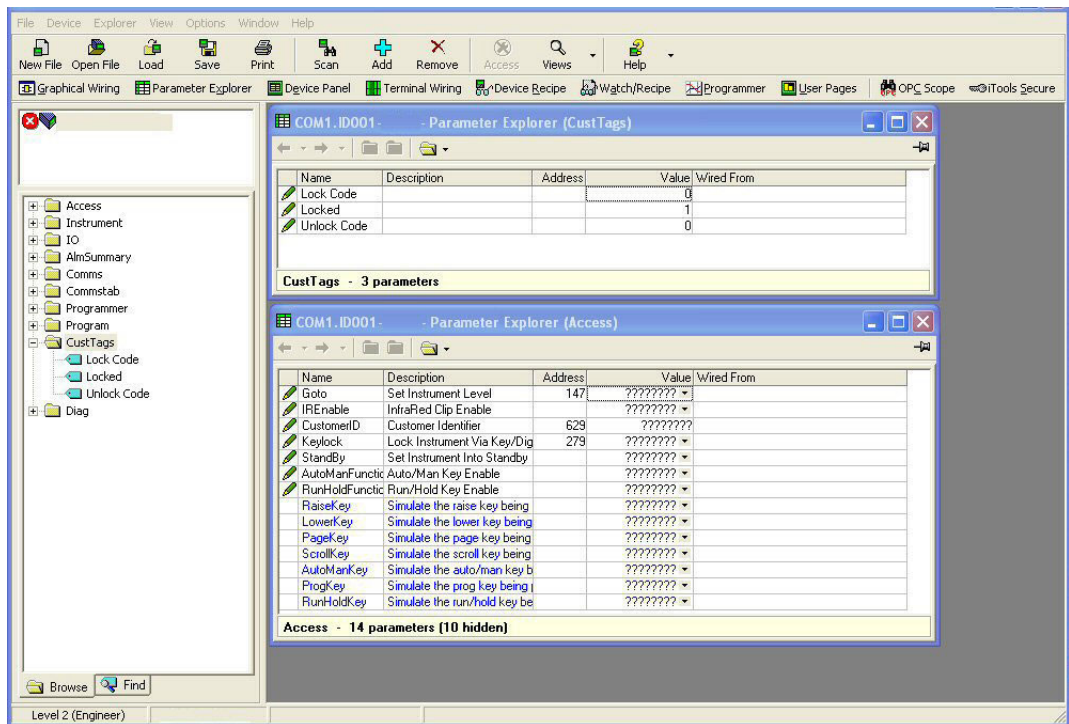
Figure 174 Locked Parameters

Step 4 – Deactivate OEM Security

Enter the code you used in step 3 into 'Unlock Code' to enable full iTools communication.

If an incorrect code is entered this parameter will become unavailable for a time period, indicated by the message 'Failed to write data to device'. This time will increase for each unsuccessful attempt limited to 1 minute. If the correct code is entered while the time delay is in operation it will not be accepted. It will be necessary to wait until the time delay is no longer operative (up to 1 minute) or to power cycle the controller.

Erasing Memory

Since the OEM Lock/Unlock code is retained in 'normal' non-volatile memory, it may be erased by use of the Access.ClearMemory (Cold Start) parameter. Using this parameter to erase AllMemory will not only unlock the OEM Security but it will also erase the application being protected.

Note: The instrument must be in Config mode to accept the ClearMemory command.

This process may also be done via the SCADA area. The Instrument Mode parameter is already in the SCADA area at address 199 - write a value of 2 to set Config mode. The Clear Memory parameter will be found at address 16119. Set a value of 5 (AllMemory) to clear the memory.

Modbus SCADA Table

These parameters are single register Modbus values for use with Third Party Modbus masters in SCADA packages or PLCs. Scaling of the parameters has to be configured – the Modbus master scaling has to match the Mini8 controller parameter resolution so that the decimal point is in the correct position.

If a parameter has no address the CommsTab feature can be used to map the parameter to a Modbus address, however, it should be noted that the address field will not be updated.

Comms Table

The tables that follow do not include every parameter in the Mini8 controller. The Comms Table is used to make most parameters available at any SCADA address.

Folder – Commstab		Sub-folders: .1 to .250		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
Destination	Modbus Destination	Not Used 0 to 16064	Not used	Conf
Source	Source Parameter	Taken from source parameter		Conf
Native	Native Data Format	0 Integer 1 Native (i.e. Float or Long)	Integer	Conf
ReadOnly	Read Only Read/Write only if source is R/W	0 Read/Write 1 Read Only	Read/Write	Conf
Minutes	Minutes Units in which time is scaled	0 Seconds 1 Minutes	Seconds	Conf

Entering a value in the Source parameter may be done in two ways:

• Drag the required parameter into the Source.

• Right-click the Source parameter, select Edit Wire and browse to the required parameter.

In the Example below the PV of Loop 1 would be available at addresses 200 and 201 as a two register floating point number - its native data type.
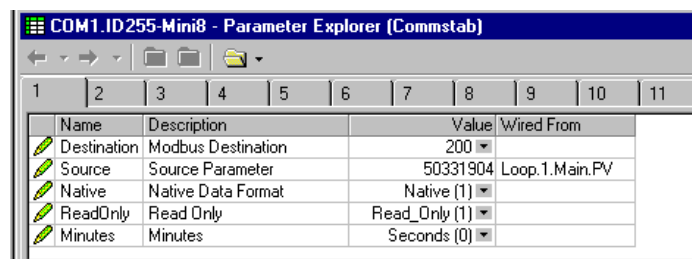
Figure 175 Parameter Explorer

There are 250 comms table entries available.

SCADA Table

The parameters in the tables following are available in scaled integer format, accessed via their associated Modbus address.

Wherever possible use an OPC client with the iTools OPCserver as the server. In this arrangement the parameters are all referenced by name and the values are floating point so the decimal point for all parameters is inherited.

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Access.CustomerID	4739	0x1283	Alarm.5.Delay	10312	0x2848
Access.InstrumentMode	199	0x00c7	Alarm.5.Hysteresis	10306	0x2842
Alarm.1.Ack	10250	0x280a	Alarm.5.Inhibit	10311	0x2847
Alarm.1.Block	10246	0x2806	Alarm.5.Latch	10308	0x2844
Alarm.1.Delay	10248	0x2808	Alarm.5.Out	10313	0x2849
Alarm.1.Hysteresis	10242	0x2802	Alarm.5.Reference	10307	0x2843
Alarm.1.Inhibit	10247	0x2807	Alarm.5.Threshold	10305	0x2841
Alarm.1.Latch	10244	0x2804	Alarm.5.Type	10304	0x2840
Alarm.1.Out	10249	0x2809	Alarm.6.Ack	10330	0x285a
Alarm.1.Reference	10243	0x2803	Alarm.6.Block	10326	0x2856
Alarm.1.Threshold	10241	0x2801	Alarm.6.Delay	10328	0x2858
Alarm.1.Type	10240	0x2800	Alarm.6.Hysteresis	10322	0x2852
Alarm.2.Ack	10266	0x281a	Alarm.6.Inhibit	10327	0x2857
Alarm.2.Block	10262	0x2816	Alarm.6.Latch	10324	0x2854
Alarm.2.Delay	10264	0x2818	Alarm.6.Out	10329	0x2859
Alarm.2.Hysteresis	10258	0x2812	Alarm.6.Reference	10323	0x2853
Alarm.2.Inhibit	10263	0x2817	Alarm.6.Threshold	10321	0x2851
Alarm.2.Latch	10260	0x2814	Alarm.6.Type	10320	0x2850
Alarm.2.Out	10265	0x2819	Alarm.7.Ack	10346	0x286a
Alarm.2.Reference	10259	0x2813	Alarm.7.Block	10342	0x2866
Alarm.2.Threshold	10257	0x2811	Alarm.7.Delay	10344	0x2868
Alarm.2.Type	10256	0x2810	Alarm.7.Hysteresis	10338	0x2862
Alarm.3.Ack	10282	0x282a	Alarm.7.Inhibit	10343	0x2867
Alarm.3.Block	10278	0x2826	Alarm.7.Latch	10340	0x2864
Alarm.3.Delay	10280	0x2828	Alarm.7.Out	10345	0x2869
Alarm.3.Hysteresis	10274	0x2822	Alarm.7.Reference	10339	0x2863
Alarm.3.Inhibit	10279	0x2827	Alarm.7.Threshold	10337	0x2861
Alarm.3.Latch	10276	0x2824	Alarm.7.Type	10336	0x2860
Alarm.3.Out	10281	0x2829	Alarm.8.Ack	10362	0x287a
Alarm.3.Reference	10275	0x2823	Alarm.8.Block	10358	0x2876
Alarm.3.Threshold	10273	0x2821	Alarm.8.Delay	10360	0x2878
Alarm.3.Type	10272	0x2820	Alarm.8.Hysteresis	10354	0x2872
Alarm.4.Ack	10298	0x283a	Alarm.8.Inhibit	10359	0x2877
Alarm.4.Block	10294	0x2836	Alarm.8.Latch	10356	0x2874
Alarm.4.Delay	10296	0x2838	Alarm.8.Out	10361	0x2879
Alarm.4.Hysteresis	10290	0x2832	Alarm.8.Reference	10355	0x2873
Alarm.4.Inhibit	10295	0x2837	Alarm.8.Threshold	10353	0x2871
Alarm.4.Latch	10292	0x2834	Alarm.8.Type	10352	0x2870
Alarm.4.Out	10297	0x2839	Alarm.9.Ack	10378	0x288a
Alarm.4.Reference	10291	0x2833	Alarm.9.Block	10374	0x2886
Alarm.4.Threshold	10289	0x2831	Alarm.9.Delay	10376	0x2888
Alarm.4.Type	10288	0x2830	Alarm.9.Hysteresis	10370	0x2882
Alarm.5.Ack	10314	0x284a	Alarm.9.Inhibit	10375	0x2887
Alarm.5.Block	10310	0x2846	Alarm.9.Latch	10372	0x2884

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Alarm.9.Out	10377	0x2889	Alarm.14.Reference	10451	0x28d3
Alarm.9.Reference	10371	0x2883	Alarm.14.Threshold	10449	0x28d1
Alarm.9.Threshold	10369	0x2881	Alarm.14.Type	10448	0x28d0
Alarm.9.Type	10368	0x2880	Alarm.15.Ack	10474	0x28ea
Alarm.10.Ack	10394	0x289a	Alarm.15.Block	10470	0x28e6
Alarm.10.Block	10390	0x2896	Alarm.15.Delay	10472	0x28e8
Alarm.10.Delay	10392	0x2898	Alarm.15.Hysteresis	10466	0x28e2
Alarm.10.Hysteresis	10386	0x2892	Alarm.15.Inhibit	10471	0x28e7
Alarm.10.Inhibit	10391	0x2897	Alarm.15.Latch	10468	0x28e4
Alarm.10.Latch	10388	0x2894	Alarm.15.Out	10473	0x28e9
Alarm.10.Out	10393	0x2899	Alarm.15.Reference	10467	0x28e3
Alarm.10.Reference	10387	0x2893	Alarm.15.Threshold	10465	0x28e1
Alarm.10.Threshold	10385	0x2891	Alarm.15.Type	10464	0x28e0
Alarm.10.Type	10384	0x2890	Alarm.16.Ack	10490	0x28fa
Alarm.11.Ack	10410	0x28aa	Alarm.16.Block	10486	0x28f6
Alarm.11.Block	10406	0x28a6	Alarm.16.Delay	10488	0x28f8
Alarm.11.Delay	10408	0x28a8	Alarm.16.Hysteresis	10482	0x28f2
Alarm.11.Hysteresis	10402	0x28a2	Alarm.16.Inhibit	10487	0x28f7
Alarm.11.Inhibit	10407	0x28a7	Alarm.16.Latch	10484	0x28f4
Alarm.11.Latch	10404	0x28a4	Alarm.16.Out	10489	0x28f9
Alarm.11.Out	10409	0x28a9	Alarm.16.Reference	10483	0x28f3
Alarm.11.Reference	10403	0x28a3	Alarm.16.Threshold	10481	0x28f1
Alarm.11.Threshold	10401	0x28a1	Alarm.16.Type	10480	0x28f0
Alarm.11.Type	10400	0x28a0	Alarm.17.Ack	10506	0x290a
Alarm.12.Ack	10426	0x28ba	Alarm.17.Block	10502	0x2906
Alarm.12.Block	10422	0x28b6	Alarm.17.Delay	10504	0x2908
Alarm.12.Delay	10424	0x28b8	Alarm.17.Hysteresis	10498	0x2902
Alarm.12.Hysteresis	10418	0x28b2	Alarm.17.Inhibit	10503	0x2907
Alarm.12.Inhibit	10423	0x28b7	Alarm.17.Latch	10500	0x2904
Alarm.12.Latch	10420	0x28b4	Alarm.17.Out	10505	0x2909
Alarm.12.Out	10425	0x28b9	Alarm.17.Reference	10499	0x2903
Alarm.12.Reference	10419	0x28b3	Alarm.17.Threshold	10497	0x2901
Alarm.12.Threshold	10417	0x28b1	Alarm.17.Type	10496	0x2900
Alarm.12.Type	10416	0x28b0	Alarm.18.Ack	10522	0x291a
Alarm.13.Ack	10442	0x28ca	Alarm.18.Block	10518	0x2916
Alarm.13.Block	10438	0x28c6	Alarm.18.Delay	10520	0x2918
Alarm.13.Delay	10440	0x28c8	Alarm.18.Hysteresis	10514	0x2912
Alarm.13.Hysteresis	10434	0x28c2	Alarm.18.Inhibit	10519	0x2917
Alarm.13.Inhibit	10439	0x28c7	Alarm.18.Latch	10516	0x2914
Alarm.13.Latch	10436	0x28c4	Alarm.18.Out	10521	0x2919
Alarm.13.Out	10441	0x28c9	Alarm.18.Reference	10515	0x2913
Alarm.13.Reference	10435	0x28c3	Alarm.18.Threshold	10513	0x2911
Alarm.13.Threshold	10433	0x28c1	Alarm.18.Type	10512	0x2910
Alarm.13.Type	10432	0x28c0	Alarm.19.Ack	10538	0x292a
Alarm.14.Ack	10458	0x28da	Alarm.19.Block	10534	0x2926
Alarm.14.Block	10454	0x28d6	Alarm.19.Delay	10536	0x2928
Alarm.14.Delay	10456	0x28d8	Alarm.19.Hysteresis	10530	0x2922
Alarm.14.Hysteresis	10450	0x28d2	Alarm.19.Inhibit	10535	0x2927
Alarm.14.Inhibit	10455	0x28d7	Alarm.19.Latch	10532	0x2924
Alarm.14.Latch	10452	0x28d4	Alarm.19.Out	10537	0x2929
Alarm.14.Out	10457	0x28d9	Alarm.19.Reference	10531	0x2923

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Alarm.19.Threshold	10529	0x2921	Alarm.24.Type	10608	0x2970
Alarm.19.Type	10528	0x2920	Alarm.25.Ack	10634	0x298a
Alarm.20.Ack	10554	0x293a	Alarm.25.Block	10630	0x2986
Alarm.20.Block	10550	0x2936	Alarm.25.Delay	10632	0x2988
Alarm.20.Delay	10552	0x2938	Alarm.25.Hysteresis	10626	0x2982
Alarm.20.Hysteresis	10546	0x2932	Alarm.25.Inhibit	10631	0x2987
Alarm.20.Inhibit	10551	0x2937	Alarm.25.Latch	10628	0x2984
Alarm.20.Latch	10548	0x2934	Alarm.25.Out	10633	0x2989
Alarm.20.Out	10553	0x2939	Alarm.25.Reference	10627	0x2983
Alarm.20.Reference	10547	0x2933	Alarm.25.Threshold	10625	0x2981
Alarm.20.Threshold	10545	0x2931	Alarm.25.Type	10624	0x2980
Alarm.20.Type	10544	0x2930	Alarm.26.Ack	10650	0x299a
Alarm.21.Ack	10570	0x294a	Alarm.26.Block	10646	0x2996
Alarm.21.Block	10566	0x2946	Alarm.26.Delay	10648	0x2998
Alarm.21.Delay	10568	0x2948	Alarm.26.Hysteresis	10642	0x2992
Alarm.21.Hysteresis	10562	0x2942	Alarm.26.Inhibit	10647	0x2997
Alarm.21.Inhibit	10567	0x2947	Alarm.26.Latch	10644	0x2994
Alarm.21.Latch	10564	0x2944	Alarm.26.Out	10649	0x2999
Alarm.21.Out	10569	0x2949	Alarm.26.Reference	10643	0x2993
Alarm.21.Reference	10563	0x2943	Alarm.26.Threshold	10641	0x2991
Alarm.21.Threshold	10561	0x2941	Alarm.26.Type	10640	0x2990
Alarm.21.Type	10560	0x2940	Alarm.27.Ack	10666	0x29aa
Alarm.22.Ack	10586	0x295a	Alarm.27.Block	10662	0x29a6
Alarm.22.Block	10582	0x2956	Alarm.27.Delay	10664	0x29a8
Alarm.22.Delay	10584	0x2958	Alarm.27.Hysteresis	10658	0x29a2
Alarm.22.Hysteresis	10578	0x2952	Alarm.27.Inhibit	10663	0x29a7
Alarm.22.Inhibit	10583	0x2957	Alarm.27.Latch	10660	0x29a4
Alarm.22.Latch	10580	0x2954	Alarm.27.Out	10665	0x29a9
Alarm.22.Out	10585	0x2959	Alarm.27.Reference	10659	0x29a3
Alarm.22.Reference	10579	0x2953	Alarm.27.Threshold	10657	0x29a1
Alarm.22.Threshold	10577	0x2951	Alarm.27.Type	10656	0x29a0
Alarm.22.Type	10576	0x2950	Alarm.28.Ack	10682	0x29ba
Alarm.23.Ack	10602	0x296a	Alarm.28.Block	10678	0x29b6
Alarm.23.Block	10598	0x2966	Alarm.28.Delay	10680	0x29b8
Alarm.23.Delay	10600	0x2968	Alarm.28.Hysteresis	10674	0x29b2
Alarm.23.Hysteresis	10594	0x2962	Alarm.28.Inhibit	10679	0x29b7
Alarm.23.Inhibit	10599	0x2967	Alarm.28.Latch	10676	0x29b4
Alarm.23.Latch	10596	0x2964	Alarm.28.Out	10681	0x29b9
Alarm.23.Out	10601	0x2969	Alarm.28.Reference	10675	0x29b3
Alarm.23.Reference	10595	0x2963	Alarm.28.Threshold	10673	0x29b1
Alarm.23.Threshold	10593	0x2961	Alarm.28.Type	10672	0x29b0
Alarm.23.Type	10592	0x2960	Alarm.29.Ack	10698	0x29ca
Alarm.24.Ack	10618	0x297a	Alarm.29.Block	10694	0x29c6
Alarm.24.Block	10614	0x2976	Alarm.29.Delay	10696	0x29c8
Alarm.24.Delay	10616	0x2978	Alarm.29.Hysteresis	10690	0x29c2
Alarm.24.Hysteresis	10610	0x2972	Alarm.29.Inhibit	10695	0x29c7
Alarm.24.Inhibit	10615	0x2977	Alarm.29.Latch	10692	0x29c4
Alarm.24.Latch	10612	0x2974	Alarm.29.Out	10697	0x29c9
Alarm.24.Out	10617	0x2979	Alarm.29.Reference	10691	0x29c3
Alarm.24.Reference	10611	0x2973	Alarm.29.Threshold	10689	0x29c1
Alarm.24.Threshold	10609	0x2971	Alarm.29.Type	10688	0x29c0

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Alarm.30.Ack	10714	0x29da	AlmSummary.General.SBrkAlarmStatus4	10203	0x27db
Alarm.30.Block	10710	0x29d6	BCDInput.1.BCDVal	5072	0x13d0
Alarm.30.Delay	10712	0x29d8	BCDInput.2.BCDVal	5073	0x13d1
Alarm.30.Hysteresis	10706	0x29d2	Comms.FC.Ident	12963	0x32a3
Alarm.30.Inhibit	10711	0x29d7	DigAlarm.1.Ack	11274	0x2c0a
Alarm.30.Latch	10708	0x29d4	DigAlarm.1.Block	11270	0x2c06
Alarm.30.Out	10713	0x29d9	DigAlarm.1.Delay	11272	0x2c08
Alarm.30.Reference	10707	0x29d3	DigAlarm.1.Inhibit	11271	0x2c07
Alarm.30.Threshold	10705	0x29d1	DigAlarm.1.Latch	11268	0x2c04
Alarm.30.Type	10704	0x29d0	DigAlarm.1.Out	11273	0x2c09
Alarm.31.Ack	10730	0x29ea	DigAlarm.1.Type	11264	0x2c00
Alarm.31.Block	10726	0x29e6	DigAlarm.2.Ack	11290	0x2c1a
Alarm.31.Delay	10728	0x29e8	DigAlarm.2.Block	11286	0x2c16
Alarm.31.Hysteresis	10722	0x29e2	DigAlarm.2.Delay	11288	0x2c18
Alarm.31.Inhibit	10727	0x29e7	DigAlarm.2.Inhibit	11287	0x2c17
Alarm.31.Latch	10724	0x29e4	DigAlarm.2.Latch	11284	0x2c14
Alarm.31.Out	10729	0x29e9	DigAlarm.2.Out	11289	0x2c19
Alarm.31.Reference	10723	0x29e3	DigAlarm.2.Type	11280	0x2c10
Alarm.31.Threshold	10721	0x29e1	DigAlarm.3.Ack	11306	0x2c2a
Alarm.31.Type	10720	0x29e0	DigAlarm.3.Block	11302	0x2c26
Alarm.32.Ack	10746	0x29fa	DigAlarm.3.Delay	11304	0x2c28
Alarm.32.Block	10742	0x29f6	DigAlarm.3.Inhibit	11303	0x2c27
Alarm.32.Delay	10744	0x29f8	DigAlarm.3.Latch	11300	0x2c24
Alarm.32.Hysteresis	10738	0x29f2	DigAlarm.3.Out	11305	0x2c29
Alarm.32.Inhibit	10743	0x29f7	DigAlarm.3.Type	11296	0x2c20
Alarm.32.Latch	10740	0x29f4	DigAlarm.4.Ack	11322	0x2c3a
Alarm.32.Out	10745	0x29f9	DigAlarm.4.Block	11318	0x2c36
Alarm.32.Reference	10739	0x29f3	DigAlarm.4.Delay	11320	0x2c38
Alarm.32.Threshold	10737	0x29f1	DigAlarm.4.Inhibit	11319	0x2c37
Alarm.32.Type	10736	0x29f0	DigAlarm.4.Latch	11316	0x2c34
AlmSummary.General.AnAlarmStatus1	10176	0x27c0	DigAlarm.4.Out	11321	0x2c39
AlmSummary.General.AnAlarmStatus2	10177	0x27c1	DigAlarm.4.Type	11312	0x2c30
AlmSummary.General.AnAlarmStatus3	10178	0x27c2	DigAlarm.5.Ack	11338	0x2c4a
AlmSummary.General.AnAlarmStatus4	10179	0x27c3	DigAlarm.5.Block	11334	0x2c46
AlmSummary.General.AnyAlarm	10213	0x27e5	DigAlarm.5.Delay	11336	0x2c48
AlmSummary.General.CTAlarmStatus1	4192	0x1060	DigAlarm.5.Inhibit	11335	0x2c47
AlmSummary.General.CTAlarmStatus2	4193	0x1061	DigAlarm.5.Latch	11332	0x2c44
AlmSummary.General.CTAlarmStatus3	4194	0x1062	DigAlarm.5.Out	11337	0x2c49
AlmSummary.General.CTAlarmStatus4	4195	0x1063	DigAlarm.5.Type	11328	0x2c40
AlmSummary.General.DigAlarmStatus1	10188	0x27cc	DigAlarm.6.Ack	11354	0x2c5a
AlmSummary.General.DigAlarmStatus2	10189	0x27cd	DigAlarm.6.Block	11350	0x2c56
AlmSummary.General.DigAlarmStatus3	10190	0x27ce	DigAlarm.6.Delay	11352	0x2c58
AlmSummary.General.DigAlarmStatus4	10191	0x27cf	DigAlarm.6.Inhibit	11351	0x2c57
AlmSummary.General.GlobalAck	10214	0x27e6	DigAlarm.6.Latch	11348	0x2c54
AlmSummary.General.NewAlarm	10212	0x27e4	DigAlarm.6.Out	11353	0x2c59
AlmSummary.General.NewCTAlarm	4196	0x1064	DigAlarm.6.Type	11344	0x2c50
AlmSummary.General.RstNewAlarm	10215	0x27e7	DigAlarm.7.Ack	11370	0x2c6a
AlmSummary.General.RstNewCTAlarm	4197	0x1065	DigAlarm.7.Block	11366	0x2c66
AlmSummary.General.SBrkAlarmStatus1	10200	0x27d8	DigAlarm.7.Delay	11368	0x2c68
AlmSummary.General.SBrkAlarmStatus2	10201	0x27d9	DigAlarm.7.Inhibit	11367	0x2c67
AlmSummary.General.SBrkAlarmStatus3	10202	0x27da	DigAlarm.7.Latch	11364	0x2c64

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
DigAlarm.7.Out	11369	0x2c69	DigAlarm.15.Ack	11498	0x2cea
DigAlarm.7.Type	11360	0x2c60	DigAlarm.15.Block	11494	0x2ce6
DigAlarm.8.Ack	11386	0x2c7a	DigAlarm.15.Delay	11496	0x2ce8
DigAlarm.8.Block	11382	0x2c76	DigAlarm.15.Inhibit	11495	0x2ce7
DigAlarm.8.Delay	11384	0x2c78	DigAlarm.15.Latch	11492	0x2ce4
DigAlarm.8.Inhibit	11383	0x2c77	DigAlarm.15.Out	11497	0x2ce9
DigAlarm.8.Latch	11380	0x2c74	DigAlarm.15.Type	11488	0x2ce0
DigAlarm.8.Out	11385	0x2c79	DigAlarm.16.Ack	11514	0x2cfa
DigAlarm.8.Type	11376	0x2c70	DigAlarm.16.Block	11510	0x2cf6
DigAlarm.9.Ack	11402	0x2c8a	DigAlarm.16.Delay	11512	0x2cf8
DigAlarm.9.Block	11398	0x2c86	DigAlarm.16.Inhibit	11511	0x2cf7
DigAlarm.9.Delay	11400	0x2c88	DigAlarm.16.Latch	11508	0x2cf4
DigAlarm.9.Inhibit	11399	0x2c87	DigAlarm.16.Out	11513	0x2cf9
DigAlarm.9.Latch	11396	0x2c84	DigAlarm.16.Type	11504	0x2cf0
DigAlarm.9.Out	11401	0x2c89	DigAlarm.17.Ack	11530	0x2d0a
DigAlarm.9.Type	11392	0x2c80	DigAlarm.17.Block	11526	0x2d06
DigAlarm.10.Ack	11418	0x2c9a	DigAlarm.17.Delay	11528	0x2d08
DigAlarm.10.Block	11414	0x2c96	DigAlarm.17.Inhibit	11527	0x2d07
DigAlarm.10.Delay	11416	0x2c98	DigAlarm.17.Latch	11524	0x2d04
DigAlarm.10.Inhibit	11415	0x2c97	DigAlarm.17.Out	11529	0x2d09
DigAlarm.10.Latch	11412	0x2c94	DigAlarm.17.Type	11520	0x2d00
DigAlarm.10.Out	11417	0x2c99	DigAlarm.18.Ack	11546	0x2d1a
DigAlarm.10.Type	11408	0x2c90	DigAlarm.18.Block	11542	0x2d16
DigAlarm.11.Ack	11434	0x2caa	DigAlarm.18.Delay	11544	0x2d18
DigAlarm.11.Block	11430	0x2ca6	DigAlarm.18.Inhibit	11543	0x2d17
DigAlarm.11.Delay	11432	0x2ca8	DigAlarm.18.Latch	11540	0x2d14
DigAlarm.11.Inhibit	11431	0x2ca7	DigAlarm.18.Out	11545	0x2d19
DigAlarm.11.Latch	11428	0x2ca4	DigAlarm.18.Type	11536	0x2d10
DigAlarm.11.Out	11433	0x2ca9	DigAlarm.19.Ack	11562	0x2d2a
DigAlarm.11.Type	11424	0x2ca0	DigAlarm.19.Block	11558	0x2d26
DigAlarm.12.Ack	11450	0x2cba	DigAlarm.19.Delay	11560	0x2d28
DigAlarm.12.Block	11446	0x2cb6	DigAlarm.19.Inhibit	11559	0x2d27
DigAlarm.12.Delay	11448	0x2cb8	DigAlarm.19.Latch	11556	0x2d24
DigAlarm.12.Inhibit	11447	0x2cb7	DigAlarm.19.Out	11561	0x2d29
DigAlarm.12.Latch	11444	0x2cb4	DigAlarm.19.Type	11552	0x2d20
DigAlarm.12.Out	11449	0x2cb9	DigAlarm.20.Ack	11578	0x2d3a
DigAlarm.12.Type	11440	0x2cb0	DigAlarm.20.Block	11574	0x2d36
DigAlarm.13.Ack	11466	0x2cca	DigAlarm.20.Delay	11576	0x2d38
DigAlarm.13.Block	11462	0x2cc6	DigAlarm.20.Inhibit	11575	0x2d37
DigAlarm.13.Delay	11464	0x2cc8	DigAlarm.20.Latch	11572	0x2d34
DigAlarm.13.Inhibit	11463	0x2cc7	DigAlarm.20.Out	11577	0x2d39
DigAlarm.13.Latch	11460	0x2cc4	DigAlarm.20.Type	11568	0x2d30
DigAlarm.13.Out	11465	0x2cc9	DigAlarm.21.Ack	11594	0x2d4a
DigAlarm.13.Type	11456	0x2cc0	DigAlarm.21.Block	11590	0x2d46
DigAlarm.14.Ack	11482	0x2cda	DigAlarm.21.Delay	11592	0x2d48
DigAlarm.14.Block	11478	0x2cd6	DigAlarm.21.Inhibit	11591	0x2d47
DigAlarm.14.Delay	11480	0x2cd8	DigAlarm.21.Latch	11588	0x2d44
DigAlarm.14.Inhibit	11479	0x2cd7	DigAlarm.21.Out	11593	0x2d49
DigAlarm.14.Latch	11476	0x2cd4	DigAlarm.21.Type	11584	0x2d40
DigAlarm.14.Out	11481	0x2cd9	DigAlarm.22.Ack	11610	0x2d5a
DigAlarm.14.Type	11472	0x2cd0	DigAlarm.22.Block	11606	0x2d56

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
DigAlarm.22.Delay	11608	0x2d58	DigAlarm.29.Latch	11716	0x2dc4
DigAlarm.22.Inhibit	11607	0x2d57	DigAlarm.29.Out	11721	0x2dc9
DigAlarm.22.Latch	11604	0x2d54	DigAlarm.29.Type	11712	0x2dc0
DigAlarm.22.Out	11609	0x2d59	DigAlarm.30.Ack	11738	0x2dda
DigAlarm.22.Type	11600	0x2d50	DigAlarm.30.Block	11734	0x2dd6
DigAlarm.23.Ack	11626	0x2d6a	DigAlarm.30.Delay	11736	0x2dd8
DigAlarm.23.Block	11622	0x2d66	DigAlarm.30.Inhibit	11735	0x2dd7
DigAlarm.23.Delay	11624	0x2d68	DigAlarm.30.Latch	11732	0x2dd4
DigAlarm.23.Inhibit	11623	0x2d67	DigAlarm.30.Out	11737	0x2dd9
DigAlarm.23.Latch	11620	0x2d64	DigAlarm.30.Type	11728	0x2dd0
DigAlarm.23.Out	11625	0x2d69	DigAlarm.31.Ack	11754	0x2dea
DigAlarm.23.Type	11616	0x2d60	DigAlarm.31.Block	11750	0x2de6
DigAlarm.24.Ack	11642	0x2d7a	DigAlarm.31.Delay	11752	0x2de8
DigAlarm.24.Block	11638	0x2d76	DigAlarm.31.Inhibit	11751	0x2de7
DigAlarm.24.Delay	11640	0x2d78	DigAlarm.31.Latch	11748	0x2de4
DigAlarm.24.Inhibit	11639	0x2d77	DigAlarm.31.Out	11753	0x2de9
DigAlarm.24.Latch	11636	0x2d74	DigAlarm.31.Type	11744	0x2de0
DigAlarm.24.Out	11641	0x2d79	DigAlarm.32.Ack	11770	0x2dfa
DigAlarm.24.Type	11632	0x2d70	DigAlarm.32.Block	11766	0x2df6
DigAlarm.25.Ack	11658	0x2d8a	DigAlarm.32.Delay	11768	0x2df8
DigAlarm.25.Block	11654	0x2d86	DigAlarm.32.Inhibit	11767	0x2df7
DigAlarm.25.Delay	11656	0x2d88	DigAlarm.32.Latch	11764	0x2df4
DigAlarm.25.Inhibit	11655	0x2d87	DigAlarm.32.Out	11769	0x2df9
DigAlarm.25.Latch	11652	0x2d84	DigAlarm.32.Type	11760	0x2df0
DigAlarm.25.Out	11657	0x2d89	Humidity.DewPoint	13317	0x3405
DigAlarm.25.Type	11648	0x2d80	Humidity.DryTemp	13318	0x3406
DigAlarm.26.Ack	11674	0x2d9a	Humidity.Pressure	13313	0x3401
DigAlarm.26.Block	11670	0x2d96	Humidity.PsychroConst	13315	0x3403
DigAlarm.26.Delay	11672	0x2d98	Humidity.RelHumid	13316	0x3404
DigAlarm.26.Inhibit	11671	0x2d97	Humidity.Resolution	13320	0x3408
DigAlarm.26.Latch	11668	0x2d94	Humidity.SBrk	13314	0x3402
DigAlarm.26.Out	11673	0x2d99	Humidity.WetOffset	13312	0x3400
DigAlarm.26.Type	11664	0x2d90	Humidity.WetTemp	13319	0x3407
DigAlarm.27.Ack	11690	0x2daa	Instrument.Diagnostics.CntrlOverrun	4737	0x1281
DigAlarm.27.Block	11686	0x2da6	Instrument.Diagnostics.ErrCount	4736	0x1280
DigAlarm.27.Delay	11688	0x2da8	Instrument.Diagnostics.PSUident	13027	0x32e3
DigAlarm.27.Inhibit	11687	0x2da7	Instrument.InstInfo.CompanyID	121	0x0079
DigAlarm.27.Latch	11684	0x2da4	Instrument.InstInfo.InstType	122	0x007a
DigAlarm.27.Out	11689	0x2da9	Instrument.InstInfo.Version	107	0x006b
DigAlarm.27.Type	11680	0x2da0	Instrument.Options.Units	4738	0x1282
DigAlarm.28.Ack	11706	0x2dba	IO.CurrentMonitor.Config.CalibrateCT1	4170	0x104a
DigAlarm.28.Block	11702	0x2db6	IO.CurrentMonitor.Config.CalibrateCT2	4171	0x104b
DigAlarm.28.Delay	11704	0x2db8	IO.CurrentMonitor.Config.CalibrateCT3	4172	0x104c
DigAlarm.28.Inhibit	11703	0x2db7	IO.CurrentMonitor.Config.Commission	4096	0x1000
DigAlarm.28.Latch	11700	0x2db4	IO.CurrentMonitor.Config.CommissionStatus	4097	0x1001
DigAlarm.28.Out	11705	0x2db9	IO.CurrentMonitor.Config.CT1Range	4103	0x1007
DigAlarm.28.Type	11696	0x2db0	IO.CurrentMonitor.Config.CT1Resolution	4198	0x1066
DigAlarm.29.Ack	11722	0x2dca	IO.CurrentMonitor.Config.CT2Range	4104	0x1008
DigAlarm.29.Block	11718	0x2dc6	IO.CurrentMonitor.Config.CT2Resolution	4199	0x1067
DigAlarm.29.Delay	11720	0x2dc8	IO.CurrentMonitor.Config.CT3Range	4105	0x1009
DigAlarm.29.Inhibit	11719	0x2dc7	IO.CurrentMonitor.Config.CT3Resolution	4200	0x1068

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
IO.CurrentMonitor.Config.Inhibit	4099	0x1003	IO.CurrentMonitor.Config.Load10Resolution	4210	0x1072
IO.CurrentMonitor.Config.Interval	4098	0x1002	IO.CurrentMonitor.Config.Load11CTInput	4147	0x1033
IO.CurrentMonitor.Config.Load1CTInput	4107	0x100b	IO.CurrentMonitor.Config.Load11DrivenBy	4146	0x1032
IO.CurrentMonitor.Config.Load1DrivenBy	4106	0x100a	IO.CurrentMonitor.Config.Load11OCFthreshold	4149	0x1035
IO.CurrentMonitor.Config.Load1OCFthreshold	4109	0x100d	IO.CurrentMonitor.Config.Load11PLFthreshold	4148	0x1034
IO.CurrentMonitor.Config.Load1PLFthreshold	4108	0x100c	IO.CurrentMonitor.Config.Load11Resolution	4211	0x1073
IO.CurrentMonitor.Config.Load1Resolution	4201	0x1069	IO.CurrentMonitor.Config.Load12CTInput	4151	0x1037
IO.CurrentMonitor.Config.Load2CTInput	4111	0x100f	IO.CurrentMonitor.Config.Load12DrivenBy	4150	0x1036
IO.CurrentMonitor.Config.Load2DrivenBy	4110	0x100e	IO.CurrentMonitor.Config.Load12OCFthreshold	4153	0x1039
IO.CurrentMonitor.Config.Load2OCFthreshold	4113	0x1011	IO.CurrentMonitor.Config.Load12PLFthreshold	4152	0x1038
IO.CurrentMonitor.Config.Load2PLFthreshold	4112	0x1010	IO.CurrentMonitor.Config.Load12Resolution	4212	0x1074
IO.CurrentMonitor.Config.Load2Resolution	4202	0x106a	IO.CurrentMonitor.Config.Load13CTInput	4155	0x103b
IO.CurrentMonitor.Config.Load3CTInput	4115	0x1013	IO.CurrentMonitor.Config.Load13DrivenBy	4154	0x103a
IO.CurrentMonitor.Config.Load3DrivenBy	4114	0x1012	IO.CurrentMonitor.Config.Load13OCFthreshold	4157	0x103d
IO.CurrentMonitor.Config.Load3OCFthreshold	4117	0x1015	IO.CurrentMonitor.Config.Load13PLFthreshold	4156	0x103c
IO.CurrentMonitor.Config.Load3PLFthreshold	4116	0x1014	IO.CurrentMonitor.Config.Load13Resolution	4213	0x1075
IO.CurrentMonitor.Config.Load3Resolution	4203	0x106b	IO.CurrentMonitor.Config.Load14CTInput	4159	0x103f
IO.CurrentMonitor.Config.Load4CTInput	4119	0x1017	IO.CurrentMonitor.Config.Load14DrivenBy	4158	0x103e
IO.CurrentMonitor.Config.Load4DrivenBy	4118	0x1016	IO.CurrentMonitor.Config.Load14OCFthreshold	4161	0x1041
IO.CurrentMonitor.Config.Load4OCFthreshold	4121	0x1019	IO.CurrentMonitor.Config.Load14PLFthreshold	4160	0x1040
IO.CurrentMonitor.Config.Load4PLFthreshold	4120	0x1018	IO.CurrentMonitor.Config.Load14Resolution	4214	0x1076
IO.CurrentMonitor.Config.Load4Resolution	4204	0x106c	IO.CurrentMonitor.Config.Load15CTInput	4163	0x1043
IO.CurrentMonitor.Config.Load5CTInput	4123	0x101b	IO.CurrentMonitor.Config.Load15DrivenBy	4162	0x1042
IO.CurrentMonitor.Config.Load5DrivenBy	4122	0x101a	IO.CurrentMonitor.Config.Load15OCFthreshold	4165	0x1045
IO.CurrentMonitor.Config.Load5OCFthreshold	4125	0x101d	IO.CurrentMonitor.Config.Load15PLFthreshold	4164	0x1044
IO.CurrentMonitor.Config.Load5PLFthreshold	4124	0x101c	IO.CurrentMonitor.Config.Load15Resolution	4215	0x1077
IO.CurrentMonitor.Config.Load5Resolution	4205	0x106d	IO.CurrentMonitor.Config.Load16CTInput	4167	0x1047
IO.CurrentMonitor.Config.Load6CTInput	4127	0x101f	IO.CurrentMonitor.Config.Load16DrivenBy	4166	0x1046
IO.CurrentMonitor.Config.Load6DrivenBy	4126	0x101e	IO.CurrentMonitor.Config.Load16OCFthreshold	4169	0x1049
IO.CurrentMonitor.Config.Load6OCFthreshold	4129	0x1021	IO.CurrentMonitor.Config.Load16PLFthreshold	4168	0x1048
IO.CurrentMonitor.Config.Load6PLFthreshold	4128	0x1020	IO.CurrentMonitor.Config.Load16Resolution	4216	0x1078
IO.CurrentMonitor.Config.Load6Resolution	4206	0x106e	IO.CurrentMonitor.Config.MaxLeakPh1	4100	0x1004
IO.CurrentMonitor.Config.Load7CTInput	4131	0x1023	IO.CurrentMonitor.Config.MaxLeakPh2	4101	0x1005
IO.CurrentMonitor.Config.Load7DrivenBy	4130	0x1022	IO.CurrentMonitor.Config.MaxLeakPh3	4102	0x1006
IO.CurrentMonitor.Config.Load7OCFthreshold	4133	0x1025	IO.CurrentMonitor.Status.Load1Current	4173	0x104d
IO.CurrentMonitor.Config.Load7PLFthreshold	4132	0x1024	IO.CurrentMonitor.Status.Load2Current	4174	0x104e
IO.CurrentMonitor.Config.Load7Resolution	4207	0x106f	IO.CurrentMonitor.Status.Load3Current	4175	0x104f
IO.CurrentMonitor.Config.Load8CTInput	4135	0x1027	IO.CurrentMonitor.Status.Load4Current	4176	0x1050
IO.CurrentMonitor.Config.Load8DrivenBy	4134	0x1026	IO.CurrentMonitor.Status.Load5Current	4177	0x1051
IO.CurrentMonitor.Config.Load8OCFthreshold	4137	0x1029	IO.CurrentMonitor.Status.Load6Current	4178	0x1052
IO.CurrentMonitor.Config.Load8PLFthreshold	4136	0x1028	IO.CurrentMonitor.Status.Load7Current	4179	0x1053
IO.CurrentMonitor.Config.Load8Resolution	4208	0x1070	IO.CurrentMonitor.Status.Load8Current	4180	0x1054
IO.CurrentMonitor.Config.Load9CTInput	4139	0x102b	IO.CurrentMonitor.Status.Load9Current	4181	0x1055
IO.CurrentMonitor.Config.Load9DrivenBy	4138	0x102a	IO.CurrentMonitor.Status.Load10Current	4182	0x1056
IO.CurrentMonitor.Config.Load9OCFthreshold	4141	0x102d	IO.CurrentMonitor.Status.Load11Current	4183	0x1057
IO.CurrentMonitor.Config.Load9PLFthreshold	4140	0x102c	IO.CurrentMonitor.Status.Load12Current	4184	0x1058
IO.CurrentMonitor.Config.Load9Resolution	4209	0x1071	IO.CurrentMonitor.Status.Load13Current	4185	0x1059
IO.CurrentMonitor.Config.Load10CTInput	4143	0x102f	IO.CurrentMonitor.Status.Load14Current	4186	0x105a
IO.CurrentMonitor.Config.Load10DrivenBy	4142	0x102e	IO.CurrentMonitor.Status.Load15Current	4187	0x105b
IO.CurrentMonitor.Config.Load10OCFthreshold	4145	0x1031	IO.CurrentMonitor.Status.Load16Current	4188	0x105c
IO.CurrentMonitor.Config.Load10PLFthreshold	4144	0x1030	IO.CurrentMonitor.Status.Ph1AllOff	4189	0x105d

