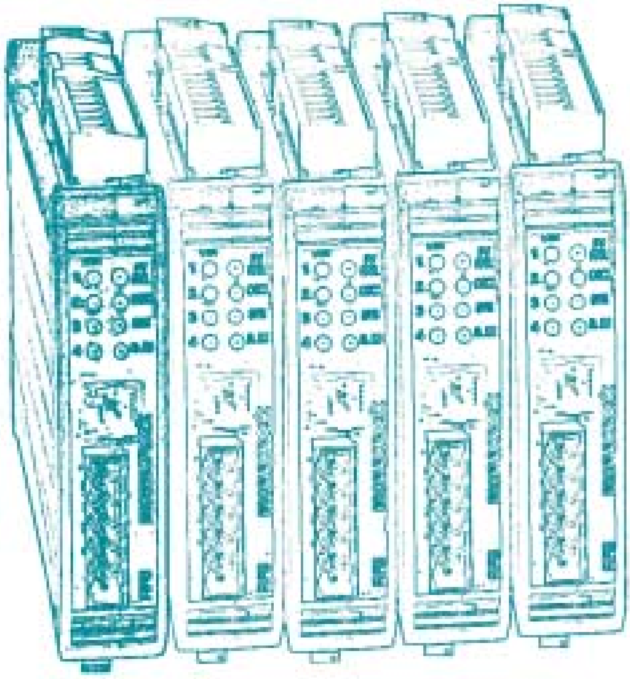
RFS

DIN RAIL TEMPERATURE CONTROLLER

invensys EUROTHERM



RFS User Manual

Mounting Requirements

Select a mounting location having the following characteristics:

1) Easily accessible.

2) No vibration or impact.

3) No corrosive gases (sulphuric gas, ammonia, etc.).

4) No water or other fluids (i.e. condensation).

5) The ambient temperature is within specifications (from 0 to 50°C).

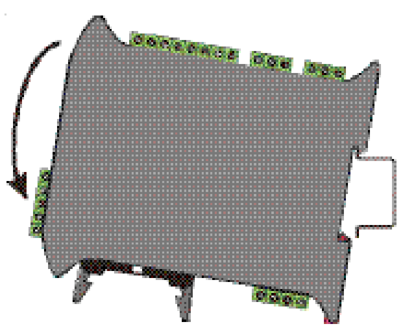
6) The relative humidity is within specifications (20% to 85% non-condensing).

The instrument can be mounted on OMEGA DIN rail in accordance with EN 50 022 (35 x 7.5 mm or 35 x 15 mm) regulations.

For outline dimensions refer to Figure 2.

MOUNTING

Fig. 1A



REMOVING

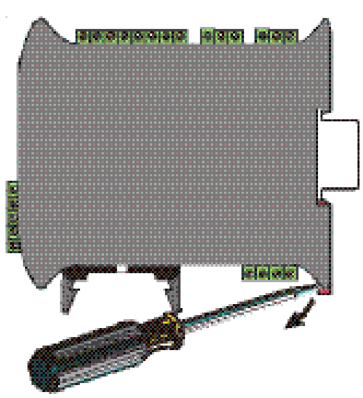


Fig. 1.B

OUTLINE DIMENSIONS

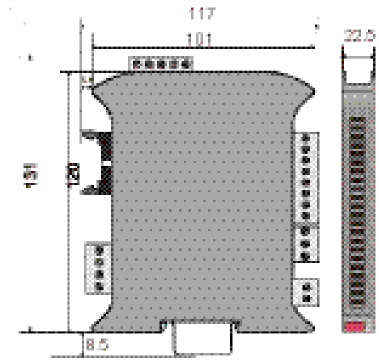


Fig. 2 – OUTLINE DIMENSIONS

CONNECTION DIAGRAMS

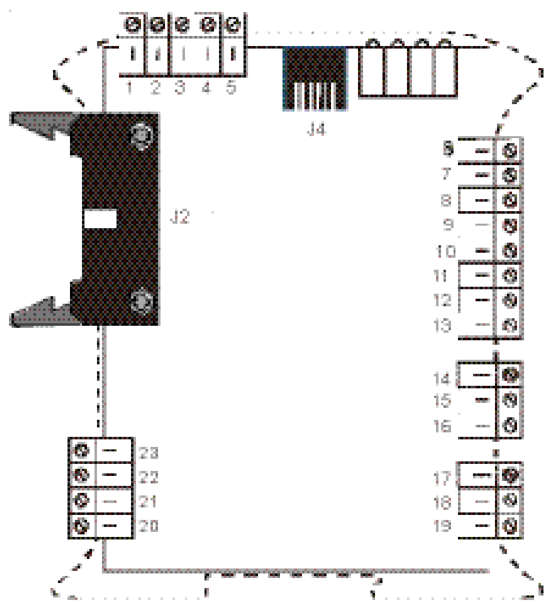


Fig. 3 – TERMINAL BLOCK

MEASURING INPUTS

NOTE: Any external component (like zener diodes, etc.) connected between sensor and input terminals may cause errors in measurement due to excessive or unbalanced line resistance or possible leakage currents.

TC INPUT

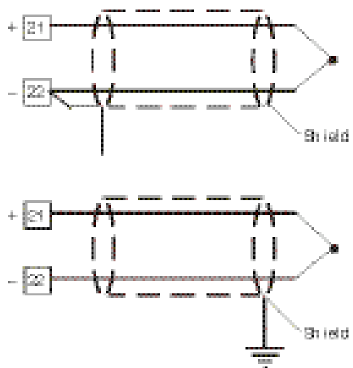


Fig. 4 – THERMOCOUPLE INPUT WIRING

NOTE:

1) Do not run input wires together with power cables.
2) For TC wiring use proper compensating cable, preferable shielded.
3) When a shielded cable is used, it should be connected at one point only.

RTD INPUT

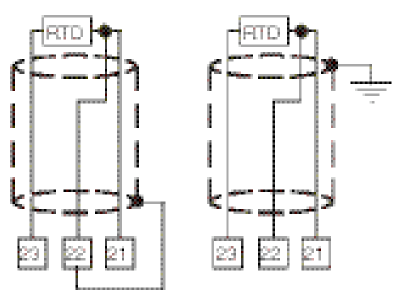


Fig. 5 – RTD INPUT WIRING

NOTE:

1) Do not run input wires together with power cables.
2) Keep line resistance as low as possible. Line resistance higher than 20 ohms/wire can cause measurement errors.
3) If shielded cable is used, it should be grounded at one point only.
4) The resistance of all 3 wires must be the same.