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
IO.CurrentMonitor.Status.Ph2AllOff	4190	0x105e	IO.Mod.7.LoOffset	4362	0x110a
IO.CurrentMonitor.Status.Ph3AllOff	4191	0x105f	IO.Mod.7.LoPoint	4330	0x10ea
IO.FixedIO.A.PV	4226	0x1082	IO.Mod.7.MinOnTime	4298	0x10ca
IO.FixedIO.B.PV	4227	0x1083	IO.Mod.7.PV	4234	0x108a
IO.FixedIO.D1.PV	4224	0x1080	IO.Mod.8.AlarmAck	4267	0x10ab
IO.FixedIO.D2.PV	4225	0x1081	IO.Mod.8.HiOffset	4427	0x114b
IO.Mod.1.AlarmAck	4260	0x10a4	IO.Mod.8.HiPoint	4395	0x112b
IO.Mod.1.HiOffset	4420	0x1144	IO.Mod.8.LoOffset	4363	0x110b
IO.Mod.1.HiPoint	4388	0x1124	IO.Mod.8.LoPoint	4331	0x10eb
IO.Mod.1.LoOffset	4356	0x1104	IO.Mod.8.MinOnTime	4299	0x10cb
IO.Mod.1.LoPoint	4324	0x10e4	IO.Mod.8.PV	4235	0x108b
IO.Mod.1.MinOnTime	4292	0x10c4	IO.Mod.9.AlarmAck	4268	0x10ac
IO.Mod.1.PV	4228	0x1084	IO.Mod.9.HiOffset	4428	0x114c
IO.Mod.2.AlarmAck	4261	0x10a5	IO.Mod.9.HiPoint	4396	0x112c
IO.Mod.2.HiOffset	4421	0x1145	IO.Mod.9.LoOffset	4364	0x110c
IO.Mod.2.HiPoint	4389	0x1125	IO.Mod.9.LoPoint	4332	0x10ec
IO.Mod.2.LoOffset	4357	0x1105	IO.Mod.9.MinOnTime	4300	0x10cc
IO.Mod.2.LoPoint	4325	0x10e5	IO.Mod.9.PV	4236	0x108c
IO.Mod.2.MinOnTime	4293	0x10c5	IO.Mod.10.AlarmAck	4269	0x10ad
IO.Mod.2.PV	4229	0x1085	IO.Mod.10.HiOffset	4429	0x114d
IO.Mod.3.AlarmAck	4262	0x10a6	IO.Mod.10.HiPoint	4397	0x112d
IO.Mod.3.HiOffset	4422	0x1146	IO.Mod.10.LoOffset	4365	0x110d
IO.Mod.3.HiPoint	4390	0x1126	IO.Mod.10.LoPoint	4333	0x10ed
IO.Mod.3.LoOffset	4358	0x1106	IO.Mod.10.MinOnTime	4301	0x10cd
IO.Mod.3.LoPoint	4326	0x10e6	IO.Mod.10.PV	4237	0x108d
IO.Mod.3.MinOnTime	4294	0x10c6	IO.Mod.11.AlarmAck	4270	0x10ae
IO.Mod.3.PV	4230	0x1086	IO.Mod.11.HiOffset	4430	0x114e
IO.Mod.4.AlarmAck	4263	0x10a7	IO.Mod.11.HiPoint	4398	0x112e
IO.Mod.4.HiOffset	4423	0x1147	IO.Mod.11.LoOffset	4366	0x110e
IO.Mod.4.HiPoint	4391	0x1127	IO.Mod.11.LoPoint	4334	0x10ee
IO.Mod.4.LoOffset	4359	0x1107	IO.Mod.11.MinOnTime	4302	0x10ce
IO.Mod.4.LoPoint	4327	0x10e7	IO.Mod.11.PV	4238	0x108e
IO.Mod.4.MinOnTime	4295	0x10c7	IO.Mod.12.AlarmAck	4271	0x10af
IO.Mod.4.PV	4231	0x1087	IO.Mod.12.HiOffset	4431	0x114f
IO.Mod.5.AlarmAck	4264	0x10a8	IO.Mod.12.HiPoint	4399	0x112f
IO.Mod.5.HiOffset	4424	0x1148	IO.Mod.12.LoOffset	4367	0x110f
IO.Mod.5.HiPoint	4392	0x1128	IO.Mod.12.LoPoint	4335	0x10ef
IO.Mod.5.LoOffset	4360	0x1108	IO.Mod.12.MinOnTime	4303	0x10cf
IO.Mod.5.LoPoint	4328	0x10e8	IO.Mod.12.PV	4239	0x108f
IO.Mod.5.MinOnTime	4296	0x10c8	IO.Mod.13.AlarmAck	4272	0x10b0
IO.Mod.5.PV	4232	0x1088	IO.Mod.13.HiOffset	4432	0x1150
IO.Mod.6.AlarmAck	4265	0x10a9	IO.Mod.13.HiPoint	4400	0x1130
IO.Mod.6.HiOffset	4425	0x1149	IO.Mod.13.LoOffset	4368	0x1110
IO.Mod.6.HiPoint	4393	0x1129	IO.Mod.13.LoPoint	4336	0x10f0
IO.Mod.6.LoOffset	4361	0x1109	IO.Mod.13.MinOnTime	4304	0x10d0
IO.Mod.6.LoPoint	4329	0x10e9	IO.Mod.13.PV	4240	0x1090
IO.Mod.6.MinOnTime	4297	0x10c9	IO.Mod.14.AlarmAck	4273	0x10b1
IO.Mod.6.PV	4233	0x1089	IO.Mod.14.HiOffset	4433	0x1151
IO.Mod.7.AlarmAck	4266	0x10aa	IO.Mod.14.HiPoint	4401	0x1131
IO.Mod.7.HiOffset	4426	0x114a	IO.Mod.14.LoOffset	4369	0x1111
IO.Mod.7.HiPoint	4394	0x112a	IO.Mod.14.LoPoint	4337	0x10f1

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
IO.Mod.14.MinOnTime	4305	0x10d1	IO.Mod.22.AlarmAck	4281	0x10b9
IO.Mod.14.PV	4241	0x1091	IO.Mod.22.HiOffset	4441	0x1159
IO.Mod.15.AlarmAck	4274	0x10b2	IO.Mod.22.HiPoint	4409	0x1139
IO.Mod.15.HiOffset	4434	0x1152	IO.Mod.22.LoOffset	4377	0x1119
IO.Mod.15.HiPoint	4402	0x1132	IO.Mod.22.LoPoint	4345	0x10f9
IO.Mod.15.LoOffset	4370	0x1112	IO.Mod.22.MinOnTime	4313	0x10d9
IO.Mod.15.LoPoint	4338	0x10f2	IO.Mod.22.PV	4249	0x1099
IO.Mod.15.MinOnTime	4306	0x10d2	IO.Mod.23.AlarmAck	4282	0x10ba
IO.Mod.15.PV	4242	0x1092	IO.Mod.23.HiOffset	4442	0x115a
IO.Mod.16.AlarmAck	4275	0x10b3	IO.Mod.23.HiPoint	4410	0x113a
IO.Mod.16.HiOffset	4435	0x1153	IO.Mod.23.LoOffset	4378	0x111a
IO.Mod.16.HiPoint	4403	0x1133	IO.Mod.23.LoPoint	4346	0x10fa
IO.Mod.16.LoOffset	4371	0x1113	IO.Mod.23.MinOnTime	4314	0x10da
IO.Mod.16.LoPoint	4339	0x10f3	IO.Mod.23.PV	4250	0x109a
IO.Mod.16.MinOnTime	4307	0x10d3	IO.Mod.24.AlarmAck	4283	0x10bb
IO.Mod.16.PV	4243	0x1093	IO.Mod.24.HiOffset	4443	0x115b
IO.Mod.17.AlarmAck	4276	0x10b4	IO.Mod.24.HiPoint	4411	0x113b
IO.Mod.17.HiOffset	4436	0x1154	IO.Mod.24.LoOffset	4379	0x111b
IO.Mod.17.HiPoint	4404	0x1134	IO.Mod.24.LoPoint	4347	0x10fb
IO.Mod.17.LoOffset	4372	0x1114	IO.Mod.24.MinOnTime	4315	0x10db
IO.Mod.17.LoPoint	4340	0x10f4	IO.Mod.24.PV	4251	0x109b
IO.Mod.17.MinOnTime	4308	0x10d4	IO.Mod.25.AlarmAck	4284	0x10bc
IO.Mod.17.PV	4244	0x1094	IO.Mod.25.HiOffset	4444	0x115c
IO.Mod.18.AlarmAck	4277	0x10b5	IO.Mod.25.HiPoint	4412	0x113c
IO.Mod.18.HiOffset	4437	0x1155	IO.Mod.25.LoOffset	4380	0x111c
IO.Mod.18.HiPoint	4405	0x1135	IO.Mod.25.LoPoint	4348	0x10fc
IO.Mod.18.LoOffset	4373	0x1115	IO.Mod.25.MinOnTime	4316	0x10dc
IO.Mod.18.LoPoint	4341	0x10f5	IO.Mod.25.PV	4252	0x109c
IO.Mod.18.MinOnTime	4309	0x10d5	IO.Mod.26.AlarmAck	4285	0x10bd
IO.Mod.18.PV	4245	0x1095	IO.Mod.26.HiOffset	4445	0x115d
IO.Mod.19.AlarmAck	4278	0x10b6	IO.Mod.26.HiPoint	4413	0x113d
IO.Mod.19.HiOffset	4438	0x1156	IO.Mod.26.LoOffset	4381	0x111d
IO.Mod.19.HiPoint	4406	0x1136	IO.Mod.26.LoPoint	4349	0x10fd
IO.Mod.19.LoOffset	4374	0x1116	IO.Mod.26.MinOnTime	4317	0x10dd
IO.Mod.19.LoPoint	4342	0x10f6	IO.Mod.26.PV	4253	0x109d
IO.Mod.19.MinOnTime	4310	0x10d6	IO.Mod.27.AlarmAck	4286	0x10be
IO.Mod.19.PV	4246	0x1096	IO.Mod.27.HiOffset	4446	0x115e
IO.Mod.20.AlarmAck	4279	0x10b7	IO.Mod.27.HiPoint	4414	0x113e
IO.Mod.20.HiOffset	4439	0x1157	IO.Mod.27.LoOffset	4382	0x111e
IO.Mod.20.HiPoint	4407	0x1137	IO.Mod.27.LoPoint	4350	0x10fe
IO.Mod.20.LoOffset	4375	0x1117	IO.Mod.27.MinOnTime	4318	0x10de
IO.Mod.20.LoPoint	4343	0x10f7	IO.Mod.27.PV	4254	0x109e
IO.Mod.20.MinOnTime	4311	0x10d7	IO.Mod.28.AlarmAck	4287	0x10bf
IO.Mod.20.PV	4247	0x1097	IO.Mod.28.HiOffset	4447	0x115f
IO.Mod.21.AlarmAck	4280	0x10b8	IO.Mod.28.HiPoint	4415	0x113f
IO.Mod.21.HiOffset	4440	0x1158	IO.Mod.28.LoOffset	4383	0x111f
IO.Mod.21.HiPoint	4408	0x1138	IO.Mod.28.LoPoint	4351	0x10ff
IO.Mod.21.LoOffset	4376	0x1118	IO.Mod.28.MinOnTime	4319	0x10df
IO.Mod.21.LoPoint	4344	0x10f8	IO.Mod.28.PV	4255	0x109f
IO.Mod.21.MinOnTime	4312	0x10d8	IO.Mod.29.AlarmAck	4288	0x10c0
IO.Mod.21.PV	4248	0x1098	IO.Mod.29.HiOffset	4448	0x1160

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
IO.Mod.29.HiPoint	4416	0x1140	Lgc2.4.Out	4833	0x12e1
IO.Mod.29.LoOffset	4384	0x1120	Lgc2.5.In1	4834	0x12e2
IO.Mod.29.LoPoint	4352	0x1100	Lgc2.5.In2	4835	0x12e3
IO.Mod.29.MinOnTime	4320	0x10e0	Lgc2.5.Out	4836	0x12e4
IO.Mod.29.PV	4256	0x10a0	Lgc2.6.In1	4837	0x12e5
IO.Mod.30.AlarmAck	4289	0x10c1	Lgc2.6.In2	4838	0x12e6
IO.Mod.30.HiOffset	4449	0x1161	Lgc2.6.Out	4839	0x12e7
IO.Mod.30.HiPoint	4417	0x1141	Lgc2.7.In1	4840	0x12e8
IO.Mod.30.LoOffset	4385	0x1121	Lgc2.7.In2	4841	0x12e9
IO.Mod.30.LoPoint	4353	0x1101	Lgc2.7.Out	4842	0x12ea
IO.Mod.30.MinOnTime	4321	0x10e1	Lgc2.8.In1	4843	0x12eb
IO.Mod.30.PV	4257	0x10a1	Lgc2.8.In2	4844	0x12ec
IO.Mod.31.AlarmAck	4290	0x10c2	Lgc2.8.Out	4845	0x12ed
IO.Mod.31.HiOffset	4450	0x1162	Lgc2.9.In1	4846	0x12ee
IO.Mod.31.HiPoint	4418	0x1142	Lgc2.9.In2	4847	0x12ef
IO.Mod.31.LoOffset	4386	0x1122	Lgc2.9.Out	4848	0x12f0
IO.Mod.31.LoPoint	4354	0x1102	Lgc2.10.In1	4849	0x12f1
IO.Mod.31.MinOnTime	4322	0x10e2	Lgc2.10.In2	4850	0x12f2
IO.Mod.31.PV	4258	0x10a2	Lgc2.10.Out	4851	0x12f3
IO.Mod.32.AlarmAck	4291	0x10c3	Lgc2.11.In1	4852	0x12f4
IO.Mod.32.HiOffset	4451	0x1163	Lgc2.11.In2	4853	0x12f5
IO.Mod.32.HiPoint	4419	0x1143	Lgc2.11.Out	4854	0x12f6
IO.Mod.32.LoOffset	4387	0x1123	Lgc2.12.In1	4855	0x12f7
IO.Mod.32.LoPoint	4355	0x1103	Lgc2.12.In2	4856	0x12f8
IO.Mod.32.MinOnTime	4323	0x10e3	Lgc2.12.Out	4857	0x12f9
IO.Mod.32.PV	4259	0x10a3	Lgc2.13.In1	4858	0x12fa
IO.ModIDs.Module1	12707	0x31a3	Lgc2.13.In2	4859	0x12fb
IO.ModIDs.Module2	12771	0x31e3	Lgc2.13.Out	4860	0x12fc
IO.ModIDs.Module3	12835	0x3223	Lgc2.14.In1	4861	0x12fd
IO.ModIDs.Module4	12899	0x3263	Lgc2.14.In2	4862	0x12fe
IPMonitor.1.Max	4915	0x1333	Lgc2.14.Out	4863	0x12ff
IPMonitor.1.Min	4916	0x1334	Lgc2.15.In1	4864	0x1300
IPMonitor.1.Reset	4919	0x1337	Lgc2.15.In2	4865	0x1301
IPMonitor.1.Threshold	4917	0x1335	Lgc2.15.Out	4866	0x1302
IPMonitor.1.TimeAbove	4918	0x1336	Lgc2.16.In1	4867	0x1303
IPMonitor.2.Max	4920	0x1338	Lgc2.16.In2	4868	0x1304
IPMonitor.2.Min	4921	0x1339	Lgc2.16.Out	4869	0x1305
IPMonitor.2.Reset	4924	0x133c	Lgc2.17.In1	4870	0x1306
IPMonitor.2.Threshold	4922	0x133a	Lgc2.17.In2	4871	0x1307
IPMonitor.2.TimeAbove	4923	0x133b	Lgc2.17.Out	4872	0x1308
Lgc2.1.In1	4822	0x12d6	Lgc2.18.In1	4873	0x1309
Lgc2.1.In2	4823	0x12d7	Lgc2.18.In2	4874	0x130a
Lgc2.1.Out	4824	0x12d8	Lgc2.18.Out	4875	0x130b
Lgc2.2.In1	4825	0x12d9	Lgc2.19.In1	4876	0x130c
Lgc2.2.In2	4826	0x12da	Lgc2.19.In2	4877	0x130d
Lgc2.2.Out	4827	0x12db	Lgc2.19.Out	4878	0x130e
Lgc2.3.In1	4828	0x12dc	Lgc2.20.In1	4879	0x130f
Lgc2.3.In2	4829	0x12dd	Lgc2.20.In2	4880	0x1310
Lgc2.3.Out	4830	0x12de	Lgc2.20.Out	4881	0x1311
Lgc2.4.In1	4831	0x12df	Lgc2.21.In1	4882	0x1312
Lgc2.4.In2	4832	0x12e0	Lgc2.21.In2	4883	0x1313

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Lgc2.21.Out	4884	0x1314	Lin16.In5	4933	0x1345
Lgc2.22.In1	4885	0x1315	Lin16.In6	4934	0x1346
Lgc2.22.In2	4886	0x1316	Lin16.In7	4935	0x1347
Lgc2.22.Out	4887	0x1317	Lin16.In8	4936	0x1348
Lgc2.23.In1	4888	0x1318	Lin16.In9	4937	0x1349
Lgc2.23.In2	4889	0x1319	Lin16.In10	4938	0x134a
Lgc2.23.Out	4890	0x131a	Lin16.In11	4939	0x134b
Lgc2.24.In1	4891	0x131b	Lin16.In12	4940	0x134c
Lgc2.24.In2	4892	0x131c	Lin16.In13	4941	0x134d
Lgc2.24.Out	4893	0x131d	Lin16.In14	4942	0x134e
Lgc8.1.In1	4894	0x131e	Lin16.InHighLimit	4943	0x134f
Lgc8.1.In2	4895	0x131f	Lin16.InLowLimit	4928	0x1340
Lgc8.1.In3	4896	0x1320	Lin16.Out	4961	0x1361
Lgc8.1.In4	4897	0x1321	Lin16.Out1	4945	0x1351
Lgc8.1.In5	4898	0x1322	Lin16.Out2	4946	0x1352
Lgc8.1.In6	4899	0x1323	Lin16.Out3	4947	0x1353
Lgc8.1.In7	4900	0x1324	Lin16.Out4	4948	0x1354
Lgc8.1.In8	4901	0x1325	Lin16.Out5	4949	0x1355
Lgc8.1.Out	4902	0x1326	Lin16.Out6	4950	0x1356
Lgc8.2.In1	4903	0x1327	Lin16.Out7	4951	0x1357
Lgc8.2.In2	4904	0x1328	Lin16.Out8	4952	0x1358
Lgc8.2.In3	4905	0x1329	Lin16.Out9	4953	0x1359
Lgc8.2.In4	4906	0x132a	Lin16.Out10	4954	0x135a
Lgc8.2.In5	4907	0x132b	Lin16.Out11	4955	0x135b
Lgc8.2.In6	4908	0x132c	Lin16.Out12	4956	0x135c
Lgc8.2.In7	4909	0x132d	Lin16.Out13	4957	0x135d
Lgc8.2.In8	4910	0x132e	Lin16.Out14	4958	0x135e
Lgc8.2.Out	4911	0x132f	Lin16.OutHighLimit	4959	0x135f
Lgc8.3.In1	5054	0x13be	Lin16.OutLowLimit	4944	0x1350
Lgc8.3.In2	5055	0x13bf	Loop.1.Diag.DerivativeOutContrib	119	0x0077
Lgc8.3.In3	5056	0x13c0	Loop.1.Diag.Error	113	0x0071
Lgc8.3.In4	5057	0x13c1	Loop.1.Diag.IntegralOutContrib	118	0x0076
Lgc8.3.In5	5058	0x13c2	Loop.1.Diag.LoopBreakAlarm	116	0x0074
Lgc8.3.In6	5059	0x13c3	Loop.1.Diag.LoopMode	114	0x0072
Lgc8.3.In7	5060	0x13c4	Loop.1.Diag.PropOutContrib	117	0x0075
Lgc8.3.In8	5061	0x13c5	Loop.1.Diag.SBrk	120	0x0078
Lgc8.3.Out	5062	0x13c6	Loop.1.Diag.SchedCBH	32	0x0020
Lgc8.4.In1	5063	0x13c7	Loop.1.Diag.SchedCBL	33	0x0021
Lgc8.4.In2	5064	0x13c8	Loop.1.Diag.SchedLPBrk	35	0x0023
Lgc8.4.In3	5065	0x13c9	Loop.1.Diag.SchedMR	34	0x0022
Lgc8.4.In4	5066	0x13ca	Loop.1.Diag.SchedOPHi	37	0x0025
Lgc8.4.In5	5067	0x13cb	Loop.1.Diag.SchedOPLo	38	0x0026
Lgc8.4.In6	5068	0x13cc	Loop.1.Diag.SchedPB	29	0x001d
Lgc8.4.In7	5069	0x13cd	Loop.1.Diag.SchedR2G	36	0x0024
Lgc8.4.In8	5070	0x13ce	Loop.1.Diag.SchedTd	31	0x001f
Lgc8.4.Out	5071	0x13cf	Loop.1.Diag.SchedTi	30	0x001e
Lin16.In	4960	0x1360	Loop.1.Diag.TargetOutVal	115	0x0073
Lin16.In1	4929	0x1341	Loop.1.Main.ActiveOut	4	0x0004
Lin16.In2	4930	0x1342	Loop.1.Main.AutoMan	10	0x000a
Lin16.In3	4931	0x1343	Loop.1.Main.Inhibit	20	0x0014
Lin16.In4	4932	0x1344	Loop.1.Main.PV	1	0x0001

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.1.Main.TargetSP	2	0x0002	Loop.1.PID.OutputHi	41	0x0029
Loop.1.Main.WorkingSP	5	0x0005	Loop.1.PID.OutputHi2	51	0x0033
Loop.1.OP.Ch1OnOffHysteresis	84	0x0054	Loop.1.PID.OutputHi3	61	0x003d
Loop.1.OP.Ch1Out	82	0x0052	Loop.1.PID.OutputLo	42	0x002a
Loop.1.OP.Ch2Deadband	16	0x0010	Loop.1.PID.OutputLo2	52	0x0034
Loop.1.OP.Ch2OnOffHysteresis	85	0x0055	Loop.1.PID.OutputLo3	62	0x003e
Loop.1.OP.Ch2Out	83	0x0053	Loop.1.PID.ProportionalBand	6	0x0006
Loop.1.OP.CoolType	93	0x005d	Loop.1.PID.ProportionalBand2	43	0x002b
Loop.1.OP.EnablePowerFeedforward	91	0x005b	Loop.1.PID.ProportionalBand3	53	0x0035
Loop.1.OP.FeedForwardGain	95	0x005f	Loop.1.PID.RelCh2Gain	19	0x0013
Loop.1.OP.FeedForwardOffset	96	0x0060	Loop.1.PID.RelCh2Gain2	50	0x0032
Loop.1.OP.FeedForwardTrimLimit	97	0x0061	Loop.1.PID.RelCh2Gain3	60	0x003c
Loop.1.OP.FeedForwardType	94	0x005e	Loop.1.PID.SchedulerRemoteInput	65	0x0041
Loop.1.OP.FeedForwardVal	98	0x0062	Loop.1.PID.SchedulerType	63	0x003f
Loop.1.OP.FF_Rem	103	0x0067	Loop.1.Setup.CH1ControlType	22	0x0016
Loop.1.OP.ManualMode	90	0x005a	Loop.1.Setup.CH2ControlType	23	0x0017
Loop.1.OP.ManualOutVal	3	0x0003	Loop.1.Setup.ControlAction	7	0x0007
Loop.1.OP.MeasuredPower	92	0x005c	Loop.1.Setup.DerivativeType	25	0x0019
Loop.1.OP.OutputHighLimit	80	0x0050	Loop.1.Setup.LoopType	21	0x0015
Loop.1.OP.OutputLowLimit	81	0x0051	Loop.1.Setup.PBUnits	24	0x0018
Loop.1.OP.Rate	86	0x0056	Loop.1.SP.AltSP	68	0x0044
Loop.1.OP.RateDisable	87	0x0057	Loop.1.SP.AltSPSelect	69	0x0045
Loop.1.OP.RemOPH	102	0x0066	Loop.1.SP.ManualTrack	75	0x004b
Loop.1.OP.RemOPL	101	0x0065	Loop.1.SP.RangeHigh	12	0x000c
Loop.1.OP.SafeOutVal	89	0x0059	Loop.1.SP.RangeLow	11	0x000b
Loop.1.OP.SBrkOP	123	0x007B	Loop.1.SP.Rate	70	0x0046
Loop.1.OP.SensorBreakMode	88	0x0058	Loop.1.SP.RateDisable	71	0x0047
Loop.1.OP.TrackEnable	100	0x0064	Loop.1.SP.RateDone	79	0x004f
Loop.1.OP.TrackOutVal	99	0x0063	Loop.1.SP.SP1	13	0x000d
Loop.1.PID.ActiveSet	28	0x001c	Loop.1.SP.SP2	14	0x000e
Loop.1.PID.Boundary1-2	26	0x001a	Loop.1.SP.SPHighLimit	66	0x0042
Loop.1.PID.Boundary2-3	27	0x001b	Loop.1.SP.SPLowLimit	67	0x0043
Loop.1.PID.CutbackHigh	18	0x0012	Loop.1.SP.SPSelect	15	0x000f
Loop.1.PID.CutbackHigh2	46	0x002e	Loop.1.SP.SPTrack	76	0x004c
Loop.1.PID.CutbackHigh3	56	0x0038	Loop.1.SP.SPTrim	72	0x0048
Loop.1.PID.CutbackLow	17	0x0011	Loop.1.SP.SPTrimHighLimit	73	0x0049
Loop.1.PID.CutbackLow2	47	0x002f	Loop.1.SP.SPTrimLowLimit	74	0x004a
Loop.1.PID.CutbackLow3	57	0x0039	Loop.1.SP.TrackPV	77	0x004d
Loop.1.PID.DerivativeTime	9	0x0009	Loop.1.SP.TrackSP	78	0x004e
Loop.1.PID.DerivativeTime2	45	0x002d	Loop.1.Tune.AutotuneEnable	108	0x006c
Loop.1.PID.DerivativeTime3	55	0x0037	Loop.1.Tune.OutputHighLimit	105	0x0069
Loop.1.PID.IntegralTime	8	0x0008	Loop.1.Tune.OutputLowLimit	106	0x006a
Loop.1.PID.IntegralTime2	44	0x002c	Loop.1.Tune.Stage	111	0x006f
Loop.1.PID.IntegralTime3	54	0x0036	Loop.1.Tune.StageTime	112	0x0070
Loop.1.PID.LoopBreakTime	40	0x0028	Loop.1.Tune.State	110	0x006e
Loop.1.PID.LoopBreakTime2	49	0x0031	Loop.1.Tune.StepSize	109	0x006d
Loop.1.PID.LoopBreakTime3	59	0x003b	Loop.1.Tune.Type	104	0x0068
Loop.1.PID.ManualReset	39	0x0027	Loop.2.Diag.DerivativeOutContrib	375	0x0177
Loop.1.PID.ManualReset2	48	0x0030	Loop.2.Diag.Error	369	0x0171
Loop.1.PID.ManualReset3	58	0x003a	Loop.2.Diag.IntegralOutContrib	374	0x0176
Loop.1.PID.NumSets	64	0x0040	Loop.2.Diag.LoopBreakAlarm	372	0x0174

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.2.Diag.LoopMode	370	0x0172	Loop.2.PID.CutbackHigh2	302	0x012e
Loop.2.Diag.PropOutContrib	373	0x0175	Loop.2.PID.CutbackHigh3	312	0x0138
Loop.2.Diag.SBrk	376	0x0178	Loop.2.PID.CutbackLow	273	0x0111
Loop.2.Diag.SchedCBH	288	0x0120	Loop.2.PID.CutbackLow2	303	0x012f
Loop.2.Diag.SchedCBL	289	0x0121	Loop.2.PID.CutbackLow3	313	0x0139
Loop.2.Diag.SchedLPBrk	291	0x0123	Loop.2.PID.DerivativeTime	265	0x0109
Loop.2.Diag.SchedMR	290	0x0122	Loop.2.PID.DerivativeTime2	301	0x012d
Loop.2.Diag.SchedOPHi	293	0x0125	Loop.2.PID.DerivativeTime3	311	0x0137
Loop.2.Diag.SchedOPLo	294	0x0126	Loop.2.PID.IntegralTime	264	0x0108
Loop.2.Diag.SchedPB	285	0x011d	Loop.2.PID.IntegralTime2	300	0x012c
Loop.2.Diag.SchedR2G	292	0x0124	Loop.2.PID.IntegralTime3	310	0x0136
Loop.2.Diag.SchedTd	287	0x011f	Loop.2.PID.LoopBreakTime	296	0x0128
Loop.2.Diag.SchedTi	286	0x011e	Loop.2.PID.LoopBreakTime2	305	0x0131
Loop.2.Diag.TargetOutVal	371	0x0173	Loop.2.PID.LoopBreakTime3	315	0x013b
Loop.2.Main.ActiveOut	260	0x0104	Loop.2.PID.ManualReset	295	0x0127
Loop.2.Main.AutoMan	266	0x010a	Loop.2.PID.ManualReset2	304	0x0130
Loop.2.Main.Inhibit	276	0x0114	Loop.2.PID.ManualReset3	314	0x013a
Loop.2.Main.PV	257	0x0101	Loop.2.PID.NumSets	320	0x0140
Loop.2.Main.TargetSP	258	0x0102	Loop.2.PID.OutputHi	297	0x0129
Loop.2.Main.WorkingSP	261	0x0105	Loop.2.PID.OutputHi2	307	0x0133
Loop.2.OP.Ch1OnOffHysteresis	340	0x0154	Loop.2.PID.OutputHi3	317	0x013d
Loop.2.OP.Ch1Out	338	0x0152	Loop.2.PID.OutputLo	298	0x012a
Loop.2.OP.Ch2Deadband	272	0x0110	Loop.2.PID.OutputLo2	308	0x0134
Loop.2.OP.Ch2OnOffHysteresis	341	0x0155	Loop.2.PID.OutputLo3	318	0x013e
Loop.2.OP.Ch2Out	339	0x0153	Loop.2.PID.ProportionalBand	262	0x0106
Loop.2.OP.CoolType	349	0x015d	Loop.2.PID.ProportionalBand2	299	0x012b
Loop.2.OP.EnablePowerFeedforward	347	0x015b	Loop.2.PID.ProportionalBand3	309	0x0135
Loop.2.OP.FeedForwardGain	351	0x015f	Loop.2.PID.RelCh2Gain	275	0x0113
Loop.2.OP.FeedForwardOffset	352	0x0160	Loop.2.PID.RelCh2Gain2	306	0x0132
Loop.2.OP.FeedForwardTrimLimit	353	0x0161	Loop.2.PID.RelCh2Gain3	316	0x013c
Loop.2.OP.FeedForwardType	350	0x015e	Loop.2.PID.SchedulerRemoteInput	321	0x0141
Loop.2.OP.FeedForwardVal	354	0x0162	Loop.2.PID.SchedulerType	319	0x013f
Loop.2.OP.FF_Rem	359	0x0167	Loop.2.Setup.CH1ControlType	278	0x0116
Loop.2.OP.ManualMode	346	0x015a	Loop.2.Setup.CH2ControlType	279	0x0117
Loop.2.OP.ManualOutVal	259	0x0103	Loop.2.Setup.ControlAction	263	0x0107
Loop.2.OP.MeasuredPower	348	0x015c	Loop.2.Setup.DerivativeType	281	0x0119
Loop.2.OP.OutputHighLimit	336	0x0150	Loop.2.Setup.LoopType	277	0x0115
Loop.2.OP.OutputLowLimit	337	0x0151	Loop.2.Setup.PBUnits	280	0x0118
Loop.2.OP.Rate	342	0x0156	Loop.2.SP.AltSP	324	0x0144
Loop.2.OP.RateDisable	343	0x0157	Loop.2.SP.AltSPSelect	325	0x0145
Loop.2.OP.RemOPH	358	0x0166	Loop.2.SP.ManualTrack	331	0x014b
Loop.2.OP.RemOPL	357	0x0165	Loop.2.SP.RangeHigh	268	0x010c
Loop.2.OP.SafeOutVal	345	0x0159	Loop.2.SP.RangeLow	267	0x010b
Loop.2.OP.SBrkOP	379	0x017B	Loop.2.SP.Rate	326	0x0146
Loop.2.OP.SensorBreakMode	344	0x0158	Loop.2.SP.RateDisable	327	0x0147
Loop.2.OP.TrackEnable	356	0x0164	Loop.2.SP.RateDone	335	0x014f
Loop.2.OP.TrackOutVal	355	0x0163	Loop.2.SP.SP1	269	0x010d
Loop.2.PID.ActiveSet	284	0x011c	Loop.2.SP.SP2	270	0x010e
Loop.2.PID.Boundary1-2	282	0x011a	Loop.2.SP.SPHighLimit	322	0x0142
Loop.2.PID.Boundary2-3	283	0x011b	Loop.2.SP.LowLimit	323	0x0143
Loop.2.PID.CutbackHigh	274	0x0112	Loop.2.SP.SPSelect	271	0x010f

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.2.SP.SPTrack	332	0x014c	Loop.3.OP.ManualMode	602	0x025a
Loop.2.SP.SPTrim	328	0x0148	Loop.3.OP.ManualOutVal	515	0x0203
Loop.2.SP.SPTrimHighLimit	329	0x0149	Loop.3.OP.MeasuredPower	604	0x025c
Loop.2.SP.SPTrimLowLimit	330	0x014a	Loop.3.OP.OutputHighLimit	592	0x0250
Loop.2.SP.TrackPV	333	0x014d	Loop.3.OP.OutputLowLimit	593	0x0251
Loop.2.SP.TrackSP	334	0x014e	Loop.3.OP.Rate	598	0x0256
Loop.2.Tune.AutotuneEnable	364	0x016c	Loop.3.OP.RateDisable	599	0x0257
Loop.2.Tune.OutputHighLimit	361	0x0169	Loop.3.OP.RemOPH	614	0x0266
Loop.2.Tune.OutputLowLimit	362	0x016a	Loop.3.OP.RemOPL	613	0x0265
Loop.2.Tune.Stage	367	0x016f	Loop.3.OP.SafeOutVal	601	0x0259
Loop.2.Tune.StageTime	368	0x0170	Loop.3.OP.SBrkOP	635	0x027B
Loop.2.Tune.State	366	0x016e	Loop.3.OP.SensorBreakMode	600	0x0258
Loop.2.Tune.StepSize	365	0x016d	Loop.3.OP.TrackEnable	612	0x0264
Loop.2.Tune.Type	360	0x0168	Loop.3.OP.TrackOutVal	611	0x0263
Loop.3.Diag.DerivativeOutContrib	631	0x0277	Loop.3.PID.ActiveSet	540	0x021c
Loop.3.Diag.Error	625	0x0271	Loop.3.PID.Boundary1-2	538	0x021a
Loop.3.Diag.IntegralOutContrib	630	0x0276	Loop.3.PID.Boundary2-3	539	0x021b
Loop.3.Diag.LoopBreakAlarm	628	0x0274	Loop.3.PID.CutbackHigh	530	0x0212
Loop.3.Diag.LoopMode	626	0x0272	Loop.3.PID.CutbackHigh2	558	0x022e
Loop.3.Diag.PropOutContrib	629	0x0275	Loop.3.PID.CutbackHigh3	568	0x0238
Loop.3.Diag.SBrk	632	0x0278	Loop.3.PID.CutbackLow	529	0x0211
Loop.3.Diag.SchedCBH	544	0x0220	Loop.3.PID.CutbackLow2	559	0x022f
Loop.3.Diag.SchedCBL	545	0x0221	Loop.3.PID.CutbackLow3	569	0x0239
Loop.3.Diag.SchedLPBrk	547	0x0223	Loop.3.PID.DerivativeTime	521	0x0209
Loop.3.Diag.SchedMR	546	0x0222	Loop.3.PID.DerivativeTime2	557	0x022d
Loop.3.Diag.SchedOPHi	549	0x0225	Loop.3.PID.DerivativeTime3	567	0x0237
Loop.3.Diag.SchedOPLo	550	0x0226	Loop.3.PID.IntegralTime	520	0x0208
Loop.3.Diag.SchedPB	541	0x021d	Loop.3.PID.IntegralTime2	556	0x022c
Loop.3.Diag.SchedR2G	548	0x0224	Loop.3.PID.IntegralTime3	566	0x0236
Loop.3.Diag.SchedTd	543	0x021f	Loop.3.PID.LoopBreakTime	552	0x0228
Loop.3.Diag.SchedTi	542	0x021e	Loop.3.PID.LoopBreakTime2	561	0x0231
Loop.3.Diag.TargetOutVal	627	0x0273	Loop.3.PID.LoopBreakTime3	571	0x023b
Loop.3.Main.ActiveOut	516	0x0204	Loop.3.PID.ManualReset	551	0x0227
Loop.3.Main.AutoMan	522	0x020a	Loop.3.PID.ManualReset2	560	0x0230
Loop.3.Main.Inhibit	532	0x0214	Loop.3.PID.ManualReset3	570	0x023a
Loop.3.Main.PV	513	0x0201	Loop.3.PID.NumSets	576	0x0240
Loop.3.Main.TargetSP	514	0x0202	Loop.3.PID.OutputHi	553	0x0229
Loop.3.Main.WorkingSP	517	0x0205	Loop.3.PID.OutputHi2	563	0x0233
Loop.3.OP.Ch1OnOffHysteresis	596	0x0254	Loop.3.PID.OutputHi3	573	0x023d
Loop.3.OP.Ch1Out	594	0x0252	Loop.3.PID.OutputLo	554	0x022a
Loop.3.OP.Ch2Deadband	528	0x0210	Loop.3.PID.OutputLo2	564	0x0234
Loop.3.OP.Ch2OnOffHysteresis	597	0x0255	Loop.3.PID.OutputLo3	574	0x023e
Loop.3.OP.Ch2Out	595	0x0253	Loop.3.PID.ProportionalBand	518	0x0206
Loop.3.OP.CoolType	605	0x025d	Loop.3.PID.ProportionalBand2	555	0x022b
Loop.3.OP.EnablePowerFeedforward	603	0x025b	Loop.3.PID.ProportionalBand3	565	0x0235
Loop.3.OP.FeedForwardGain	607	0x025f	Loop.3.PID.RelCh2Gain	531	0x0213
Loop.3.OP.FeedForwardOffset	608	0x0260	Loop.3.PID.RelCh2Gain2	562	0x0232
Loop.3.OP.FeedForwardTrimLimit	609	0x0261	Loop.3.PID.RelCh2Gain3	572	0x023c
Loop.3.OP.FeedForwardType	606	0x025e	Loop.3.PID.SchedulerRemoteInput	577	0x0241
Loop.3.OP.FeedForwardVal	610	0x0262	Loop.3.PID.SchedulerType	575	0x023f
Loop.3.OP.FF_Rem	615	0x0267	Loop.3.Setup.CH1ControlType	534	0x0216

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.3.Setup.CH2ControlType	535	0x0217	Loop.4.Main.AutoMan	778	0x030a
Loop.3.Setup.ControlAction	519	0x0207	Loop.4.Main.Inhibit	788	0x0314
Loop.3.Setup.DerivativeType	537	0x0219	Loop.4.Main.PV	769	0x0301
Loop.3.Setup.LoopType	533	0x0215	Loop.4.Main.TargetSP	770	0x0302
Loop.3.Setup.PBUnits	536	0x0218	Loop.4.Main.WorkingSP	773	0x0305
Loop.3.SP.AltSP	580	0x0244	Loop.4.OP.Ch1OnOffHysteresis	852	0x0354
Loop.3.SP.AltSPSelect	581	0x0245	Loop.4.OP.Ch1Out	850	0x0352
Loop.3.SP.ManualTrack	587	0x024b	Loop.4.OP.Ch2Deadband	784	0x0310
Loop.3.SP.RangeHigh	524	0x020c	Loop.4.OP.Ch2OnOffHysteresis	853	0x0355
Loop.3.SP.RangeLow	523	0x020b	Loop.4.OP.Ch2Out	851	0x0353
Loop.3.SP.Rate	582	0x0246	Loop.4.OP.CoolType	861	0x035d
Loop.3.SP.RateDisable	583	0x0247	Loop.4.OP.EnablePowerFeedforward	859	0x035b
Loop.3.SP.RateDone	591	0x024f	Loop.4.OP.FeedForwardGain	863	0x035f
Loop.3.SP.SP1	525	0x020d	Loop.4.OP.FeedForwardOffset	864	0x0360
Loop.3.SP.SP2	526	0x020e	Loop.4.OP.FeedForwardTrimLimit	865	0x0361
Loop.3.SP.SPHighLimit	578	0x0242	Loop.4.OP.FeedForwardType	862	0x035e
Loop.3.SP.SPLowLimit	579	0x0243	Loop.4.OP.FeedForwardVal	866	0x0362
Loop.3.SP.SPSelect	527	0x020f	Loop.4.OP.FF_Rem	871	0x0367
Loop.3.SP.SPTrack	588	0x024c	Loop.4.OP.ManualMode	858	0x035a
Loop.3.SP.SPTrim	584	0x0248	Loop.4.OP.ManualOutVal	771	0x0303
Loop.3.SP.SPTrimHighLimit	585	0x0249	Loop.4.OP.MeasuredPower	860	0x035c
Loop.3.SP.SPTrimLowLimit	586	0x024a	Loop.4.OP.OutputHighLimit	848	0x0350
Loop.3.SP.TrackPV	589	0x024d	Loop.4.OP.OutputLowLimit	849	0x0351
Loop.3.SP.TrackSP	590	0x024e	Loop.4.OP.Rate	854	0x0356
Loop.3.Tune.AutotuneEnable	620	0x026c	Loop.4.OP.RateDisable	855	0x0357
Loop.3.Tune.OutputHighLimit	617	0x0269	Loop.4.OP.RemOPH	870	0x0366
Loop.3.Tune.OutputLowLimit	618	0x026a	Loop.4.OP.RemOPL	869	0x0365
Loop.3.Tune.Stage	623	0x026f	Loop.4.OP.SafeOutVal	857	0x0359
Loop.3.Tune.StageTime	624	0x0270	Loop.4.OP.SBrkOP	891	0x037B
Loop.3.Tune.State	622	0x026e	Loop.4.OP.SensorBreakMode	856	0x0358
Loop.3.Tune.StepSize	621	0x026d	Loop.4.OP.TrackEnable	868	0x0364
Loop.3.Tune.Type	616	0x0268	Loop.4.OP.TrackOutVal	867	0x0363
Loop.4.Diag.DerivativeOutContrib	887	0x0377	Loop.4.PID.ActiveSet	796	0x031c
Loop.4.Diag.Error	881	0x0371	Loop.4.PID.Boundary1-2	794	0x031a
Loop.4.Diag.IntegralOutContrib	886	0x0376	Loop.4.PID.Boundary2-3	795	0x031b
Loop.4.Diag.LoopBreakAlarm	884	0x0374	Loop.4.PID.CutbackHigh	786	0x0312
Loop.4.Diag.LoopMode	882	0x0372	Loop.4.PID.CutbackHigh2	814	0x032e
Loop.4.Diag.PropOutContrib	885	0x0375	Loop.4.PID.CutbackHigh3	824	0x0338
Loop.4.Diag.SBrk	888	0x0378	Loop.4.PID.CutbackLow	785	0x0311
Loop.4.Diag.SchedCBH	800	0x0320	Loop.4.PID.CutbackLow2	815	0x032f
Loop.4.Diag.SchedCBL	801	0x0321	Loop.4.PID.CutbackLow3	825	0x0339
Loop.4.Diag.SchedLPBrk	803	0x0323	Loop.4.PID.DerivativeTime	777	0x0309
Loop.4.Diag.SchedMR	802	0x0322	Loop.4.PID.DerivativeTime2	813	0x032d
Loop.4.Diag.SchedOPHi	805	0x0325	Loop.4.PID.DerivativeTime3	823	0x0337
Loop.4.Diag.SchedOPLo	806	0x0326	Loop.4.PID.IntegralTime	776	0x0308
Loop.4.Diag.SchedPB	797	0x031d	Loop.4.PID.IntegralTime2	812	0x032c
Loop.4.Diag.SchedR2G	804	0x0324	Loop.4.PID.IntegralTime3	822	0x0336
Loop.4.Diag.SchedTd	799	0x031f	Loop.4.PID.LoopBreakTime	808	0x0328
Loop.4.Diag.SchedTi	798	0x031e	Loop.4.PID.LoopBreakTime2	817	0x0331
Loop.4.Diag.TargetOutVal	883	0x0373	Loop.4.PID.LoopBreakTime3	827	0x033b
Loop.4.Main.ActiveOut	772	0x0304	Loop.4.PID.ManualReset	807	0x0327

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.4.PID.ManualReset2	816	0x0330	Loop.5.Diag.Error	1137	0x0471
Loop.4.PID.ManualReset3	826	0x033a	Loop.5.Diag.IntegralOutContrib	1142	0x0476
Loop.4.PID.NumSets	832	0x0340	Loop.5.Diag.LoopBreakAlarm	1140	0x0474
Loop.4.PID.OutputHi	809	0x0329	Loop.5.Diag.LoopMode	1138	0x0472
Loop.4.PID.OutputHi2	819	0x0333	Loop.5.Diag.PropOutContrib	1141	0x0475
Loop.4.PID.OutputHi3	829	0x033d	Loop.5.Diag.SBrk	1144	0x0478
Loop.4.PID.OutputLo	810	0x032a	Loop.5.Diag.SchedCBH	1056	0x0420
Loop.4.PID.OutputLo2	820	0x0334	Loop.5.Diag.SchedCBL	1057	0x0421
Loop.4.PID.OutputLo3	830	0x033e	Loop.5.Diag.SchedLPBrk	1059	0x0423
Loop.4.PID.ProportionalBand	774	0x0306	Loop.5.Diag.SchedMR	1058	0x0422
Loop.4.PID.ProportionalBand2	811	0x032b	Loop.5.Diag.SchedOPHi	1061	0x0425
Loop.4.PID.ProportionalBand3	821	0x0335	Loop.5.Diag.SchedOPLo	1062	0x0426
Loop.4.PID.RelCh2Gain	787	0x0313	Loop.5.Diag.SchedPB	1053	0x041d
Loop.4.PID.RelCh2Gain2	818	0x0332	Loop.5.Diag.SchedR2G	1060	0x0424
Loop.4.PID.RelCh2Gain3	828	0x033c	Loop.5.Diag.SchedTd	1055	0x041f
Loop.4.PID.SchedulerRemoteInput	833	0x0341	Loop.5.Diag.SchedTi	1054	0x041e
Loop.4.PID.SchedulerType	831	0x033f	Loop.5.Diag.TargetOutVal	1139	0x0473
Loop.4.Setup.CH1ControlType	790	0x0316	Loop.5.Main.ActiveOut	1028	0x0404
Loop.4.Setup.CH2ControlType	791	0x0317	Loop.5.Main.AutoMan	1034	0x040a
Loop.4.Setup.ControlAction	775	0x0307	Loop.5.Main.Inhibit	1044	0x0414
Loop.4.Setup.DerivativeType	793	0x0319	Loop.5.Main.PV	1025	0x0401
Loop.4.Setup.LoopType	789	0x0315	Loop.5.Main.TargetSP	1026	0x0402
Loop.4.Setup.PBUnits	792	0x0318	Loop.5.Main.WorkingSP	1029	0x0405
Loop.4.SP.AltSP	836	0x0344	Loop.5.OP.Ch1OnOffHysteresis	1108	0x0454
Loop.4.SP.AltSPSelect	837	0x0345	Loop.5.OP.Ch1Out	1106	0x0452
Loop.4.SP.ManualTrack	843	0x034b	Loop.5.OP.Ch2Deadband	1040	0x0410
Loop.4.SP.RangeHigh	780	0x030c	Loop.5.OP.Ch2OnOffHysteresis	1109	0x0455
Loop.4.SP.RangeLow	779	0x030b	Loop.5.OP.Ch2Out	1107	0x0453
Loop.4.SP.Rate	838	0x0346	Loop.5.OP.CoolType	1117	0x045d
Loop.4.SP.RateDisable	839	0x0347	Loop.5.OP.EnablePowerFeedforward	1115	0x045b
Loop.4.SP.RateDone	847	0x034f	Loop.5.OP.FeedForwardGain	1119	0x045f
Loop.4.SP.SP1	781	0x030d	Loop.5.OP.FeedForwardOffset	1120	0x0460
Loop.4.SP.SP2	782	0x030e	Loop.5.OP.FeedForwardTrimLimit	1121	0x0461
Loop.4.SP.SPHighLimit	834	0x0342	Loop.5.OP.FeedForwardType	1118	0x045e
Loop.4.SP.SPLowLimit	835	0x0343	Loop.5.OP.FeedForwardVal	1122	0x0462
Loop.4.SP.SPSelect	783	0x030f	Loop.5.OP.FF_Rem	1127	0x0467
Loop.4.SP.SPTrack	844	0x034c	Loop.5.OP.ManualMode	1114	0x045a
Loop.4.SP.SPTrim	840	0x0348	Loop.5.OP.ManualOutVal	1027	0x0403
Loop.4.SP.SPTrimHighLimit	841	0x0349	Loop.5.OP.MeasuredPower	1116	0x045c
Loop.4.SP.SPTrimLowLimit	842	0x034a	Loop.5.OP.OutputHighLimit	1104	0x0450
Loop.4.SP.TrackPV	845	0x034d	Loop.5.OP.OutputLowLimit	1105	0x0451
Loop.4.SP.TrackSP	846	0x034e	Loop.5.OP.Rate	1110	0x0456
Loop.4.Tune.AutotuneEnable	876	0x036c	Loop.5.OP.RateDisable	1111	0x0457
Loop.4.Tune.OutputHighLimit	873	0x0369	Loop.5.OP.RemOPH	1126	0x0466
Loop.4.Tune.OutputLowLimit	874	0x036a	Loop.5.OP.RemOPL	1125	0x0465
Loop.4.Tune.Stage	879	0x036f	Loop.5.OP.SafeOutVal	1113	0x0459
Loop.4.Tune.StageTime	880	0x0370	Loop.5.OP.SBrkOP	1147	0x047B
Loop.4.Tune.State	878	0x036e	Loop.5.OP.SensorBreakMode	1112	0x0458
Loop.4.Tune.StepSize	877	0x036d	Loop.5.OP.TrackEnable	1124	0x0464
Loop.4.Tune.Type	872	0x0368	Loop.5.OP.TrackOutVal	1123	0x0463
Loop.5.Diag.DerivativeOutContrib	1143	0x0477	Loop.5.PID.ActiveSet	1052	0x041c

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.5.PID.Boundary1-2	1050	0x041a	Loop.5.SP.SPHighLimit	1090	0x0442
Loop.5.PID.Boundary2-3	1051	0x041b	Loop.5.SP.SPLowLimit	1091	0x0443
Loop.5.PID.CutbackHigh	1042	0x0412	Loop.5.SP.SPSelect	1039	0x040f
Loop.5.PID.CutbackHigh2	1070	0x042e	Loop.5.SP.SPTrack	1100	0x044c
Loop.5.PID.CutbackHigh3	1080	0x0438	Loop.5.SP.SPTrim	1096	0x0448
Loop.5.PID.CutbackLow	1041	0x0411	Loop.5.SP.SPTrimHighLimit	1097	0x0449
Loop.5.PID.CutbackLow2	1071	0x042f	Loop.5.SP.SPTrimLowLimit	1098	0x044a
Loop.5.PID.CutbackLow3	1081	0x0439	Loop.5.SP.TrackPV	1101	0x044d
Loop.5.PID.DerivativeTime	1033	0x0409	Loop.5.SP.TrackSP	1102	0x044e
Loop.5.PID.DerivativeTime2	1069	0x042d	Loop.5.Tune.AutotuneEnable	1132	0x046c
Loop.5.PID.DerivativeTime3	1079	0x0437	Loop.5.Tune.OutputHighLimit	1129	0x0469
Loop.5.PID.IntegralTime	1032	0x0408	Loop.5.Tune.OutputLowLimit	1130	0x046a
Loop.5.PID.IntegralTime2	1068	0x042c	Loop.5.Tune.Stage	1135	0x046f
Loop.5.PID.IntegralTime3	1078	0x0436	Loop.5.Tune.StageTime	1136	0x0470
Loop.5.PID.LoopBreakTime	1064	0x0428	Loop.5.Tune.State	1134	0x046e
Loop.5.PID.LoopBreakTime2	1073	0x0431	Loop.5.Tune.StepSize	1133	0x046d
Loop.5.PID.LoopBreakTime3	1083	0x043b	Loop.5.Tune.Type	1128	0x0468
Loop.5.PID.ManualReset	1063	0x0427	Loop.6.Diag.DerivativeOutContrib	1399	0x0577
Loop.5.PID.ManualReset2	1072	0x0430	Loop.6.Diag.Error	1393	0x0571
Loop.5.PID.ManualReset3	1082	0x043a	Loop.6.Diag.IntegralOutContrib	1398	0x0576
Loop.5.PID.NumSets	1088	0x0440	Loop.6.Diag.LoopBreakAlarm	1396	0x0574
Loop.5.PID.OutputHi	1065	0x0429	Loop.6.Diag.LoopMode	1394	0x0572
Loop.5.PID.OutputHi2	1075	0x0433	Loop.6.Diag.PropOutContrib	1397	0x0575
Loop.5.PID.OutputHi3	1085	0x043d	Loop.6.Diag.SBrk	1400	0x0578
Loop.5.PID.OutputLo	1066	0x042a	Loop.6.Diag.SchedCBH	1312	0x0520
Loop.5.PID.OutputLo2	1076	0x0434	Loop.6.Diag.SchedCBL	1313	0x0521
Loop.5.PID.OutputLo3	1086	0x043e	Loop.6.Diag.SchedLPBrk	1315	0x0523
Loop.5.PID.ProportionalBand	1030	0x0406	Loop.6.Diag.SchedMR	1314	0x0522
Loop.5.PID.ProportionalBand2	1067	0x042b	Loop.6.Diag.SchedOPHi	1317	0x0525
Loop.5.PID.ProportionalBand3	1077	0x0435	Loop.6.Diag.SchedOPLo	1318	0x0526
Loop.5.PID.RelCh2Gain	1043	0x0413	Loop.6.Diag.SchedPB	1309	0x051d
Loop.5.PID.RelCh2Gain2	1074	0x0432	Loop.6.Diag.SchedR2G	1316	0x0524
Loop.5.PID.RelCh2Gain3	1084	0x043c	Loop.6.Diag.SchedTd	1311	0x051f
Loop.5.PID.SchedulerRemoteInput	1089	0x0441	Loop.6.Diag.SchedTi	1310	0x051e
Loop.5.PID.SchedulerType	1087	0x043f	Loop.6.Diag.TargetOutVal	1395	0x0573
Loop.5.Setup.CH1ControlType	1046	0x0416	Loop.6.Main.ActiveOut	1284	0x0504
Loop.5.Setup.CH2ControlType	1047	0x0417	Loop.6.Main.AutoMan	1290	0x050a
Loop.5.Setup.ControlAction	1031	0x0407	Loop.6.Main.Inhibit	1300	0x0514
Loop.5.Setup.DerivativeType	1049	0x0419	Loop.6.Main.PV	1281	0x0501
Loop.5.Setup.LoopType	1045	0x0415	Loop.6.Main.TargetSP	1282	0x0502
Loop.5.Setup.PBUnits	1048	0x0418	Loop.6.Main.WorkingSP	1285	0x0505
Loop.5.SP.AltSP	1092	0x0444	Loop.6.OP.Ch1OnOffHysteresis	1364	0x0554
Loop.5.SP.AltSPSelect	1093	0x0445	Loop.6.OP.Ch1Out	1362	0x0552
Loop.5.SP.ManualTrack	1099	0x044b	Loop.6.OP.Ch2Deadband	1296	0x0510
Loop.5.SP.RangeHigh	1036	0x040c	Loop.6.OP.Ch2OnOffHysteresis	1365	0x0555
Loop.5.SP.RangeLow	1035	0x040b	Loop.6.OP.Ch2Out	1363	0x0553
Loop.5.SP.Rate	1094	0x0446	Loop.6.OP.CoolType	1373	0x055d
Loop.5.SP.RateDisable	1095	0x0447	Loop.6.OP.EnablePowerFeedforward	1371	0x055b
Loop.5.SP.RateDone	1103	0x044f	Loop.6.OP.FeedForwardGain	1375	0x055f
Loop.5.SP.SP1	1037	0x040d	Loop.6.OP.FeedForwardOffset	1376	0x0560
Loop.5.SP.SP2	1038	0x040e	Loop.6.OP.FeedForwardTrimLimit	1377	0x0561

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.6.OP.FeedForwardType	1374	0x055e	Loop.6.PID.SchedulerRemoteInput	1345	0x0541
Loop.6.OP.FeedForwardVal	1378	0x0562	Loop.6.PID.SchedulerType	1343	0x053f
Loop.6.OP.FF_Rem	1383	0x0567	Loop.6.Setup.CH1ControlType	1302	0x0516
Loop.6.OP.ManualMode	1370	0x055a	Loop.6.Setup.CH2ControlType	1303	0x0517
Loop.6.OP.ManualOutVal	1283	0x0503	Loop.6.Setup.ControlAction	1287	0x0507
Loop.6.OP.MeasuredPower	1372	0x055c	Loop.6.Setup.DerivativeType	1305	0x0519
Loop.6.OP.OutputHighLimit	1360	0x0550	Loop.6.Setup.LoopType	1301	0x0515
Loop.6.OP.OutputLowLimit	1361	0x0551	Loop.6.Setup.PBUnits	1304	0x0518
Loop.6.OP.Rate	1366	0x0556	Loop.6.SP.AltSP	1348	0x0544
Loop.6.OP.RateDisable	1367	0x0557	Loop.6.SP.AltSPSelect	1349	0x0545
Loop.6.OP.RemOPH	1382	0x0566	Loop.6.SP.ManualTrack	1355	0x054b
Loop.6.OP.RemOPL	1381	0x0565	Loop.6.SP.RangeHigh	1292	0x050c
Loop.6.OP.SafeOutVal	1369	0x0559	Loop.6.SP.RangeLow	1291	0x050b
Loop.6.OP.SBrkOP	1403	0x057B	Loop.6.SP.Rate	1350	0x0546
Loop.6.OP.SensorBreakMode	1368	0x0558	Loop.6.SP.RateDisable	1351	0x0547
Loop.6.OP.TrackEnable	1380	0x0564	Loop.6.SP.RateDone	1359	0x054f
Loop.6.OP.TrackOutVal	1379	0x0563	Loop.6.SP.SP1	1293	0x050d
Loop.6.PID.ActiveSet	1308	0x051c	Loop.6.SP.SP2	1294	0x050e
Loop.6.PID.Boundary1-2	1306	0x051a	Loop.6.SP.SPHighLimit	1346	0x0542
Loop.6.PID.Boundary2-3	1307	0x051b	Loop.6.SP.SPLowLimit	1347	0x0543
Loop.6.PID.CutbackHigh	1298	0x0512	Loop.6.SP.SPSelect	1295	0x050f
Loop.6.PID.CutbackHigh2	1326	0x052e	Loop.6.SP.SPTrack	1356	0x054c
Loop.6.PID.CutbackHigh3	1336	0x0538	Loop.6.SP.SPTrim	1352	0x0548
Loop.6.PID.CutbackLow	1297	0x0511	Loop.6.SP.SPTrimHighLimit	1353	0x0549
Loop.6.PID.CutbackLow2	1327	0x052f	Loop.6.SP.SPTrimLowLimit	1354	0x054a
Loop.6.PID.CutbackLow3	1337	0x0539	Loop.6.SP.TrackPV	1357	0x054d
Loop.6.PID.DerivativeTime	1289	0x0509	Loop.6.SP.TrackSP	1358	0x054e
Loop.6.PID.DerivativeTime2	1325	0x052d	Loop.6.Tune.AutotuneEnable	1388	0x056c
Loop.6.PID.DerivativeTime3	1335	0x0537	Loop.6.Tune.OutputHighLimit	1385	0x0569
Loop.6.PID.IntegralTime	1288	0x0508	Loop.6.Tune.OutputLowLimit	1386	0x056a
Loop.6.PID.IntegralTime2	1324	0x052c	Loop.6.Tune.Stage	1391	0x056f
Loop.6.PID.IntegralTime3	1334	0x0536	Loop.6.Tune.StageTime	1392	0x0570
Loop.6.PID.LoopBreakTime	1320	0x0528	Loop.6.Tune.State	1390	0x056e
Loop.6.PID.LoopBreakTime2	1329	0x0531	Loop.6.Tune.StepSize	1389	0x056d
Loop.6.PID.LoopBreakTime3	1339	0x053b	Loop.6.Tune.Type	1384	0x0568
Loop.6.PID.ManualReset	1319	0x0527	Loop.7.Diag.DerivativeOutContrib	1655	0x0677
Loop.6.PID.ManualReset2	1328	0x0530	Loop.7.Diag.Error	1649	0x0671
Loop.6.PID.ManualReset3	1338	0x053a	Loop.7.Diag.IntegralOutContrib	1654	0x0676
Loop.6.PID.NumSets	1344	0x0540	Loop.7.Diag.LoopBreakAlarm	1652	0x0674
Loop.6.PID.OutputHi	1321	0x0529	Loop.7.Diag.LoopMode	1650	0x0672
Loop.6.PID.OutputHi2	1331	0x0533	Loop.7.Diag.PropOutContrib	1653	0x0675
Loop.6.PID.OutputHi3	1341	0x053d	Loop.7.Diag.SBrk	1656	0x0678
Loop.6.PID.OutputLo	1322	0x052a	Loop.7.Diag.SchedCBH	1568	0x0620
Loop.6.PID.OutputLo2	1332	0x0534	Loop.7.Diag.SchedCBL	1569	0x0621
Loop.6.PID.OutputLo3	1342	0x053e	Loop.7.Diag.SchedLPBrk	1571	0x0623
Loop.6.PID.ProportionalBand	1286	0x0506	Loop.7.Diag.SchedMR	1570	0x0622
Loop.6.PID.ProportionalBand2	1323	0x052b	Loop.7.Diag.SchedOPHi	1573	0x0625
Loop.6.PID.ProportionalBand3	1333	0x0535	Loop.7.Diag.SchedOPLo	1574	0x0626
Loop.6.PID.RelCh2Gain	1299	0x0513	Loop.7.Diag.SchedPB	1565	0x061d
Loop.6.PID.RelCh2Gain2	1330	0x0532	Loop.7.Diag.SchedR2G	1572	0x0624
Loop.6.PID.RelCh2Gain3	1340	0x053c	Loop.7.Diag.SchedTd	1567	0x061f

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.7.Diag.SchedTi	1566	0x061e	Loop.7.PID.LoopBreakTime2	1585	0x0631
Loop.7.Diag.TargetOutVal	1651	0x0673	Loop.7.PID.LoopBreakTime3	1595	0x063b
Loop.7.Main.ActiveOut	1540	0x0604	Loop.7.PID.ManualReset	1575	0x0627
Loop.7.Main.AutoMan	1546	0x060a	Loop.7.PID.ManualReset2	1584	0x0630
Loop.7.Main.Inhibit	1556	0x0614	Loop.7.PID.ManualReset3	1594	0x063a
Loop.7.Main.PV	1537	0x0601	Loop.7.PID.NumSets	1600	0x0640
Loop.7.Main.TargetSP	1538	0x0602	Loop.7.PID.OutputHi	1577	0x0629
Loop.7.Main.WorkingSP	1541	0x0605	Loop.7.PID.OutputHi2	1587	0x0633
Loop.7.OP.Ch1OnOffHysteresis	1620	0x0654	Loop.7.PID.OutputHi3	1597	0x063d
Loop.7.OP.Ch1Out	1618	0x0652	Loop.7.PID.OutputLo	1578	0x062a
Loop.7.OP.Ch2Deadband	1552	0x0610	Loop.7.PID.OutputLo2	1588	0x0634
Loop.7.OP.Ch2OnOffHysteresis	1621	0x0655	Loop.7.PID.OutputLo3	1598	0x063e
Loop.7.OP.Ch2Out	1619	0x0653	Loop.7.PID.ProportionalBand	1542	0x0606
Loop.7.OP.CoolType	1629	0x065d	Loop.7.PID.ProportionalBand2	1579	0x062b
Loop.7.OP.EnablePowerFeedforward	1627	0x065b	Loop.7.PID.ProportionalBand3	1589	0x0635
Loop.7.OP.FeedForwardGain	1631	0x065f	Loop.7.PID.RelCh2Gain	1555	0x0613
Loop.7.OP.FeedForwardOffset	1632	0x0660	Loop.7.PID.RelCh2Gain2	1586	0x0632
Loop.7.OP.FeedForwardTrimLimit	1633	0x0661	Loop.7.PID.RelCh2Gain3	1596	0x063c
Loop.7.OP.FeedForwardType	1630	0x065e	Loop.7.PID.SchedulerRemoteInput	1601	0x0641
Loop.7.OP.FeedForwardVal	1634	0x0662	Loop.7.PID.SchedulerType	1599	0x063f
Loop.7.OP.FF_Rem	1639	0x0667	Loop.7.Setup.CH1ControlType	1558	0x0616
Loop.7.OP.ManualMode	1626	0x065a	Loop.7.Setup.CH2ControlType	1559	0x0617
Loop.7.OP.ManualOutVal	1539	0x0603	Loop.7.Setup.ControlAction	1543	0x0607
Loop.7.OP.MeasuredPower	1628	0x065c	Loop.7.Setup.DerivativeType	1561	0x0619
Loop.7.OP.OutputHighLimit	1616	0x0650	Loop.7.Setup.LoopType	1557	0x0615
Loop.7.OP.OutputLowLimit	1617	0x0651	Loop.7.Setup.PBUnits	1560	0x0618
Loop.7.OP.Rate	1622	0x0656	Loop.7.SP.AltSP	1604	0x0644
Loop.7.OP.RateDisable	1623	0x0657	Loop.7.SP.AltSPSelect	1605	0x0645
Loop.7.OP.RemOPH	1638	0x0666	Loop.7.SP.ManualTrack	1611	0x064b
Loop.7.OP.RemOPL	1637	0x0665	Loop.7.SP.RangeHigh	1548	0x060c
Loop.7.OP.SafeOutVal	1625	0x0659	Loop.7.SP.RangeLow	1547	0x060b
Loop.7.OP.SBrkOP	1659	0x067B	Loop.7.SP.Rate	1606	0x0646
Loop.7.OP.SensorBreakMode	1624	0x0658	Loop.7.SP.RateDisable	1607	0x0647
Loop.7.OP.TrackEnable	1636	0x0664	Loop.7.SP.RateDone	1615	0x064f
Loop.7.OP.TrackOutVal	1635	0x0663	Loop.7.SP.SP1	1549	0x060d
Loop.7.PID.ActiveSet	1564	0x061c	Loop.7.SP.SP2	1550	0x060e
Loop.7.PID.Boundary1-2	1562	0x061a	Loop.7.SP.SPHighLimit	1602	0x0642
Loop.7.PID.Boundary2-3	1563	0x061b	Loop.7.SP.SPLowLimit	1603	0x0643
Loop.7.PID.CutbackHigh	1554	0x0612	Loop.7.SP.SPSelect	1551	0x060f
Loop.7.PID.CutbackHigh2	1582	0x062e	Loop.7.SP.SPTrack	1612	0x064c
Loop.7.PID.CutbackHigh3	1592	0x0638	Loop.7.SP.SPTrim	1608	0x0648
Loop.7.PID.CutbackLow	1553	0x0611	Loop.7.SP.SPTrimHighLimit	1609	0x0649
Loop.7.PID.CutbackLow2	1583	0x062f	Loop.7.SP.SPTrimLowLimit	1610	0x064a
Loop.7.PID.CutbackLow3	1593	0x0639	Loop.7.SP.TrackPV	1613	0x064d
Loop.7.PID.DerivativeTime	1545	0x0609	Loop.7.SP.TrackSP	1614	0x064e
Loop.7.PID.DerivativeTime2	1581	0x062d	Loop.7.Tune.AutotuneEnable	1644	0x066c
Loop.7.PID.DerivativeTime3	1591	0x0637	Loop.7.Tune.OutputHighLimit	1641	0x0669
Loop.7.PID.IntegralTime	1544	0x0608	Loop.7.Tune.OutputLowLimit	1642	0x066a
Loop.7.PID.IntegralTime2	1580	0x062c	Loop.7.Tune.Stage	1647	0x066f
Loop.7.PID.IntegralTime3	1590	0x0636	Loop.7.Tune.StageTime	1648	0x0670
Loop.7.PID.LoopBreakTime	1576	0x0628	Loop.7.Tune.State	1646	0x066e

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.7.Tune.StepSize	1645	0x066d	Loop.8.OP.TrackEnable	1892	0x0764
Loop.7.Tune.Type	1640	0x0668	Loop.8.OP.TrackOutVal	1891	0x0763
Loop.8.Diag.DerivativeOutContrib	1911	0x0777	Loop.8.PID.ActiveSet	1820	0x071c
Loop.8.Diag.Error	1905	0x0771	Loop.8.PID.Boundary1-2	1818	0x071a
Loop.8.Diag.IntegralOutContrib	1910	0x0776	Loop.8.PID.Boundary2-3	1819	0x071b
Loop.8.Diag.LoopBreakAlarm	1908	0x0774	Loop.8.PID.CutbackHigh	1810	0x0712
Loop.8.Diag.LoopMode	1906	0x0772	Loop.8.PID.CutbackHigh2	1838	0x072e
Loop.8.Diag.PropOutContrib	1909	0x0775	Loop.8.PID.CutbackHigh3	1848	0x0738
Loop.8.Diag.SBrk	1912	0x0778	Loop.8.PID.CutbackLow	1809	0x0711
Loop.8.Diag.SchedCBH	1824	0x0720	Loop.8.PID.CutbackLow2	1839	0x072f
Loop.8.Diag.SchedCBL	1825	0x0721	Loop.8.PID.CutbackLow3	1849	0x0739
Loop.8.Diag.SchedLPBrk	1827	0x0723	Loop.8.PID.DerivativeTime	1801	0x0709
Loop.8.Diag.SchedMR	1826	0x0722	Loop.8.PID.DerivativeTime2	1837	0x072d
Loop.8.Diag.SchedOPHi	1829	0x0725	Loop.8.PID.DerivativeTime3	1847	0x0737
Loop.8.Diag.SchedOPLo	1830	0x0726	Loop.8.PID.IntegralTime	1800	0x0708
Loop.8.Diag.SchedPB	1821	0x071d	Loop.8.PID.IntegralTime2	1836	0x072c
Loop.8.Diag.SchedR2G	1828	0x0724	Loop.8.PID.IntegralTime3	1846	0x0736
Loop.8.Diag.SchedTd	1823	0x071f	Loop.8.PID.LoopBreakTime	1832	0x0728
Loop.8.Diag.SchedTi	1822	0x071e	Loop.8.PID.LoopBreakTime2	1841	0x0731
Loop.8.Diag.TargetOutVal	1907	0x0773	Loop.8.PID.LoopBreakTime3	1851	0x073b
Loop.8.Main.ActiveOut	1796	0x0704	Loop.8.PID.ManualReset	1831	0x0727
Loop.8.Main.AutoMan	1802	0x070a	Loop.8.PID.ManualReset2	1840	0x0730
Loop.8.Main.Inhibit	1812	0x0714	Loop.8.PID.ManualReset3	1850	0x073a
Loop.8.Main.PV	1793	0x0701	Loop.8.PID.NumSets	1856	0x0740
Loop.8.Main.TargetSP	1794	0x0702	Loop.8.PID.OutputHi	1833	0x0729
Loop.8.Main.WorkingSP	1797	0x0705	Loop.8.PID.OutputHi2	1843	0x0733
Loop.8.OP.Ch1OnOffHysteresis	1876	0x0754	Loop.8.PID.OutputHi3	1853	0x073d
Loop.8.OP.Ch1Out	1874	0x0752	Loop.8.PID.OutputLo	1834	0x072a
Loop.8.OP.Ch2Deadband	1808	0x0710	Loop.8.PID.OutputLo2	1844	0x0734
Loop.8.OP.Ch2OnOffHysteresis	1877	0x0755	Loop.8.PID.OutputLo3	1854	0x073e
Loop.8.OP.Ch2Out	1875	0x0753	Loop.8.PID.ProportionalBand	1798	0x0706
Loop.8.OP.CoolType	1885	0x075d	Loop.8.PID.ProportionalBand2	1835	0x072b
Loop.8.OP.EnablePowerFeedforward	1883	0x075b	Loop.8.PID.ProportionalBand3	1845	0x0735
Loop.8.OP.FeedForwardGain	1887	0x075f	Loop.8.PID.RelCh2Gain	1811	0x0713
Loop.8.OP.FeedForwardOffset	1888	0x0760	Loop.8.PID.RelCh2Gain2	1842	0x0732
Loop.8.OP.FeedForwardTrimLimit	1889	0x0761	Loop.8.PID.RelCh2Gain3	1852	0x073c
Loop.8.OP.FeedForwardType	1886	0x075e	Loop.8.PID.SchedulerRemoteInput	1857	0x0741
Loop.8.OP.FeedForwardVal	1890	0x0762	Loop.8.PID.SchedulerType	1855	0x073f
Loop.8.OP.FF_Rem	1895	0x0767	Loop.8.Setup.CH1ControlType	1814	0x0716
Loop.8.OP.ManualMode	1882	0x075a	Loop.8.Setup.CH2ControlType	1815	0x0717
Loop.8.OP.ManualOutVal	1795	0x0703	Loop.8.Setup.ControlAction	1799	0x0707
Loop.8.OP.MeasuredPower	1884	0x075c	Loop.8.Setup.DerivativeType	1817	0x0719
Loop.8.OP.OutputHighLimit	1872	0x0750	Loop.8.Setup.LoopType	1813	0x0715
Loop.8.OP.OutputLowLimit	1873	0x0751	Loop.8.Setup.PBUnits	1816	0x0718
Loop.8.OP.Rate	1878	0x0756	Loop.8.SP.AltSP	1860	0x0744
Loop.8.OP.RateDisable	1879	0x0757	Loop.8.SP.AltSPSelect	1861	0x0745
Loop.8.OP.RemOPH	1894	0x0766	Loop.8.SP.ManualTrack	1867	0x074b
Loop.8.OP.RemOPL	1893	0x0765	Loop.8.SP.RangeHigh	1804	0x070c
Loop.8.OP.SafeOutVal	1881	0x0759	Loop.8.SP.RangeLow	1803	0x070b
Loop.8.OP.SBrkOP	1915	0x077B	Loop.8.SP.Rate	1862	0x0746
Loop.8.OP.SensorBreakMode	1880	0x0758	Loop.8.SP.RateDisable	1863	0x0747

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.8.SP.RateDone	1871	0x074f	Loop.9.OP.FeedForwardGain	2143	0x085F
Loop.8.SP.SP1	1805	0x070d	Loop.9.OP.FeedForwardOffset	2144	0x0860
Loop.8.SP.SP2	1806	0x070e	Loop.9.OP.FeedForwardTrimLimit	2145	0x0861
Loop.8.SP.SPHighLimit	1858	0x0742	Loop.9.OP.FeedForwardType	2142	0x085E
Loop.8.SP.SPLowLimit	1859	0x0743	Loop.9.OP.FeedForwardVal	2146	0x0862
Loop.8.SP.SPSelect	1807	0x070f	Loop.9.OP.FF_Rem	2151	0x0867
Loop.8.SP.SPTrack	1868	0x074c	Loop.9.OP.ManualMode	2138	0x085A
Loop.8.SP.SPTrim	1864	0x0748	Loop.9.OP.ManualOutVal	2051	0x0803
Loop.8.SP.SPTrimHighLimit	1865	0x0749	Loop.9.OP.MeasuredPower	2140	0x085C
Loop.8.SP.SPTrimLowLimit	1866	0x074a	Loop.9.OP.OutputHighLimit	2128	0x0850
Loop.8.SP.TrackPV	1869	0x074d	Loop.9.OP.OutputLowLimit	2129	0x0851
Loop.8.SP.TrackSP	1870	0x074e	Loop.9.OP.Rate	2134	0x0856
Loop.8.Tune.AutotuneEnable	1900	0x076c	Loop.9.OP.RateDisable	2135	0x0857
Loop.8.Tune.OutputHighLimit	1897	0x0769	Loop.9.OP.RemOPH	2150	0x0866
Loop.8.Tune.OutputLowLimit	1898	0x076a	Loop.9.OP.RemOPL	2149	0x0865
Loop.8.Tune.Stage	1903	0x076f	Loop.9.OP.SafeOutVal	2137	0x0859
Loop.8.Tune.StageTime	1904	0x0770	Loop.9.OP.SBrkOP	2171	0x087B
Loop.8.Tune.State	1902	0x076e	Loop.9.OP.SensorBreakMode	2136	0x0858
Loop.8.Tune.StepSize	1901	0x076d	Loop.9.OP.TrackEnable	2148	0x0864
Loop.8.Tune.Type	1896	0x0768	Loop.9.OP.TrackOutVal	2147	0x0863
Loop.9.Diag.DerivativeOutContrib	2167	0x0877	Loop.9.PID.ActiveSet	2076	0x081C
Loop.9.Diag.Error	2161	0x0871	Loop.9.PID.Boundary1-2	2074	0x081A
Loop.9.Diag.IntegralOutContrib	2166	0x0876	Loop.9.PID.Boundary2-3	2075	0x081B
Loop.9.Diag.LoopBreakAlarm	2164	0x0874	Loop.9.PID.CutbackHigh	2066	0x0812
Loop.9.Diag.LoopMode	2162	0x0872	Loop.9.PID.CutbackHigh2	2094	0x082E
Loop.9.Diag.PropOutContrib	2165	0x0875	Loop.9.PID.CutbackHigh3	2104	0x0838
Loop.9.Diag.SBrk	2168	0x0878	Loop.9.PID.CutbackLow	2065	0x0811
Loop.9.Diag.SchedCBH	2080	0x0820	Loop.9.PID.CutbackLow2	2095	0x082F
Loop.9.Diag.SchedCBL	2081	0x0821	Loop.9.PID.CutbackLow3	2105	0x0839
Loop.9.Diag.SchedLPBrk	2083	0x0823	Loop.9.PID.DerivativeTime	2057	0x0809
Loop.9.Diag.SchedMR	2082	0x0822	Loop.9.PID.DerivativeTime2	2093	0x082D
Loop.9.Diag.SchedOPHi	2085	0x0825	Loop.9.PID.DerivativeTime3	2103	0x0837
Loop.9.Diag.SchedOPLo	2086	0x0826	Loop.9.PID.IntegralTime	2056	0x0808
Loop.9.Diag.SchedPB	2077	0x081D	Loop.9.PID.IntegralTime2	2092	0x082C
Loop.9.Diag.SchedR2G	2084	0x0824	Loop.9.PID.IntegralTime3	2102	0x0836
Loop.9.Diag.SchedTd	2079	0x081F	Loop.9.PID.LoopBreakTime	2088	0x0828
Loop.9.Diag.SchedTi	2078	0x081E	Loop.9.PID.LoopBreakTime2	2097	0x0831
Loop.9.Diag.TargetOutVal	2163	0x0873	Loop.9.PID.LoopBreakTime3	2107	0x083B
Loop.9.Main.ActiveOut	2052	0x0804	Loop.9.PID.ManualReset	2087	0x0827
Loop.9.Main.AutoMan	2058	0x080A	Loop.9.PID.ManualReset2	2096	0x0830
Loop.9.Main.Inhibit	2068	0x0814	Loop.9.PID.ManualReset3	2106	0x083A
Loop.9.Main.PV	2049	0x0801	Loop.9.PID.NumSets	2112	0x0840
Loop.9.Main.TargetSP	2050	0x0802	Loop.9.PID.OutputHi	2089	0x0829
Loop.9.Main.WorkingSP	2053	0x0805	Loop.9.PID.OutputHi2	2099	0x0833
Loop.9.OP.Ch1OnOffHysteresis	2132	0x0854	Loop.9.PID.OutputHi3	2109	0x083D
Loop.9.OP.Ch1Out	2130	0x0852	Loop.9.PID.OutputLo	2090	0x082A
Loop.9.OP.Ch2Deadband	2064	0x0810	Loop.9.PID.OutputLo2	2100	0x0834
Loop.9.OP.Ch2OnOffHysteresis	2133	0x0855	Loop.9.PID.OutputLo3	2110	0x083E
Loop.9.OP.Ch2Out	2131	0x0853	Loop.9.PID.ProportionalBand	2054	0x0806
Loop.9.OP.CoolType	2141	0x085D	Loop.9.PID.ProportionalBand2	2091	0x082B
Loop.9.OP.EnablePowerFeedforward	2139	0x085B	Loop.9.PID.ProportionalBand3	2101	0x0835