LINEAR INPUT

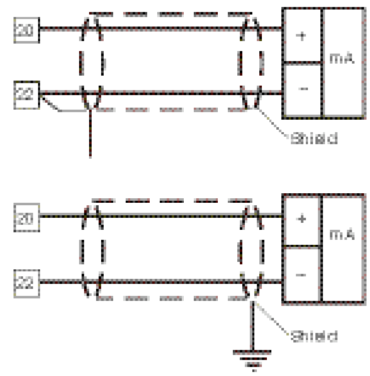


Fig. 6A – 6 mA INPUT WIRING

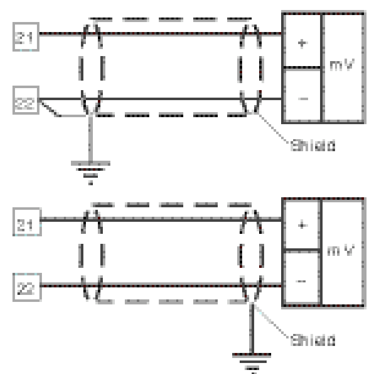


Fig. 6B – 60mV INPUT WIRING

NOTE:

1) Do not run input wires together with power cables.
2) When shielded cable is used, it should be grounded at one point only to avoid ground loop currents.
3) For mV inputs, pay attention to the line resistance; high line resistance can cause measurement errors.

The input impedance is equal to:
< 5 ohms for 20 mA input.
> 1M ohms for 60 mV input.

LOGIC INPUT

Safety note:

1) Do not run logic input wiring together with power cables.
2) Use an external dry contact capable of switching 5 mA, 7.5 VDC.
3) The instrument needs 100ms to recognize a contact status variation.
4) The logic input is isolated from the measuring input.

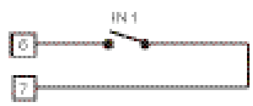


Fig. 7 - LOGIC INPUT WIRING

The logic input can be programmed to perform the following functions:

a) to switch between the main setpoint and auxiliary setpoint.

logic input	operating setpoint
open	main SP
close	auxiliary SP (SP2)

b) to hold the setpoint ramp execution.

logic input	Ramp
open	RUN
close	HOLD

CURRENT TRANSFORMER INPUT

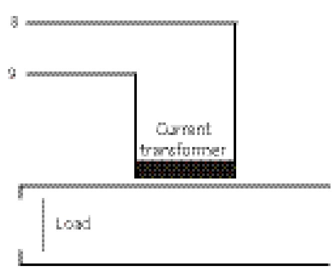


Fig. 8 – CURRENT TRANSFORMER INPUT WIRING

NOTE:

1) The input impedance is 12 ohms.
2) The maximum input current is 50 mA rms (50/60 Hz).

RELAY OUTPUTS

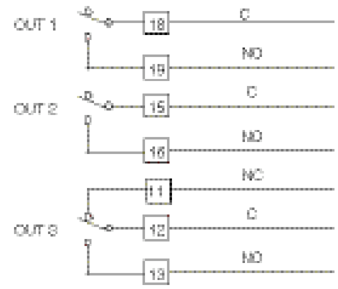


Fig. 9 – RELAY OUTPUTS WIRING

The contact rating of OUT 1, 2 and 3 is 3A/250VAC on a resistive load.

The number of operations is 3 x 10^7 at specified rating.

NOTES

1) To avoid electrical shock, connect the power line at the end of the wiring procedure.
2) For power connections use No 16 AWG or larger wires rated for at last 75 °C.
3) Use copper conductors only.
4) Do not run input wires together with power cables.

All relay contacts are protected by varistor against inductive load with an inductive component up to 0.5 A.

The following recommendations avoid serious problems that can occur when using a relay output to drive an inductive load.

INDUCTIVE LOADS

High voltage transients can occur when switching inductive loads. Through the internal contacts these transients can introduce disturbances which effect the performance of the instrument.

For all outputs, the internal varistor assures protection up to 0.5A of inductive component.

The same problem can occur when a switch is used in series with the internal contacts as shown in Fig. 10.

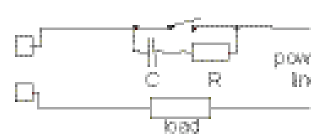


Fig. 10 – EXTERNAL SWITCH IN SERIES WITH THE INTERNAL CONTACT

In this case it is recommended to install an additional RC network across the external contact as show in Fig. 10

The value of capacitor (C) and resistor (R) are shown in the following table.

Load	C	R	P	Op Voltage
<40mA	0.047µf	100 ohms	1/2W	260VAC
<150mA	0.1µf	22 ohms	2W	260VAC
<0.5A	0.33µf	47 ohms	2W	260VAC

The cable involved in relay output wiring must be as far away as possible from input or communication cables.

VOLTAGE OUTPUTS FOR SSR DRIVE

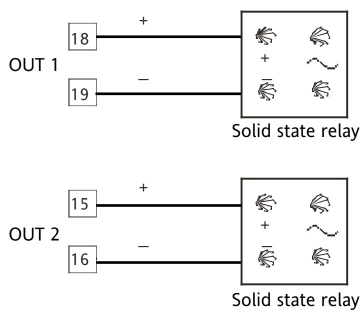


Fig. 11 – SSR DRIVE OUTPUT WIRING

The SSR Drive output is a time proportioning output.

Logic level 0:
 Vout < 0.5VDC
Logic level 1:
 14VDC (+20%) @ 20mA
 24VDC (+20%) @ 1 mA
 Maximum current = 20 mA

NOTE: This output is not isolated. A double or reinforced isolation between instrument output and power supply must be assured by the external solid state relay.

SERIAL INTERFACE

The RS-485 interface allows you to connect slave devices with one remote master unit.

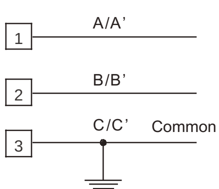


Fig. 12 - RS-485 WIRING

NOTES:

1) The RFS is equipped with an RS-485 driver that has an input impedance four times higher than standard. It is therefore possible to connect 120 RFS units to the same master (instead of 30).

2) The cable length must not exceed 1.5 km at 19200 BAUD.

3) This serial interface is isolated.