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.9.PID.RelCh2Gain	2067	0x0813	Loop.10.Diag.SchedPB	2333	0x091D
Loop.9.PID.RelCh2Gain2	2098	0x0832	Loop.10.Diag.SchedR2G	2340	0x0924
Loop.9.PID.RelCh2Gain3	2108	0x083C	Loop.10.Diag.SchedTd	2335	0x091F
Loop.9.PID.SchedulerRemoteInput	2113	0x0841	Loop.10.Diag.SchedTi	2334	0x091E
Loop.9.PID.SchedulerType	2111	0x083F	Loop.10.Diag.TargetOutVal	2419	0x0973
Loop.9.Setup.CH1ControlType	2070	0x0816	Loop.10.Main.ActiveOut	2308	0x0904
Loop.9.Setup.CH2ControlType	2071	0x0817	Loop.10.Main.AutoMan	2314	0x090A
Loop.9.Setup.ControlAction	2055	0x0807	Loop.10.Main.Inhibit	2324	0x0914
Loop.9.Setup.DerivativeType	2073	0x0819	Loop.10.Main.PV	2305	0x0901
Loop.9.Setup.LoopType	2069	0x0815	Loop.10.Main.TargetSP	2306	0x0902
Loop.9.Setup.PBUnits	2072	0x0818	Loop.10.Main.WorkingSP	2309	0x0905
Loop.9.SP.AltSP	2116	0x0844	Loop.10.OP.Ch1OnOffHysteresis	2388	0x0954
Loop.9.SP.AltSPSelect	2117	0x0845	Loop.10.OP.Ch1Out	2386	0x0952
Loop.9.SP.ManualTrack	2123	0x084B	Loop.10.OP.Ch2Deadband	2320	0x0910
Loop.9.SP.RangeHigh	2060	0x080C	Loop.10.OP.Ch2OnOffHysteresis	2389	0x0955
Loop.9.SP.RangeLow	2059	0x080B	Loop.10.OP.Ch2Out	2387	0x0953
Loop.9.SP.Rate	2118	0x0846	Loop.10.OP.CoolType	2397	0x095D
Loop.9.SP.RateDisable	2119	0x0847	Loop.10.OP.EnablePowerFeedforward	2395	0x095B
Loop.9.SP.RateDone	2127	0x084F	Loop.10.OP.FeedForwardGain	2399	0x095F
Loop.9.SP.SP1	2061	0x080D	Loop.10.OP.FeedForwardOffset	2400	0x0960
Loop.9.SP.SP2	2062	0x080E	Loop.10.OP.FeedForwardTrimLimit	2401	0x0961
Loop.9.SP.SPHighLimit	2114	0x0842	Loop.10.OP.FeedForwardType	2398	0x095E
Loop.9.SP.SPLowLimit	2115	0x0843	Loop.10.OP.FeedForwardVal	2402	0x0962
Loop.9.SP.SPSelect	2063	0x080F	Loop.10.OP.FF_Rem	2407	0x0967
Loop.9.SP.SPTrack	2124	0x084C	Loop.10.OP.ManualMode	2394	0x095A
Loop.9.SP.SPTrim	2120	0x0848	Loop.10.OP.ManualOutVal	2307	0x0903
Loop.9.SP.SPTrimHighLimit	2121	0x0849	Loop.10.OP.MeasuredPower	2396	0x095C
Loop.9.SP.SPTrimLowLimit	2122	0x084A	Loop.10.OP.OutputHighLimit	2384	0x0950
Loop.9.SP.TrackPV	2125	0x084D	Loop.10.OP.OutputLowLimit	2385	0x0951
Loop.9.SP.TrackSP	2126	0x084E	Loop.10.OP.Rate	2390	0x0956
Loop.9.Tune.AutotuneEnable	2156	0x086C	Loop.10.OP.RateDisable	2391	0x0957
Loop.9.Tune.OutputHighLimit	2153	0x0869	Loop.10.OP.RemOPH	2406	0x0966
Loop.9.Tune.OutputLowLimit	2154	0x086A	Loop.10.OP.RemOPL	2405	0x0965
Loop.9.Tune.Stage	2159	0x086F	Loop.10.OP.SafeOutVal	2393	0x0959
Loop.9.Tune.StageTime	2160	0x0870	Loop.10.OP.SBrkOP	2427	0x097B
Loop.9.Tune.State	2158	0x086E	Loop.10.OP.SensorBreakMode	2392	0x0958
Loop.9.Tune.StepSize	2157	0x086D	Loop.10.OP.TrackEnable	2404	0x0964
Loop.9.Tune.Type	2152	0x0868	Loop.10.OP.TrackOutVal	2403	0x0963
Loop.10.Diag.DerivativeOutContrib	2423	0x0977	Loop.10.PID.ActiveSet	2332	0x091C
Loop.10.Diag.Error	2417	0x0971	Loop.10.PID.Boundary1-2	2330	0x091A
Loop.10.Diag.IntegralOutContrib	2422	0x0976	Loop.10.PID.Boundary2-3	2331	0x091B
Loop.10.Diag.LoopBreakAlarm	2420	0x0974	Loop.10.PID.CutbackHigh	2322	0x0912
Loop.10.Diag.LoopMode	2418	0x0972	Loop.10.PID.CutbackHigh2	2350	0x092E
Loop.10.Diag.PropOutContrib	2421	0x0975	Loop.10.PID.CutbackHigh3	2360	0x0938
Loop.10.Diag.SBrk	2424	0x0978	Loop.10.PID.CutbackLow	2321	0x0911
Loop.10.Diag.SchedCBH	2336	0x0920	Loop.10.PID.CutbackLow2	2351	0x092F
Loop.10.Diag.SchedCBL	2337	0x0921	Loop.10.PID.CutbackLow3	2361	0x0939
Loop.10.Diag.SchedLPBrk	2339	0x0923	Loop.10.PID.DerivativeTime	2313	0x0909
Loop.10.Diag.SchedMR	2338	0x0922	Loop.10.PID.DerivativeTime2	2349	0x092D
Loop.10.Diag.SchedOPHi	2341	0x0925	Loop.10.PID.DerivativeTime3	2359	0x0937
Loop.10.Diag.SchedOPLo	2342	0x0926	Loop.10.PID.IntegralTime	2312	0x0908

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.10.PID.IntegralTime2	2348	0x092C	Loop.10.Tune.Stage	2415	0x96F
Loop.10.PID.IntegralTime3	2358	0x0936	Loop.10.Tune.StageTime	2416	0x0970
Loop.10.PID.LoopBreakTime	2344	0x0928	Loop.10.Tune.State	2414	0x096E
Loop.10.PID.LoopBreakTime2	2353	0x0931	Loop.10.Tune.StepSize	2413	0x096D
Loop.10.PID.LoopBreakTime3	2363	0x093B	Loop.10.Tune.Type	2408	0x0968
Loop.10.PID.ManualReset	2343	0x0927	Loop.11.Diag.DerivativeOutContrib	2679	0x0A77
Loop.10.PID.ManualReset2	2352	0x0930	Loop.11.Diag.Error	2673	0x0A71
Loop.10.PID.ManualReset3	2362	0x093A	Loop.11.Diag.IntegralOutContrib	2678	0x0A76
Loop.10.PID.NumSets	2368	0x0940	Loop.11.Diag.LoopBreakAlarm	2676	0x0A74
Loop.10.PID.OutputHi	2345	0x0929	Loop.11.Diag.LoopMode	2674	0x0A72
Loop.10.PID.OutputHi2	2355	0x0933	Loop.11.Diag.PropOutContrib	2677	0x0A75
Loop.10.PID.OutputHi3	2365	0x093D	Loop.11.Diag.SBrk	2680	0x0A78
Loop.10.PID.OutputLo	2346	0x092A	Loop.11.Diag.SchedCBH	2592	0x0A20
Loop.10.PID.OutputLo2	2356	0x0934	Loop.11.Diag.SchedCBL	2593	0x0A21
Loop.10.PID.OutputLo3	2366	0x093E	Loop.11.Diag.SchedLPBrk	2595	0x0A23
Loop.10.PID.ProportionalBand	2310	0x0906	Loop.11.Diag.SchedMR	2594	0x0A22
Loop.10.PID.ProportionalBand2	2347	0x092B	Loop.11.Diag.SchedOPHi	2597	0x0A25
Loop.10.PID.ProportionalBand3	2357	0x0935	Loop.11.Diag.SchedOPLo	2598	0x0A26
Loop.10.PID.RelCh2Gain	2323	0x0913	Loop.11.Diag.SchedPB	2589	0x0A1D
Loop.10.PID.RelCh2Gain2	2354	0x0932	Loop.11.Diag.SchedR2G	2596	0x0A24
Loop.10.PID.RelCh2Gain3	2364	0x093C	Loop.11.Diag.SchedTd	2591	0x0A1F
Loop.10.PID.SchedulerRemoteInput	2369	0x0941	Loop.11.Diag.SchedTi	2590	0x0A1E
Loop.10.PID.SchedulerType	2367	0x093F	Loop.11.Diag.TargetOutVal	2675	0x0A73
Loop.10.Setup.CH1ControlType	2326	0x0916	Loop.11.Main.ActiveOut	2564	0x0A04
Loop.10.Setup.CH2ControlType	2327	0x0917	Loop.11.Main.AutoMan	2570	0x0A0A
Loop.10.Setup.ControlAction	2311	0x0907	Loop.11.Main.Inhibit	2580	0x0A14
Loop.10.Setup.DerivativeType	2329	0x0919	Loop.11.Main.PV	2561	0x0A01
Loop.10.Setup.LoopType	2325	0x0915	Loop.11.Main.TargetSP	2562	0x0A02
Loop.10.Setup.PBUnits	2328	0x0918	Loop.11.Main.WorkingSP	2565	0x0A05
Loop.10.SP.AltSP	2372	0x0944	Loop.11.OP.Ch1OnOffHysteresis	2644	0x0A54
Loop.10.SP.AltSPSelect	2373	0x0945	Loop.11.OP.Ch1Out	2642	0x0A52
Loop.10.SP.ManualTrack	2379	0x094B	Loop.11.OP.Ch2Deadband	2576	0x0A10
Loop.10.SP.RangeHigh	2316	0x090C	Loop.11.OP.Ch2OnOffHysteresis	2645	0x0A55
Loop.10.SP.RangeLow	2315	0x090B	Loop.11.OP.Ch2Out	2643	0x0A53
Loop.10.SP.Rate	2374	0x0946	Loop.11.OP.CoolType	2653	0x0A5D
Loop.10.SP.RateDisable	2375	0x0947	Loop.11.OP.EnablePowerFeedforward	2651	0x0A5B
Loop.10.SP.RateDone	2383	0x094F	Loop.11.OP.FeedForwardGain	2655	0x0A5F
Loop.10.SP.SP1	2317	0x090D	Loop.11.OP.FeedForwardOffset	2656	0x0A60
Loop.10.SP.SP2	2318	0x090E	Loop.11.OP.FeedForwardTrimLimit	2657	0x0A61
Loop.10.SP.SPHighLimit	2370	0x0942	Loop.11.OP.FeedForwardType	2654	0x0A5E
Loop.10.SP.SPLowLimit	2371	0x0943	Loop.11.OP.FeedForwardVal	2658	0x0A62
Loop.10.SP.SPSelect	2319	0x090F	Loop.11.OP.FF_Rem	2663	0x0A67
Loop.10.SP.SPTrack	2380	0x094C	Loop.11.OP.ManualMode	2650	0x0A5A
Loop.10.SP.SPTrim	2376	0x0948	Loop.11.OP.ManualOutVal	2563	0x0A03
Loop.10.SP.SPTrimHighLimit	2377	0x0949	Loop.11.OP.MeasuredPower	2652	0x0A5C
Loop.10.SP.SPTrimLowLimit	2378	0x094A	Loop.11.OP.OutputHighLimit	2640	0x0A50
Loop.10.SP.TrackPV	2381	0x094D	Loop.11.OP.OutputLowLimit	2641	0x0A51
Loop.10.SP.TrackSP	2382	0x094E	Loop.11.OP.Rate	2646	0x0A56
Loop.10.Tune.AutotuneEnable	2412	0x096C	Loop.11.OP.RateDisable	2647	0x0A57
Loop.10.Tune.OutputHighLimit	2409	0x0969	Loop.11.OP.RemOPH	2662	0x0A66
Loop.10.Tune.OutputLowLimit	2410	0x096A	Loop.11.OP.RemOPL	2661	0x0A65

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.11.OP.SafeOutVal	2649	0x0A59	Loop.11.SP.RangeLow	2571	0x0A0B
Loop.11.OP.SBrkOP	2683	0x0A7B	Loop.11.SP.Rate	2630	0x0A46
Loop.11.OP.SensorBreakMode	2648	0x0A58	Loop.11.SP.RateDisable	2631	0x0A47
Loop.11.OP.TrackEnable	2660	0x0A64	Loop.11.SP.RateDone	2639	0x0A4F
Loop.11.OP.TrackOutVal	2659	0x0A63	Loop.11.SP.SP1	2573	0x0A0D
Loop.11.PID.ActiveSet	2588	0x0A1C	Loop.11.SP.SP2	2574	0x0A0E
Loop.11.PID.Boundary1-2	2586	0x0A1A	Loop.11.SP.SPHighLimit	2626	0x0A42
Loop.11.PID.Boundary2-3	2587	0x0A1B	Loop.11.SP.SPLowLimit	2627	0x0A43
Loop.11.PID.CutbackHigh	2578	0x0A12	Loop.11.SP.SPSelect	2575	0x0A0F
Loop.11.PID.CutbackHigh2	2606	0x0A2E	Loop.11.SP.SPTrack	2636	0x0A4C
Loop.11.PID.CutbackHigh3	2616	0x0A38	Loop.11.SP.SPTrim	2632	0x0A48
Loop.11.PID.CutbackLow	2577	0x0A11	Loop.11.SP.SPTrimHighLimit	2633	0x0A49
Loop.11.PID.CutbackLow2	2607	0x0A2F	Loop.11.SP.SPTrimLowLimit	2634	0x0A4A
Loop.11.PID.CutbackLow3	2617	0x0A39	Loop.11.SP.TrackPV	2637	0x0A4D
Loop.11.PID.DerivativeTime	2569	0x0A09	Loop.11.SP.TrackSP	2638	0x0A4E
Loop.11.PID.DerivativeTime2	2605	0x0A2D	Loop.11.Tune.AutotuneEnable	2668	0x0A6C
Loop.11.PID.DerivativeTime3	2615	0x0A37	Loop.11.Tune.OutputHighLimit	2665	0x0A69
Loop.11.PID.IntegralTime	2568	0x0A08	Loop.11.Tune.OutputLowLimit	2666	0x0A6A
Loop.11.PID.IntegralTime2	2604	0x0A2C	Loop.11.Tune.Stage	2671	0x0A6F
Loop.11.PID.IntegralTime3	2614	0x0A36	Loop.11.Tune.StageTime	2672	0x0A70
Loop.11.PID.LoopBreakTime	2600	0x0A28	Loop.11.Tune.State	2670	0x0A6E
Loop.11.PID.LoopBreakTime2	2609	0x0A31	Loop.11.Tune.StepSize	2669	0x0A6D
Loop.11.PID.LoopBreakTime3	2619	0x0A3B	Loop.11.Tune.Type	2664	0x0A68
Loop.11.PID.ManualReset	2599	0x0A27	Loop.12.Diag.DerivativeOutContrib	2935	0x0B77
Loop.11.PID.ManualReset2	2608	0x0A30	Loop.12.Diag.Error	2929	0x0B71
Loop.11.PID.ManualReset3	2618	0x0A3A	Loop.12.Diag.IntegralOutContrib	2934	0x0B76
Loop.11.PID.NumSets	2624	0x0A40	Loop.12.Diag.LoopBreakAlarm	2932	0x0B74
Loop.11.PID.OutputHi	2601	0x0A29	Loop.12.Diag.LoopMode	2930	0x0B72
Loop.11.PID.OutputHi2	2611	0x0A33	Loop.12.Diag.PropOutContrib	2933	0x0B75
Loop.11.PID.OutputHi3	2621	0x0A3D	Loop.12.Diag.SBrk	2936	0x0B78
Loop.11.PID.OutputLo	2602	0x0A2A	Loop.12.Diag.SchedCBH	2848	0x0B20
Loop.11.PID.OutputLo2	2612	0x0A34	Loop.12.Diag.SchedCBL	2849	0x0B21
Loop.11.PID.OutputLo3	2622	0x0A3E	Loop.12.Diag.SchedLPBrk	2851	0x0B23
Loop.11.PID.ProportionalBand	2566	0x0A06	Loop.12.Diag.SchedMR	2850	0x0B22
Loop.11.PID.ProportionalBand2	2603	0x0A2B	Loop.12.Diag.SchedOPHi	2853	0x0B25
Loop.11.PID.ProportionalBand3	2613	0x0A35	Loop.12.Diag.SchedOPLo	2854	0x0B26
Loop.11.PID.RelCh2Gain	2579	0x0A13	Loop.12.Diag.SchedPB	2845	0x0B1D
Loop.11.PID.RelCh2Gain2	2610	0x0A32	Loop.12.Diag.SchedR2G	2852	0x0B24
Loop.11.PID.RelCh2Gain3	2620	0x0A3C	Loop.12.Diag.SchedTd	2847	0x0B1F
Loop.11.PID.SchedulerRemoteInput	2625	0x0A41	Loop.12.Diag.SchedTi	2846	0x0B1E
Loop.11.PID.SchedulerType	2623	0x0A3F	Loop.12.Diag.TargetOutVal	2931	0x0B73
Loop.11.Setup.CH1ControlType	2582	0x0A16	Loop.12.Main.ActiveOut	2820	0x0B04
Loop.11.Setup.CH2ControlType	2583	0x0A17	Loop.12.Main.AutoMan	2826	0x0B0A
Loop.11.Setup.ControlAction	2567	0x0A07	Loop.12.Main.Inhibit	2836	0x0B14
Loop.11.Setup.DerivativeType	2585	0x0A19	Loop.12.Main.PV	2817	0x0B01
Loop.11.Setup.LoopType	2581	0x0A15	Loop.12.Main.TargetSP	2818	0x0B02
Loop.11.Setup.PBUnits	2584	0x0A18	Loop.12.Main.WorkingSP	2821	0x0B05
Loop.11.SP.AltSP	2628	0x0A44	Loop.12.OP.Ch1OnOffHysteresis	2900	0x0B54
Loop.11.SP.AltSPSelect	2629	0x0A45	Loop.12.OP.Ch1Out	2898	0x0B52
Loop.11.SP.ManualTrack	2635	0x0A4B	Loop.12.OP.Ch2Deadband	2832	0x0B10
Loop.11.SP.RangeHigh	2572	0x0A0C	Loop.12.OP.Ch2OnOffHysteresis	2901	0x0B55

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.12.OP.Ch2Out	2899	0x0B53	Loop.12.PID.ProportionalBand	2822	0x0B06
Loop.12.OP.CoolType	2909	0x0B5D	Loop.12.PID.ProportionalBand2	2859	0x0B2B
Loop.12.OP.EnablePowerFeedforward	2907	0x0B5B	Loop.12.PID.ProportionalBand3	2869	0x0B35
Loop.12.OP.FeedForwardGain	2911	0x0B5F	Loop.12.PID.RelCh2Gain	2835	0x0B13
Loop.12.OP.FeedForwardOffset	2912	0x0B60	Loop.12.PID.RelCh2Gain2	2866	0x0B32
Loop.12.OP.FeedForwardTrimLimit	2913	0x0B61	Loop.12.PID.RelCh2Gain3	2876	0x0B3C
Loop.12.OP.FeedForwardType	2910	0x0B5E	Loop.12.PID.SchedulerRemoteInput	2881	0x0B41
Loop.12.OP.FeedForwardVal	2914	0x0B62	Loop.12.PID.SchedulerType	2879	0x0B3F
Loop.12.OP.FF_Rem	2919	0x0B67	Loop.12.Setup.CH1ControlType	2838	0x0B16
Loop.12.OP.ManualMode	2906	0x0B5A	Loop.12.Setup.CH2ControlType	2839	0x0B17
Loop.12.OP.ManualOutVal	2819	0x0B03	Loop.12.Setup.ControlAction	2823	0x0B07
Loop.12.OP.MeasuredPower	2908	0x0B5C	Loop.12.Setup.DerivativeType	2841	0x0B19
Loop.12.OP.OutputHighLimit	2896	0x0B50	Loop.12.Setup.LoopType	2837	0x0B15
Loop.12.OP.OutputLowLimit	2897	0x0B51	Loop.12.Setup.PBUnits	2840	0x0B18
Loop.12.OP.Rate	2902	0x0B56	Loop.12.SP.AltSP	2884	0x0B44
Loop.12.OP.RateDisable	2903	0x0B57	Loop.12.SP.AltSPSelect	2885	0x0B45
Loop.12.OP.RemOPH	2918	0x0B66	Loop.12.SP.ManualTrack	2891	0x0B4B
Loop.12.OP.RemOPL	2917	0x0B65	Loop.12.SP.RangeHigh	2828	0x0B0C
Loop.12.OP.SafeOutVal	2905	0x0B59	Loop.12.SP.RangeLow	2827	0x0B0B
Loop.12.OP.SBrkOP	2939	0x0B7B	Loop.12.SP.Rate	2886	0x0B46
Loop.12.OP.SensorBreakMode	2904	0x0B58	Loop.12.SP.RateDisable	2887	0x0B47
Loop.12.OP.TrackEnable	2916	0x0B64	Loop.12.SP.RateDone	2895	0x0B4F
Loop.12.OP.TrackOutVal	2915	0x0B63	Loop.12.SP.SP1	2829	0x0B0D
Loop.12.PID.ActiveSet	2844	0x0B1C	Loop.12.SP.SP2	2830	0x0B0E
Loop.12.PID.Boundary1-2	2842	0x0B1A	Loop.12.SP.SPHighLimit	2882	0x0B42
Loop.12.PID.Boundary2-3	2843	0x0B1B	Loop.12.SP.SPLowLimit	2883	0x0B43
Loop.12.PID.CutbackHigh	2834	0x0B12	Loop.12.SP.SPSelect	2831	0x0B0F
Loop.12.PID.CutbackHigh2	2862	0x0B2E	Loop.12.SP.SPTrack	2892	0x0B4C
Loop.12.PID.CutbackHigh3	2872	0x0B38	Loop.12.SP.SPTrim	2888	0x0B48
Loop.12.PID.CutbackLow	2833	0x0B11	Loop.12.SP.SPTrimHighLimit	2889	0x0B49
Loop.12.PID.CutbackLow2	2863	0x0B2F	Loop.12.SP.SPTrimLowLimit	2890	0x0B4A
Loop.12.PID.CutbackLow3	2873	0x0B39	Loop.12.SP.TrackPV	2893	0x0B4D
Loop.12.PID.DerivativeTime	2825	0x0B09	Loop.12.SP.TrackSP	2894	0x0B4E
Loop.12.PID.DerivativeTime2	2861	0x0B2D	Loop.12.Tune.AutotuneEnable	2924	0x0B6C
Loop.12.PID.DerivativeTime3	2871	0x0B37	Loop.12.Tune.OutputHighLimit	2921	0x0B69
Loop.12.PID.IntegralTime	2824	0x0B08	Loop.12.Tune.OutputLowLimit	2922	0x0B6A
Loop.12.PID.IntegralTime2	2860	0x0B2C	Loop.12.Tune.Stage	2927	0x0B6F
Loop.12.PID.IntegralTime3	2870	0x0B36	Loop.12.Tune.StageTime	2928	0x0B70
Loop.12.PID.LoopBreakTime	2856	0x0B28	Loop.12.Tune.State	2926	0x0B6E
Loop.12.PID.LoopBreakTime2	2865	0x0B31	Loop.12.Tune.StepSize	2925	0x0B6D
Loop.12.PID.LoopBreakTime3	2875	0x0B3B	Loop.12.Tune.Type	2920	0x0B68
Loop.12.PID.ManualReset	2855	0x0B27	Loop.13.Diag.DerivativeOutContrib	3191	0x0C77
Loop.12.PID.ManualReset2	2864	0x0B30	Loop.13.Diag.Error	3185	0x0C71
Loop.12.PID.ManualReset3	2874	0x0B3A	Loop.13.Diag.IntegralOutContrib	3190	0x0C76
Loop.12.PID.NumSets	2880	0x0B40	Loop.13.Diag.LoopBreakAlarm	3188	0x0C74
Loop.12.PID.OutputHi	2857	0x0B29	Loop.13.Diag.LoopMode	3186	0x0C72
Loop.12.PID.OutputHi2	2867	0x0B33	Loop.13.Diag.PropOutContrib	3189	0x0C75
Loop.12.PID.OutputHi3	2877	0x0B3D	Loop.13.Diag.SBrk	3192	0x0C78
Loop.12.PID.OutputLo	2858	0x0B2A	Loop.13.Diag.SchedCBH	3104	0x0C20
Loop.12.PID.OutputLo2	2868	0x0B34	Loop.13.Diag.SchedCBL	3105	0x0C21
Loop.12.PID.OutputLo3	2878	0x0B3E	Loop.13.Diag.SchedLPBrk	3107	0x0C23

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.13.Diag.SchedMR	3106	0x0C22	Loop.13.PID.DerivativeTime2	3117	0x0C2D
Loop.13.Diag.SchedOPHi	3109	0x0C25	Loop.13.PID.DerivativeTime3	3127	0x0C37
Loop.13.Diag.SchedOPLo	3110	0x0C26	Loop.13.PID.IntegralTime	3080	0x0C08
Loop.13.Diag.SchedPB	3101	0x0C1D	Loop.13.PID.IntegralTime2	3116	0x0C2C
Loop.13.Diag.SchedR2G	3108	0x0C24	Loop.13.PID.IntegralTime3	3126	0x0C36
Loop.13.Diag.SchedTd	3103	0x0C1F	Loop.13.PID.LoopBreakTime	3112	0x0C28
Loop.13.Diag.SchedTi	3102	0x0C1E	Loop.13.PID.LoopBreakTime2	3121	0x0C31
Loop.13.Diag.TargetOutVal	3187	0x0C73	Loop.13.PID.LoopBreakTime3	3131	0x0C3B
Loop.13.Main.ActiveOut	3076	0x0C04	Loop.13.PID.ManualReset	3111	0x0C27
Loop.13.Main.AutoMan	3082	0x0C0A	Loop.13.PID.ManualReset2	3120	0x0C30
Loop.13.Main.Inhibit	3092	0x0C14	Loop.13.PID.ManualReset3	3130	0x0C3A
Loop.13.Main.PV	3073	0x0C01	Loop.13.PID.NumSets	3136	0x0C40
Loop.13.Main.TargetSP	3074	0x0C02	Loop.13.PID.OutputHi	3113	0x0C29
Loop.13.Main.WorkingSP	3077	0x0C05	Loop.13.PID.OutputHi2	3123	0x0C33
Loop.13.OP.Ch1OnOffHysteresis	3156	0x0C54	Loop.13.PID.OutputHi3	3133	0x0C3D
Loop.13.OP.Ch1Out	3154	0x0C52	Loop.13.PID.OutputLo	3114	0x0C2A
Loop.13.OP.Ch2Deadband	3088	0x0C10	Loop.13.PID.OutputLo2	3124	0x0C34
Loop.13.OP.Ch2OnOffHysteresis	3157	0x0C55	Loop.13.PID.OutputLo3	3134	0x0C3E
Loop.13.OP.Ch2Out	3155	0x0C53	Loop.13.PID.ProportionalBand	3078	0x0C06
Loop.13.OP.CoolType	3165	0x0C5D	Loop.13.PID.ProportionalBand2	3115	0x0C2B
Loop.13.OP.EnablePowerFeedforward	3163	0x0C5B	Loop.13.PID.ProportionalBand3	3125	0x0C35
Loop.13.OP.FeedForwardGain	3167	0x0C5F	Loop.13.PID.RelCh2Gain	3091	0x0C13
Loop.13.OP.FeedForwardOffset	3168	0x0C60	Loop.13.PID.RelCh2Gain2	3122	0x0C32
Loop.13.OP.FeedForwardTrimLimit	3169	0x0C61	Loop.13.PID.RelCh2Gain3	3132	0x0C3C
Loop.13.OP.FeedForwardType	3166	0x0C5E	Loop.13.PID.SchedulerRemoteInput	3137	0x0C41
Loop.13.OP.FeedForwardVal	3170	0x0C62	Loop.13.PID.SchedulerType	3135	0x0C3F
Loop.13.OP.FF_Rem	3175	0x0C67	Loop.13.Setup.CH1ControlType	3094	0x0C16
Loop.13.OP.ManualMode	3162	0x0C5A	Loop.13.Setup.CH2ControlType	3095	0x0C17
Loop.13.OP.ManualOutVal	3075	0x0C03	Loop.13.Setup.ControlAction	3079	0x0C07
Loop.13.OP.MeasuredPower	3164	0x0C5C	Loop.13.Setup.DerivativeType	3097	0x0C19
Loop.13.OP.OutputHighLimit	3152	0x0C50	Loop.13.Setup.LoopType	3093	0x0C15
Loop.13.OP.OutputLowLimit	3153	0x0C51	Loop.13.Setup.PBUnits	3096	0x0C18
Loop.13.OP.Rate	3158	0x0C56	Loop.13.SP.AltSP	3140	0x0C44
Loop.13.OP.RateDisable	3159	0x0C57	Loop.13.SP.AltSPSelect	3141	0x0C45
Loop.13.OP.RemOPH	3174	0x0C66	Loop.13.SP.ManualTrack	3147	0x0C4B
Loop.13.OP.RemOPL	3173	0x0C65	Loop.13.SP.RangeHigh	3084	0x0C0C
Loop.13.OP.SafeOutVal	3161	0x0C59	Loop.13.SP.RangeLow	3083	0x0C0B
Loop.13.OP.SBrkOP	3195	0x0C7B	Loop.13.SP.Rate	3142	0x0C46
Loop.13.OP.SensorBreakMode	3160	0x0C58	Loop.13.SP.RateDisable	3143	0x0C47
Loop.13.OP.TrackEnable	3172	0x0C64	Loop.13.SP.RateDone	3151	0x0C4F
Loop.13.OP.TrackOutVal	3171	0x0C63	Loop.13.SP.SP1	3085	0x0C0D
Loop.13.PID.ActiveSet	3100	0x0C1C	Loop.13.SP.SP2	3086	0x0C0E
Loop.13.PID.Boundary1-2	3098	0x0C1A	Loop.13.SP.SPHighLimit	3138	0x0C42
Loop.13.PID.Boundary2-3	3099	0x0C1B	Loop.13.SP.SPLowLimit	3139	0x0C43
Loop.13.PID.CutbackHigh	3090	0x0C12	Loop.13.SP.SPSelect	3087	0x0C0F
Loop.13.PID.CutbackHigh2	3118	0x0C2E	Loop.13.SP.SPTrack	3148	0x0C4C
Loop.13.PID.CutbackHigh3	3128	0x0C38	Loop.13.SP.SPTrim	3144	0x0C48
Loop.13.PID.CutbackLow	3089	0x0C11	Loop.13.SP.SPTrimHighLimit	3145	0x0C49
Loop.13.PID.CutbackLow2	3119	0x0C2F	Loop.13.SP.SPTrimLowLimit	3146	0x0C4A
Loop.13.PID.CutbackLow3	3129	0x0C39	Loop.13.SP.TrackPV	3149	0x0C4D
Loop.13.PID.DerivativeTime	3081	0x0C09	Loop.13.SP.TrackSP	3150	0x0C4E

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.13.Tune.AutotuneEnable	3180	0x0C6C	Loop.14.OP.RateDisable	3415	0x0D57
Loop.13.Tune.OutputHighLimit	3177	0x0C69	Loop.14.OP.RemOPH	3430	0x0D66
Loop.13.Tune.OutputLowLimit	3178	0x0C6A	Loop.14.OP.RemOPL	3429	0x0D65
Loop.13.Tune.Stage	3183	0x0C6F	Loop.14.OP.SafeOutVal	3417	0x0D59
Loop.13.Tune.StageTime	3184	0x0C70	Loop.14.OP.SBrkOP	3451	0x0D7B
Loop.13.Tune.State	3182	0x0C6E	Loop.14.OP.SensorBreakMode	3416	0x0D58
Loop.13.Tune.StepSize	3181	0x0C6D	Loop.14.OP.TrackEnable	3428	0x0D64
Loop.13.Tune.Type	3176	0x0C68	Loop.14.OP.TrackOutVal	3427	0x0D63
Loop.14.Diag.DerivativeOutContrib	3447	0x0D77	Loop.14.PID.ActiveSet	3356	0x0D1C
Loop.14.Diag.Error	3441	0x0D71	Loop.14.PID.Boundary1-2	3354	0x0D1A
Loop.14.Diag.IntegralOutContrib	3446	0x0D76	Loop.14.PID.Boundary2-3	3355	0x0D1B
Loop.14.Diag.LoopBreakAlarm	3444	0x0D74	Loop.14.PID.CutbackHigh	3346	0x0D12
Loop.14.Diag.LoopMode	3442	0x0D72	Loop.14.PID.CutbackHigh2	3374	0x0D2E
Loop.14.Diag.PropOutContrib	3445	0x0D75	Loop.14.PID.CutbackHigh3	3384	0x0D38
Loop.14.Diag.SBrk	3448	0x0D78	Loop.14.PID.CutbackLow	3345	0x0D11
Loop.14.Diag.SchedCBH	3360	0x0D20	Loop.14.PID.CutbackLow2	3375	0x0D2F
Loop.14.Diag.SchedCBL	3361	0x0D21	Loop.14.PID.CutbackLow3	3385	0x0D39
Loop.14.Diag.SchedLPBrk	3363	0x0D23	Loop.14.PID.DerivativeTime	3337	0x0D09
Loop.14.Diag.SchedMR	3362	0x0D22	Loop.14.PID.DerivativeTime2	3373	0x0D2D
Loop.14.Diag.SchedOPHi	3365	0x0D25	Loop.14.PID.DerivativeTime3	3383	0x0D37
Loop.14.Diag.SchedOPLo	3366	0x0D26	Loop.14.PID.IntegralTime	3336	0x0D08
Loop.14.Diag.SchedPB	3357	0x0D1D	Loop.14.PID.IntegralTime2	3372	0x0D2C
Loop.14.Diag.SchedR2G	3364	0x0D24	Loop.14.PID.IntegralTime3	3382	0x0D36
Loop.14.Diag.SchedTd	3359	0x0D1F	Loop.14.PID.LoopBreakTime	3368	0x0D28
Loop.14.Diag.SchedTi	3358	0x0D1E	Loop.14.PID.LoopBreakTime2	3377	0x0D31
Loop.14.Diag.TargetOutVal	3443	0x0D73	Loop.14.PID.LoopBreakTime3	3387	0x0D3B
Loop.14.Main.ActiveOut	3332	0x0D04	Loop.14.PID.ManualReset	3367	0x0D27
Loop.14.Main.AutoMan	3338	0x0D0A	Loop.14.PID.ManualReset2	3376	0x0D30
Loop.14.Main.Inhibit	3348	0x0D14	Loop.14.PID.ManualReset3	3386	0x0D3A
Loop.14.Main.PV	3329	0x0D01	Loop.14.PID.NumSets	3392	0x0D40
Loop.14.Main.TargetSP	3330	0x0D02	Loop.14.PID.OutputHi	3369	0x0D29
Loop.14.Main.WorkingSP	3333	0x0D05	Loop.14.PID.OutputHi2	3379	0x0D33
Loop.14.OP.Ch1OnOffHysteresis	3412	0x0D54	Loop.14.PID.OutputHi3	3389	0x0D3D
Loop.14.OP.Ch1Out	3410	0x0D52	Loop.14.PID.OutputLo	3370	0x0D2A
Loop.14.OP.Ch2Deadband	3344	0x0D10	Loop.14.PID.OutputLo2	3380	0x0D34
Loop.14.OP.Ch2OnOffHysteresis	3413	0x0D55	Loop.14.PID.OutputLo3	3390	0x0D3E
Loop.14.OP.Ch2Out	3411	0x0D53	Loop.14.PID.ProportionalBand	3334	0x0D06
Loop.14.OP.CoolType	3421	0x0D5D	Loop.14.PID.ProportionalBand2	3371	0x0D2B
Loop.14.OP.EnablePowerFeedforward	3419	0x0D5B	Loop.14.PID.ProportionalBand3	3381	0x0D35
Loop.14.OP.FeedForwardGain	3423	0x0D5F	Loop.14.PID.RelCh2Gain	3347	0x0D13
Loop.14.OP.FeedForwardOffset	3424	0x0D60	Loop.14.PID.RelCh2Gain2	3378	0x0D32
Loop.14.OP.FeedForwardTrimLimit	3425	0x0D61	Loop.14.PID.RelCh2Gain3	3388	0x0D3C
Loop.14.OP.FeedForwardType	3422	0x0D5E	Loop.14.PID.SchedulerRemoteInput	3393	0x0D41
Loop.14.OP.FeedForwardVal	3426	0x0D62	Loop.14.PID.SchedulerType	3391	0x0D3F
Loop.14.OP.FF_Rem	3431	0x0D67	Loop.14.Setup.CH1ControlType	3350	0x0D16
Loop.14.OP.ManualMode	3418	0x0D5A	Loop.14.Setup.CH2ControlType	3351	0x0D17
Loop.14.OP.ManualOutVal	3331	0x0D03	Loop.14.Setup.ControlAction	3335	0x0D07
Loop.14.OP.MeasuredPower	3420	0x0D5C	Loop.14.Setup.DerivativeType	3353	0x0D19
Loop.14.OP.OutputHighLimit	3408	0x0D50	Loop.14.Setup.LoopType	3349	0x0D15
Loop.14.OP.OutputLowLimit	3409	0x0D51	Loop.14.Setup.PBUnits	3352	0x0D18
Loop.14.OP.Rate	3414	0x0D56	Loop.14.SP.AltSP	3396	0x0D44

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.14.SP.AltSPSelect	3397	0x0D45	Loop.15.OP.Ch1Out	3666	0x0E52
Loop.14.SP.ManualTrack	3403	0x0D4B	Loop.15.OP.Ch2Deadband	3600	0x0E10
Loop.14.SP.RangeHigh	3340	0x0D0C	Loop.15.OP.Ch2OnOffHysteresis	3669	0x0E55
Loop.14.SP.RangeLow	3339	0x0D0B	Loop.15.OP.Ch2Out	3667	0x0E53
Loop.14.SP.Rate	3398	0x0D46	Loop.15.OP.CoolType	3677	0x0E5D
Loop.14.SP.RateDisable	3399	0x0D47	Loop.15.OP.EnablePowerFeedforward	3675	0x0E5B
Loop.14.SP.RateDone	3407	0x0D4F	Loop.15.OP.FeedForwardGain	3679	0x0E5F
Loop.14.SP.SP1	3341	0x0D0D	Loop.15.OP.FeedForwardOffset	3680	0x0E60
Loop.14.SP.SP2	3342	0x0D0E	Loop.15.OP.FeedForwardTrimLimit	3681	0x0E61
Loop.14.SP.SPHighLimit	3394	0x0D42	Loop.15.OP.FeedForwardType	3678	0x0E5E
Loop.14.SP.SPLowLimit	3395	0x0D43	Loop.15.OP.FeedForwardVal	3682	0x0E62
Loop.14.SP.SPSelect	3343	0x0D0F	Loop.15.OP.FF_Rem	3687	0x0E67
Loop.14.SP.SPTrack	3404	0x0D4C	Loop.15.OP.ManualMode	3674	0x0E5A
Loop.14.SP.SPTrim	3400	0x0D48	Loop.15.OP.ManualOutVal	3587	0x0E03
Loop.14.SP.SPTrimHighLimit	3401	0x0D49	Loop.15.OP.MeasuredPower	3676	0x0E5C
Loop.14.SP.SPTrimLowLimit	3402	0x0D4A	Loop.15.OP.OutputHighLimit	3664	0x0E50
Loop.14.SP.TrackPV	3405	0x0D4D	Loop.15.OP.OutputLowLimit	3665	0x0E51
Loop.14.SP.TrackSP	3406	0x0D4E	Loop.15.OP.Rate	3670	0x0E56
Loop.14.Tune.AutotuneEnable	3436	0x0D6C	Loop.15.OP.RateDisable	3671	0x0E57
Loop.14.Tune.OutputHighLimit	3433	0x0D69	Loop.15.OP.RemOPH	3686	0x0E66
Loop.14.Tune.OutputLowLimit	3434	0x0D6A	Loop.15.OP.RemOPL	3685	0x0E65
Loop.14.Tune.Stage	3439	0x0D6F	Loop.15.OP.SafeOutVal	3673	0x0E59
Loop.14.Tune.StageTime	3440	0x0D70	Loop.15.OP.SBrkOP	3707	0x0E7B
Loop.14.Tune.State	3438	0x0D6E	Loop.15.OP.SensorBreakMode	3672	0x0E58
Loop.14.Tune.StepSize	3437	0x0D6D	Loop.15.OP.TrackEnable	3684	0x0E64
Loop.14.Tune.Type	3432	0x0D68	Loop.15.OP.TrackOutVal	3683	0x0E63
Loop.15.Diag.DerivativeOutContrib	3703	0x0E77	Loop.15.PID.ActiveSet	3612	0x0E1C
Loop.15.Diag.Error	3697	0x0E71	Loop.15.PID.Boundary1-2	3610	0x0E1A
Loop.15.Diag.IntegralOutContrib	3702	0x0E76	Loop.15.PID.Boundary2-3	3611	0x0E1B
Loop.15.Diag.LoopBreakAlarm	3700	0x0E74	Loop.15.PID.CutbackHigh	3602	0x0E12
Loop.15.Diag.LoopMode	3698	0x0E72	Loop.15.PID.CutbackHigh2	3630	0x0E2E
Loop.15.Diag.PropOutContrib	3701	0x0E75	Loop.15.PID.CutbackHigh3	3640	0x0E38
Loop.15.Diag.SBrk	3704	0x0E78	Loop.15.PID.CutbackLow	3601	0x0E11
Loop.15.Diag.SchedCBH	3616	0x0E20	Loop.15.PID.CutbackLow2	3631	0x0E2F
Loop.15.Diag.SchedCBL	3617	0x0E21	Loop.15.PID.CutbackLow3	3641	0x0E39
Loop.15.Diag.SchedLPBrk	3619	0x0E23	Loop.15.PID.DerivativeTime	3593	0x0E09
Loop.15.Diag.SchedMR	3618	0x0E22	Loop.15.PID.DerivativeTime2	3629	0x0E2D
Loop.15.Diag.SchedOPHi	3621	0x0E25	Loop.15.PID.DerivativeTime3	3639	0x0E37
Loop.15.Diag.SchedOPLo	3622	0x0E26	Loop.15.PID.IntegralTime	3592	0x0E08
Loop.15.Diag.SchedPB	3613	0x0E1D	Loop.15.PID.IntegralTime2	3628	0x0E2C
Loop.15.Diag.SchedR2G	3620	0x0E24	Loop.15.PID.IntegralTime3	3638	0x0E36
Loop.15.Diag.SchedTd	3615	0x0E1F	Loop.15.PID.LoopBreakTime	3624	0x0E28
Loop.15.Diag.SchedTi	3614	0x0E1E	Loop.15.PID.LoopBreakTime2	3633	0x0E31
Loop.15.Diag.TargetOutVal	3699	0x0E73	Loop.15.PID.LoopBreakTime3	3643	0x0E3B
Loop.15.Main.ActiveOut	3588	0x0E04	Loop.15.PID.ManualReset	3623	0x0E27
Loop.15.Main.AutoMan	3594	0x0E0A	Loop.15.PID.ManualReset2	3632	0x0E30
Loop.15.Main.Inhibit	3604	0x0E14	Loop.15.PID.ManualReset3	3642	0x0E3A
Loop.15.Main.PV	3585	0x0E01	Loop.15.PID.NumSets	3648	0x0E40
Loop.15.Main.TargetSP	3586	0x0E02	Loop.15.PID.OutputHi	3625	0x0E29
Loop.15.Main.WorkingSP	3589	0x0E05	Loop.15.PID.OutputHi2	3635	0x0E33
Loop.15.OP.Ch1OnOffHysteresis	3668	0x0E54	Loop.15.PID.OutputHi3	3645	0x0E3D

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.15.PID.OutputLo	3626	0x0E2A	Loop.16.Diag.SchedCBH	3872	0x0F20
Loop.15.PID.OutputLo2	3636	0x0E34	Loop.16.Diag.SchedCBL	3873	0x0F21
Loop.15.PID.OutputLo3	3646	0x0E3E	Loop.16.Diag.SchedLPBrk	3875	0x0F23
Loop.15.PID.ProportionalBand	3590	0x0E06	Loop.16.Diag.SchedMR	3874	0x0F22
Loop.15.PID.ProportionalBand2	3627	0x0E2B	Loop.16.Diag.SchedOPHi	3877	0x0F25
Loop.15.PID.ProportionalBand3	3637	0x0E35	Loop.16.Diag.SchedOPLo	3878	0x0F26
Loop.15.PID.RelCh2Gain	3603	0x0E13	Loop.16.Diag.SchedPB	3869	0x0F1D
Loop.15.PID.RelCh2Gain2	3634	0x0E32	Loop.16.Diag.SchedR2G	3876	0x0F24
Loop.15.PID.RelCh2Gain3	3644	0x0E3C	Loop.16.Diag.SchedTd	3871	0x0F1F
Loop.15.PID.SchedulerRemoteInput	3649	0x0E41	Loop.16.Diag.SchedTi	3870	0x0F1E
Loop.15.PID.SchedulerType	3647	0x0E3F	Loop.16.Diag.TargetOutVal	3955	0x0F73
Loop.15.Setup.CH1ControlType	3606	0x0E16	Loop.16.Main.ActiveOut	3844	0x0F04
Loop.15.Setup.CH2ControlType	3607	0x0E17	Loop.16.Main.AutoMan	3850	0x0F0A
Loop.15.Setup.ControlAction	3591	0x0E07	Loop.16.Main.Inhibit	3860	0x0F14
Loop.15.Setup.DerivativeType	3609	0x0E19	Loop.16.Main.PV	3841	0x0F01
Loop.15.Setup.LoopType	3605	0x0E15	Loop.16.Main.TargetSP	3842	0x0F02
Loop.15.Setup.PBUnits	3608	0x0E18	Loop.16.Main.WorkingSP	3845	0x0F05
Loop.15.SP.AltSP	3652	0x0E44	Loop.16.OP.Ch1OnOffHysteresis	3924	0x0F54
Loop.15.SP.AltSPSelect	3653	0x0E45	Loop.16.OP.Ch1Out	3922	0x0F52
Loop.15.SP.ManualTrack	3659	0x0E4B	Loop.16.OP.Ch2Deadband	3856	0x0F10
Loop.15.SP.RangeHigh	3596	0x0E0C	Loop.16.OP.Ch2OnOffHysteresis	3925	0x0F55
Loop.15.SP.RangeLow	3595	0x0E0B	Loop.16.OP.Ch2Out	3923	0x0F53
Loop.15.SP.Rate	3654	0x0E46	Loop.16.OP.CoolType	3933	0x0F5D
Loop.15.SP.RateDisable	3655	0x0E47	Loop.16.OP.EnablePowerFeedforward	3931	0x0F5B
Loop.15.SP.RateDone	3663	0x0E4F	Loop.16.OP.FeedForwardGain	3935	0x0F5F
Loop.15.SP.SP1	3597	0x0E0D	Loop.16.OP.FeedForwardOffset	3936	0x0F60
Loop.15.SP.SP2	3598	0x0E0E	Loop.16.OP.FeedForwardTrimLimit	3937	0x0F61
Loop.15.SP.SPHighLimit	3650	0x0E42	Loop.16.OP.FeedForwardType	3934	0x0F5E
Loop.15.SP.SPLowLimit	3651	0x0E43	Loop.16.OP.FeedForwardVal	3938	0x0F62
Loop.15.SP.SPSelect	3599	0x0E0F	Loop.16.OP.FF_Rem	3943	0x0F67
Loop.15.SP.SPTrack	3660	0x0E4C	Loop.16.OP.ManualMode	3930	0x0F5A
Loop.15.SP.SPTrim	3656	0x0E48	Loop.16.OP.ManualOutVal	3843	0x0F03
Loop.15.SP.SPTrimHighLimit	3657	0x0E49	Loop.16.OP.MeasuredPower	3932	0x0F5C
Loop.15.SP.SPTrimLowLimit	3658	0x0E4A	Loop.16.OP.OutputHighLimit	3920	0x0F50
Loop.15.SP.TrackPV	3661	0x0E4D	Loop.16.OP.OutputLowLimit	3921	0x0F51
Loop.15.SP.TrackSP	3662	0x0E4E	Loop.16.OP.Rate	3926	0x0F56
Loop.15.Tune.AutotuneEnable	3692	0x0E6C	Loop.16.OP.RateDisable	3927	0x0F57
Loop.15.Tune.OutputHighLimit	3689	0x0E69	Loop.16.OP.RemOPH	3942	0x0F66
Loop.15.Tune.OutputLowLimit	3690	0x0E6A	Loop.16.OP.RemOPL	3941	0x0F65
Loop.15.Tune.Stage	3695	0x0E6F	Loop.16.OP.SafeOutVal	3929	0x0F59
Loop.15.Tune.StageTime	3696	0x0E70	Loop.16.OP.SBrkOP	3963	0x0F7B
Loop.15.Tune.State	3694	0x0E6E	Loop.16.OP.SensorBreakMode	3928	0x0F58
Loop.15.Tune.StepSize	3693	0x0E6D	Loop.16.OP.TrackEnable	3940	0x0F64
Loop.15.Tune.Type	3688	0x0E68	Loop.16.OP.TrackOutVal	3939	0x0F63
Loop.16.Diag.DerivativeOutContrib	3959	0x0F77	Loop.16.PID.ActiveSet	3868	0x0F1C
Loop.16.Diag.Error	3953	0x0F71	Loop.16.PID.Boundary1-2	3866	0x0F1A
Loop.16.Diag.IntegralOutContrib	3958	0x0F76	Loop.16.PID.Boundary2-3	3867	0x0F1B
Loop.16.Diag.LoopBreakAlarm	3956	0x0F74	Loop.16.PID.CutbackHigh	3858	0x0F12
Loop.16.Diag.LoopMode	3954	0x0F72	Loop.16.PID.CutbackHigh2	3886	0x0F2E
Loop.16.Diag.PropOutContrib	3957	0x0F75	Loop.16.PID.CutbackHigh3	3896	0x0F38
Loop.16.Diag.SBrk	3960	0x0F78	Loop.16.PID.CutbackLow	3857	0x0F11

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Loop.16.PID.CutbackLow2	3887	0x0F2F	Loop.16.SP.SPTrimLowLimit	3914	0x0F4A
Loop.16.PID.CutbackLow3	3897	0x0F39	Loop.16.SP.TrackPV	3917	0x0F4D
Loop.16.PID.DerivativeTime	3849	0x0F09	Loop.16.SP.TrackSP	3918	0x0F4E
Loop.16.PID.DerivativeTime2	3885	0x0F2D	Loop.16.Tune.AutotuneEnable	3948	0x0F6C
Loop.16.PID.DerivativeTime3	3895	0x0F37	Loop.16.Tune.OutputHighLimit	3945	0x0F69
Loop.16.PID.IntegralTime	3848	0x0F08	Loop.16.Tune.OutputLowLimit	3946	0x0F6A
Loop.16.PID.IntegralTime2	3884	0x0F2C	Loop.16.Tune.Stage	3951	0x0F6F
Loop.16.PID.IntegralTime3	3894	0x0F36	Loop.16.Tune.StageTime	3952	0x0F70
Loop.16.PID.LoopBreakTime	3880	0x0F28	Loop.16.Tune.State	3950	0x0F6E
Loop.16.PID.LoopBreakTime2	3889	0x0F31	Loop.16.Tune.StepSize	3949	0x0F6D
Loop.16.PID.LoopBreakTime3	3899	0x0F3B	Loop.16.Tune.Type	3944	0x0F68
Loop.16.PID.ManualReset	3879	0x0F27	Math2.1.In1	4750	0x128e
Loop.16.PID.ManualReset2	3888	0x0F30	Math2.1.In2	4751	0x128f
Loop.16.PID.ManualReset3	3898	0x0F3A	Math2.1.Out	4752	0x1290
Loop.16.PID.NumSets	3904	0x0F40	Math2.2.In1	4753	0x1291
Loop.16.PID.OutputHi	3881	0x0F29	Math2.2.In2	4754	0x1292
Loop.16.PID.OutputHi2	3891	0x0F33	Math2.2.Out	4755	0x1293
Loop.16.PID.OutputHi3	3901	0x0F3D	Math2.3.In1	4756	0x1294
Loop.16.PID.OutputLo	3882	0x0F2A	Math2.3.In2	4757	0x1295
Loop.16.PID.OutputLo2	3892	0x0F34	Math2.3.Out	4758	0x1296
Loop.16.PID.OutputLo3	3902	0x0F3E	Math2.4.In1	4759	0x1297
Loop.16.PID.ProportionalBand	3846	0x0F06	Math2.4.In2	4760	0x1298
Loop.16.PID.ProportionalBand2	3883	0x0F2B	Math2.4.Out	4761	0x1299
Loop.16.PID.ProportionalBand3	3893	0x0F35	Math2.5.In1	4762	0x129a
Loop.16.PID.RelCh2Gain	3859	0x0F13	Math2.5.In2	4763	0x129b
Loop.16.PID.RelCh2Gain2	3890	0x0F32	Math2.5.Out	4764	0x129c
Loop.16.PID.RelCh2Gain3	3900	0x0F3C	Math2.6.In1	4765	0x129d
Loop.16.PID.SchedulerRemoteInput	3905	0x0F41	Math2.6.In2	4766	0x129e
Loop.16.PID.SchedulerType	3903	0x0F3F	Math2.6.Out	4767	0x129f
Loop.16.Setup.CH1ControlType	3862	0x0F16	Math2.7.In1	4768	0x12a0
Loop.16.Setup.CH2ControlType	3863	0x0F17	Math2.7.In2	4769	0x12a1
Loop.16.Setup.ControlAction	3847	0x0F07	Math2.7.Out	4770	0x12a2
Loop.16.Setup.DerivativeType	3865	0x0F19	Math2.8.In1	4771	0x12a3
Loop.16.Setup.LoopType	3861	0x0F15	Math2.8.In2	4772	0x12a4
Loop.16.Setup.PBUnits	3864	0x0F18	Math2.8.Out	4773	0x12a5
Loop.16.SP.AltSP	3908	0x0F44	Math2.9.In1	4774	0x12a6
Loop.16.SP.AltSPSelect	3909	0x0F45	Math2.9.In2	4775	0x12a7
Loop.16.SP.ManualTrack	3915	0x0F4B	Math2.9.Out	4776	0x12a8
Loop.16.SP.RangeHigh	3852	0x0F0C	Math2.10.In1	4777	0x12a9
Loop.16.SP.RangeLow	3851	0x0F0B	Math2.10.In2	4778	0x12aa
Loop.16.SP.Rate	3910	0x0F46	Math2.10.Out	4779	0x12ab
Loop.16.SP.RateDisable	3911	0x0F47	Math2.11.In1	4780	0x12ac
Loop.16.SP.RateDone	3919	0x0F4F	Math2.11.In2	4781	0x12ad
Loop.16.SP.SP1	3853	0x0F0D	Math2.11.Out	4782	0x12ae
Loop.16.SP.SP2	3854	0x0F0E	Math2.12.In1	4783	0x12af
Loop.16.SP.SPHighLimit	3906	0x0F42	Math2.12.In2	4784	0x12b0
Loop.16.SP.SPLowLimit	3907	0x0F43	Math2.12.Out	4785	0x12b1
Loop.16.SP.SPSelect	3855	0x0F0F	Math2.13.In1	4786	0x12b2
Loop.16.SP.SPTrack	3916	0x0F4C	Math2.13.In2	4787	0x12b3
Loop.16.SP.SPTrim	3912	0x0F48	Math2.13.Out	4788	0x12b4
Loop.16.SP.SPTrimHighLimit	3913	0x0F49	Math2.14.In1	4789	0x12b5

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
Math2.14.In2	4790	0x12b6	MultiOper.2.In7	5024	0x13a0
Math2.14.Out	4791	0x12b7	MultiOper.2.In8	5025	0x13a1
Math2.15.In1	4792	0x12b8	MultiOper.2.MaxOut	5027	0x13a3
Math2.15.In2	4793	0x12b9	MultiOper.2.MinOut	5028	0x13a4
Math2.15.Out	4794	0x12ba	MultiOper.2.SumOut	5026	0x13a2
Math2.16.In1	4795	0x12bb	MultiOper.3.AverageOut	5041	0x13b1
Math2.16.In2	4796	0x12bc	MultiOper.3.In1	5030	0x13a6
Math2.16.Out	4797	0x12bd	MultiOper.3.In2	5031	0x13a7
Math2.17.In1	4798	0x12be	MultiOper.3.In3	5032	0x13a8
Math2.17.In2	4799	0x12bf	MultiOper.3.In4	5033	0x13a9
Math2.17.Out	4800	0x12c0	MultiOper.3.In5	5034	0x13aa
Math2.18.In1	4801	0x12c1	MultiOper.3.In6	5035	0x13ab
Math2.18.In2	4802	0x12c2	MultiOper.3.In7	5036	0x13ac
Math2.18.Out	4803	0x12c3	MultiOper.3.In8	5037	0x13ad
Math2.19.In1	4804	0x12c4	MultiOper.3.MaxOut	5039	0x13af
Math2.19.In2	4805	0x12c5	MultiOper.3.MinOut	5040	0x13b0
Math2.19.Out	4806	0x12c6	MultiOper.3.SumOut	5038	0x13ae
Math2.20.In1	4807	0x12c7	MultiOper.4.AverageOut	5053	0x13bd
Math2.20.In2	4808	0x12c8	MultiOper.4.In1	5042	0x13b2
Math2.20.Out	4809	0x12c9	MultiOper.4.In2	5043	0x13b3
Math2.21.In1	4810	0x12ca	MultiOper.4.In3	5044	0x13b4
Math2.21.In2	4811	0x12cb	MultiOper.4.In4	5045	0x13b5
Math2.21.Out	4812	0x12cc	MultiOper.4.In5	5046	0x13b6
Math2.22.In1	4813	0x12cd	MultiOper.4.In6	5047	0x13b7
Math2.22.In2	4814	0x12ce	MultiOper.4.In7	5048	0x13b8
Math2.22.Out	4815	0x12cf	MultiOper.4.In8	5049	0x13b9
Math2.23.In1	4816	0x12d0	MultiOper.4.MaxOut	5051	0x13bb
Math2.23.In2	4817	0x12d1	MultiOper.4.MinOut	5052	0x13bc
Math2.23.Out	4818	0x12d2	MultiOper.4.SumOut	5050	0x13ba
Math2.24.In1	4819	0x12d3	Recipe.LastDataset	4913	0x1331
Math2.24.In2	4820	0x12d4	Recipe.LoadingStatus	4914	0x1332
Math2.24.Out	4821	0x12d5	Recipe.RecipeSelect	4912	0x1330
MultiOper.1.AverageOut	5017	0x1399	SwitchOver.SelectIn	4927	0x133f
MultiOper.1.In1	5006	0x138e	SwitchOver.SwitchHigh	4925	0x133d
MultiOper.1.In2	5007	0x138f	SwitchOver.SwitchLow	4926	0x133e
MultiOper.1.In3	5008	0x1390	Timer.1.ElapsedTime	4995	0x1383
MultiOper.1.In4	5009	0x1391	Timer.1.Out	4996	0x1384
MultiOper.1.In5	5010	0x1392	Timer.1.Time	4994	0x1382
MultiOper.1.In6	5011	0x1393	Timer.2.ElapsedTime	4998	0x1386
MultiOper.1.In7	5012	0x1394	Timer.2.Out	4999	0x1387
MultiOper.1.In8	5013	0x1395	Timer.2.Time	4997	0x1385
MultiOper.1.MaxOut	5015	0x1397	Timer.3.ElapsedTime	5001	0x1389
MultiOper.1.MinOut	5016	0x1398	Timer.3.Out	5002	0x138A
MultiOper.1.SumOut	5014	0x1396	Timer.3.Time	5000	0x1388
MultiOper.2.AverageOut	5029	0x13a5	Timer.4.ElapsedTime	5004	0x138C
MultiOper.2.In1	5018	0x139a	Timer.4.Out	5005	0x138D
MultiOper.2.In2	5019	0x139b	Timer.4.Time	5003	0x138B
MultiOper.2.In3	5020	0x139c	UsrVal.1.Val	4962	0x1362
MultiOper.2.In4	5021	0x139d	UsrVal.2.Val	4963	0x1363
MultiOper.2.In5	5022	0x139e	UsrVal.3.Val	4964	0x1364
MultiOper.2.In6	5023	0x139f	UsrVal.4.Val	4965	0x1365

Parameter Description / Modbus address	DEC	HEX	Parameter Description / Modbus address	DEC	HEX
UsrVal.5.Val	4966	0x1366	Zirconia.1.SootAlm	13264	0x33D0
UsrVal.6.Val	4967	0x1367	Zirconia.1.TempInput	13269	0x33D5
UsrVal.7.Val	4968	0x1368	Zirconia.1.TempOffset	13266	0x33D2
UsrVal.8.Val	4969	0x1369	Zirconia.1.Time2Clean	13249	0x33C1
UsrVal.9.Val	4970	0x136a	Zirconia.1.Tolerence	13276	0x33DC
UsrVal.10.Val	4971	0x136b	Zirconia.1.WrkGas	13265	0x33D1
UsrVal.11.Val	4972	0x136c	Zirconia.2.CarbonPot	13288	0x33E8
UsrVal.12.Val	4973	0x136d	Zirconia.2.CleanFreq	13283	0x33E3
UsrVal.13.Val	4974	0x136e	Zirconia.2.CleanProbe	13280	0x33EO
UsrVal.14.Val	4975	0x136f	Zirconia.2.CleanState	13300	0x33F4
UsrVal.15.Val	4976	0x1370	Zirconia.2.CleanTime	13284	0x33E4
UsrVal.16.Val	4977	0x1371	Zirconia.2.CleanValve	13295	0x33EF
UsrVal.17.Val	4978	0x1372	Zirconia.2.DewPoint	13306	0x33FA
UsrVal.18.Val	4979	0x1373	Zirconia.2.GasRef	13286	0x33E6
UsrVal.19.Val	4980	0x1374	Zirconia.2.MaxRcovTime	13285	0x33E5
UsrVal.20.Val	4981	0x1375	Zirconia.2.MinCalTemp	13302	0x33F6
UsrVal.21.Val	4982	0x1376	Zirconia.2.MinRcovTime	13287	0x33E7
UsrVal.22.Val	4983	0x1377	Zirconia.2.Oxygen	13293	0x33ED
UsrVal.23.Val	4984	0x1378	Zirconia.2.OxygenExp	13292	0x33EC
UsrVal.24.Val	4985	0x1379	Zirconia.2.ProbeFault	13303	0x33F7
UsrVal.25.Val	4986	0x137a	Zirconia.2.ProbeInput	13291	0x33EB
UsrVal.26.Val	4987	0x137b	Zirconia.2.ProbeOffset	13282	0x33E2
UsrVal.27.Val	4988	0x137c	Zirconia.2.ProbeStatus	13294	0x33EE
UsrVal.28.Val	4989	0x137d	Zirconia.2.ProbeType	13290	0x33EA
UsrVal.29.Val	4990	0x137e	Zirconia.2.ProcFactor	13307	0x33FB
UsrVal.30.Val	4991	0x137f	Zirconia.2.PVFrozen	13304	0x33F8
UsrVal.31.Val	4992	0x1380	Zirconia.2.RemGasEn	13289	0x33E9
UsrVal.32.Val	4993	0x1381	Zirconia.2.RemGasRef	13299	0x33F3
Zirconia.1.CarbonPot	13256	0x33C8	Zirconia.2.Resolution	13305	0x33F9
Zirconia.1.CleanFreq	13251	0x33C3	Zirconia.2.SootAlm	13296	0x33F0
Zirconia.1.CleanProbe	13248	0x33CO	Zirconia.2.TempInput	13301	0x33F5
Zirconia.1.CleanState	13268	0x33D4	Zirconia.2.TempOffset	13298	0x33F2
Zirconia.1.CleanTime	13252	0x33C4	Zirconia.2.Time2Clean	13281	0x33E1
Zirconia.1.CleanValve	13263	0x33CF	Zirconia.2.Tolerence	13308	0x33FC
Zirconia.1.DewPoint	13274	0x33DA	Zirconia.2.WrkGas	13297	0x33F1
Zirconia.1.GasRef	13254	0x33C6			
Zirconia.1.MaxRcovTime	13253	0x33C5			
Zirconia.1.MinCalTemp	13270	0x33D6			
Zirconia.1.MinRcovTime	13255	0x33C7			
Zirconia.1.Oxygen	13261	0x33CD			
Zirconia.1.OxygenExp	13260	0x33CC			
Zirconia.1.ProbeFault	13271	0x33D7			
Zirconia.1.ProbeInput	13259	0x33CB			
Zirconia.1.ProbeOffset	13250	0x33C2			
Zirconia.1.ProbeStatus	13262	0x33CE			
Zirconia.1.ProbeType	13258	0x33CA			
Zirconia.1.ProcFactor	13275	0x33DB			
Zirconia.1.PVFrozen	13272	0x33D8			
Zirconia.1.RemGasEn	13257	0x33C9			
Zirconia.1.RemGasRef	13267	0x33D3			
Zirconia.1.Resolution	13273	0x33D9			

Programmer Address Ranges - Decimal

The following table shows the addresses set aside for programmers.

PROGRAM NUMBER DECIMAL ADDRESSES (2.xx)	1	2	3	4	5	6	7	8
Comms.n.ProgramNumber	5568	5632	5696	5760	5824	5888	5952	6016
Program.n.HoldbackVal	5569	5633	5697	5761	5825	5889	5953	6017
Program.n.RampUnits	5570	5634	5698	5762	5826	5890	5954	6018
Program.n.DwellUnits	5571	5635	5699	5763	5827	5891	5955	6019
Program.n.Cycles	5572	5636	5700	5764	5828	5892	5956	6020
Programmer.n.PowerFailAct	5573	5637	5701	5765	5829	5893	5957	6021
Programmer.n.Servo	5574	5638	5702	5766	5830	5894	5958	6022
Programmer.n.ResetEventOuts	5576	5640	5704	5768	5832	5896	5960	6024
Programmer.n.CurProg	5577	5641	5705	5769	5833	5897	5961	6025
Programmer.n.CurSeg	5578	5642	5706	5770	5834	5898	5962	6026
Programmer.n.ProgStatus	5579	5643	5707	5771	5835	5899	5963	6027
Programmer.n.PSP	5580	5644	5708	5772	5836	5900	5964	6028
Programmer.n.CyclesLeft	5581	5645	5709	5773	5837	5901	5965	6029
Programmer.n.CurSegType	5582	5646	5710	5774	5838	5902	5966	6030
Programmer.n.SegTarget	5583	5647	5711	5775	5839	5903	5967	6031
Programmer.n.SegRate	5584	5648	5712	5776	5840	5904	5968	6032
Programmer.n.ProgTimeLeft	5585	5649	5713	5777	5841	5905	5969	6033
Programmer.n.PVIn	5586	5650	5714	5778	5842	5906	5970	6034
Programmer.n.SPIn	5587	5651	5715	5779	5843	5907	5971	6035
Programmer.n.EventOuts	5588	5652	5716	5780	5844	5908	5972	6036
Programmer.n.SegTimeLeft	5589	5653	5717	5781	5845	5909	5973	6037
Programmer.n.EndOfSeg	5590	5654	5718	5782	5846	5910	5974	6038
Programmer.n.SyncIn	5591	5655	5719	5783	5847	5911	5975	6039
Programmer.n.FastRun	5592	5656	5720	5784	5848	5912	5976	6040
Programmer.n.AdvSeg	5593	5657	5721	5785	5849	5913	5977	6041
Programmer.n.SkipSeg	5594	5658	5722	5786	5850	5914	5978	6042
Program.n.PVStart	5597	5661	5725	5789	5853	5917	5981	6045
Programmer.n.PrgIn1	5602	5666	5730	5794	5858	5922	5986	6050
Programmer.n.PrgIn2	5603	5667	5731	5795	5859	5923	5987	6051
Programmer.n.PVWaitIP	5604	5668	5732	5796	5860	5924	5988	6052
Programmer.n.ProgError	5605	5669	5733	5797	5861	5925	5989	6053
Programmer.n.PVEventOP	5606	5670	5734	5798	5862	5926	5990	6054
Programmer.n.GoBackCyclesLeft	5645	5709	5773	5837	5901	5965	6029	6093
Programmer.n.DelayTime	5685	5749	5813	5877	5941	6005	6069	6133
Programmer.n.ProgReset	5726	5790	5854	5918	5982	6046	6110	6174
Programmer.n.ProgRun	5768	5832	5896	5960	6024	6088	6152	6216
Programmer.n.ProgHold	5811	5875	5939	6003	6067	6131	6195	6259
Programmer.n.ProgRunHold	5855	5919	5983	6047	6111	6175	6239	6303
Programmer.n.ProgRunReset	5900	5964	6028	6092	6156	6220	6284	6348
Segment.1.Type	6080	6592	7104	7616	8128	8640	9152	9664
Segment.1.Holdback	6081	6593	7105	7617	8129	8641	9153	9665
Segment.1.Duration	6084	6596	7108	7620	8132	8644	9156	9668
Segment.1.RampRate	6085	6597	7109	7621	8133	8645	9157	9669
Segment.1.TargetSP	6086	6598	7110	7622	8134	8646	9158	9670
Segment.1.EndAction	6087	6599	7111	7623	8135	8647	9159	9671
Segment.1.EventOutputs	6088	6600	7112	7624	8136	8648	9160	9672
Segment.1.WaitFor	6089	6601	7113	7625	8137	8649	9161	9673
	6090	6602	7114	7626	8138	8650	9162	9674

PROGRAM NUMBER DECIMAL ADDRESSES (2.xx)	1	2	3	4	5	6	7	8
Segment.1.PVEvent	6093	6605	7117	7629	8141	8653	9165	9677
Segment.1.PVThreshold	6094	6606	7118	7630	8142	8654	9166	9678
Segment.1.UserVal	6095	6607	7119	7631	8143	8655	9167	9679
Segment.1.GsoakType	6096	6608	7120	7632	8144	8656	9168	9680
Segment.1.GsoakVal	6097	6609	7121	7633	8145	8657	9169	9681
Segment.1.TimeEvent	6098	6610	7122	7634	8146	8658	9170	9682
Segment.1.OnTime	6099	6611	7123	7635	8147	8659	9171	9683
Segment.1.OffTime	6100	6612	7124	7636	8148	8660	9172	9684
Segment.1.PIDSet	6101	6613	7125	7637	8149	8661	9173	9685
Segment.1.PVWait	6102	6614	7126	7638	8150	8662	9174	9686
Segment.1.WaitVal	6103	6615	7127	7639	8151	8663	9175	9687
Segment.2.Type	6112	6624	7136	7648	8160	8672	9184	9696
Segment.2.Holdback	6113	6625	7137	7649	8161	8673	9185	9697
Segment.2.Duration	6116	6628	7140	7652	8164	8676	9188	9700
Segment.2.RampRate	6117	6629	7141	7653	8165	8677	9189	9701
Segment.2.TargetSP	6118	6630	7142	7654	8166	8678	9190	9702
Segment.2.EndAction	6119	6631	7143	7655	8167	8679	9191	9703
Segment.2.EventOutputs	6120	6632	7144	7656	8168	8680	9192	9704
Segment.2.WaitFor	6121	6633	7145	7657	8169	8681	9193	9705
	6122	6634	7146	7658	8170	8682	9194	9706
Segment.2.GobackSeg	6123	6635	7147	7659	8171	8683	9195	9707
Segment.2.GobackCycles	6124	6636	7148	7660	8172	8684	9196	9708
Segment.2.PVEvent	6125	6637	7149	7661	8173	8685	9197	9709
Segment.2.PVThreshold	6126	6638	7150	7662	8174	8686	9198	9710
Segment.2.UserVal	6127	6639	7151	7663	8175	8687	9199	9711
Segment.2.GsoakType	6128	6640	7152	7664	8176	8688	9200	9712
Segment.2.GsoakVal	6129	6641	7153	7665	8177	8689	9201	9713
Segment.2.TimeEvent	6130	6642	7154	7666	8178	8690	9202	9714
Segment.2.OnTime	6131	6643	7155	7667	8179	8691	9203	9715
Segment.2.OffTime	6132	6644	7156	7668	8180	8692	9204	9716
Segment.2.PIDSet	6133	6645	7157	7669	8181	8693	9205	9717
Segment.2.PVWait	6134	6646	7158	7670	8182	8694	9206	9718
Segment.2.WaitVal	6135	6647	7159	7671	8183	8695	9207	9719
Segment.3.Type	6144	6656	7168	7680	8192	8704	9216	9728
Segment.3.Holdback	6145	6657	7169	7681	8193	8705	9217	9729
Segment.3.Duration	6148	6660	7172	7684	8196	8708	9220	9732
Segment.3.RampRate	6149	6661	7173	7685	8197	8709	9221	9733
Segment.3.TargetSP	6150	6662	7174	7686	8198	8710	9222	9734
Segment.3.EndAction	6151	6663	7175	7687	8199	8711	9223	9735
Segment.3.EventOutputs	6152	6664	7176	7688	8200	8712	9224	9736
Segment.3.WaitFor	6153	6665	7177	7689	8201	8713	9225	9737
	6154	6666	7178	7690	8202	8714	9226	9738
Segment.3.GobackSeg	6155	6667	7179	7691	8203	8715	9227	9739
Segment.3.GobackCycles	6156	6668	7180	7692	8204	8716	9228	9740
Segment.3.PVEvent	6157	6669	7181	7693	8205	8717	9229	9741
Segment.3.PVThreshold	6158	6670	7182	7694	8206	8718	9230	9742
Segment.3.UserVal	6159	6671	7183	7695	8207	8719	9231	9743
Segment.3.GsoakType	6160	6672	7184	7696	8208	8720	9232	9744
Segment.3.GsoakVal	6161	6673	7185	7697	8209	8721	9233	9745
Segment.3.TimeEvent	6162	6674	7186	7698	8210	8722	9234	9746
Segment.3.OnTime	6163	6675	7187	7699	8211	8723	9235	9747
Segment.3.OffTime	6164	6676	7188	7700	8212	8724	9236	9748

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Segment.3.PIDSet	6165	6677	7189	7701	8213	8725	9237	9749
Segment.3.PVWait	6166	6678	7190	7702	8214	8726	9238	9750
Segment.3.WaitVal	6167	6679	7191	7703	8215	8727	9239	9751
Segment.4.Type	6176	6688	7200	7712	8224	8736	9248	9760
Segment.4.Holdback	6177	6689	7201	7713	8225	8737	9249	9761
Segment.4.Duration	6180	6692	7204	7716	8228	8740	9252	9764
Segment.4.RampRate	6181	6693	7205	7717	8229	8741	9253	9765
Segment.4.TargetSP	6182	6694	7206	7718	8230	8742	9254	9766
Segment.4.EndAction	6183	6695	7207	7719	8231	8743	9255	9767
Segment.4.EventOutputs	6184	6696	7208	7720	8232	8744	9256	9768
Segment.4.WaitFor	6185	6697	7209	7721	8233	8745	9257	9769
	6186	6698	7210	7722	8234	8746	9258	9770
Segment.4.GobackSeg	6187	6699	7211	7723	8235	8747	9259	9771
Segment.4.GobackCycles	6188	6700	7212	7724	8236	8748	9260	9772
Segment.4.PVEvent	6189	6701	7213	7725	8237	8749	9261	9773
Segment.4.PVThreshold	6190	6702	7214	7726	8238	8750	9262	9774
Segment.4.UserVal	6191	6703	7215	7727	8239	8751	9263	9775
Segment.4.GsoakType	6192	6704	7216	7728	8240	8752	9264	9776
Segment.4.GsoakVal	6193	6705	7217	7729	8241	8753	9265	9777
Segment.4.TimeEvent	6194	6706	7218	7730	8242	8754	9266	9778
Segment.4.OnTime	6195	6707	7219	7731	8243	8755	9267	9779
Segment.4.OffTime	6196	6708	7220	7732	8244	8756	9268	9780
Segment.4.PIDSet	6197	6709	7221	7733	8245	8757	9269	9781
Segment.4.PVWait	6198	6710	7222	7734	8246	8758	9270	9782
Segment.4.WaitVal	6199	6711	7223	7735	8247	8759	9271	9783
Segment.5.Type	6208	6720	7232	7744	8256	8768	9280	9792
Segment.5.Holdback	6209	6721	7233	7745	8257	8769	9281	9793
Segment.5.Duration	6212	6724	7236	7748	8260	8772	9284	9796
Segment.5.RampRate	6213	6725	7237	7749	8261	8773	9285	9797
Segment.5.TargetSP	6214	6726	7238	7750	8262	8774	9286	9798
Segment.5.EndAction	6215	6727	7239	7751	8263	8775	9287	9799
Segment.5.EventOutputs	6216	6728	7240	7752	8264	8776	9288	9800
Segment.5.WaitFor	6217	6729	7241	7753	8265	8777	9289	9801
	6218	6730	7242	7754	8266	8778	9290	9802
Segment.5.GobackSeg	6219	6731	7243	7755	8267	8779	9291	9803
Segment.5.GobackCycles	6220	6732	7244	7756	8268	8780	9292	9804
Segment.5.PVEvent	6221	6733	7245	7757	8269	8781	9293	9805
Segment.5.PVThreshold	6222	6734	7246	7758	8270	8782	9294	9806
Segment.5.UserVal	6223	6735	7247	7759	8271	8783	9295	9807
Segment.5.GsoakType	6224	6736	7248	7760	8272	8784	9296	9808
Segment.5.GsoakVal	6225	6737	7249	7761	8273	8785	9297	9809
Segment.5.TimeEvent	6226	6738	7250	7762	8274	8786	9298	9810
Segment.5.OnTime	6227	6739	7251	7763	8275	8787	9299	9811
Segment.5.OffTime	6228	6740	7252	7764	8276	8788	9300	9812
Segment.5.PIDSet	6229	6741	7253	7765	8277	8789	9301	9813
Segment.5.PVWait	6230	6742	7254	7766	8278	8790	9302	9814
Segment.5.WaitVal	6231	6743	7255	7767	8279	8791	9303	9815
Segment.6.Type	6240	6752	7264	7776	8288	8800	9312	9824
Segment.6.Holdback	6241	6753	7265	7777	8289	8801	9313	9825
Segment.6.Duration	6244	6756	7268	7780	8292	8804	9316	9828
Segment.6.RampRate	6245	6757	7269	7781	8293	8805	9317	9829
Segment.6.TargetSP	6246	6758	7270	7782	8294	8806	9318	9830