4) The following report describes the signal sense of the voltage appearing across the interconnection cable as defined by EIA for RS-485.

 a) The " A " terminal of the generator shall be negative with respect to the " B " terminal for a binary 1 (MARK or OFF) state.

 b) The " A " terminal of the generator shall be positive with respect to the " B " terminal for a binary 0 (SPACE or ON).

5) The EIA standard establishes that by RS-485 interface it is possible to connect up to 30 devices with one remote master unit.

 This serial interface is based on "High input impedance" transceivers which allow you to connect up to 120 devices with one remote master unit.

POWER LINE WIRING

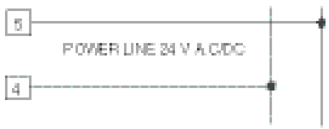


Fig. 13 – POWER LINE WIRING

NOTES:

1) Before connecting the instrument to the power line, make sure that line voltage matches the description on the identification label.

2) Use copper conductors only.

3) Do not run input wires together with power cables.

4) The power supply input is NOT fuse protected. Please provide it externally. For one unit only, the fuse must be rated as follows:

Power Supply Type	Current Voltage
24VAC/DC T	315mA 250 V

If the fuse is damaged, it is advisable to verify the power supply circuit, so that it is necessary to send back the instrument to your supplier.

5) The maximum power consumption is 6VA (4 W).

ACCESSORIES

BUS cable

Note that the screw connectors can be used instead of the flat cable, allowing the normal wiring of a single controller.

This flat cable allows the simultaneous connection of the power supply, the serial interface, the common alarm output (Out 4) and the common logic input of up to 12 instruments plus one Common I/O unit.

NOTE:

1) The logic inputs of each instrument can be driven:

By its own connector (Terminals 6 and 7) without effecting the working of the other elements.

By the common logic input (Terminals 24 and 25) present on the common I/O unit. In this case, all instruments connected with the BUS cable will detect the same logic input condition.

The local logic input (Terminals 6 and 7) and the common logic input (Terminals 24 and 25), are in an OR condition.

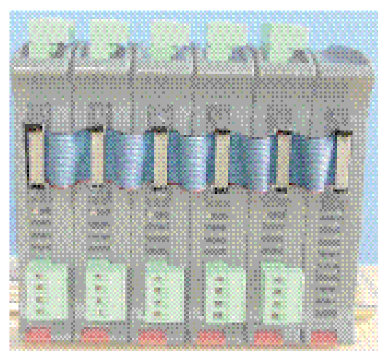


Fig. 14 – BUS CABLE

The connector is a MOLEX Europe, part number 39512163 with16 circuits.

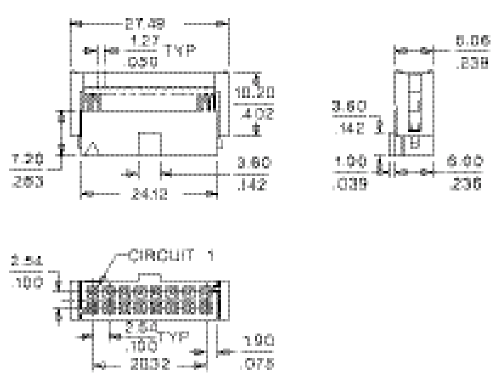


Fig. 15 – CONNECTOR 8x2 FOR BUS CABLE

COMMON I/O UNIT

The Common I/O unit performs 3 different functions:

1. It is the relay output of the common alarms connected to the BUS cable.
2. It performs the connection of the common logic input of all the units connected by the BUS cable.
3. It is the neutral connection of the power supply and of the serial link for all units connected by the BUS cable.

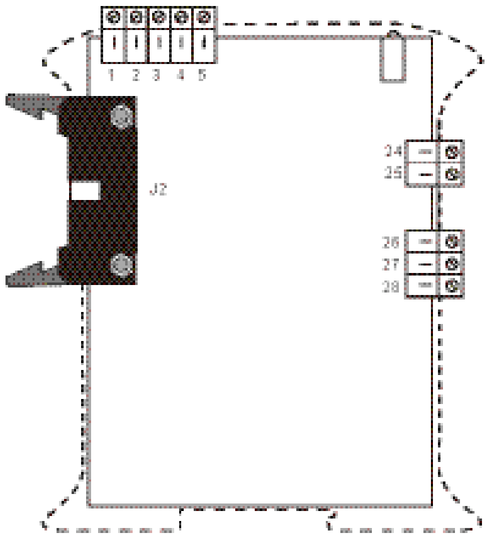


Fig. 16 - COMMON I/O UNIT TERMINAL BLOCK

For the serial interface and the power supply connections see figure 12 and 13 and relative notes.

Common logic input

Safety notes:

1) Do not run logic input wiring together with power cables.
2) Use an external dry contact capable of switching 100 mA, 7.5 VDC minimum.
3) The instrument needs 100ms to recognize a contact status variation.
4) The logic input is isolated from the measuring input.

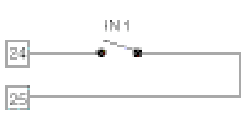


Fig. 17 – COMMON LOGIC INPUT WIRING

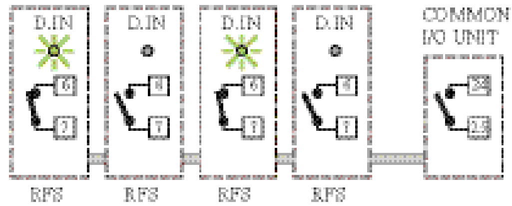


Fig. 18A – Common logic input OPEN

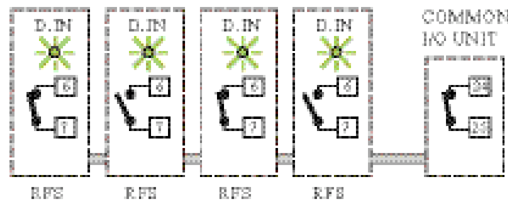


Fig. 18B – Common logic input CLOSE

NOTE:

As shown in Fig 18, the logic input of a group of RFS instruments can be driven separately (using Terminals 6 and 7 of the specific instrument) or collectively (using Terminals 24 and 25 of the Common I/O unit).

The logic input can be programmed to perform the following functions:

a) to switch between the main setpoint and the auxiliary setpoint.

logic input	selected setpoint
open	main SP
close	auxiliary SP (SP2)

b) to hold the setpoint ramp execution.

logic input	ramp
open	RUN
close	HOLD

Common alarm output

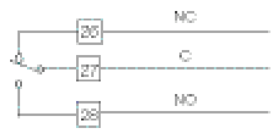


Fig. 19 – COMMON ALARM OUTPUT WIRING

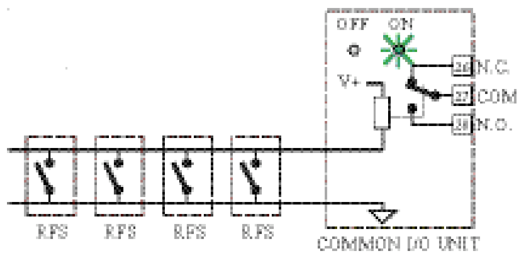


Fig. 20A – Relay de-energized, beacon ON lit.

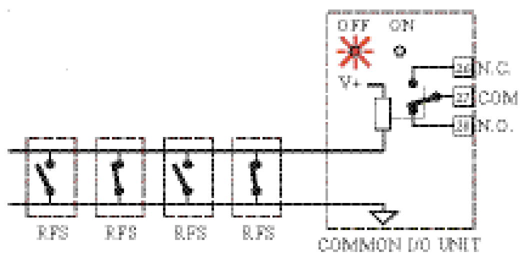


Fig. 20B – Relay energized, beacon OFF lit.

The contact rating of this output is 8A/250VAC on a resistive load.

The number of operations is 3 x 10^5 at specified rating.

NOTE:

Do not run input wires together with power cables.

The relay contacts are protected by varistor against an inductive load with inductive component up to 0.5 A.

CONNECTOR KIT

The unit can be supplied with or without the connector kit. The number of connectors depends on the specific options that have been ordered.

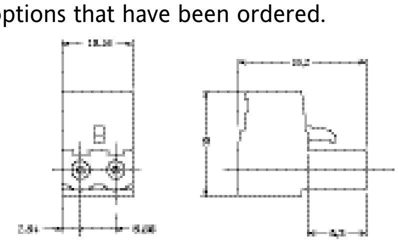


Fig 21 – 2 wire connector

Phoenix model MSTB 2.5/2-ST-5.08

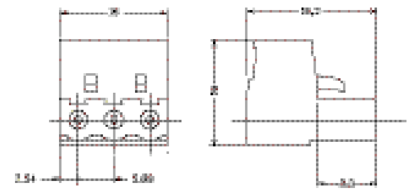


Fig. 22 - 3 wire connector

Phoenix model MSTB 2.5/3-ST-5.08

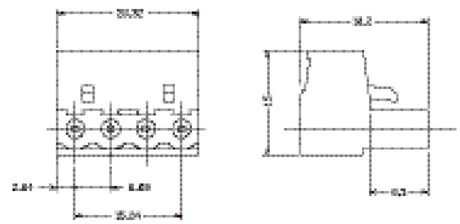


Fig. 23 - 4 wire connector

Phoenix model MSTB 2.5/4-ST-5.08

NOTE:

This connector is gold plated. It is shipped with the instrument and is not included in the connector kit.

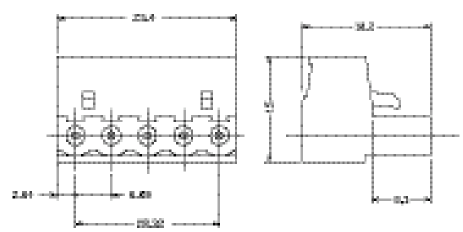
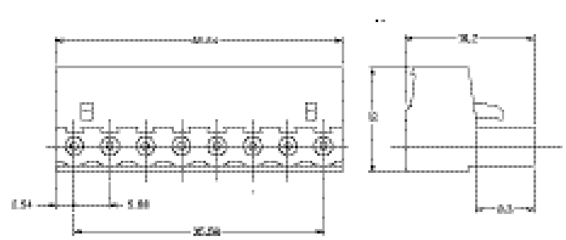


Fig. 24 - 5 wire connector



Phoenix model MSTB 2.5/5-ST-5.08

Fig. 25 - 8 wire connector

Phoenix model MSTB 2.5/8-ST-5.08

FUNCTIONALITY

The RFS has 3 modes:

- Calibration
- Configuration
- Operating

The calibration mode

This mode is detailed in a specific “RFS Calibration manual.”

The configuration mode

During configuration mode the instrument does not perform process control or alarm functions.

During configuration it is possible to read and write all of the instrument parameters.

Configuration can be performed by RS-485 or by a specific tool named CPI.

NOTE that the standard RS-485 and the CPI are mutually exclusive and CPI has priority with respect to the RS-485.

The CPI is shipped with software which greatly simplifies the configuration procedure.

The CPI and RFS configuration are described in a specific manual. The “RFS Modbus Protocol” chapter contains the information related to the various parameters (when it can be read or write, limits, and so on).

The operating mode

During operating mode the instrument performs process control and alarm management and all the other special functions (SMART, soft start, etc.).

During the operating mode it is possible to read and write a subset of parameters.

SPECIAL FUNCTIONS IN THE OPERATING MODE

The following functions occur in the operating mode. This description is meant to help you during configuration and in the operating mode in order to obtain the best performance from the instrument.

NOTE: In the following descriptions two square brackets are used to define the Modbus address of a parameter.

Indicators

1	Lit when OUT 1 is ON
2	Lit when OUT 2 is ON
3	Lit when OUT 3 is ON
4	Lit when OUT 4 is ON
PV FAIL	Lit when failure is detected on measuring input
COM	Lit during transmission
SYS	Flashes during operating mode Lit during configuration and calibration mode
D.IN	lit when the logic input is closed

Enable/disable the control output

When the instrument is in the operating mode, it is possible to disable the control outputs [1504]. In this open loop mode the device will function as an indicato., The instrument will perform measurements but all control outputs will be forced to 0.

When the control outputs are disabled the alarms are also disabled.

If a power down occurs when the control output is disabled, at powerup the control output will be automatically disabled.

When control is restored the instrument operates as in a powerup condition and the alarm mask function, if configured, will be activated.

MANUAL function

The MANUAL mode function [1503] allows you to directly set the power output of the instrument.

The transfer from AUTO to MANUAL and viceversa is bumpless (this function is not provided if integral action is excluded).