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Segment.6.EndAction	6247	6759	7271	7783	8295	8807	9319	9831
Segment.6.EventOutputs	6248	6760	7272	7784	8296	8808	9320	9832
Segment.6.WaitFor	6249	6761	7273	7785	8297	8809	9321	9833
	6250	6762	7274	7786	8298	8810	9322	9834
Segment.6.GobackSeg	6251	6763	7275	7787	8299	8811	9323	9835
Segment.6.GobackCycles	6252	6764	7276	7788	8300	8812	9324	9836
Segment.6.PVEvent	6253	6765	7277	7789	8301	8813	9325	9837
Segment.6.PVThreshold	6254	6766	7278	7790	8302	8814	9326	9838
Segment.6.UserVal	6255	6767	7279	7791	8303	8815	9327	9839
Segment.6.GsoakType	6256	6768	7280	7792	8304	8816	9328	9840
Segment.6.GsoakVal	6257	6769	7281	7793	8305	8817	9329	9841
Segment.6.TimeEvent	6258	6770	7282	7794	8306	8818	9330	9842
Segment.6.OnTime	6259	6771	7283	7795	8307	8819	9331	9843
Segment.6.OffTime	6260	6772	7284	7796	8308	8820	9332	9844
Segment.6.PIDSet	6261	6773	7285	7797	8309	8821	9333	9845
Segment.6.PVWait	6262	6774	7286	7798	8310	8822	9334	9846
Segment.6.WaitVal	6263	6775	7287	7799	8311	8823	9335	9847
Segment.7.Type	6272	6784	7296	7808	8320	8832	9344	9856
Segment.7.Holdback	6273	6785	7297	7809	8321	8833	9345	9857
Segment.7.Duration	6276	6788	7300	7812	8324	8836	9348	9860
Segment.7.RampRate	6277	6789	7301	7813	8325	8837	9349	9861
Segment.7.TargetSP	6278	6790	7302	7814	8326	8838	9350	9862
Segment.7.EndAction	6279	6791	7303	7815	8327	8839	9351	9863
Segment.7.EventOutputs	6280	6792	7304	7816	8328	8840	9352	9864
Segment.7.WaitFor	6281	6793	7305	7817	8329	8841	9353	9865
	6282	6794	7306	7818	8330	8842	9354	9866
Segment.7.GobackSeg	6283	6795	7307	7819	8331	8843	9355	9867
Segment.7.GobackCycles	6284	6796	7308	7820	8332	8844	9356	9868
Segment.7.PVEvent	6285	6797	7309	7821	8333	8845	9357	9869
Segment.7.PVThreshold	6286	6798	7310	7822	8334	8846	9358	9870
Segment.7.UserVal	6287	6799	7311	7823	8335	8847	9359	9871
Segment.7.GsoakType	6288	6800	7312	7824	8336	8848	9360	9872
Segment.7.GsoakVal	6289	6801	7313	7825	8337	8849	9361	9873
Segment.7.TimeEvent	6290	6802	7314	7826	8338	8850	9362	9874
Segment.7.OnTime	6291	6803	7315	7827	8339	8851	9363	9875
Segment.7.OffTime	6292	6804	7316	7828	8340	8852	9364	9876
Segment.7.PIDSet	6293	6805	7317	7829	8341	8853	9365	9877
Segment.7.PVWait	6294	6806	7318	7830	8342	8854	9366	9878
Segment.7.WaitVal	6295	6807	7319	7831	8343	8855	9367	9879
Segment.8.Type	6304	6816	7328	7840	8352	8864	9376	9888
Segment.8.Holdback	6305	6817	7329	7841	8353	8865	9377	9889
Segment.8.Duration	6308	6820	7332	7844	8356	8868	9380	9892
Segment.8.RampRate	6309	6821	7333	7845	8357	8869	9381	9893
Segment.8.TargetSP	6310	6822	7334	7846	8358	8870	9382	9894
Segment.8.EndAction	6311	6823	7335	7847	8359	8871	9383	9895
Segment.8.EventOutputs	6312	6824	7336	7848	8360	8872	9384	9896
Segment.8.WaitFor	6313	6825	7337	7849	8361	8873	9385	9897
	6314	6826	7338	7850	8362	8874	9386	9898
Segment.8.GobackSeg	6315	6827	7339	7851	8363	8875	9387	9899
Segment.8.GobackCycles	6316	6828	7340	7852	8364	8876	9388	9900
Segment.8.PVEvent	6317	6829	7341	7853	8365	8877	9389	9901
Segment.8.PVThreshold	6318	6830	7342	7854	8366	8878	9390	9902

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Segment.8.UserVal	6319	6831	7343	7855	8367	8879	9391	9903
Segment.8.GsoakType	6320	6832	7344	7856	8368	8880	9392	9904
Segment.8.GsoakVal	6321	6833	7345	7857	8369	8881	9393	9905
Segment.8.TimeEvent	6322	6834	7346	7858	8370	8882	9394	9906
Segment.8.OnTime	6323	6835	7347	7859	8371	8883	9395	9907
Segment.8.OffTime	6324	6836	7348	7860	8372	8884	9396	9908
Segment.8.PIDSet	6325	6837	7349	7861	8373	8885	9397	9909
Segment.8.PVWait	6326	6838	7350	7862	8374	8886	9398	9910
Segment.8.WaitVal	6327	6839	7351	7863	8375	8887	9399	9911
Segment.9.Type	6336	6848	7360	7872	8384	8896	9408	9920
Segment.9.Holdback	6337	6849	7361	7873	8385	8897	9409	9921
Segment.9.Duration	6340	6852	7364	7876	8388	8900	9412	9924
Segment.9.RampRate	6341	6853	7365	7877	8389	8901	9413	9925
Segment.9.TargetSP	6342	6854	7366	7878	8390	8902	9414	9926
Segment.9.EndAction	6343	6855	7367	7879	8391	8903	9415	9927
Segment.9.EventOutputs	6344	6856	7368	7880	8392	8904	9416	9928
Segment.9.WaitFor	6345	6857	7369	7881	8393	8905	9417	9929
	6346	6858	7370	7882	8394	8906	9418	9930
Segment.9.GobackSeg	6347	6859	7371	7883	8395	8907	9419	9931
Segment.9.GobackCycles	6348	6860	7372	7884	8396	8908	9420	9932
Segment.9.PVEvent	6349	6861	7373	7885	8397	8909	9421	9933
Segment.9.PVThreshold	6350	6862	7374	7886	8398	8910	9422	9934
Segment.9.UserVal	6351	6863	7375	7887	8399	8911	9423	9935
Segment.9.GsoakType	6352	6864	7376	7888	8400	8912	9424	9936
Segment.9.GsoakVal	6353	6865	7377	7889	8401	8913	9425	9937
Segment.9.TimeEvent	6354	6866	7378	7890	8402	8914	9426	9938
Segment.9.OnTime	6355	6867	7379	7891	8403	8915	9427	9939
Segment.9.OffTime	6356	6868	7380	7892	8404	8916	9428	9940
Segment.9.PIDSet	6357	6869	7381	7893	8405	8917	9429	9941
Segment.9.PVWait	6358	6870	7382	7894	8406	8918	9430	9942
Segment.9.WaitVal	6359	6871	7383	7895	8407	8919	9431	9943
Segment.10.Type	6368	6880	7392	7904	8416	8928	9440	9952
Segment.10.Holdback	6369	6881	7393	7905	8417	8929	9441	9953
Segment.10.Duration	6372	6884	7396	7908	8420	8932	9444	9956
Segment.10.RampRate	6373	6885	7397	7909	8421	8933	9445	9957
Segment.10.TargetSP	6374	6886	7398	7910	8422	8934	9446	9958
Segment.10.EndAction	6375	6887	7399	7911	8423	8935	9447	9959
Segment.10.EventOutputs	6376	6888	7400	7912	8424	8936	9448	9960
Segment.10.WaitFor	6377	6889	7401	7913	8425	8937	9449	9961
	6378	6890	7402	7914	8426	8938	9450	9962
Segment.10.GobackSeg	6379	6891	7403	7915	8427	8939	9451	9963
Segment.10.GobackCycles	6380	6892	7404	7916	8428	8940	9452	9964
Segment.10.PVEvent	6381	6893	7405	7917	8429	8941	9453	9965
Segment.10.PVThreshold	6382	6894	7406	7918	8430	8942	9454	9966
Segment.10.UserVal	6383	6895	7407	7919	8431	8943	9455	9967
Segment.10.GsoakType	6384	6896	7408	7920	8432	8944	9456	9968
Segment.10.GsoakVal	6385	6897	7409	7921	8433	8945	9457	9969
Segment.10.TimeEvent	6386	6898	7410	7922	8434	8946	9458	9970
Segment.10.OnTime	6387	6899	7411	7923	8435	8947	9459	9971
Segment.10.OffTime	6388	6900	7412	7924	8436	8948	9460	9972
Segment.10.PIDSet	6389	6901	7413	7925	8437	8949	9461	9973
Segment.10.PVWait	6390	6902	7414	7926	8438	8950	9462	9974

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Segment.10.WaitVal	6391	6903	7415	7927	8439	8951	9463	9975
Segment.11.Type	6400	6912	7424	7936	8448	8960	9472	9984
Segment.11.Holdback	6401	6913	7425	7937	8449	8961	9473	9985
Segment.11.Duration	6404	6916	7428	7940	8452	8964	9476	9988
Segment.11.RampRate	6405	6917	7429	7941	8453	8965	9477	9989
Segment.11.TargetSP	6406	6918	7430	7942	8454	8966	9478	9990
Segment.11.EndAction	6407	6919	7431	7943	8455	8967	9479	9991
Segment.11.EventOutputs	6408	6920	7432	7944	8456	8968	9480	9992
Segment.11.WaitFor	6409	6921	7433	7945	8457	8969	9481	9993
	6410	6922	7434	7946	8458	8970	9482	9994
Segment.11.GobackSeg	6411	6923	7435	7947	8459	8971	9483	9995
Segment.11.GobackCycles	6412	6924	7436	7948	8460	8972	9484	9996
Segment.11.PVEvent	6413	6925	7437	7949	8461	8973	9485	9997
Segment.11.PVThreshold	6414	6926	7438	7950	8462	8974	9486	9998
Segment.11.UserVal	6415	6927	7439	7951	8463	8975	9487	9999
Segment.11.GsoakType	6416	6928	7440	7952	8464	8976	9488	10000
Segment.11.GsoakVal	6417	6929	7441	7953	8465	8977	9489	10001
Segment.11.TimeEvent	6418	6930	7442	7954	8466	8978	9490	10002
Segment.11.OnTime	6419	6931	7443	7955	8467	8979	9491	10003
Segment.11.OffTime	6420	6932	7444	7956	8468	8980	9492	10004
Segment.11.PIDSet	6421	6933	7445	7957	8469	8981	9493	10005
Segment.11.PVWait	6422	6934	7446	7958	8470	8982	9494	10006
Segment.11.WaitVal	6423	6935	7447	7959	8471	8983	9495	10007
Segment.12.Type	6432	6944	7456	7968	8480	8992	9504	10016
Segment.12.Holdback	6433	6945	7457	7969	8481	8993	9505	10017
Segment.12.Duration	6436	6948	7460	7972	8484	8996	9508	10020
Segment.12.RampRate	6437	6949	7461	7973	8485	8997	9509	10021
Segment.12.TargetSP	6438	6950	7462	7974	8486	8998	9510	10022
Segment.12.EndAction	6439	6951	7463	7975	8487	8999	9511	10023
Segment.12.EventOutputs	6440	6952	7464	7976	8488	9000	9512	10024
Segment.12.WaitFor	6441	6953	7465	7977	8489	9001	9513	10025
	6442	6954	7466	7978	8490	9002	9514	10026
Segment.12.GobackSeg	6443	6955	7467	7979	8491	9003	9515	10027
Segment.12.GobackCycles	6444	6956	7468	7980	8492	9004	9516	10028
Segment.12.PVEvent	6445	6957	7469	7981	8493	9005	9517	10029
Segment.12.PVThreshold	6446	6958	7470	7982	8494	9006	9518	10030
Segment.12.UserVal	6447	6959	7471	7983	8495	9007	9519	10031
Segment.12.GsoakType	6448	6960	7472	7984	8496	9008	9520	10032
Segment.12.GsoakVal	6449	6961	7473	7985	8497	9009	9521	10033
Segment.12.TimeEvent	6450	6962	7474	7986	8498	9010	9522	10034
Segment.12.OnTime	6451	6963	7475	7987	8499	9011	9523	10035
Segment.12.OffTime	6452	6964	7476	7988	8500	9012	9524	10036
Segment.12.PIDSet	6453	6965	7477	7989	8501	9013	9525	10037
Segment.12.PVWait	6454	6966	7478	7990	8502	9014	9526	10038
Segment.12.WaitVal	6455	6967	7479	7991	8503	9015	9527	10039
Segment.13.Type	6464	6976	7488	8000	8512	9024	9536	10048
Segment.13.Holdback	6465	6977	7489	8001	8513	9025	9537	10049
Segment.13.Duration	6468	6980	7492	8004	8516	9028	9540	10052
Segment.13.RampRate	6469	6981	7493	8005	8517	9029	9541	10053
Segment.13.TargetSP	6470	6982	7494	8006	8518	9030	9542	10054
Segment.13.EndAction	6471	6983	7495	8007	8519	9031	9543	10055
Segment.13.EventOutputs	6472	6984	7496	8008	8520	9032	9544	10056

PROGRAM NUMBER DECIMAL ADDRESSES (2.xx)	1	2	3	4	5	6	7	8
Segment.13.WaitFor	6473	6985	7497	8009	8521	9033	9545	10057
	6474	6986	7498	8010	8522	9034	9546	10058
Segment.13.GobackSeg	6475	6987	7499	8011	8523	9035	9547	10059
Segment.13.GobackCycles	6476	6988	7500	8012	8524	9036	9548	10060
Segment.13.PVEvent	6477	6989	7501	8013	8525	9037	9549	10061
Segment.13.PVThreshold	6478	6990	7502	8014	8526	9038	9550	10062
Segment.13.UserVal	6479	6991	7503	8015	8527	9039	9551	10063
Segment.13.GsoakType	6480	6992	7504	8016	8528	9040	9552	10064
Segment.13.GsoakVal	6481	6993	7505	8017	8529	9041	9553	10065
Segment.13.TimeEvent	6482	6994	7506	8018	8530	9042	9554	10066
Segment.13.OnTime	6483	6995	7507	8019	8531	9043	9555	10067
Segment.13.OffTime	6484	6996	7508	8020	8532	9044	9556	10068
Segment.13.PIDSet	6485	6997	7509	8021	8533	9045	9557	10069
Segment.13.PVWait	6486	6998	7510	8022	8534	9046	9558	10070
Segment.13.WaitVal	6487	6999	7511	8023	8535	9047	9559	10071
Segment.14.Type	6496	7008	7520	8032	8544	9056	9568	10080
Segment.14.Holdback	6497	7009	7521	8033	8545	9057	9569	10081
Segment.14.Duration	6500	7012	7524	8036	8548	9060	9572	10084
Segment.14.RampRate	6501	7013	7525	8037	8549	9061	9573	10085
Segment.14.TargetSP	6502	7014	7526	8038	8550	9062	9574	10086
Segment.14.EndAction	6503	7015	7527	8039	8551	9063	9575	10087
Segment.14.EventOutputs	6504	7016	7528	8040	8552	9064	9576	10088
Segment.14.WaitFor	6505	7017	7529	8041	8553	9065	9577	10089
	6506	7018	7530	8042	8554	9066	9578	10090
Segment.14.GobackSeg	6507	7019	7531	8043	8555	9067	9579	10091
Segment.14.GobackCycles	6508	7020	7532	8044	8556	9068	9580	10092
Segment.14.PVEvent	6509	7021	7533	8045	8557	9069	9581	10093
Segment.14.PVThreshold	6510	7022	7534	8046	8558	9070	9582	10094
Segment.14.UserVal	6511	7023	7535	8047	8559	9071	9583	10095
Segment.14.GsoakType	6512	7024	7536	8048	8560	9072	9584	10096
Segment.14.GsoakVal	6513	7025	7537	8049	8561	9073	9585	10097
Segment.14.TimeEvent	6514	7026	7538	8050	8562	9074	9586	10098
Segment.14.OnTime	6515	7027	7539	8051	8563	9075	9587	10099
Segment.14.OffTime	6516	7028	7540	8052	8564	9076	9588	10100
Segment.14.PIDSet	6517	7029	7541	8053	8565	9077	9589	10101
Segment.14.PVWait	6518	7030	7542	8054	8566	9078	9590	10102
Segment.14.WaitVal	6519	7031	7543	8055	8567	9079	9591	10103
Segment.15.Type	6528	7040	7552	8064	8576	9088	9600	10112
Segment.15.Holdback	6529	7041	7553	8065	8577	9089	9601	10113
Segment.15.Duration	6532	7044	7556	8068	8580	9092	9604	10116
Segment.15.RampRate	6533	7045	7557	8069	8581	9093	9605	10117
Segment.15.TargetSP	6534	7046	7558	8070	8582	9094	9606	10118
Segment.15.EndAction	6535	7047	7559	8071	8583	9095	9607	10119
Segment.15.EventOutputs	6536	7048	7560	8072	8584	9096	9608	10120
Segment.15.WaitFor	6537	7049	7561	8073	8585	9097	9609	10121
	6538	7050	7562	8074	8586	9098	9610	10122
Segment.15.GobackSeg	6539	7051	7563	8075	8587	9099	9611	10123
Segment.15.GobackCycles	6540	7052	7564	8076	8588	9100	9612	10124
Segment.15.PVEvent	6541	7053	7565	8077	8589	9101	9613	10125
Segment.15.PVThreshold	6542	7054	7566	8078	8590	9102	9614	10126
Segment.15.UserVal	6543	7055	7567	8079	8591	9103	9615	10127
Segment.15.GsoakType	6544	7056	7568	8080	8592	9104	9616	10128

PROGRAM NUMBER DECIMAL ADDRESSES (2.xx)	1	2	3	4	5	6	7	8
Segment.15.GsoakVal	6545	7057	7569	8081	8593	9105	9617	10129
Segment.15.TimeEvent	6546	7058	7570	8082	8594	9106	9618	10130
Segment.15.OnTime	6547	7059	7571	8083	8595	9107	9619	10131
Segment.15.OffTime	6548	7060	7572	8084	8596	9108	9620	10132
Segment.15.PIDSet	6549	7061	7573	8085	8597	9109	9621	10133
Segment.15.PVWait	6550	7062	7574	8086	8598	9110	9622	10134
Segment.15.WaitVal	6551	7063	7575	8087	8599	9111	9623	10135
Segment.16.Type	6560	7072	7584	8096	8608	9120	9632	10144
Segment.16.Holdback	6561	7073	7585	8097	8609	9121	9633	10145
Segment.16.Duration	6564	7076	7588	8100	8612	9124	9636	10148
Segment.16.RampRate	6565	7077	7589	8101	8613	9125	9637	10149
Segment.16.TargetSP	6566	7078	7590	8102	8614	9126	9638	10150
Segment.16.EndAction	6567	7079	7591	8103	8615	9127	9639	10151
Segment.16.EventOutputs	6568	7080	7592	8104	8616	9128	9640	10152
Segment.16.WaitFor	6569	7081	7593	8105	8617	9129	9641	10153
	6570	7082	7594	8106	8618	9130	9642	10154
Segment.16.GobackSeg	6571	7083	7595	8107	8619	9131	9643	10155
Segment.16.GobackCycles	6572	7084	7596	8108	8620	9132	9644	10156
Segment.16.PVEvent	6573	7085	7597	8109	8621	9133	9645	10157
Segment.16.PVThreshold	6574	7086	7598	8110	8622	9134	9646	10158
Segment.16.UserVal	6575	7087	7599	8111	8623	9135	9647	10159
Segment.16.GsoakType	6576	7088	7600	8112	8624	9136	9648	10160
Segment.16.GsoakVal	6577	7089	7601	8113	8625	9137	9649	10161
Segment.16.TimeEvent	6578	7090	7602	8114	8626	9138	9650	10162
Segment.16.OnTime	6579	7091	7603	8115	8627	9139	9651	10163
Segment.16.OffTime	6580	7092	7604	8116	8628	9140	9652	10164
Segment.16.PIDSet	6581	7093	7605	8117	8629	9141	9653	10165
Segment.16.PVWait	6582	7094	7606	8118	8630	9142	9654	10166
Segment.16.WaitVal	6583	7095	7607	8119	8631	9143	9655	10167

Version 2.xx Programmer Addresses - Hexadecimal

PROGRAM NUMBER HEXADECIMAL ADDRESS (2.xx)	1	2	3	4	5	6	7	8
Comms.n.ProgramNumber	15C0	1600	1640	1680	16C0	1700	1740	1780
Program.n.HoldbackVal	15C1	1601	1641	1681	16C1	1701	1741	1781
Program.n.RampUnits	15C2	1602	1642	1682	16C2	1702	1742	1782
Program.n.DwellUnits	15C3	1603	1643	1683	16C3	1703	1743	1783
Program.n.Cycles	15C4	1604	1644	1684	16C4	1704	1744	1784
Programmer.n.PowerFailAct	15C5	1605	1645	1685	16C5	1705	1745	1785
Programmer.n.Servo	15C6	1606	1646	1686	16C6	1706	1746	1786
Programmer.n.ResetEventOuts	15C8	1608	1648	1688	16C8	1708	1748	1788
Programmer.n.CurProg	15C9	1609	1649	1689	16C9	1709	1749	1789
Programmer.n.CurSeg	15CA	160A	164A	168A	16CA	170A	174A	178A
Programmer.n.ProgStatus	15CB	160B	164B	168B	16CB	170B	174B	178B
Programmer.n.PSP	15CC	160C	164C	168C	16CC	170C	174C	178C
Programmer.n.CyclesLeft	15CD	160D	164D	168D	16CD	170D	174D	178D
Programmer.n.CurSegType	15CE	160E	164E	168E	16CE	170E	174E	178E
Programmer.n.SegTarget	15CF	160F	164F	168F	16CF	170F	174F	178F
Programmer.n.SegRate	15D0	1610	1650	1690	16D0	1710	1750	1790
Programmer.n.ProgTimeLeft	15D1	1611	1651	1691	16D1	1711	1751	1791
Programmer.n.PVIn	15D2	1612	1652	1692	16D2	1712	1752	1792
Programmer.n.SPIn	15D3	1613	1653	1693	16D3	1713	1753	1793
Programmer.n.EventOuts	15D4	1614	1654	1694	16D4	1714	1754	1794
Programmer.n.SegTimeLeft	15D5	1615	1655	1695	16D5	1715	1755	1795
Programmer.n.EndOfSeg	15D6	1616	1656	1696	16D6	1716	1756	1796
Programmer.n.SyncIn	15D7	1617	1657	1697	16D7	1717	1757	1797
Programmer.n.FastRun	15D8	1618	1658	1698	16D8	1718	1758	1798
Programmer.n.AdvSeg	15D9	1619	1659	1699	16D9	1719	1759	1799
Programmer.n.SkipSeg	15DA	161A	165A	169A	16DA	171A	175A	179A
Program.n.PVStart	15DD	161D	165D	169D	16DD	171D	175D	179D
Programmer.n.PrgIn1	15E2	1622	1662	16A2	16E2	1722	1762	17A2
Programmer.n.PrgIn2	15E3	1623	1663	16A3	16E3	1723	1763	17A3
Programmer.n.PVWaitIP	15E4	1624	1664	16A4	16E4	1724	1764	17A4
Programmer.n.ProgError	15E5	1625	1665	16A5	16E5	1725	1765	17A5
Programmer.n.PVEventOP	15E6	1626	1666	16A6	16E6	1726	1766	17A6
Programmer.n.GoBackCyclesLeft	160D	164D	168D	16CD	170D	174D	178D	17CD
Programmer.n.DelayTime	1635	1675	16B5	16F5	1735	1775	17B5	17F5
Programmer.n.ProgReset	165E	169E	16DE	171E	175E	179E	17DE	181E
Programmer.n.ProgRun	1688	16C8	1708	1748	1788	17C8	1808	1848
Programmer.n.ProgHold	16B3	16F3	1733	1773	17B3	17F3	1833	1873
Programmer.n.ProgRunHold	16DF	171F	175F	179F	17DF	181F	185F	189F
Programmer.n.ProgRunReset	170C	174C	178C	17CC	180C	184C	188C	18CC
Segment.1.Type	17C0	19C0	1BC0	1DC0	1FC0	21C0	23C0	25C0
Segment.1.Holdback	17C1	19C1	1BC1	1DC1	1FC1	21C1	23C1	25C1
Segment.1.CallProgNum	17C2	19C2	1BC2	1DC2	1FC2	21C2	23C2	25C2
Segment.1.Cycles	17C3	19C3	1BC3	1DC3	1FC3	21C3	23C3	25C3
Segment.1.Duration	17C4	19C4	1BC4	1DC4	1FC4	21C4	23C4	25C4
Segment.1.RampRate	17C5	19C5	1BC5	1DC5	1FC5	21C5	23C5	25C5
Segment.1.TargetSP	17C6	19C6	1BC6	1DC6	1FC6	21C6	23C6	25C6
Segment.1.EndAction	17C7	19C7	1BC7	1DC7	1FC7	21C7	23C7	25C7
Segment.1.EventOutputs	17C8	19C8	1BC8	1DC8	1FC8	21C8	23C8	25C8
Segment.1.WaitFor	17C9	19C9	1BC9	1DC9	1FC9	21C9	23C9	25C9

PROGRAM NUMBER HEXADECIMAL ADDRESS (2.xx)	1	2	3	4	5	6	7	8
	17CA	19CA	1BCA	1DCA	1FCA	21CA	23CA	25CA
Segment.1.PVEvent	17CD	19CD	1BCD	1DCD	1FCD	21CD	23CD	25CD
Segment.1.PVThreshold	17CE	19CE	1BCE	1DCE	1FCE	21CE	23CE	25CE
Segment.1.UserVal	17CF	19CF	1BCF	1DCF	1FCF	21CF	23CF	25CF
Segment.1.GsoakType	17D0	19D0	1BD0	1DD0	1FD0	21D0	23D0	25D0
Segment.1.GsoakVal	17D1	19D1	1BD1	1DD1	1FD1	21D1	23D1	25D1
Segment.1.TimeEvent	17D2	19D2	1BD2	1DD2	1FD2	21D2	23D2	25D2
Segment.1.OnTime	17D3	19D3	1BD3	1DD3	1FD3	21D3	23D3	25D3
Segment.1.OffTime	17D4	19D4	1BD4	1DD4	1FD4	21D4	23D4	25D4
Segment.1.PIDSet	17D5	19D5	1BD5	1DD5	1FD5	21D5	23D5	25D5
Segment.1.PVWait	17D6	19D6	1BD6	1DD6	1FD6	21D6	23D6	25D6
Segment.1.WaitVal	17D7	19D7	1BD7	1DD7	1FD7	21D7	23D7	25D7
Segment.2.Type	17E0	19E0	1BE0	1DE0	1FE0	21E0	23E0	25E0
Segment.2.Holdback	17E1	19E1	1BE1	1DE1	1FE1	21E1	23E1	25E1
Segment.2.Duration	17E4	19E4	1BE4	1DE4	1FE4	21E4	23E4	25E4
Segment.2.RampRate	17E5	19E5	1BE5	1DE5	1FE5	21E5	23E5	25E5
Segment.2.TargetSP	17E6	19E6	1BE6	1DE6	1FE6	21E6	23E6	25E6
Segment.2.EndAction	17E7	19E7	1BE7	1DE7	1FE7	21E7	23E7	25E7
Segment.2.EventOutputs	17E8	19E8	1BE8	1DE8	1FE8	21E8	23E8	25E8
Segment.2.WaitFor	17E9	19E9	1BE9	1DE9	1FE9	21E9	23E9	25E9
	17EA	19EA	1BEA	1DEA	1FEA	21EA	23EA	25EA
Segment.2.GobackSeg	17EB	19EB	1BEB	1DEB	1FEB	21EB	23EB	25EB
Segment.2.GobackCycles	17EC	19EC	1BEC	1DEC	1FEC	21EC	23EC	25EC
Segment.2.PVEvent	17ED	19ED	1BED	1DED	1FED	21ED	23ED	25ED
Segment.2.PVThreshold	17EE	19EE	1BEE	1DEE	1FEE	21EE	23EE	25EE
Segment.2.UserVal	17EF	19EF	1BEF	1DEF	1FEF	21EF	23EF	25EF
Segment.2.GsoakType	17F0	19F0	1BF0	1DF0	1FF0	21F0	23F0	25F0
Segment.2.GsoakVal	17F1	19F1	1BF1	1DF1	1FF1	21F1	23F1	25F1
Segment.2.TimeEvent	17F2	19F2	1BF2	1DF2	1FF2	21F2	23F2	25F2
Segment.2.OnTime	17F3	19F3	1BF3	1DF3	1FF3	21F3	23F3	25F3
Segment.2.OffTime	17F4	19F4	1BF4	1DF4	1FF4	21F4	23F4	25F4
Segment.2.PIDSet	17F5	19F5	1BF5	1DF5	1FF5	21F5	23F5	25F5
Segment.2.PVWait	17F6	19F6	1BF6	1DF6	1FF6	21F6	23F6	25F6
Segment.2.WaitVal	17F7	19F7	1BF7	1DF7	1FF7	21F7	23F7	25F7
Segment.3.Type	1800	1A00	1C00	1E00	2000	2200	2400	2600
Segment.3.Holdback	1801	1A01	1C01	1E01	2001	2201	2401	2601
Segment.3.Duration	1804	1A04	1C04	1E04	2004	2204	2404	2604
Segment.3.RampRate	1805	1A05	1C05	1E05	2005	2205	2405	2605
Segment.3.TargetSP	1806	1A06	1C06	1E06	2006	2206	2406	2606
Segment.3.EndAction	1807	1A07	1C07	1E07	2007	2207	2407	2607
Segment.3.EventOutputs	1808	1A08	1C08	1E08	2008	2208	2408	2608
Segment.3.WaitFor	1809	1A09	1C09	1E09	2009	2209	2409	2609
	180A	1A0A	1C0A	1E0A	200A	220A	240A	260A
Segment.3.GobackSeg	180B	1A0B	1C0B	1E0B	200B	220B	240B	260B
Segment.3.GobackCycles	180C	1A0C	1C0C	1E0C	200C	220C	240C	260C
Segment.3.PVEvent	180D	1A0D	1C0D	1E0D	200D	220D	240D	260D
Segment.3.PVThreshold	180E	1A0E	1C0E	1E0E	200E	220E	240E	260E
Segment.3.UserVal	180F	1A0F	1C0F	1E0F	200F	220F	240F	260F
Segment.3.GsoakType	1810	1A10	1C10	1E10	2010	2210	2410	2610
Segment.3.GsoakVal	1811	1A11	1C11	1E11	2011	2211	2411	2611
Segment.3.TimeEvent	1812	1A12	1C12	1E12	2012	2212	2412	2612

PROGRAM NUMBER HEXADECIMAL ADDRESS (2.xx)	1	2	3	4	5	6	7	8
Segment.3.OnTime	1813	1A13	1C13	1E13	2013	2213	2413	2613
Segment.3.OffTime	1814	1A14	1C14	1E14	2014	2214	2414	2614
Segment.3.PIDSet	1815	1A15	1C15	1E15	2015	2215	2415	2615
Segment.3.PVWait	1816	1A16	1C16	1E16	2016	2216	2416	2616
Segment.3.WaitVal	1817	1A17	1C17	1E17	2017	2217	2417	2617
Segment.4.Type	1820	1A20	1C20	1E20	2020	2220	2420	2620
Segment.4.Holdback	1821	1A21	1C21	1E21	2021	2221	2421	2621
Segment.4.Duration	1824	1A24	1C24	1E24	2024	2224	2424	2624
Segment.4.RampRate	1825	1A25	1C25	1E25	2025	2225	2425	2625
Segment.4.TargetSP	1826	1A26	1C26	1E26	2026	2226	2426	2626
Segment.4.EndAction	1827	1A27	1C27	1E27	2027	2227	2427	2627
Segment.4.EventOutputs	1828	1A28	1C28	1E28	2028	2228	2428	2628
Segment.4.WaitFor	1829	1A29	1C29	1E29	2029	2229	2429	2629
	182A	1A2A	1C2A	1E2A	202A	222A	242A	262A
Segment.4.GobackSeg	182B	1A2B	1C2B	1E2B	202B	222B	242B	262B
Segment.4.GobackCycles	182C	1A2C	1C2C	1E2C	202C	222C	242C	262C
Segment.4.PVEvent	182D	1A2D	1C2D	1E2D	202D	222D	242D	262D
Segment.4.PVThreshold	182E	1A2E	1C2E	1E2E	202E	222E	242E	262E
Segment.4.UserVal	182F	1A2F	1C2F	1E2F	202F	222F	242F	262F
Segment.4.GsoakType	1830	1A30	1C30	1E30	2030	2230	2430	2630
Segment.4.GsoakVal	1831	1A31	1C31	1E31	2031	2231	2431	2631
Segment.4.TimeEvent	1832	1A32	1C32	1E32	2032	2232	2432	2632
Segment.4.OnTime	1833	1A33	1C33	1E33	2033	2233	2433	2633
Segment.4.OffTime	1834	1A34	1C34	1E34	2034	2234	2434	2634
Segment.4.PIDSet	1835	1A35	1C35	1E35	2035	2235	2435	2635
Segment.4.PVWait	1836	1A36	1C36	1E36	2036	2236	2436	2636
Segment.4.WaitVal	1837	1A37	1C37	1E37	2037	2237	2437	2637
Segment.5.Type	1840	1A40	1C40	1E40	2040	2240	2440	2640
Segment.5.Holdback	1841	1A41	1C41	1E41	2041	2241	2441	2641
Segment.5.Duration	1844	1A44	1C44	1E44	2044	2244	2444	2644
Segment.5.RampRate	1845	1A45	1C45	1E45	2045	2245	2445	2645
Segment.5.TargetSP	1846	1A46	1C46	1E46	2046	2246	2446	2646
Segment.5.EndAction	1847	1A47	1C47	1E47	2047	2247	2447	2647
Segment.5.EventOutputs	1848	1A48	1C48	1E48	2048	2248	2448	2648
Segment.5.WaitFor	1849	1A49	1C49	1E49	2049	2249	2449	2649
	184A	1A4A	1C4A	1E4A	204A	224A	244A	264A
Segment.5.GobackSeg	184B	1A4B	1C4B	1E4B	204B	224B	244B	264B
Segment.5.GobackCycles	184C	1A4C	1C4C	1E4C	204C	224C	244C	264C
Segment.5.PVEvent	184D	1A4D	1C4D	1E4D	204D	224D	244D	264D
Segment.5.PVThreshold	184E	1A4E	1C4E	1E4E	204E	224E	244E	264E
Segment.5.UserVal	184F	1A4F	1C4F	1E4F	204F	224F	244F	264F
Segment.5.GsoakType	1850	1A50	1C50	1E50	2050	2250	2450	2650
Segment.5.GsoakVal	1851	1A51	1C51	1E51	2051	2251	2451	2651
Segment.5.TimeEvent	1852	1A52	1C52	1E52	2052	2252	2452	2652
Segment.5.OnTime	1853	1A53	1C53	1E53	2053	2253	2453	2653
Segment.5.OffTime	1854	1A54	1C54	1E54	2054	2254	2454	2654
Segment.5.PIDSet	1855	1A55	1C55	1E55	2055	2255	2455	2655
Segment.5.PVWait	1856	1A56	1C56	1E56	2056	2256	2456	2656
Segment.5.WaitVal	1857	1A57	1C57	1E57	2057	2257	2457	2657
Segment.6.Type	1860	1A60	1C60	1E60	2060	2260	2460	2660
Segment.6.Holdback	1861	1A61	1C61	1E61	2061	2261	2461	2661

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Segment.6.Duration	1864	1A64	1C64	1E64	2064	2264	2464	2664
Segment.6.RampRate	1865	1A65	1C65	1E65	2065	2265	2465	2665
Segment.6.TargetSP	1866	1A66	1C66	1E66	2066	2266	2466	2666
Segment.6.EndAction	1867	1A67	1C67	1E67	2067	2267	2467	2667
Segment.6.EventOutputs	1868	1A68	1C68	1E68	2068	2268	2468	2668
Segment.6.WaitFor	1869	1A69	1C69	1E69	2069	2269	2469	2669
	186A	1A6A	1C6A	1E6A	206A	226A	246A	266A
Segment.6.GobackSeg	186B	1A6B	1C6B	1E6B	206B	226B	246B	266B
Segment.6.GobackCycles	186C	1A6C	1C6C	1E6C	206C	226C	246C	266C
Segment.6.PVEvent	186D	1A6D	1C6D	1E6D	206D	226D	246D	266D
Segment.6.PVThreshold	186E	1A6E	1C6E	1E6E	206E	226E	246E	266E
Segment.6.UserVal	186F	1A6F	1C6F	1E6F	206F	226F	246F	266F
Segment.6.GsoakType	1870	1A70	1C70	1E70	2070	2270	2470	2670
Segment.6.GsoakVal	1871	1A71	1C71	1E71	2071	2271	2471	2671
Segment.6.TimeEvent	1872	1A72	1C72	1E72	2072	2272	2472	2672
Segment.6.OnTime	1873	1A73	1C73	1E73	2073	2273	2473	2673
Segment.6.OffTime	1874	1A74	1C74	1E74	2074	2274	2474	2674
Segment.6.PIDSet	1875	1A75	1C75	1E75	2075	2275	2475	2675
Segment.6.PVWait	1876	1A76	1C76	1E76	2076	2276	2476	2676
Segment.6.WaitVal	1877	1A77	1C77	1E77	2077	2277	2477	2677
Segment.7.Type	1880	1A80	1C80	1E80	2080	2280	2480	2680
Segment.7.Holdback	1881	1A81	1C81	1E81	2081	2281	2481	2681
Segment.7.Duration	1884	1A84	1C84	1E84	2084	2284	2484	2684
Segment.7.RampRate	1885	1A85	1C85	1E85	2085	2285	2485	2685
Segment.7.TargetSP	1886	1A86	1C86	1E86	2086	2286	2486	2686
Segment.7.EndAction	1887	1A87	1C87	1E87	2087	2287	2487	2687
Segment.7.EventOutputs	1888	1A88	1C88	1E88	2088	2288	2488	2688
Segment.7.WaitFor	1889	1A89	1C89	1E89	2089	2289	2489	2689
	188A	1A8A	1C8A	1E8A	208A	228A	248A	268A
Segment.7.GobackSeg	188B	1A8B	1C8B	1E8B	208B	228B	248B	268B
Segment.7.GobackCycles	188C	1A8C	1C8C	1E8C	208C	228C	248C	268C
Segment.7.PVEvent	188D	1A8D	1C8D	1E8D	208D	228D	248D	268D
Segment.7.PVThreshold	188E	1A8E	1C8E	1E8E	208E	228E	248E	268E
Segment.7.UserVal	188F	1A8F	1C8F	1E8F	208F	228F	248F	268F
Segment.7.GsoakType	1890	1A90	1C90	1E90	2090	2290	2490	2690
Segment.7.GsoakVal	1891	1A91	1C91	1E91	2091	2291	2491	2691
Segment.7.TimeEvent	1892	1A92	1C92	1E92	2092	2292	2492	2692
Segment.7.OnTime	1893	1A93	1C93	1E93	2093	2293	2493	2693
Segment.7.OffTime	1894	1A94	1C94	1E94	2094	2294	2494	2694
Segment.7.PIDSet	1895	1A95	1C95	1E95	2095	2295	2495	2695
Segment.7.PVWait	1896	1A96	1C96	1E96	2096	2296	2496	2696
Segment.7.WaitVal	1897	1A97	1C97	1E97	2097	2297	2497	2697
Segment.8.Type	18A0	1AA0	1CA0	1EA0	20A0	22A0	24A0	26A0
Segment.8.Holdback	18A1	1AA1	1CA1	1EA1	20A1	22A1	24A1	26A1
Segment.8.Duration	18A4	1AA4	1CA4	1EA4	20A4	22A4	24A4	26A4
Segment.8.RampRate	18A5	1AA5	1CA5	1EA5	20A5	22A5	24A5	26A5
Segment.8.TargetSP	18A6	1AA6	1CA6	1EA6	20A6	22A6	24A6	26A6
Segment.8.EndAction	18A7	1AA7	1CA7	1EA7	20A7	22A7	24A7	26A7
Segment.8.EventOutputs	18A8	1AA8	1CA8	1EA8	20A8	22A8	24A8	26A8
Segment.8.WaitFor	18A9	1AA9	1CA9	1EA9	20A9	22A9	24A9	26A9
	18AA	1AAA	1CAA	1EAA	20AA	22AA	24AA	26AA