If transfer from AUTO to MANUAL is performed during the first part of SMART algorithm (TUNE) when returning to AUTO the device will automatically be forced into the second part of the SMART algorithm (ADAPTIVE).

At powerup the device will be in the AUTO mode or as it was left prior to power shutdown, depending on [1521] configuration selection.

Note: When startup occurs in the Manual mode the power output (OUT1 - OUT2) is set to 0.

SMART function

SMART tuning is used to automatically optimize the control action.

When the SMART function is enabled, it is possible to read but not to write the control parameters (Pb, Ti, Td).

If the SMART function is disabled, the instrument maintains the actual set of control parameters and enables parameter modification.

NOTE: When ON/OFF control is programmed (Pb=0), the SMART function is disabled.

Synchronous pre-heating

Synchronous pre-heating eliminates differential heating during machine startup due to differing heat rates of individual heaters.

This function operates as follows:
At startup all controllers use the first measured value as an initial setpoint and start a ramp to the final setpoint previously programmed.

All common alarms are set as band alarms and are connected to the common logic input.

If one of the loops goes outside of the band, the common alarm will close the common logic input and the ramp execution of all the loops will be on hold.

Ramping will restart when all readings are back in the tracking band.

In order to obtain this function, set the instruments as follows:

1. Alarm 3 must be set as a band alarm ([1903] = 2, [1904] = 0, [1905] = 0, [1906] = 0 and [1907] = 0)
2. The operating setpoint at startup must be set equal to the measured value ([1410] = 1)
3. The logic input is used for ramp hold ([1301] = 2)
4. The "rate of change for positive setpoint variation" [1408] and the "rate of change for negative setpoint variation" [1409] must be set between 1 and 100 digits per minute.
5. The common alarm output must be connected to the common logic input.

Sequential addresses for frequently accessed parameters (Modbus)

To maximize the data transfer rates between the RFS and the host supervisory system important operating parameters are grouped with sequential addresses (see operating group [900]).

To further increase data transfer efficiency, all digital status information is transferred as one data word.
The system enables the RFS to communicate relevant parameter information with a single data request, instead of a series of separate address operations.

Energy management at startup

When you powerup a multi-loop machine in which all loops have the soft start function, the ON and OFF period of the control output of all loops will be (more or less) synchronous, which produces high current peaks.

The RFS instruments will use their Modbus address (all addresses are different) in order to displace the ON and OFF period of the control outputs.

This significantly reduces maximum machine startup current requirements and offers potential savings in electrical installation capacity and cable requirements.

Availability of the not used I/O by serial link

All RFS I/O can be read directly over the Modbus communication interface by the host supervisory system. Additionally, the host can write to RFS outputs that are not assigned as alarm or output functions.

This expands the available PLC and host supervisory system I/O, simplifies machine troubleshooting and provides the possibility to perform remote diagnostics.

OFD – Output failure detection (optional)

Using the CT input, the output failure detection function monitors the current in the load driven by Output 1.

Load and actuator protection is provided in the following manner:

During the ON period of the output, the instrument measures the current through the load and generates an alarm condition if the current is lower than a pre-programmed threshold [1206]. A low current indicates a partial or total breakdown of the load or actuator SSR.

During the OFF period of the output, the instrument measures the leakage current through the load and generates an alarm condition if the current is higher than a pre-programmed threshold [1205]. A high leakage current shows a short circuit of the actuator.

Soft start

This function allows the gradual warm up of the machine during startup.

The energy applied is restricted (by [1514]) for a programmable time [1515].

GENERAL NOTES ON THE MODBUS RTU PROTOCOL

This half duplex protocol accepts one master and one or more slaves.

The physical interface should be RS-485.

A single multidrop link can take up to 120 devices having the same “high input impedance” as the transceiver used.

The computer must be programmed to serve as a master controlling which slave has access to the link. All other slaves are in wait state. Each slave has a unique address ranging from 1 to 254.

Address “0” is for a broadcast. When the master sends a message with address “0”, all slaves receive it and none reply.

NOTE: The numerical values shown in this text are expressed as:

binary if they are followed by b
decimal if they are not followed by any letter
hexadecimal if they are followed by h

TRANSMISSION FORMAT

The protocol uses the RTU (Remote terminal unit) mode of transmission.
RTU is a binary method with the byte format composed as follows:

1 start bit, 8 data bit, 1 parity bit (optional), 1 stop bit.

The communication speed is selectable from 600, 1200, 2400, 4800, 9600 and 19200 baud.

NOTE: If CPI (Configuration Port Interface) is used, the transmission format is fixed (19200 - 8 bits – No parity) and the address is fixed at 255. The broadcast address (0) is not allowed.

COMMUNICATION PROCEDURE

Communications can be initiated only by the master unit; the slave units can transmit only after a query has been received from the master.

The general format for the transmission from master to slave is as follows:

RANGE	BYTE
Slave address	1
Function code	1
Data n Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

The slave detects the start of a query frame when the delay time between two characters is greater than 3.5TUs (Time Unit = Time necessary to transmit one character).

ERROR CHECK (CRC-16 Cyclical Redundancy Check)

The CRC-16 value is calculated by the transmitting device. This value is appended to the message. The receiving device recalculates a CRC-16 and compares the calculated value to the received value. The two values must be equal.

The CRC-16 is started by first pre-loading a 16-bit register with all 1's. The bytes of the message are successively applied to the current contents of the register.

Only the eight bits of data in each character are used for generating the CRC-16. Start and stop bits, and the parity bit if one is used, do not apply to the CRC-16.

During generation of the CRC-16, each byte is exclusively ORed with the register contents. The result is shifted to the right, with a zero filled into the most significant bit (MSB) position. If the LSB was a 1, the register is then exclusively ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last shift, the next byte is exclusively ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, is the CRC-16 value.

A procedure for generating a CRC-16 is:

1. Load a 16-bit register (CRC-16 register) with FFFFh (all 1's).
2. Exclusive OR the first byte of the message with the low byte of the CRC-16 register. Put the result in the CRC-16 register.
3. Shift the CRC-16 register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat Step 3 (another shift).
   (If the LSB was 1): Exclusive OR the CRC-16 register with the polynomial
   value A001h (1010 0000 0000 0001b).
5. Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete byte will have been processed.
6. Repeat Steps 2 through 5 for the next byte of the message. Continue doing this until all bytes have been processed.
7. The final contents of the CRC-16 register is the CRC-16 value.

When the CRC-16 (16 bytes) is transmitted in the message, the low byte will be transmitted first, followed by the high byte.

An example of a C language function performing CRC generation is shown below.

```
/* ..........................................................................
crc_16         calculate the crc_16 error check field
Input parameters:
  buffer: string to calculate CRC
  length: bytes number of the string
This function returns the CRC value.
   .........................................................................*/
unsigned int crc_16 (unsigned char *buffer, unsigned int length)
{
    unsigned int i, j, temp_bit, temp_int, crc;
    crc = 0xFFFF;
    for ( i = 0; i < length; i++ ) {
        temp_int = (unsigned char) *buffer++;
        crc ^= temp_int;
        for ( j = 0; j < 8; j++ ) {
            temp_bit = crc & 0x0001;
            crc >>= 1;
            if ( temp_bit != 0 )
                crc ^= 0xA001;
        }
    }
    return (crc);
}
```

Function code 1 and 2: Reading Bits

These function codes are used by the master unit to request the value of a consecutive group of bits (max 24) which represent the status of the slave unit.

Request from master to slave

Range	**Byte**
Slave address (1-255)	1
Function code (01-02)	1
Bit starting address (high byte)	1
Bit starting address (low byte)	1
Number of bits (high byte)	1
Number of bits (low byte)	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master

Range	**Byte**
Slave address (1-255)	1
Function code (01-02)	1
Byte counter (n)	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

The "Data" field indicates the bits requested: the bit with the lower address is in bit 0 of the first byte, the next is in bit 1, and so on. The eventual don't care bits necessary to complete the last byte are equal to 0.

Example:
Ask the slave at address 3 (3h) the status of 4 (4h) bits starting from bit 2000 (7D0h) "Digital outputs group".

Request from master to slave

Range	**Byte**
Slave address	03h
Function code	01h
Bit starting address (high byte)	07h
Bit starting address (low byte)	D0h
Number of bits (high byte)	00h
Number of bits (low byte)	04h
Error check (CRC-16) (low byte)	3Ch
Error check (CRC-16) (high byte)	A6h

Reply from slave to master

Range	**Byte**
Slave address	03h
Function code	01h
Byte counter	01h
Data	0Ah
Error check (CRC-16) (low byte)	D0h
Error check (CRC-16) (high byte)	37h

The byte in "Data" field (0Ah=000001010b) means:

Bit 2000 status=	0	Status of output 1, output not energized
Bit 2001 status=	1	Status of output 2, output energized
Bit 2002 status=	0	Status of output 3, output not energized
Bit 2003 status=	1	Status of output 4, output energized
Don't care=	0	
Don't care=	0	
Don't care=	0	
Don't care=	0	

Function code 3 and 4: Reading Words

These function codes are used by the master unit to read a consecutive group of words (16 bit) which contain the value of the variable of the slave unit.

The master can request a maximum of 20 words at a time.

Request from master to slave

Range	Byte
Slave address (1-255)	1
Function code (03-04)	1
Word starting address (high byte)	1
Word starting address (low byte)	1
Number of word (high byte)	1
Number of word (low byte)	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master

Range	Byte
Slave address(1-255)	1
Function code (03-04)	1
Byte counter (n)	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

The "Data" field contains the requested words in the following format: high byte of the first word, low byte of the first word, high byte of the second word, and so on.

The "Data" field contains 8000h for not implemented addresses or for information not relevant in the actual device configuration.

Example:

Ask the slave at address 1 (1h) the value of 3 (3h) words starting from word 1100 (44Ch) "Process variable input group".

Request from master to slave

Range	Byte
Slave address	01h
Function code	03h
Word starting address (high byte)	04h
Word starting address (low byte)	4Ch
Number of words (high byte)	00h
Number of words (low byte)	03h
Error check (CRC-16) (low byte)	C5h
Error check (CRC-16) (high byte)	2Ch

Reply from slave to master

Range	Byte
Slave address	01h
Function code	03h
Byte counter	06h
Data	00h
Data	Dh
Data	00h
Data	1Dh
Data	00h
Data	03h
Error check (CRC-16) (low byte)	1Dh
Error check (CRC-16) (high byte)	70h

The 6 bytes in "Data" field (00h, 1Dh, 00h, 1Dh, 00h, 03h) are 3 words whose meaning is:

Word 1100 value =	29 (1Dh)	Input variable without filter, 29°C
Word 1101 value =	29 (1Dh)	Filtered input variable, 29°C
Word 1102 value =	3 (3h)	Input type and range value for main input, Tc J –100 ÷ 1000°C

Function code 5: Writing Single Bits

By using this command, the master unit can change the state of one bit of the slave unit.

Command from master to slave

Range	**Byte**
Slave address (0*-255)	1
Function code (05)	1
Bit address (high byte)	1
Bit address (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master

Range	**Byte**
Slave address (1-255)	1
Function code (05)	1
it address (high byte)	1
Bit address (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

* *To use address 0, see note 1 (“Broadcast” address) in the “Notes” section.*

“Data” field = 0h to reset the bit

= FF00h to set the bit

Example:

Set bit 1003 (3EBh) of slave at address 35 (23h), “Manual reset of an alarm condition” in “Device management group”.

Command from master to slave

Range	**Byte**
Slave address	23h
Function code	05h
Bit address (high byte)	03h
Bit address (low byte)	EBh
Data	FFh
Data	00h
Error check (CRC-16) (low byte)	FAh
Error check (CRC-16) (high byte)	C8h

Reply from slave to master

Range	**Byte**
Slave address	23h
Function code	05h
Bit address (high byte)	03h
Bit address (low byte)	EBh
Data	FFh
Data	00h
Error check (CRC-16) (low byte)	FAh
Error check (CRC-16) (high byte)	C8h

Function code 6: Writing Single Words

By using this command, the master unit can change the value of one word (16 bit) of the slave unit.

Command from master to slave Range	Byte
Slave address (0*-255)	1
Function code (06)	1
Word address (high byte)	1
Word address (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master Range	Byte
Slave address (1-255)	1
Function code (06)	1
Word address (high byte)	1
Word address (low byte)	1
Data	2
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

** To use address 0, see note 1 (“Broadcast” address) in the “Notes” section.*

The 8000h value, present in the “Data” field, should be considered as a don’t care value, that is, the value present in the device at this address will not be modified.