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Segment.8.GobackSeg	18AB	1AAB	1CAB	1EAB	20AB	22AB	24AB	26AB
Segment.8.GobackCycles	18AC	1AAC	1CAC	1EAC	20AC	22AC	24AC	26AC
Segment.8.PVEvent	18AD	1AAD	1CAD	1EAD	20AD	22AD	24AD	26AD
Segment.8.PVThreshold	18AE	1AAE	1CAE	1EAE	20AE	22AE	24AE	26AE
Segment.8.UserVal	18AF	1AAF	1CAF	1EAF	20AF	22AF	24AF	26AF
Segment.8.GsoakType	18B0	1AB0	1CB0	1EB0	20B0	22B0	24B0	26B0
Segment.8.GsoakVal	18B1	1AB1	1CB1	1EB1	20B1	22B1	24B1	26B1
Segment.8.TimeEvent	18B2	1AB2	1CB2	1EB2	20B2	22B2	24B2	26B2
Segment.8.OnTime	18B3	1AB3	1CB3	1EB3	20B3	22B3	24B3	26B3
Segment.8.OffTime	18B4	1AB4	1CB4	1EB4	20B4	22B4	24B4	26B4
Segment.8.PIDSet	18B5	1AB5	1CB5	1EB5	20B5	22B5	24B5	26B5
Segment.8.PVWait	18B6	1AB6	1CB6	1EB6	20B6	22B6	24B6	26B6
Segment.8.WaitVal	18B7	1AB7	1CB7	1EB7	20B7	22B7	24B7	26B7
Segment.9.Type	18C0	1AC0	1CC0	1EC0	20C0	22C0	24C0	26C0
Segment.9.Holdback	18C1	1AC1	1CC1	1EC1	20C1	22C1	24C1	26C1
Segment.9.Duration	18C4	1AC4	1CC4	1EC4	20C4	22C4	24C4	26C4
Segment.9.RampRate	18C5	1AC5	1CC5	1EC5	20C5	22C5	24C5	26C5
Segment.9.TargetSP	18C6	1AC6	1CC6	1EC6	20C6	22C6	24C6	26C6
Segment.9.EndAction	18C7	1AC7	1CC7	1EC7	20C7	22C7	24C7	26C7
Segment.9.EventOutputs	18C8	1AC8	1CC8	1EC8	20C8	22C8	24C8	26C8
Segment.9.WaitFor	18C9	1AC9	1CC9	1EC9	20C9	22C9	24C9	26C9
	18CA	1ACA	1CCA	1ECA	20CA	22CA	24CA	26CA
Segment.9.GobackSeg	18CB	1ACB	1CCB	1ECB	20CB	22CB	24CB	26CB
Segment.9.GobackCycles	18CC	1ACC	1CCC	1ECC	20CC	22CC	24CC	26CC
Segment.9.PVEvent	18CD	1ACD	1CCD	1ECD	20CD	22CD	24CD	26CD
Segment.9.PVThreshold	18CE	1ACE	1CCE	1ECE	20CE	22CE	24CE	26CE
Segment.9.UserVal	18CF	1ACF	1CCF	1ECF	20CF	22CF	24CF	26CF
Segment.9.GsoakType	18D0	1AD0	1CD0	1ED0	20D0	22D0	24D0	26D0
Segment.9.GsoakVal	18D1	1AD1	1CD1	1ED1	20D1	22D1	24D1	26D1
Segment.9.TimeEvent	18D2	1AD2	1CD2	1ED2	20D2	22D2	24D2	26D2
Segment.9.OnTime	18D3	1AD3	1CD3	1ED3	20D3	22D3	24D3	26D3
Segment.9.OffTime	18D4	1AD4	1CD4	1ED4	20D4	22D4	24D4	26D4
Segment.9.PIDSet	18D5	1AD5	1CD5	1ED5	20D5	22D5	24D5	26D5
Segment.9.PVWait	18D6	1AD6	1CD6	1ED6	20D6	22D6	24D6	26D6
Segment.9.WaitVal	18D7	1AD7	1CD7	1ED7	20D7	22D7	24D7	26D7
Segment.10.Type	18E0	1AE0	1CE0	1EE0	20E0	22E0	24E0	26E0
Segment.10.Holdback	18E1	1AE1	1CE1	1EE1	20E1	22E1	24E1	26E1
Segment.10.Duration	18E4	1AE4	1CE4	1EE4	20E4	22E4	24E4	26E4
Segment.10.RampRate	18E5	1AE5	1CE5	1EE5	20E5	22E5	24E5	26E5
Segment.10.TargetSP	18E6	1AE6	1CE6	1EE6	20E6	22E6	24E6	26E6
Segment.10.EndAction	18E7	1AE7	1CE7	1EE7	20E7	22E7	24E7	26E7
Segment.10.EventOutputs	18E8	1AE8	1CE8	1EE8	20E8	22E8	24E8	26E8
Segment.10.WaitFor	18E9	1AE9	1CE9	1EE9	20E9	22E9	24E9	26E9
	18EA	1AEA	1CEA	1EEA	20EA	22EA	24EA	26EA
Segment.10.GobackSeg	18EB	1AEB	1CEB	1EEB	20EB	22EB	24EB	26EB
Segment.10.GobackCycles	18EC	1AEC	1CEC	1EEC	20EC	22EC	24EC	26EC
Segment.10.PVEvent	18ED	1AED	1CED	1EED	20ED	22ED	24ED	26ED
Segment.10.PVThreshold	18EE	1AEE	1CEE	1EEE	20EE	22EE	24EE	26EE
Segment.10.UserVal	18EF	1AEF	1CEF	1EEF	20EF	22EF	24EF	26EF
Segment.10.GsoakType	18F0	1AF0	1CF0	1EF0	20F0	22F0	24F0	26F0
Segment.10.GsoakVal	18F1	1AF1	1CF1	1EF1	20F1	22F1	24F1	26F1

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Segment.10.TimeEvent	18F2	1AF2	1CF2	1EF2	20F2	22F2	24F2	26F2
Segment.10.OnTime	18F3	1AF3	1CF3	1EF3	20F3	22F3	24F3	26F3
Segment.10.OffTime	18F4	1AF4	1CF4	1EF4	20F4	22F4	24F4	26F4
Segment.10.PIDSet	18F5	1AF5	1CF5	1EF5	20F5	22F5	24F5	26F5
Segment.10.PVWait	18F6	1AF6	1CF6	1EF6	20F6	22F6	24F6	26F6
Segment.10.WaitVal	18F7	1AF7	1CF7	1EF7	20F7	22F7	24F7	26F7
Segment.11.Type	1900	1B00	1D00	1F00	2100	2300	2500	2700
Segment.11.Holdback	1901	1B01	1D01	1F01	2101	2301	2501	2701
Segment.11.Duration	1904	1B04	1D04	1F04	2104	2304	2504	2704
Segment.11.RampRate	1905	1B05	1D05	1F05	2105	2305	2505	2705
Segment.11.TargetSP	1906	1B06	1D06	1F06	2106	2306	2506	2706
Segment.11.EndAction	1907	1B07	1D07	1F07	2107	2307	2507	2707
Segment.11.EventOutputs	1908	1B08	1D08	1F08	2108	2308	2508	2708
Segment.11.WaitFor	1909	1B09	1D09	1F09	2109	2309	2509	2709
	190A	1B0A	1D0A	1F0A	210A	230A	250A	270A
Segment.11.GobackSeg	190B	1B0B	1D0B	1F0B	210B	230B	250B	270B
Segment.11.GobackCycles	190C	1B0C	1D0C	1F0C	210C	230C	250C	270C
Segment.11.PVEvent	190D	1B0D	1D0D	1F0D	210D	230D	250D	270D
Segment.11.PVThreshold	190E	1B0E	1D0E	1F0E	210E	230E	250E	270E
Segment.11.UserVal	190F	1B0F	1D0F	1F0F	210F	230F	250F	270F
Segment.11.GsoakType	1910	1B10	1D10	1F10	2110	2310	2510	2710
Segment.11.GsoakVal	1911	1B11	1D11	1F11	2111	2311	2511	2711
Segment.11.TimeEvent	1912	1B12	1D12	1F12	2112	2312	2512	2712
Segment.11.OnTime	1913	1B13	1D13	1F13	2113	2313	2513	2713
Segment.11.OffTime	1914	1B14	1D14	1F14	2114	2314	2514	2714
Segment.11.PIDSet	1915	1B15	1D15	1F15	2115	2315	2515	2715
Segment.11.PVWait	1916	1B16	1D16	1F16	2116	2316	2516	2716
Segment.11.WaitVal	1917	1B17	1D17	1F17	2117	2317	2517	2717
Segment.12.Type	1920	1B20	1D20	1F20	2120	2320	2520	2720
Segment.12.Holdback	1921	1B21	1D21	1F21	2121	2321	2521	2721
Segment.12.Duration	1924	1B24	1D24	1F24	2124	2324	2524	2724
Segment.12.RampRate	1925	1B25	1D25	1F25	2125	2325	2525	2725
Segment.12.TargetSP	1926	1B26	1D26	1F26	2126	2326	2526	2726
Segment.12.EndAction	1927	1B27	1D27	1F27	2127	2327	2527	2727
Segment.12.EventOutputs	1928	1B28	1D28	1F28	2128	2328	2528	2728
Segment.12.WaitFor	1929	1B29	1D29	1F29	2129	2329	2529	2729
	192A	1B2A	1D2A	1F2A	212A	232A	252A	272A
Segment.12.GobackSeg	192B	1B2B	1D2B	1F2B	212B	232B	252B	272B
Segment.12.GobackCycles	192C	1B2C	1D2C	1F2C	212C	232C	252C	272C
Segment.12.PVEvent	192D	1B2D	1D2D	1F2D	212D	232D	252D	272D
Segment.12.PVThreshold	192E	1B2E	1D2E	1F2E	212E	232E	252E	272E
Segment.12.UserVal	192F	1B2F	1D2F	1F2F	212F	232F	252F	272F
Segment.12.GsoakType	1930	1B30	1D30	1F30	2130	2330	2530	2730
Segment.12.GsoakVal	1931	1B31	1D31	1F31	2131	2331	2531	2731
Segment.12.TimeEvent	1932	1B32	1D32	1F32	2132	2332	2532	2732
Segment.12.OnTime	1933	1B33	1D33	1F33	2133	2333	2533	2733
Segment.12.OffTime	1934	1B34	1D34	1F34	2134	2334	2534	2734
Segment.12.PIDSet	1935	1B35	1D35	1F35	2135	2335	2535	2735
Segment.12.PVWait	1936	1B36	1D36	1F36	2136	2336	2536	2736
Segment.12.WaitVal	1937	1B37	1D37	1F37	2137	2337	2537	2737
Segment.13.Type	1940	1B40	1D40	1F40	2140	2340	2540	2740

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Segment.13.Holdback	1941	1B41	1D41	1F41	2141	2341	2541	2741
Segment.13.Duration	1944	1B44	1D44	1F44	2144	2344	2544	2744
Segment.13.RampRate	1945	1B45	1D45	1F45	2145	2345	2545	2745
Segment.13.TargetSP	1946	1B46	1D46	1F46	2146	2346	2546	2746
Segment.13.EndAction	1947	1B47	1D47	1F47	2147	2347	2547	2747
Segment.13.EventOutputs	1948	1B48	1D48	1F48	2148	2348	2548	2748
Segment.13.WaitFor	1949	1B49	1D49	1F49	2149	2349	2549	2749
	194A	1B4A	1D4A	1F4A	214A	234A	254A	274A
Segment.13.GobackSeg	194B	1B4B	1D4B	1F4B	214B	234B	254B	274B
Segment.13.GobackCycles	194C	1B4C	1D4C	1F4C	214C	234C	254C	274C
Segment.13.PVEvent	194D	1B4D	1D4D	1F4D	214D	234D	254D	274D
Segment.13.PVThreshold	194E	1B4E	1D4E	1F4E	214E	234E	254E	274E
Segment.13.UserVal	194F	1B4F	1D4F	1F4F	214F	234F	254F	274F
Segment.13.GsoakType	1950	1B50	1D50	1F50	2150	2350	2550	2750
Segment.13.GsoakVal	1951	1B51	1D51	1F51	2151	2351	2551	2751
Segment.13.TimeEvent	1952	1B52	1D52	1F52	2152	2352	2552	2752
Segment.13.OnTime	1953	1B53	1D53	1F53	2153	2353	2553	2753
Segment.13.OffTime	1954	1B54	1D54	1F54	2154	2354	2554	2754
Segment.13.PIDSet	1955	1B55	1D55	1F55	2155	2355	2555	2755
Segment.13.PVWait	1956	1B56	1D56	1F56	2156	2356	2556	2756
Segment.13.WaitVal	1957	1B57	1D57	1F57	2157	2357	2557	2757
Segment.14.Type	1960	1B60	1D60	1F60	2160	2360	2560	2760
Segment.14.Holdback	1961	1B61	1D61	1F61	2161	2361	2561	2761
Segment.14.Duration	1964	1B64	1D64	1F64	2164	2364	2564	2764
Segment.14.RampRate	1965	1B65	1D65	1F65	2165	2365	2565	2765
Segment.14.TargetSP	1966	1B66	1D66	1F66	2166	2366	2566	2766
Segment.14.EndAction	1967	1B67	1D67	1F67	2167	2367	2567	2767
Segment.14.EventOutputs	1968	1B68	1D68	1F68	2168	2368	2568	2768
Segment.14.WaitFor	1969	1B69	1D69	1F69	2169	2369	2569	2769
	196A	1B6A	1D6A	1F6A	216A	236A	256A	276A
Segment.14.GobackSeg	196B	1B6B	1D6B	1F6B	216B	236B	256B	276B
Segment.14.GobackCycles	196C	1B6C	1D6C	1F6C	216C	236C	256C	276C
Segment.14.PVEvent	196D	1B6D	1D6D	1F6D	216D	236D	256D	276D
Segment.14.PVThreshold	196E	1B6E	1D6E	1F6E	216E	236E	256E	276E
Segment.14.UserVal	196F	1B6F	1D6F	1F6F	216F	236F	256F	276F
Segment.14.GsoakType	1970	1B70	1D70	1F70	2170	2370	2570	2770
Segment.14.GsoakVal	1971	1B71	1D71	1F71	2171	2371	2571	2771
Segment.14.TimeEvent	1972	1B72	1D72	1F72	2172	2372	2572	2772
Segment.14.OnTime	1973	1B73	1D73	1F73	2173	2373	2573	2773
Segment.14.OffTime	1974	1B74	1D74	1F74	2174	2374	2574	2774
Segment.14.PIDSet	1975	1B75	1D75	1F75	2175	2375	2575	2775
Segment.14.PVWait	1976	1B76	1D76	1F76	2176	2376	2576	2776
Segment.14.WaitVal	1977	1B77	1D77	1F77	2177	2377	2577	2777
Segment.15.Type	1980	1B80	1D80	1F80	2180	2380	2580	2780
Segment.15.Holdback	1981	1B81	1D81	1F81	2181	2381	2581	2781
Segment.15.Duration	1984	1B84	1D84	1F84	2184	2384	2584	2784
Segment.15.RampRate	1985	1B85	1D85	1F85	2185	2385	2585	2785
Segment.15.TargetSP	1986	1B86	1D86	1F86	2186	2386	2586	2786
Segment.15.EndAction	1987	1B87	1D87	1F87	2187	2387	2587	2787
Segment.15.EventOutputs	1988	1B88	1D88	1F88	2188	2388	2588	2788
Segment.15.WaitFor	1989	1B89	1D89	1F89	2189	2389	2589	2789

PROGRAM NUMBER HEXADECIMAL ADDRESS (2.xx)	1	2	3	4	5	6	7	8
	198A	1B8A	1D8A	1F8A	218A	238A	258A	278A
Segment.15.GobackSeg	198B	1B8B	1D8B	1F8B	218B	238B	258B	278B
Segment.15.GobackCycles	198C	1B8C	1D8C	1F8C	218C	238C	258C	278C
Segment.15.PVEvent	198D	1B8D	1D8D	1F8D	218D	238D	258D	278D
Segment.15.PVThreshold	198E	1B8E	1D8E	1F8E	218E	238E	258E	278E
Segment.15.UserVal	198F	1B8F	1D8F	1F8F	218F	238F	258F	278F
Segment.15.GsoakType	1990	1B90	1D90	1F90	2190	2390	2590	2790
Segment.15.GsoakVal	1991	1B91	1D91	1F91	2191	2391	2591	2791
Segment.15.TimeEvent	1992	1B92	1D92	1F92	2192	2392	2592	2792
Segment.15.OnTime	1993	1B93	1D93	1F93	2193	2393	2593	2793
Segment.15.OffTime	1994	1B94	1D94	1F94	2194	2394	2594	2794
Segment.15.PIDSet	1995	1B95	1D95	1F95	2195	2395	2595	2795
Segment.15.PVWait	1996	1B96	1D96	1F96	2196	2396	2596	2796
Segment.15.WaitVal	1997	1B97	1D97	1F97	2197	2397	2597	2797
Segment.16.Type	19A0	1BA0	1DA0	1FA0	21A0	23A0	25A0	27A0
Segment.16.Holdback	19A1	1BA1	1DA1	1FA1	21A1	23A1	25A1	27A1
Segment.16.Duration	19A4	1BA4	1DA4	1FA4	21A4	23A4	25A4	27A4
Segment.16.RampRate	19A5	1BA5	1DA5	1FA5	21A5	23A5	25A5	27A5
Segment.16.TargetSP	19A6	1BA6	1DA6	1FA6	21A6	23A6	25A6	27A6
Segment.16.EndAction	19A7	1BA7	1DA7	1FA7	21A7	23A7	25A7	27A7
Segment.16.EventOutputs	19A8	1BA8	1DA8	1FA8	21A8	23A8	25A8	27A8
Segment.16.WaitFor	19A9	1BA9	1DA9	1FA9	21A9	23A9	25A9	27A9
	19AA	1BAA	1DAA	1FAA	21AA	23AA	25AA	27AA
Segment.16.GobackSeg	19AB	1BAB	1DAB	1FAB	21AB	23AB	25AB	27AB
Segment.16.GobackCycles	19AC	1BAC	1DAC	1FAC	21AC	23AC	25AC	27AC
Segment.16.PVEvent	19AD	1BAD	1DAD	1FAD	21AD	23AD	25AD	27AD
Segment.16.PVThreshold	19AE	1BAE	1DAE	1FAE	21AE	23AE	25AE	27AE
Segment.16.UserVal	19AF	1BAF	1DAF	1FAF	21AF	23AF	25AF	27AF
Segment.16.GsoakType	19B0	1BB0	1DB0	1FB0	21B0	23B0	25B0	27B0
Segment.16.GsoakVal	19B1	1BB1	1DB1	1FB1	21B1	23B1	25B1	27B1
Segment.16.TimeEvent	19B2	1BB2	1DB2	1FB2	21B2	23B2	25B2	27B2
Segment.16.OnTime	19B3	1BB3	1DB3	1FB3	21B3	23B3	25B3	27B3
Segment.16.OffTime	19B4	1BB4	1DB4	1FB4	21B4	23B4	25B4	27B4
Segment.16.PIDSet	19B5	1BB5	1DB5	1FB5	21B5	23B5	25B5	27B5
Segment.16.PVWait	19B6	1BB6	1DB6	1FB6	21B6	23B6	25B6	27B6
Segment.16.WaitVal	19B7	1BB7	1DB7	1FB7	21B7	23B7	25B7	27B7

Modbus Function Codes

Mini8 supports the following function codes:

3, 4	Multiple parameter read
6	Single parameter write
7	Status read
8	Loop back
16	Multiple parameter write

Function codes 103 and 106 are special codes used by iTools. These should not be used.

Mini8 does not support function code 23.

DeviceNET Parameter Tables

IO Re-Mapping Object

DeviceNet comes pre-configured with the key parameters of eight PID loops and alarms (60 input parameters process variables, alarm status, and so on and 60 output parameters – setpoints, and so on). Loops 9-16 are not included in the DeviceNet tables as there are insufficient attributes for the DeviceNet parameters.

The Mini8 controller DeviceNet communicates is supplied with a default input assembly table (80 bytes) and output assembly table (48 bytes). The parameters included are listed below.

Note: To modify these tables see the next section.

The default Input assembly table:

Input Parameter	Offset	Value (Attr ID)
PV – Loop 1	0	0
Working SP – Loop 1	2	1
Working Output – Loop 1	4	2
PV – Loop 2	6	14 (0EH)
Working SP – Loop 2	8	15 (0FH)
Working Output – Loop 2	10	16 (10H)
PV – Loop 3	12	28 (1CH)
Working SP – Loop 3	14	29 (1DH)
Working Output – Loop 3	16	30 (1EH)
PV – Loop 4	18	42 (2AH)
Working SP – Loop 4	20	43 (2BH)
Working Output – Loop 4	22	44 (2CH)
PV – Loop 5	24	56 (38H)
Working SP – Loop 5	26	57 (39H)
Working Output – Loop 5	28	58 (3AH)
PV – Loop 6	30	70 (46H)
Working SP – Loop 6	32	71 (47H)
Working Output – Loop 6	34	72 (48H)
PV – Loop 7	36	84 (54H)
Working SP – Loop 7	38	85 (55H)
Working Output – Loop 7	40	86 (56H)
PV – Loop 8	42	98 (62H)
Working SP – Loop 8	44	99 (63H)
Working Output – Loop 8	46	100 (64H)
Analogue Alarm Status 1	48	144 (90H)
Analogue Alarm Status 2	50	145 (91H)
Analogue Alarm Status 3	52	146 (92H)
Analogue Alarm Status 4	54	147 (93H)
Sensor Break Alarm Status 1	56	148 (94H)
Sensor Break Alarm Status 2	58	149 (95H)
Sensor Break Alarm Status 3	60	150 (96H)
Sensor Break Alarm Status 4	62	151 (97H)
CT Alarm Status 1	64	152 (98H)
CT Alarm Status 2	66	153 (99H)
CT Alarm Status 3	68	154 (9AH)
CT Alarm Status 4	70	155 (9BH)

Input Parameter	Offset	Value (Attr ID)
New Alarm Output	72	156 (9CH)
Any Alarm Output	74	157 (9DH)
New CT Alarm Output	76	158 (9EH)
Program Status	78	184 (B8H)
TOTAL LENGTH	**80**	

The default output assembly table.

Output Parameter	Offset	Value
Target SP – Loop 1	0	3
Auto/Manual – Loop 1	2	7
Manual Output – Loop 1	4	4
Target SP – Loop 2	6	17 (11H)
Auto/Manual – Loop 2	8	21 (15H)
Manual Output – Loop 2	10	18 (12H)
Target SP – Loop 3	12	31 (1FH)
Auto/Manual – Loop 3	14	35 (23H)
Manual Output – Loop 3	16	32 (20H)
Target SP – Loop 4	18	45 (2DH)
Auto/Manual – Loop 4	20	49 (31H)
Manual Output – Loop 4	22	46 (2EH)
Target SP – Loop 5	24	59 (3BH)
Auto/Manual – Loop 5	26	63 (3FH)
Manual Output – Loop 5	28	60 (3CH)
Target SP – Loop 6	30	73 (49H)
Auto/Manual – Loop 6	32	77 (4DH)
Manual Output – Loop 6	34	74 (4AH)
Target SP – Loop 7	36	87 (57H)
Auto/Manual – Loop 7	38	91 (5BH)
Manual Output – Loop 7	40	88 (58H)
Target SP – Loop 8	42	101 (65H)
Auto/Manual – Loop 8	44	105 (69H)
Manual Output – Loop 8	46	102 (66H)
TOTAL LENGTH	**48**	

Application Variables Object

This is the list of parameters available to be included in the input and output tables.

Parameter	Attribute ID
Process Variable – Loop 1	0
Working Setpoint – Loop 1	1
Working Output – Loop 1	2
Target Setpoint – Loop 1	3
Manual Output – Loop 1	4
Setpoint 1 – Loop 1	5
Setpoint 2 – Loop 1	6
Auto/Manual Mode – Loop 1	7
Proportional Band – Loop 1 working Set	8
Integral Time – Loop 1 working Set	9
Derivative Time – Loop 1 working Set	10
Cutback Low – Loop 1 working Set	11
Cutback High – Loop 1 working Set	12
Relative Cooling Gain – Loop 1 working Set	13
Process Variable – Loop 2	14
Working Setpoint – Loop 2	15
Working Output – Loop 2	16
Target Setpoint – Loop 2	17
Manual Output – Loop 2	18
Setpoint 1 – Loop 2	19
Setpoint 2 – Loop 2	20
Auto/Manual Mode – Loop 2	21
Proportional Band – Loop 2 working Set	22
Integral Time – Loop 2 working Set	23
Derivative Time – Loop 2 working Set	24
Cutback Low – Loop 2 working Set	25
Cutback High – Loop 2 working Set	26
Relative Cooling Gain – Loop 2 working Set	27
Process Variable – Loop 3	28
Working Setpoint – Loop 3	29
Working Output – Loop 3	30
Target Setpoint – Loop 3	31
Manual Output – Loop 3	32
Setpoint 1 – Loop 3	33
Setpoint 2 – Loop 3	34
Auto/Manual Mode – Loop 3	35
Proportional Band – Loop 3 working Set	36
Integral Time – Loop 3 working Set	37
Derivative Time – Loop 3 working Set	38
Cutback Low – Loop 3 working Set	39
Cutback High – Loop 3 working Set	40
Relative Cooling Gain – Loop 3 working Set	41
Process Variable – Loop 4	42
Working Setpoint – Loop 4	43
Working Output – Loop 4	44
Target Setpoint – Loop 4	45
Manual Output – Loop 4	46
Setpoint 1 – Loop 4	47
Setpoint 2 – Loop 4	48

Parameter	Attribute ID
Auto/Manual Mode – Loop 4	49
Proportional Band – Loop 4 working Set	50
Integral Time – Loop 4 working Set	51
Derivative Time – Loop 4 working Set	52
Cutback Low – Loop 4 working Set	53
Cutback High – Loop 4 working Set	54
Relative Cooling Gain – Loop 4 working Set	55
Process Variable – Loop 5	56
Working Setpoint – Loop 5	57
Working Output – Loop 5	58
Target Setpoint – Loop 5	59
Manual Output – Loop 5	60
Setpoint 1 – Loop 5	61
Setpoint 2 – Loop 5	62
Auto/Manual Mode – Loop 5	63
Proportional Band – Loop 5 working Set	64
Integral Time – Loop 5 working Set	65
Derivative Time – Loop 5 working Set	66
Cutback Low – Loop 5 working Set	67
Cutback High – Loop 5 working Set	68
Relative Cooling Gain – Loop 5 working Set	69
Process Variable – Loop 6	70
Working Setpoint – Loop 6	71
Working Output – Loop 6	72
Target Setpoint – Loop 6	73
Manual Output – Loop 6	74
Setpoint 1 – Loop 6	75
Setpoint 2 – Loop 6	76
Auto/Manual Mode – Loop 6	77
Proportional Band – Loop 6 working Set	78
Integral Time – Loop 6 working Set	79
Derivative Time – Loop 6 working Set	80
Cutback Low – Loop 6 working Set	81
Cutback High – Loop 6 working Set	82
Relative Cooling Gain – Loop 6 working Set	83
Process Variable – Loop 7	84
Working Setpoint – Loop 7	85
Working Output – Loop 7	86
Target Setpoint – Loop 7	87
Manual Output – Loop 7	88
Setpoint 1 – Loop 7	89
Setpoint 2 – Loop 7	90
Auto/Manual Mode – Loop 7	91
Proportional Band – Loop 7 working Set	92
Integral Time – Loop 7 working Set	93
Derivative Time – Loop 7 working Set	94
Cutback Low – Loop 7 working Set	95
Cutback High – Loop 7 working Set	96
Relative Cooling Gain – Loop 7 working Set	97
Process Variable – Loop 8	98
Working Setpoint – Loop 8	99
Working Output – Loop 8	100

Parameter	Attribute ID
Target Setpoint – Loop 8	101
Manual Output – Loop 8	102
Setpoint 1 – Loop 8	103
Setpoint 2 – Loop 8	104
Auto/Manual Mode – Loop 8	105
Proportional Band – Loop 8 working Set	106
Integral Time – Loop 8 working Set	107
Derivative Time – Loop 8 working Set	108
Cutback Low – Loop 8 working Set	109
Cutback High – Loop 8 working Set	110
Relative Cooling Gain – Loop 8 working Set	111
Module PV – Channel 1	112
Module PV – Channel 2	113
Module PV – Channel 3	114
Module PV – Channel 4	115
Module PV – Channel 5	116
Module PV – Channel 6	117
Module PV – Channel 7	118
Module PV – Channel 8	119
Module PV – Channel 9	120
Module PV – Channel 10	121
Module PV – Channel 11	122
Module PV – Channel 12	123
Module PV – Channel 13	124
Module PV – Channel 14	125
Module PV – Channel 15	126
Module PV – Channel 16	127
Module PV – Channel 17	128
Module PV – Channel 18	129
Module PV – Channel 19	130
Module PV – Channel 20	131
Module PV – Channel 21	132
Module PV – Channel 22	133
Module PV – Channel 23	134
Module PV – Channel 24	135
Module PV – Channel 25	136
Module PV – Channel 26	137
Module PV – Channel 27	138
Module PV – Channel 28	139
Module PV – Channel 29	140
Module PV – Channel 30	141
Module PV – Channel 31	142
Module PV – Channel 32	143
Analogue Alarm Status 1	144
Analogue Alarm Status 2	145
Analogue Alarm Status 3	146
Analogue Alarm Status 4	147
Sensor Break Alarm Status 1	148
Sensor Break Alarm Status 2	149
Sensor Break Alarm Status 3	150
Sensor Break Alarm Status 4	151
CT Alarm Status 1	152

Parameter	Attribute ID
CT Alarm Status 2	153
CT Alarm Status 3	154
CT Alarm Status 4	155
New Alarm Output	156
Any Alarm Output	157
New CT Alarm Output	158
Reset New Alarm	159
Reset New CT Alarm	160
CT Load Current 1	161
CT Load Current 2	162
CT Load Current 3	163
CT Load Current 4	164
CT Load Current 5	165
CT Load Current 6	166
CT Load Current 7	167
CT Load Current 8	168
CT Load Status 1	169
CT Load Status 2	170
CT Load Status 3	171
CT Load Status 4	172
CT Load Status 5	173
CT Load Status 6	174
CT Load Status 7	175
CT Load Status 8	176
PSU Relay 1 Output	177
PSU Relay 2 Output	178
PSU Digital Input 1	179
PSU Digital Input 2	180
Program Run	181
Program Hold	182
Program Reset	183
Program Status	184
Current Program	185
Program Time Left	186
Segment Time Left	187
User Value 1	188
User Value 2	189
User Value 3	190
User Value 4	191
User Value 5	192
User Value 6	193
User Value 7	194
User Value 8	195
User Value 9	196
User Value 10	197
User Value 11	198
User Value 12	199

Table Modification

Make a list of parameters required in the input and output tables to suit the application. If the parameter is listed in the predefined list then use the attribute number of that parameter.

To set up the controller so that the required parameters are available on the network requires setting up the INPUT and OUTPUT data assembly tables with the IDs from the Application Variable Object.

Mini8 controller
Application
Variable Object

Mini8 controller
IO Remapping
Object

List of available
parameters

USER OUTPUT
assembly table

(Max 60)

Predefined #0

to

#199

USER INPUT
assembly table

(Max 60)
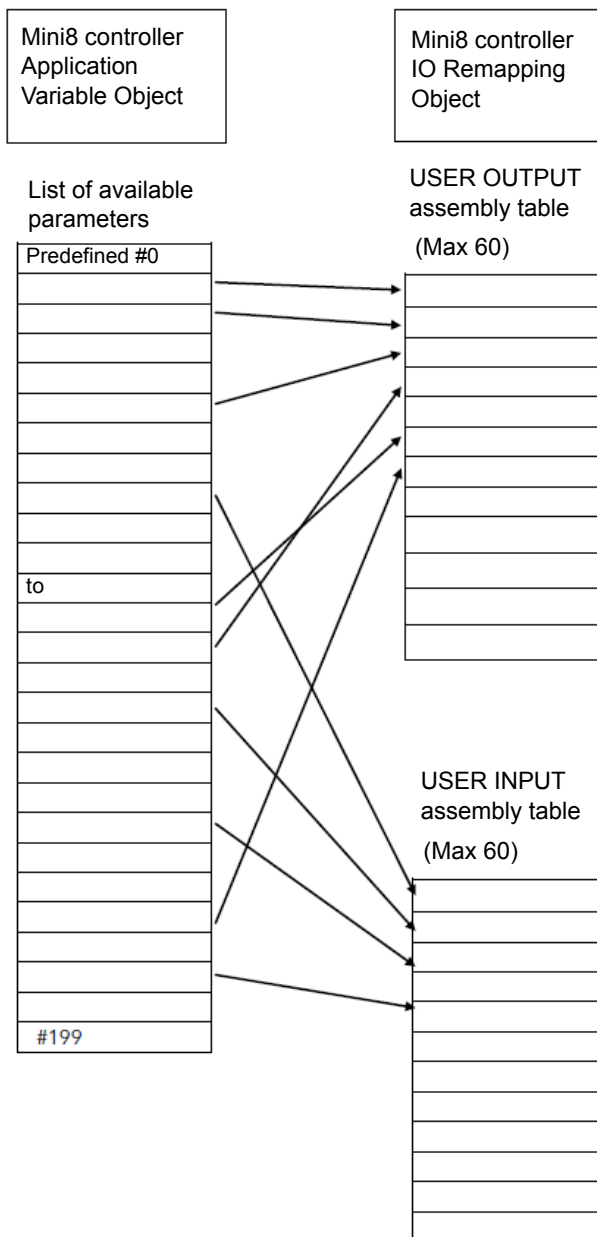
Version 1.xx Programmer

Version 1.xx Parameter Tables

Configuring the Programmer (V1.xx)

Programmer.1.Setup contains the general configuration settings for the Programmer Block. Programs are created and stored in the Program Folder. Once a Program exists it can be run using the parameters in the Programmer.1.Run folder.

Folder – Programmer.1		Sub-folder: Setup			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Units	Units of the Output			None	Conf
Resolution	Programmer Output resolution	X to X.XXXX			Conf
PVIn	The programmer uses the PV input for a number of functions In holdback, the PV is monitored against the setpoint, and if a deviation occurs the program is paused. The programmer can be configured to start its profile from the current PV value (servo to PV). The programmer monitors the PV value for Sensor Break. The programmer holds in sensor break.	The PV Input is normally wired from the loop TrackPV parameter. Note: This input is automatically wired when the programmer and loop are enabled and there are no existing wires to track interface parameters. Track interface parameters are Programmer.Setup, PVInput, SPInput, Loop.SP, AltSP, Loop.SP, AltSPSelect.			Conf
SPIn	The programmer needs to know the working setpoint of the loop it is profiling. The SP input is used in the servo to setpoint start type.	SP Input is normally wired from the loop Track SP parameter as the PV input.			Conf
Servo	The transfer of program setpoint to PV Input (normally the Loop PV) or the SP Input (normally the Loop setpoint).	PV SP	See also "Servo" on page 247		Conf
PowerFailAct	Power interruption recovery strategy	Ramp Reset Cont	See "Power Interruption Recovery" on page 248		Conf
SyncIn	The synchronize input is a way of synchronizing programs. At the end of a segment the programmer will inspect the sync. input, if it is True (1) then the programmer will advance to the next segment. It is typically wired from the end of segment output of another programmer.	0 1	This will normally be wired to the 'End of Seg' parameter.		Oper
Max Events	To set the maximum number of output events required for the program. This is for convenience to avoid having to scroll through unwanted events when setting up each segment	1 to 8			Conf
Prog Reset	Flag showing reset state	No/Yes	Can be wired to logic inputs to provide remote program control		Oper
Prog Run	Flag showing run state	No/Yes			Oper
Prog Hold	Flag showing hold state	No/Yes			Oper
AdvSeg	Set output to target setpoint and advance to next segment	No/Yes			Oper
SkipSeg	Skip to the next setpoint and start the segment at the current output value.	No/Yes			Oper
EventOut1 to 8	Flags showing event states	No/Yes			Read Only
End of Seg	Flag showing end of segment state	No/Yes			Read Only

To Select, Run, Hold or Reset a Program (V1.xx)

The 'Run' folder allows an existing program to be selected and run. The folder also shows the current program status:

Folder – Programmer.1		Sub-folder: Run		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
CurProg	Current Program Number	0 to 50. Change only when Programmer is in Reset.	0	Oper Read Only
CurrSeg	Current Running Segment	1 to 255	1	Read Only
ProgStatus	Program Status	Reset Run Hold Holdback End		Oper
PSP	Programmer Setpoint		0	Read Only
CyclesLeft	Number of Cycles Remaining	0 to 1000	0	Read Only
CurSegType	Current Segment type	End Rate Time Dwell Step Call	End	Read Only
SegTimeLeft	Segment Time Remaining	Hr Min Sec Millisec	0	Read Only
ResetEventOP	Reset Event Outputs	0 to 255, each bit resets its corresponding output	0	Oper
SegTarget	Current Target Setpoint Value			Read Only
SegRate	Segment Ramp Rate	0.1 to 9999.9	0	Read Only
ProgTimeLeft	Program Time Remaining	Hrs Min Sec Millisec	0	Read Only
FastRun	Fast Run	No (0) Normal Yes (1) Program executes at 10 times real time	No	Conf
EndOutput	End Output	Off (0) Program not in End On (1) Program at End	Off	Read Only
EventsOut	Event Outputs	0 to 255, each bit represents an output.	0	Read Only

Creating a Program (V1.xx)

A folder exists for each Program containing a few key parameters listed below. This folder would normally be viewed via the iTools Program Editor under the Program Parameters tab. The Program Editor is used to create the segments of Program itself using the Segment Editor tab.