Example:

Set word 1403 (57Bh) of slave at address 1 (1h) with value 240 (F0h), “Main setpoint” in “Setpoint group”.

Command from master to slave Range	Byte
Slave address	01h
Function code	06h
Word address (high byte)	05h
Word address (low byte)	7Bh
Data	00h
Data	F0h
Error check (CRC-16) (low byte)	F9h
Error check (CRC-16) (high byte)	5Bh

Reply from slave to master Range	Byte
Slave address	01h
Function code	06h
Word address (high byte)	05h
Word address (low byte)	7Bh
Data	00h
Data	F0h
Error check (CRC-16) (low byte)	F9h
Error check (CRC-16) (high byte)	5Bh

Function code 15: Writing Multiple Bits

This function code is used by master unit to set/reset a consecutive group of bits (Max 24).

Command from master to slave

Range	Byte
Slave address (0*-255)	1
Function code (15)	1
Bit starting address (high byte)	1
Bit starting address (low byte)	1
Number of bits (high byte)	1
Number of bits (low byte)	1
Byte counter (n)	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master

Range	Byte
Slave address (1-255)	1
Function code (15)	1
Bit starting address (high byte)	1
Bit starting address (low byte)	1
Number of bits (high byte)	1
Number of bits (low byte)	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

** To use address 0, see note 1 ("Broadcast" address) in the "Notes" section.*

The desired status of each bit is packed in the "Data" field (1 = ON, 0 = OFF).
The status imposed for read only bits will be ignored. The command will be processed starting from the first bit and it will be executed or not executed depending on the actual device status. At the first error found, the command will be aborted and the slave will answer with an error.

Example:

Send to slave, at address 2 (2h), the following set of 2 bits:

Bit 2002 (7D2h) status=	0	(bit 0)	Status of output 3, output not energized
Bit 2003 (7D3h) status=	1	(bit 1)	Status of output 4, output energized
Filler=	0	(bit 2)	
Filler=	0	(bit 3)	
Filler=	0	(bit 4)	
Filler=	0	(bit 5)	
Filler=	0	(bit 6)	
Filler=	0	(bit 7)	

NOTE: 1 byte with 2 bits and 6 filler bits must be sent

Command from master to slave

Range	Byte
Slave address	02h
Function code	0Fh
Bit starting address (high byte)	07h
Bit starting address (low byte)	D2h
Number of bits (high byte)	00h
Number of bits (low byte)	02h
Byte counter	01h
Data	02h
Error check (CRC-16) (low byte)	A6h

Reply from slave to master

Range	Byte
Slave address	02h
Function code	0Fh
Bit starting address (high byte)	07h
Bit starting address (low byte)	D2h
Number of bits (high byte)	00h
Number of bits (low byte)	02h
Error check (CRC-16) (low byte)	75h
Error check (CRC-16) (high byte)	74h
Error check (CRC-16) (high byte)	E6h

Function code 16: Writing Multiple Words

This function code is used by the master unit to write a consecutive group of words.

The master unit can change a maximum of 20 words at a time.

Command from master to slave

Range	Byte
Slave address (0*-255)	1
Function code (16)	1
Word starting address (high byte)	1
Word starting address (low byte)	1
Number of words (high byte)	1
Number of words (low byte)	1
Byte counter (n)	1
Data	n
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

Reply from slave to master

Range	Byte
Slave address (1-255)	1
Function code (16)	1
Word starting address (high byte)	1
Word starting address (low byte)	1
Number of words (high byte)	1
Number of words (low byte)	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

* To use address 0, see note 1 (“Broadcast” address) in the “Notes” section.

The data imposed for read only words will be ignored. The command will be processed starting from the first word and it will be executed or not executed depending on the actual device status. At the first error found, the command will be aborted and the slave will answer with an error.

The 8000h value, present in the “data” field, should be considered as a don’t care value, this is, the value present in the device at this address will not be modified.

Example:

Set words 1505 (5E1h), 1506 (5E2h), 1507 (5E3h) of slave at address 10 (Ah) with 40 (28h), don’t care (8000h) and 300 (12Ch) values; “Proportional band”, “Hysteresis” and “Integral time” in “Control group”.

Command from master to slave

Range	Byte
Slave address	0Ah
Function code	10h
Word starting address(high byte)	05h
Word starting address (low byte)	E1h
Number of words (high byte)	00h
Number of words (low byte)	03h
Byte counter	06h
Data	00h
Data	28h
Data	80h
Data	00h
Data	01h
Data	2Ch
Error check (CRC-16) (low byte)	F1h
Error check (CRC-16) (high byte)	DFh

Reply from slave to master

Range	Byte
Slave address	0Ah
Function code	10h
Word starting address (high byte)	05h
Word starting address (low byte)	E1h
Number of words (high byte)	00h
Number of words (low byte)	03h
Error check (CRC-16) (low byte)	D1h
Error check (CRC-16) (high byte)	89h

NOTES

1. “Broadcast” address

When using the writing codes (5, 6, 15 and 16) the slave address 0 is permitted: in this case all slaves connected accept the command but do not give any reply.

2. Word format

Every time the information transfer is performed by using 2 bytes (1 word of 16 bits), the first byte transmitted is the most significant one. For negative numbers the “two’s complement” format is used.

3. Reply time

The slave will start to send a reply from 2ms to 700ms after the end of the request detected by counting the received bytes.

4. Decimal digits

The decimal point that may be present in the value is ignored.

Example:
The value 204.6 is transmitted as 2046 (07FEh)
The value -12.50 is transmitted as -1250 (FB1Eh)

The number of decimal digits, if significant, is stated for each parameter (see the DEC column in the parameters tables).

Some parameters have a variable number of decimal digits according to the configuration below:

PV number of decimal digits apply on process variable [1105]
CT number of decimal digits apply on current transformer read-out [1211]
OP number of decimal digits apply on output power [1524]

5. Local/remote status

In this controller, the “Local/remote status” setting isn’t required. This means that the master unit can modify any parameters without setting any local/remote status bit, moreover no “3 second timeout” will be applied.

6. Operating mode

The “operating mode” indicates the normal functioning status of the device (controller).

In the operating mode the master can read the whole parameters; the device returns 8000h for meaningless ones (for example: the threshold of an unconfigured alarm).

The write operation is allowed only for a restricted number of parameters (for example: it isn’t permitted to change the input configuration). In the operating mode the controller checks the write data to be within the allowable limits (for example: the main setpoint must be inside the setpoint low and high limits).