Folder – Program		Sub-folder: 1 to 50			
Name	**Parameter Description**	**Value**		**Default**	**Access Level**
Name	Program Name	Up to 8 characters		Null	Oper
Holdback Value	Deviation between SP and PV at which holdback is applied. This value applies to the whole program.	Minimum setting 0		0	Oper
Ramp Units	Time units applied to the segments	Sec	Seconds	sec	Oper
		Min	Minutes		
		Hour	Hours		
Cycles	Number of times the whole program repeats	Cont (0)	Repeats continuously	1	Oper
		1 to 999	Program executes once to 999 times		

To Select, Run, Hold or Reset a Program (Version 1.xx)

The 'Run' folder allows an existing program to be selected and run. The folder also shows the current program status:

Folder – Programmer.1		Sub-folder: Run		
Name	**Parameter Description**	**Value**	**Default**	**Access Level**
CurProg	Current Program Number	0 to 50. Change only when Programmer is in Reset.	0	Oper Read Only
CurrSeg	Current Running Segment	1 to 255	1	Read Only
ProgStatus	Program Status	Reset Run Hold Holdback End		Oper
PSP	Programmer Setpoint		0	Read Only
CyclesLeft	Number of Cycles Remaining	0 to 1000	0	Read Only
CurSegType	Current Segment type	End Rate Time Dwell Step Call	End	Read Only
SegTimeLeft	Segment Time Remaining	Hr Min Sec Millisec	0	Read Only
ResetEventOP	Reset Event Outputs	0 to 255, each bit resets its corresponding output	0	Oper
SegTarget	Current Target Setpoint Value			Read Only
SegRate	Segment Ramp Rate	0.1 to 9999.9	0	Read Only
ProgTimeLeft	Program Time Remaining	Hrs Min Sec Millisec	0	Read Only
FastRun	Fast Run	No (0) Normal Yes (1) Program executes at 10 times real time	No	Conf
EndOutput	End Output	Off (0) Program not in End On (1) Program at End	Off	Read Only
EventsOut	Event Outputs	0 to 255, each bit represents an output.	0	Read Only

SCADA addresses for Programmer Version 1.xx

Version 1.xx Programmer Parameters	DEC	HEX	Version 1.xx Programmer Parameters	DEC	HEX
Program.Cycles	8196	2004	Segment.3.EndType	8295	2067
Program.DwellUnits	8195	2003	Segment.3.EventOuts	8296	2068
Program.HoldbackVal	8193	2001	Segment.3.Holdback	8289	2061
Program.RampUnits	8194	2002	Segment.3.RampRate	8293	2065
Programmer.CommsProgNum	8192	2000	Segment.3.SegType	8288	2060
Programmer.Run.CurProg	8201	2009	Segment.3.TargetSP	8294	2066
Programmer.Run.CurSeg	8202	200A	Segment.4.CallCycles	8307	2073
Programmer.Run.CurSegType	8206	200E	Segment.4.CallProg	8306	2072
Programmer.Run.CyclesLeft	8205	200D	Segment.4.Duration	8308	2074
Programmer.Run.EventOuts	8212	2014	Segment.4.EndType	8311	2077
Programmer.Run.FastRun	8216	2018	Segment.4.EventOuts	8312	2078
Programmer.Run.ProgStatus	8203	200B	Segment.4.Holdback	8305	2071
Programmer.Run.ProgTimeLeft	8209	2011	Segment.4.RampRate	8309	2075
Programmer.Run.PSP	8204	200C	Segment.4.SegType	8304	2070
Programmer.Run.ResetEventOuts	8200	2008	Segment.4.TargetSP	8310	2076
Programmer.Run.SegRate	8208	2010	Segment.5.CallCycles	8323	2083
Programmer.Run.SegTarget	8207	200F	Segment.5.CallProg	8322	2082
Programmer.Run.SegTimeLeft	8213	2015	Segment.5.Duration	8324	2084
Programmer.Setup.AdvSeg	8217	2019	Segment.5.EndType	8327	2087
Programmer.Setup.EndOfSeg	8214	2016	Segment.5.EventOuts	8328	2088
Programmer.Setup.PowerFailAct	8197	2005	Segment.5.Holdback	8321	2081
Programmer.Setup.PVIn	8210	2012	Segment.5.RampRate	8325	2085
Programmer.Setup.Servo	8198	2006	Segment.5.SegType	8320	2080
Programmer.Setup.SkipSeg	8218	201A	Segment.5.TargetSP	8326	2086
Programmer.Setup.SPIn	8211	2013	Segment.6.CallCycles	8339	2093
Programmer.Setup.SyncIn	8215	2017	Segment.6.CallProg	8338	2092
Recipe.LastDataset	4913	1331	Segment.6.Duration	8340	2094
Recipe.LoadingStatus	4914	1332	Segment.6.EndType	8343	2097
Recipe.RecipeSelect	4912	1330	Segment.6.EventOuts	8344	2098
Segment.1.CallCycles	8259	2043	Segment.6.Holdback	8337	2091
Segment.1.CallProg	8258	2042	Segment.6.RampRate	8341	2095
Segment.1.Duration	8260	2044	Segment.6.SegType	8336	2090
Segment.1.EndType	8263	2047	Segment.6.TargetSP	8342	2096
Segment.1.EventOuts	8264	2048	Segment.7.CallCycles	8355	20A3
Segment.1.Holdback	8257	2041	Segment.7.CallProg	8354	20A2
Segment.1.RampRate	8261	2045	Segment.7.Duration	8356	20A4
Segment.1.SegType	8256	2040	Segment.7.EndType	8359	20A7
Segment.1.TargetSP	8262	2046	Segment.7.EventOuts	8360	20A8
Segment.2.CallCycles	8275	2053	Segment.7.Holdback	8353	20A1
Segment.2.CallProg	8274	2052	Segment.7.RampRate	8357	20A5
Segment.2.Duration	8276	2054	Segment.7.SegType	8352	20A0
Segment.2.EndType	8279	2057	Segment.7.TargetSP	8358	20A6
Segment.2.EventOuts	8280	2058	Segment.8.CallCycles	8371	20B3
Segment.2.Holdback	8273	2051	Segment.8.CallProg	8370	20B2
Segment.2.RampRate	8277	2055	Segment.8.Duration	8372	20B4
Segment.2.SegType	8272	2050	Segment.8.EndType	8375	20B7
Segment.2.TargetSP	8278	2056	Segment.8.EventOuts	8376	20B8
Segment.3.CallCycles	8291	2063	Segment.8.Holdback	8369	20B1
Segment.3.CallProg	8290	2062	Segment.8.RampRate	8373	20B5
Segment.3.Duration	8292	2064	Segment.8.SegType	8368	20B0

Version 1.xx Programmer Parameters	DEC	HEX	Version 1.xx Programmer Parameters	DEC	HEX
Segment.8.TargetSP	8374	20B6	Segment.14.RampRate	8469	2115
Segment.9.CallCycles	8387	20C3	Segment.14.SegType	8464	2110
Segment.9.CallProg	8386	20C2	Segment.14.TargetSP	8470	2116
Segment.9.Duration	8388	20C4	Segment.15.CallCycles	8483	2123
Segment.9.EndType	8391	20C7	Segment.15.CallProg	8482	2122
Segment.9.EventOuts	8392	20C8	Segment.15.Duration	8484	2124
Segment.9.Holdback	8385	20C1	Segment.15.EndType	8487	2127
Segment.9.RampRate	8389	20C5	Segment.15.EventOuts	8488	2128
Segment.9.SegType	8384	20C0	Segment.15.Holdback	8481	2121
Segment.9.TargetSP	8390	20C6	Segment.15.RampRate	8485	2125
Segment.10.CallCycles	8403	20D3	Segment.15.SegType	8480	2120
Segment.10.CallProg	8402	20D2	Segment.15.TargetSP	8486	2126
Segment.10.Duration	8404	20D4	Segment.16.CallCycles	8499	2133
Segment.10.EndType	8407	20D7	Segment.16.CallProg	8498	2132
Segment.10.EventOuts	8408	20D8	Segment.16.Duration	8500	2134
Segment.10.Holdback	8401	20D1	Segment.16.EndType	8503	2137
Segment.10.RampRate	8405	20D5	Segment.16.EventOuts	8504	2138
Segment.10.SegType	8400	20D0	Segment.16.Holdback	8497	2131
Segment.10.TargetSP	8406	20D6	Segment.16.RampRate	8501	2135
Segment.11.CallCycles	8419	20E3	Segment.16.SegType	8496	2130
Segment.11.CallProg	8418	20E2	Segment.16.TargetSP	8502	2136
Segment.11.Duration	8420	20E4	Segment.17.CallCycles	8515	2143
Segment.11.EndType	8423	20E7	Segment.17.CallProg	8514	2142
Segment.11.EventOuts	8424	20E8	Segment.17.Duration	8516	2144
Segment.11.Holdback	8417	20E1	Segment.17.EndType	8519	2147
Segment.11.RampRate	8421	20E5	Segment.17.EventOuts	8520	2148
Segment.11.SegType	8416	20E0	Segment.17.Holdback	8513	2141
Segment.11.TargetSP	8422	20E6	Segment.17.RampRate	8517	2145
Segment.12.CallCycles	8435	20F3	Segment.17.SegType	8512	2140
Segment.12.CallProg	8434	20F2	Segment.17.TargetSP	8518	2146
Segment.12.Duration	8436	20F4	Segment.18.CallCycles	8531	2153
Segment.12.EndType	8439	20F7	Segment.18.CallProg	8530	2152
Segment.12.EventOuts	8440	20F8	Segment.18.Duration	8532	2154
Segment.12.Holdback	8433	20F1	Segment.18.EndType	8535	2157
Segment.12.RampRate	8437	20F5	Segment.18.EventOuts	8536	2158
Segment.12.SegType	8432	20F0	Segment.18.Holdback	8529	2151
Segment.12.TargetSP	8438	20F6	Segment.18.RampRate	8533	2155
Segment.13.CallCycles	8451	2103	Segment.18.SegType	8528	2150
Segment.13.CallProg	8450	2102	Segment.18.TargetSP	8534	2156
Segment.13.Duration	8452	2104	Segment.19.CallCycles	8547	2163
Segment.13.EndType	8455	2107	Segment.19.CallProg	8546	2162
Segment.13.EventOuts	8456	2108	Segment.19.Duration	8548	2164
Segment.13.Holdback	8449	2101	Segment.19.EndType	8551	2167
Segment.13.RampRate	8453	2105	Segment.19.EventOuts	8552	2168
Segment.13.SegType	8448	2100	Segment.19.Holdback	8545	2161
Segment.13.TargetSP	8454	2106	Segment.19.RampRate	8549	2165
Segment.14.CallCycles	8467	2113	Segment.19.SegType	8544	2160
Segment.14.CallProg	8466	2112	Segment.19.TargetSP	8550	2166
Segment.14.Duration	8468	2114	Segment.20.CallCycles	8563	2173
Segment.14.EndType	8471	2117	Segment.20.CallProg	8562	2172
Segment.14.EventOuts	8472	2118	Segment.20.Duration	8564	2174
Segment.14.Holdback	8465	2111	Segment.20.EndType	8567	2177

Version 1.xx Programmer Parameters	DEC	HEX	Version 1.xx Programmer Parameters	DEC	HEX
Segment.20.EventOuts	8568	2178	Segment.26.Duration	8660	21D4
Segment.20.Holdback	8561	2171	Segment.26.EndType	8663	21D7
Segment.20.RampRate	8565	2175	Segment.26.EventOuts	8664	21D8
Segment.20.SegType	8560	2170	Segment.26.Holdback	8657	21D1
Segment.20.TargetSP	8566	2176	Segment.26.RampRate	8661	21D5
Segment.21.CallCycles	8579	2183	Segment.26.SegType	8656	21D0
Segment.21.CallProg	8578	2182	Segment.26.TargetSP	8662	21D6
Segment.21.Duration	8580	2184	Segment.27.CallCycles	8675	21E3
Segment.21.EndType	8583	2187	Segment.27.CallProg	8674	21E2
Segment.21.EventOuts	8584	2188	Segment.27.Duration	8676	21E4
Segment.21.Holdback	8577	2181	Segment.27.EndType	8679	21E7
Segment.21.RampRate	8581	2185	Segment.27.EventOuts	8680	21E8
Segment.21.SegType	8576	2180	Segment.27.Holdback	8673	21E1
Segment.21.TargetSP	8582	2186	Segment.27.RampRate	8677	21E5
Segment.22.CallCycles	8595	2193	Segment.27.SegType	8672	21E0
Segment.22.CallProg	8594	2192	Segment.27.TargetSP	8678	21E6
Segment.22.Duration	8596	2194	Segment.28.CallCycles	8691	21F3
Segment.22.EndType	8599	2197	Segment.28.CallProg	8690	21F2
Segment.22.EventOuts	8600	2198	Segment.28.Duration	8692	21F4
Segment.22.Holdback	8593	2191	Segment.28.EndType	8695	21F7
Segment.22.RampRate	8597	2195	Segment.28.EventOuts	8696	21F8
Segment.22.SegType	8592	2190	Segment.28.Holdback	8689	21F1
Segment.22.TargetSP	8598	2196	Segment.28.RampRate	8693	21F5
Segment.23.CallCycles	8611	21A3	Segment.28.SegType	8688	21F0
Segment.23.CallProg	8610	21A2	Segment.28.TargetSP	8694	21F6
Segment.23.Duration	8612	21A4	Segment.29.CallCycles	8707	2203
Segment.23.EndType	8615	21A7	Segment.29.CallProg	8706	2202
Segment.23.EventOuts	8616	21A8	Segment.29.Duration	8708	2204
Segment.23.Holdback	8609	21A1	Segment.29.EndType	8711	2207
Segment.23.RampRate	8613	21A5	Segment.29.EventOuts	8712	2208
Segment.23.SegType	8608	21A0	Segment.29.Holdback	8705	2201
Segment.23.TargetSP	8614	21A6	Segment.29.RampRate	8709	2205
Segment.24.CallCycles	8627	21B3	Segment.29.SegType	8704	2200
Segment.24.CallProg	8626	21B2	Segment.29.TargetSP	8710	2206
Segment.24.Duration	8628	21B4	Segment.30.CallCycles	8723	2213
Segment.24.EndType	8631	21B7	Segment.30.CallProg	8722	2212
Segment.24.EventOuts	8632	21B8	Segment.30.Duration	8724	2214
Segment.24.Holdback	8625	21B1	Segment.30.EndType	8727	2217
Segment.24.RampRate	8629	21B5	Segment.30.EventOuts	8728	2218
Segment.24.SegType	8624	21B0	Segment.30.Holdback	8721	2211
Segment.24.TargetSP	8630	21B6	Segment.30.RampRate	8725	2215
Segment.25.CallCycles	8643	21C3	Segment.30.SegType	8720	2210
Segment.25.CallProg	8642	21C2	Segment.30.TargetSP	8726	2216
Segment.25.Duration	8644	21C4	Segment.31.CallCycles	8739	2223
Segment.25.EndType	8647	21C7	Segment.31.CallProg	8738	2222
Segment.25.EventOuts	8648	21C8	Segment.31.Duration	8740	2224
Segment.25.Holdback	8641	21C1	Segment.31.EndType	8743	2227
Segment.25.RampRate	8645	21C5	Segment.31.EventOuts	8744	2228
Segment.25.SegType	8640	21C0	Segment.31.Holdback	8737	2221
Segment.25.TargetSP	8646	21C6	Segment.31.RampRate	8741	2225
Segment.26.CallCycles	8659	21D3	Segment.31.SegType	8736	2220
Segment.26.CallProg	8658	21D2	Segment.31.TargetSP	8742	2226

Version 1.xx Programmer Parameters	DEC	HEX	Version 1.xx Programmer Parameters	DEC	HEX
Segment.32.CallCycles	8755	2233	Segment.37.SegType	8832	2280
Segment.32.CallProg	8754	2232	Segment.37.TargetSP	8838	2286
Segment.32.Duration	8756	2234	Segment.38.CallCycles	8851	2293
Segment.32.EndType	8759	2237	Segment.38.CallProg	8850	2292
Segment.32.EventOuts	8760	2238	Segment.38.Duration	8852	2294
Segment.32.Holdback	8753	2231	Segment.38.EndType	8855	2297
Segment.32.RampRate	8757	2235	Segment.38.EventOuts	8856	2298
Segment.32.SegType	8752	2230	Segment.38.Holdback	8849	2291
Segment.32.TargetSP	8758	2236	Segment.38.RampRate	8853	2295
Segment.33.CallCycles	8771	2243	Segment.38.SegType	8848	2290
Segment.33.CallProg	8770	2242	Segment.38.TargetSP	8854	2296
Segment.33.Duration	8772	2244	Segment.39.CallCycles	8867	22A3
Segment.33.EndType	8775	2247	Segment.39.CallProg	8866	22A2
Segment.33.EventOuts	8776	2248	Segment.39.Duration	8868	22A4
Segment.33.Holdback	8769	2241	Segment.39.EndType	8871	22A7
Segment.33.RampRate	8773	2245	Segment.39.EventOuts	8872	22A8
Segment.33.SegType	8768	2240	Segment.39.Holdback	8865	22A1
Segment.33.TargetSP	8774	2246	Segment.39.RampRate	8869	22A5
Segment.34.CallCycles	8787	2253	Segment.39.SegType	8864	22A0
Segment.34.CallProg	8786	2252	Segment.39.TargetSP	8870	22A6
Segment.34.Duration	8788	2254	Segment.40.CallCycles	8883	22B3
Segment.34.EndType	8791	2257	Segment.40.CallProg	8882	22B2
Segment.34.EventOuts	8792	2258	Segment.40.Duration	8884	22B4
Segment.34.Holdback	8785	2251	Segment.40.EndType	8887	22B7
Segment.34.RampRate	8789	2255	Segment.40.EventOuts	8888	22B8
Segment.34.SegType	8784	2250	Segment.40.Holdback	8881	22B1
Segment.34.TargetSP	8790	2256	Segment.40.RampRate	8885	22B5
Segment.35.CallCycles	8803	2263	Segment.40.SegType	8880	22B0
Segment.35.CallProg	8802	2262	Segment.40.TargetSP	8886	22B6
Segment.35.Duration	8804	2264	Segment.41.CallCycles	8899	22C3
Segment.35.EndType	8807	2267	Segment.41.CallProg	8898	22C2
Segment.35.EventOuts	8808	2268	Segment.41.Duration	8900	22C4
Segment.35.Holdback	8801	2261	Segment.41.EndType	8903	22C7
Segment.35.RampRate	8805	2265	Segment.41.EventOuts	8904	22C8
Segment.35.SegType	8800	2260	Segment.41.Holdback	8897	22C1
Segment.35.TargetSP	8806	2266	Segment.41.RampRate	8901	22C5
Segment.36.CallCycles	8819	2273	Segment.41.SegType	8896	22C0
Segment.36.CallProg	8818	2272	Segment.41.TargetSP	8902	22C6
Segment.36.Duration	8820	2274	Segment.42.CallCycles	8915	22D3
Segment.36.EndType	8823	2277	Segment.42.CallProg	8914	22D2
Segment.36.EventOuts	8824	2278	Segment.42.Duration	8916	22D4
Segment.36.Holdback	8817	2271	Segment.42.EndType	8919	22D7
Segment.36.RampRate	8821	2275	Segment.42.EventOuts	8920	22D8
Segment.36.SegType	8816	2270	Segment.42.Holdback	8913	22D1
Segment.36.TargetSP	8822	2276	Segment.42.RampRate	8917	22D5
Segment.37.CallCycles	8835	2283	Segment.42.SegType	8912	22D0
Segment.37.CallProg	8834	2282	Segment.42.TargetSP	8918	22D6
Segment.37.Duration	8836	2284	Segment.43.CallCycles	8931	22E3
Segment.37.EndType	8839	2287	Segment.43.CallProg	8930	22E2
Segment.37.EventOuts	8840	2288	Segment.43.Duration	8932	22E4
Segment.37.Holdback	8833	2281	Segment.43.EndType	8935	22E7
Segment.37.RampRate	8837	2285	Segment.43.EventOuts	8936	22E8

Version 1.xx Programmer Parameters	DEC	HEX	Version 1.xx Programmer Parameters	DEC	HEX
Segment.43.Holdback	8929	22E1	Segment.49.CallProg	9026	2342
Segment.43.RampRate	8933	22E5	Segment.49.Duration	9028	2344
Segment.43.SegType	8928	22E0	Segment.49.EndType	9031	2347
Segment.43.TargetSP	8934	22E6	Segment.49.EventOuts	9032	2348
Segment.44.CallCycles	8947	22F3	Segment.49.Holdback	9025	2341
Segment.44.CallProg	8946	22F2	Segment.49.RampRate	9029	2345
Segment.44.Duration	8948	22F4	Segment.49.SegType	9024	2340
Segment.44.EndType	8951	22F7	Segment.49.TargetSP	9030	2346
Segment.44.EventOuts	8952	22F8	Segment.50.CallCycles	9043	2353
Segment.44.Holdback	8945	22F1	Segment.50.CallProg	9042	2352
Segment.44.RampRate	8949	22F5	Segment.50.Duration	9044	2354
Segment.44.SegType	8944	22F0	Segment.50.EndType	9047	2357
Segment.44.TargetSP	8950	22F6	Segment.50.EventOuts	9048	2358
Segment.45.CallCycles	8963	2303	Segment.50.Holdback	9041	2351
Segment.45.CallProg	8962	2302	Segment.50.RampRate	9045	2355
Segment.45.Duration	8964	2304	Segment.50.SegType	9040	2350
Segment.45.EndType	8967	2307	Segment.50.TargetSP	9046	2356
Segment.45.EventOuts	8968	2308			
Segment.45.Holdback	8961	2301			
Segment.45.RampRate	8965	2305			
Segment.45.SegType	8960	2300			
Segment.45.TargetSP	8966	2306			
Segment.46.CallCycles	8979	2313			
Segment.46.CallProg	8978	2312			
Segment.46.Duration	8980	2314			
Segment.46.EndType	8983	2317			
Segment.46.EventOuts	8984	2318			
Segment.46.Holdback	8977	2311			
Segment.46.RampRate	8981	2315			
Segment.46.SegType	8976	2310			
Segment.46.TargetSP	8982	2316			
Segment.47.CallCycles	8995	2323			
Segment.47.CallProg	8994	2322			
Segment.47.Duration	8996	2324			
Segment.47.EndType	8999	2327			
Segment.47.EventOuts	9000	2328			
Segment.47.Holdback	8993	2321			
Segment.47.RampRate	8997	2325			
Segment.47.SegType	8992	2320			
Segment.47.TargetSP	8998	2326			
Segment.48.CallCycles	9011	2333			
Segment.48.CallProg	9010	2332			
Segment.48.Duration	9012	2334			
Segment.48.EndType	9015	2337			
Segment.48.EventOuts	9016	2338			
Segment.48.Holdback	9009	2331			
Segment.48.RampRate	9013	2335			
Segment.48.SegType	9008	2330			
Segment.48.TargetSP	9014	2336			
Segment.49.CallCycles	9027	2343			

Technical Specification

The I/O electrical specifications are quoted as factory calibrated worst-case; for life, over full ambient temperature range and supply voltage. Any "typical" figures quoted are the expected values at 25°C ambient and 24Vdc supply.

The nominal update of all inputs and function blocks is every 110ms. However, in complex applications the Mini8 controller will automatically extend this time in multiples of 110ms.

Environmental Specification

Power Supply Voltage	17.8Vdc min to 28.8Vdc max.
Supply Ripple	2Vp-p max
Power Consumption	15W max
Max. applied voltage any terminal	42Vpk.
Operating Temperature	0 to 55°C (32°F to 131°F)
Storage Temperature	-10°C to +70°C (14°F to 158°F)
Relative Humidity	5% to 95% RH non-condensing
Altitude	<2000m (<6561.68ft)
Approvals	CE UL, cUL EAC Approval
Safety	Meets EN61010-1: 2010 and UL 61010-1: 2012 Installation Category II Pollution Degree 2.
EMC	EN61326:2013 Emissions: Class A - Heavy Industrial Immunity: Industrial
Protection	IP20 The Mini8 controller must be mounted in a protective enclosure.
RoHS Compliance	EU RoHS EN50581:2012 REACH WEEE China RoHS

Network Communications Support

Modbus RTU: EIA-485, 2 x RJ45, user select switch for 3-wire or 5-wire.	Baud rates: 4800bps, 9600bps, 19200bps
DeviceNet: CAN, 5-pin standard "open connector" with screw terminals.	Baud rates: 125kbps, 250kbps, 500kbps
Profibus DP: EIA-485 via standard 9 pin D connector OR 2 x RJ45 connectors	Baud rates: Up to 12Mbps set by the Master
EtherNet: Standard EtherNet RJ45 connector.	Baud rate: 10Base-T
EtherNet/IP: Standard EtherNet RJ45 connector.	Baud rates: 10Base-T, 100Base-T
EtherCAT: 2 x Standard EtherNet RJ45 connector	Baud rates: 10Base-T, 100Base-T
Isolation between RJ45 connector and system	1500Vac.
Modbus, DeviceNet, Profibus, EtherNet, EtherNet/IP, and EtherCAT are mutually exclusive options; refer to the Mini8 controller order code document.	

Configuration Communications Support

Modbus RTU: 3-wire EIA-232, through RJ11 configuration port.	Baud rates: 4800, 9600, 19200
All versions of Mini8 controller support one configuration port. The configuration port can be used simultaneously with the network link.	

Fixed I/O Resources

The PSU card supports two independent and isolated relay contacts	
Relay Output Types	On/Off (C/O contacts, "On" closing the N/O pair)
Contact Current	<1A (resistive loads)
Terminal Voltage	<42Vpk
Contact Material	Gold
Snubbers	Snubber networks are NOT fitted.
Contact Isolation	42Vpk max.
The PSU card supports two independent and isolated logic inputs	
Input Types	Logic (24Vdc)
Input Logic 0 (off)	-28.8V to +5Vdc.
Input Logic 1 (on)	+10.8V to +28.8Vdc.
Input Current	2.5mA (approx.) at 10.8V; 10mA max at 28.8V supply.
Detectable Pulse Width	110ms min.
Isolation to system	42Vpk max.

TC8/ET8 8-Channel and TC4 4-Channel TC Input Card

The TC8/ET8 supports eight independently programmable and electrically isolated channels, catering for all standard and custom thermocouple types. The TC4 supports four channels to the same specification.	
Channel Types	TC, mV Input Range: -77mV to +77mV.
Resolution	20 bit ($\Sigma\Delta$ converter), 1.6µV with 1.6s filter time
Temperature Coefficient	< ±50ppm (0.005%) of reading/ °C (TC4/TC8) <±1µV/C ±25ppm/C of measurement, from 25°C ambient (ET8)
Cold Junction Range	-10°C to +70°C (14°F to 158°F)
CJ Rejection	> 30:1 (TC4/TC8) 100:1 (ET8)
CJ Accuracy	±1°C (TC4/TC8) ±0.25°C (ET8)
Linearisation Types	C, J, K, L, R, B, N, T, S, LINEAR mV, custom.
Total accuracy	±1°C ±0.1% of reading (using internal CJC) (TC4/TC8) ±0.25°C ±0.05% of reading at 25°C ambient (ET8)
Channel PV Filter	0.0 seconds (off) to 999.9 seconds, 1st order low-pass.
Sensor Break: AC detector	Off, Low or High resistance trip levels.
Input Resistance	>100MΩ
Input Leakage Current	<±100nA (1nA typical).
Common mode rejection	>120dB, 47 - 63Hz
Series mode rejection	>60dB, 47 - 63Hz
Isolation channel-channel	42Vpkmax
Isolation to system	42Vpkmax

DO8 8-Channel Digital Output Card

The DO8 supports eight independently programmable channels, the output switches requiring external power supply. Each channel is current and temperature protected, foldback limiting occurring at about 100mA.

The supply line is protected to limit total card current to 200mA.

The eight channels are isolated from the system (but not from each other). To maintain isolation it is essential to use an independent and isolated PSU.

Channel Types	On/Off, Time Proportioned
Channel Supply (Vcs)	15Vdc to 30Vdc
Logic 1 Voltage Output	> (Vcs - 3V) (not in power limiting)
Logic 0 Voltage Output	< 1.2Vdc no-load, 0.9V typical
Logic 1 Current Output	100mA max. (not in power limiting)
Min. Pulse Time	20ms
Channel Power Limiting	Current limiting capable of driving short-circuit load
Terminal Supply Protection	Card supply is protected by 200mA self-healing fuse
Isolation (channel-channel)	N/A (Channels share common connections)
Isolation to system	42Vpk max.

RL8 8-Channel Relay Output Card

The RL8 supports eight independently programmable channels. This module may only be fitted in slot 2 or 3, giving a maximum of 16 relays in a Mini8 controller.

The Mini8 controller chassis must be grounded using the protective earth ground stud.

Channel Types	On/Off, Time Proportioned	
Maximum contact voltage	264Vac	
Maximum contact current	2A ac	
Contact snubber	Fitted on module	
Minimum contact wetting	5Vdc, 10mA	
Min. Pulse Time	220ms	
Isolation (channel-channel)	264V	230V nominal
Isolation to system	264V	

CT3 3-Channel Current-Transformer Input Card

The CT3 supports three independent channels designed for heater current monitoring. A scan block allows periodic test of nominated outputs to detect load changes due to issues with the heater.

Channel Types	A (current)
Factory set accuracy	better than ±2% of range
Current Input Range	0mA to 50mA RMS, 50/60Hz nominal
Transformer Ratio	10/0.05 to 1000/0.05
Input Load Burden	1W
Isolation	None (provided by CT)

Load Failure Detection

Requires CT3 module	
Max number of loads	16 Time Proportioned Outputs
Max loads per CT	Six loads per CT input
Alarms	1 in 8 'Partial load failure', Over current, SSR short-circuit, SSR open circuit
Commissioning	Automatic or manual
Measurement interval	1 sec - 60 sec

DI8 8-Channel Digital Input Card

The DI8 supports eight independent input channels.	
Input Types	Logic (24Vdc)
Input Logic 0 (off)	-28.8V to +5Vdc.
Input Logic 1 (on)	+10.8V to +28.8Vdc.
Input Current	2.5mA (approx.) at 10.8V; 10mA max at 28.8V supply.
Detectable Pulse Width	110ms min.
Isolation channel-channel	42Vpkmax
Isolation to system	42Vpkmax.

RT4 Resistance Thermometer Input Card

The RT4 supports four independently programmable and electrically isolated resistance input channels. Each channel may be connected as 2-wire, 3-wire or 4-wire and either Low or High Resistance range.		
Channel Types	Low Resistance/Pt100	High Resistance/Pt1000
Input Range	0 to 420Ω, -242.02°C to +850°C (-404°F to +1562°F) for Pt100	0 to 4200Ω, -242.02°C to +850°C (-404°F to +1562°F) for Pt1000
Calibration Error	±0.1Ω ±0.1% of reading, 22Ω to 420Ω ±0.3°C ±0.1% of reading, -200°C to +850°C	±0.6Ω ±0.1% of reading, 220Ω to 4200Ω ±0.2°C ±0.1% of reading, -200°C to +850°C
Resolution	0.008Ω, 0.02°C	0.6Ω, 0.15°C
Measurement Noise	0.016Ω, 0.04°C peak to peak, 1.6s channel filter 0.06Ω, 0.15°C peak to peak, no filter	0.2Ω, 0.05°C peak to peak, 1.6s channel filter 0.6Ω, 0.15°C peak to peak, no filter
Linearity error	±0.02Ω, ±0.05°C	±0.2Ω, ±0.05°C
Temp coefficient	±0.002% of Ω reading per deg C ambient change relative to normal ambient 25°C	±0.002% of Ω reading per deg C ambient change relative to normal ambient 25°C
Lead resistance	22Ω max in each leg. Total resistance including leads is restricted to the 420Ω maximum limit. 3-wire connection assumed matched leads.	22Ω max in each leg. Total resistance including leads is restricted to the 4200Ω maximum limit. For the 3-wire connection it is assumed that the leads are matched.
Maximum Bulb current	300µA	300µA
Isolation channel-channel	42Vpkmax	42Vpkmax
Isolation to system	42Vpkmax	42Vpkmax

AO8 8-Channel and AO4 4-Channel 4-20mA Output Card

The AO8 supports eight independently programmable and electrically isolated mA output channels for 4-20mA current-loop applications. The AO4 supports four channels to the same specification. The AO4 and AO8 modules may only be fitted in slot 4.	
Channel Types	mA (current) Output
Output Range	0-20mA, 360Ω load max.
Setting Accuracy	±0.5% of reading
Resolution	1 part in 10000 (1uA typical)
Isolation channel-channel	42Vpk max
Isolation to system	42Vpk max

Recipes

Recipes are a software orderable option	
Number of recipes	8
Tags	24 tags in total

Toolkit Blocks

User Wires	Orderable options of 30, 60 120 or 250	
User values	32 real values	
2-Input Maths	24 blocks	Add, subtract, multiply, divide, absolute difference, maximum, minimum, hot swap, sample and hold, power, square root, Log, Ln, exponential, switch
2-Input Logic	24 blocks	AND, OR, XOR, latch, equal, not equal, greater than, less than, greater than or equal to, less than or equal to
8-Input Logic	4 blocks	AND, OR, XOR
8-Input Multiple Operator	4 blocks	Maximum, Minimum, Average. Input/Outputs to allow cascading of blocks
8-Input Multiplexer	4 blocks	Eight sets of eight values selected by input parameter
BCD Input	2 blocks	Two decades (eight inputs giving 0 to 99).
Input monitor	2 blocks	Max, min, time above threshold
16 Point Linearization	2 blocks	16-point linearization fit
Polynomial Fit	2 blocks	Characterisation by Poly Fit table
Switchover	1 block	Smooth transition between two input values
Timer blocks	8 blocks	OnPulse, OnDelay, OneShot, MinOn Time
Counter blocks	2 blocks	Up or down, Directional flag
Totaliser blocks	2 blocks	Alarm at Threshold value
Real time clock	1 block	Day & time, two time-based alarms
Transducer Scaling	2 blocks	Transducer Auto-tare, calibration & comparison cal.

PID Control Loop Blocks

Number of Loops	0, 4, 8 or 16 Loops (order options)
Control modes	On/Off, single PID, Dual channel OP
Control Outputs	Analog 4-20mA, Time proportioned logic
Cooling algorithms	Linear, water, fan, or oil
Tuning	Three sets PID, One-shot auto-tune.
Auto manual control	Bumpless transfer or forced manual output available
Setpoint rate limit	Ramp in units per sec, per min or per hour.
Output rate limit	Ramp in % change per second
Other features	Feedforward, Input track, Sensor break OP, Loop break alarm, remote SP, two internal loop setpoints

Process Alarms

Number of alarms	32 analog, 32 digital, 32 Sensor break
Alarm types	Absolute high, absolute low, deviation high, deviation low, deviation band, sensor break, logic high, logic low, rising edge, falling edge, edge
Alarm modes	Latching or non-latching, blocking, time delay

Setpoint Programmer

The Setpoint Programmer is a software orderable option	
Number of programs	Eight
Number of segments	128
Number of event outputs	Eight per program (64 total)
Digital inputs	Run, Hold, Reset, Run/Hold, Run/Reset, Program Advance, Skip, Segment, Sync
Power interruption action	Ramp, Reset, Continue
Servo start	PV, SP

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Parameter	Folder	Section	Parameter	Folder	Section
Range Low	Setpoint	Setpoint Limits	SbrkOp	Output function block	Output Function Block
Range Max	Transducer scaling	Transducer Scaling Parameters	SbrkOutput	IO - Thermocouple input	Thermocouple Input Parameters
Range Min	Transducer scaling	Transducer Scaling Parameters	SbrkOutput	IO - PRT input	RT Input Parameters
RangeHigh	IO - Logic output	Logic Out Parameters	SbyAct	IO - Logic output	Logic Out Parameters
RangeHigh	IO - Relay output	Relay Parameters	SbyAct	IO - Relay output	Relay Parameters
RangeHigh	IO - Thermocouple input	Thermocouple Input Parameters	SbyAct	IO - Fixed IO	Fixed IO
RangeLow	IO - Logic output	Logic Out Parameters	Scale Low	Transducer scaling	Transducer Scaling Parameters
RangeLow	IO - Relay output	Relay Parameters	Scheduler	Loop PID	PID Parameters
RangeLow	IO - Thermocouple input	Thermocouple Input Parameters	SchedulerType	Loop PID	PID Parameters
Rate	Setpoint	Setpoint Limits	SegDuration	Programmer - Run Status	Introduction to Setpoint Programmer
Rate	Output function block	Output Function Block	Segments Left	Instrument - Diagnostics	Instrument / Diagnostics
Rate Disable	Setpoint	Setpoint Limits	SegRate	Programmer - Run Status	Introduction to Setpoint Programmer
Rate Disable	Output function block	Output Function Block	SegTarget	Programmer - Run Status	Introduction to Setpoint Programmer
RateDone	Setpoint	Setpoint Limits	SegTimeLeft	Programmer - Run Status	Introduction to Setpoint Programmer
RateResolution	Programmer - Setup	Introduction to Setpoint Programmer	Select	Mux8 operators	Multiple Input Operator Parameters
ReadOnly	Comms - SCADA Table	Comms Table	SelectIn	Switch over	Switch Over Parameters
Reference	Analogue alarms	Alarm Parameters	SensorBreak Mode	Output function block	Output Function Block
RelCh2Gain 1, 2, 3	Loop PID	PID Parameters	Serial No	Instrument - InstInfo	Instrument / InstInfo
RelHumid	Humidity	Humidity Parameters	Servo	Programmer - Setup	Introduction to Setpoint Programmer
RemGasEn	Zirconia	Analog Output	ServoToPV	Setpoint	Setpoint Parameters
RemGasRef	Zirconia	Zirconia Parameters	ShuntOut	Transducer scaling	Transducer Scaling Parameters
RemOPH	Output function block	Output Function Block	SkipSeg	Programmer - Setup	Introduction to Setpoint Programmer
RemOPL	Output function block	Output Function Block	SootAlm	Zirconia	Zirconia Parameters
RemoteInput	Loop PID	PID Parameters	Source	Comms - SCADA Table	Comms Table
Reset	Counter	Counter Parameters	SP HighLimit	Setpoint	Setpoint Limits
Reset	Totaliser	Totalizer Parameters	SP LowLimit	Setpoint	Setpoint Limits
Reset	Input monitor	Input Monitor Parameters	SP Select	Setpoint	Setpoint Limits
ResetEventOuts	Programmer - Run Status	Introduction to Setpoint Programmer	SP Track	Setpoint	Setpoint Limits
ResetUVal	Programmer - Run Status	Introduction to Setpoint Programmer	SP Trim	Setpoint	Setpoint Limits
Resolution	IO - Thermocouple input	Thermocouple Input Parameters	SP1	Setpoint	Setpoint Limits
Resolution	IO - PRT input	RT Input Parameters	SP2	Setpoint	Setpoint Limits
Resolution	IO - Analogue output	Analog Output	SPIn	Programmer - Setup	Introduction to Setpoint Programmer
Resolution	Totaliser	Totalizer Parameters	SPIntBal	Setpoint	Setpoint Limits
Resolution	Humidity	Humidity Parameters	SPTrim HighLimit	Setpoint	Setpoint Limits
Resolution	Zirconia	Zirconia Parameters	SPTrim LowLimit	Setpoint	Setpoint Limits
Resolution	Maths operators	Math Operator Parameters	Stage	Loop tune	Tune Parameters
Resolution	Multi operators	Multiple Input Operator Block Parameters	Stage Time	Loop tune	Tune Parameters
Resolution	Input linearisation	Input Linearization Parameters	Standby	Access	Access Folder
Resolution	Polynomial	Polynomial	Start Cal	Transducer scaling	Transducer Scaling Parameters
Resolution	Load	Load Parameters	Start HighCal	Transducer scaling	Transducer Scaling Parameters
Resolution	Programmer - Setup	Introduction to Setpoint Programmer	Start Tare	Transducer scaling	Transducer Scaling Parameters
Resolution	User values	User Value Parameters	State	Loop tune	Tune Parameters
Ripple Carry	Counter	Counter Parameters	Status	IO - Thermocouple input	Thermocouple Input Parameters
RstNewAlarm	Alarm summary	Alarm Summary	Status	IO - PRT input	RT Input Parameters
RstNewCTAlarm	Alarm summary	Alarm Summary	Status	IO - Analogue output	Analog Output
RTClock En	Instrument - Enables	Instrument / Enables	Status	Comms - Devicenet	DeviceNet Parameters
Run	Totaliser	Totalizer Parameters	Status	Logic operators	Logic Operator Parameters
Safe OP Val	Output function block	Output Function Block	Status	Maths operators	Math Operator Parameters
Sat-Sun	Real time clock	Real Time Clock	Status	Mux8 operators	Multiple Input Operator Parameters
Saturday	Real time clock	Real Time Clock	Status	Polynomial	Polynomial
Sbrk	Humidity	Humidity Parameters	Status	Switch over	Switch Over Parameters
SBrk Alarm	IO - Thermocouple input	Thermocouple Input Parameters	Status	Transducer scaling	Transducer Scaling Parameters
SBrk Alarm	IO - PRT input	RT Input Parameters	Status	User values	User Value Parameters
SBrk Type	IO - Thermocouple input	Thermocouple Input Parameters	Status	Calibration	Calibration Parameters
SBrk Type	IO - PRT input	RT Input Parameters	Subnet Mask 1	Comms - EtherNet	EtherNet Parameters
SBrk Value	IO - Thermocouple input	Thermocouple Input Parameters	Subnet Mask 2	Comms - EtherNet	EtherNet Parameters
SBrk Value	IO - PRT input	RT Input Parameters	Subnet Mask 3	Comms - EtherNet	EtherNet Parameters
SBrkAlarmStatus1	Alarm summary	Alarm Summary	Subnet Mask 4	Comms - EtherNet	EtherNet Parameters
SBrkAlarmStatus2	Alarm summary	Alarm Summary	Sum Out	Multi operators	Multiple Input Operator Block Parameters
SBrkAlarmStatus3	Alarm summary	Alarm Summary	Sunday	Real time clock	Real Time Clock
SBrkAlarmStatus4	Alarm summary	Alarm Summary	Switch High	Switch over	Switch Over Parameters

Parameter	Folder	Section	Parameter	Folder	Section
Switch Low	Switch over	Switch Over Parameters	Units	BCD Input	BCD Parameters
SwOver En	Instrument - Enables	Instrument / Enables	Units	Totaliser	Totalizer Parameters
SyncIn	Programmer - Setup	Introduction to Setpoint Programmer	Units	Maths operators	Math Operator Parameters
Tare Value	Transducer scaling	Transducer Scaling Parameters	Units	Multi operators	Multiple Input Operator Block Parameters
Target	Counter	Counter Parameters	Units	Input linearisation	Input Linearization Parameters
TargetSP	Loop - main	Loop Parameters – Main	Units	Polynomial	Polynomial
TempInput	Zirconia	Zirconia Parameters	Units	Load	Load Parameters
TempOffset	Zirconia	Zirconia Parameters	Units	Programmer - Setup	Introduction to Setpoint Programmer
Tens	BCD Input	BCD Parameters	Units	User values	User Value Parameters
Threshold	Analogue alarms	Alarm Parameters	UserStringCharSpace	Instrument - Diagnostics	Instrument / Diagnostics
Threshold	Input monitor	Input Monitor Parameters	UserStringCount	Instrument - Diagnostics	Instrument / Diagnostics
Thursday	Real time clock	Real Time Clock	UsrVal En1	Instrument - Enables	Instrument / Enables
Time	Timer	Timer Parameters	UsrVal En2	Instrument - Enables	Instrument / Enables
Time	Real time clock	Real Time Clock	UsrVal En3	Instrument - Enables	Instrument / Enables
Time Above	Input monitor	Input Monitor Parameters	UsrVal En4	Instrument - Enables	Instrument / Enables
Time2Clean	Zirconia	Zirconia Parameters	UValName	Programmer - Setup	Introduction to Setpoint Programmer
TimeConst1	Load	Load Parameters	Val	User values	User Value Parameters
TimeConst2	Load	Load Parameters	Version	Instrument - InstInfo	Instrument / InstInfo
Timer En	Instrument - Enables	Instrument / Enables	Wait	Comms - CC (config)	Configuration Communications Parameters
Tolerance	Zirconia	Zirconia Parameters	Wait	Comms - Modbus	Modbus Parameters
Totalise En	Instrument - Enables	Instrument / Enables	WDAct	Comms - Modbus	Modbus Parameters
TotalOut	Totaliser	Totalizer Parameters	WDAct	Comms - Devicenet	DeviceNet Parameters
Track Enable	Output function block	Output Function Block	WDAct	Comms - Profibus	Profibus Parameters
Track PV	Setpoint	Setpoint Limits	WDAct	Comms - EtherNet	EtherNet Parameters
Track SP	Setpoint	Setpoint Limits	WDFlag	Comms - Modbus	Modbus Parameters
TrackOutVal	Output function block	Output Function Block	WDFlag	Comms - Devicenet	DeviceNet Parameters
Triggered	Timer	Timer Parameters	WDFlag	Comms - Profibus	Profibus Parameters
TrScale En	Instrument - Enables	Instrument / Enables	WDFlag	Comms - EtherNet	EtherNet Parameters
Tuesday	Real time clock	Real Time Clock	WDTime	Comms - Modbus	Modbus Parameters
Type	Analogue alarms	Alarm Parameters	WDTime	Comms - Devicenet	DeviceNet Parameters
Type	Digital alarms	Digital Alarm Parameters	WDTime	Comms - Profibus	Profibus Parameters
Type	Timer	Timer Parameters	WDTime	Comms - EtherNet	EtherNet Parameters
Type	Load	Load Parameters	Wednesday	Real time clock	Real Time Clock
Type	Loop set up	Loop Set up	WetOffset	Humidity	Humidity Parameters
UnitID Enable	Comms - EtherNet	EtherNet Parameters	WetTemp	Humidity	Humidity Parameters
Units	Instrument - Options	Instrument / Options	WorkingSP	Loop - main	Loop Parameters – Main
Units	IO - Thermocouple input	Thermocouple Input Parameters	Zirconia En	Instrument - Enables	Instrument / Enables
Units	IO - PRT input	RT Input Parameters			

Scan for local contacts

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this publication.

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