7. Configuration mode

The “configuration mode” is used to setup the device (and control is disabled).

In the configuration mode the master can read and write the whole parameters.

In the configuration mode, unlike the operating mode, the device always returns a value for each parameter, even for meaningless one’s; this is intended to exactly clone the unit.

Moreover, no check is done by the device receiving parameters; it is the responsibility of the master to send a valid set of parameters. If the master fails to follow the above rule, it will be impossible to switch the controller to the operating mode until all parameters are valid.

8. Read/write access permissions

The access permissions are stated for each parameter in the description tables by means of two columns labeled “read” and “write” according the following definition:

O: access allowed in the operating mode
C: access allowed in the configuration mode
L: access allowed in the calibration mode
F: access allowed in the factory test mode

9. Software key to lock/unlock control parameters

Due to the lack of front panel, no one protection scheme is available for this device.

10. Address space

Variables are addressable as words as well as bits; the user can choose the better way according to the condition.

Although we suggest managing analog variables as words and boolean variables as bits, below is described how to access analog variables (example: alarm threshold) as bits and boolean variables (example: alarm status) as words.

- Reading analog variables as bits: if the variable is not relevant in the actual device configuration (word value 8000h) or if the value is zero, the bit is reset; otherwise the bit is set.
- Writing analog variables as bits: the reset bit means 0000h; the set bit means 0001h.
- Reading boolean variables as words: a reset variable is reported as 0000h; a set one is reported as 0001h.
- Writing boolean variables as words: send 0000h to reset the variable; send a value different from 0000h and 8000h to set the variable.

11. Communication parameters at startup

When it is desired to regain the control of an instrument with an unknown set of communication parameters, you can proceed two different ways:

11.1. Use the CPI adapter. The instrument automatically recognizes the CPI adapter and it will use the following communication parameter set:

- Address = 255

- Baud rate = 19200

- Bite format = 8 bit without parity

This is a fixed parameter set and is not configurable.

11.2. At powerup the instrument will use the same communication parameter set used with the CPI adapter.

- If the instrument receives a correct Modbus request within the first 3 seconds, it will continue to operate with the same communication parameters.
- If, during the 3 second time-ut, the instrument doesn't receive a correct request, it will setup the communication interface with the parameter values previously programmed.

ERROR REPLY

If the "error check" is wrong or the function code is not implemented or a buffer overflow has been received, the slave does not send any reply to the master.

If other errors are detected in the request or command frame, or the slave cannot reply with the requested values or it cannot accept the requested sets because it is in an error condition, the slave replies by forcing a "1" at bit 7 of the received "Function code" byte, followed by an error code.

Error reply (from slave to master)

RANGE	BYTE
Slave address	1
Function code (+80h)	1
Error code	1
Error check (CRC-16) (low byte)	1
Error check (CRC-16) (high byte)	1

List of error codes

ERROR CODE	DESCRIPTION
2	Illegal data address
3	Illegal data value
9	Illegal number of data required
10	The parameter indicated cannot be modified or the command cannot be executed

Error 2 is used only when all addresses involved in a read or write operation are not implemented on the device.

DEVICE IDENTIFICATION GROUP (120)

Modbus Address	DESCRIPTION	READ	WRITE	DEC
120	Manufactured trade mark 50 (32h)	OCLF		
121	Device identification code Note: Number of software revision x 100 + identificatior code 54 (36h)	OCLF		
122	Serial firmware identification code	OCLF		

OPERATING GROUP (900)

Note: Some information shown in this group is repeated in other groups. The purpose of this is to have this information at consecutive addresses. This allows maximum data transfer rates between the RFS and the host supervisory system.

Modbus Address	DESCRIPTI ON	RANGE	READ	WRITE	DEC	Default Value
900	OUT 1 Leakage current measure val ue (in Ampere) **(Same as address 1201)**		O		CT	
901	OUT 1 Load current measure value (in Ampere) **(Same as address 1203)**		O		CT	
902	OUT 2 valu e (in %) **(Same as address 1501)**	0 / 100	O	O	OP	
903	OUT 1 valu e (in %) **(Same as address 1500)**	0 / 100	O	O	OP	
904	STATUS D15 = OUT 1 Leakage current measure updatin g (See address 120 2) (0 = Measure updat ed) (1 = Measure not update d) D14 = 0 (Reserved) D13 = Status alarm 3 (0 = No alarm 1 = Alarm) D12 = Status alarm 2 (0 = No alarm 1 = Alarm) D11 = Status alarm 1 (0 = No alarm 1 = Alarm) D10 = Status CT alarm (0 = No alarm 1 = Alarm) D 9 = OUT 1 Load curr ent measure updating (See address 120 4) (0 = Measure updat ed) (1 = Measure not update d) D 8 = 0 (Reserved) D 7 = Status of Out 4 (0 = Out not energized 1 = Out energized) D 6 = Status of Out 3 (0 = Out not energized 1 = Out energized) D 5 = Status of Out 2 (0 = Out not energized 1 = Out energized) D 4 = Status of Out 1 (0 = Out not energized 1 = Out energized) D 3 = Digital input status (0 = Contact open 1 = Contact close d) D 2 = Auto / Manual (0 = Auto 1 = Manual) D 1 = control output Enabled or disabled (0 = Enabled 1 = Disabled) D 0 = SMART Enable or Disable (0 = Disable d 1 = Enabled)		O			

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
905	Filtered Input variable (in engineering units) Notes: When a measure error is detected, the "Data field" contains one of these error codes: 30004 (7534h) = Under-range 30005 (7535h) = Over-range (or open input) 30014 (753Eh) = Error on reference junction temperature (<-25 °C or >75 °C) 30050 (7562h) = Error on internal auto-zero **(Same as address 1101)**		O		PV	
906	Input variable without filter (in engineering units) Notes: When a measure error is detected, the "Data field" contains one of these error codes: 30004 (7534h) = Under-range 30005 (7535h) = Over-range (or open input) 30014 (753Eh) = Error on reference junction temperature (<-25 °C or >75 °C) 30050 (7562h) = Error on internal auto-zero **(Same as address 1100)**		O		PV	
907	Working set point (in engineering units) **(Same as address 1402)**		O		PV	
908	Main set point (in engineering units) **(Same as address 1403)**	SP L. SP H.	OC L F	OC L F	PV	
909	Auxiliary set point (in engineering units) **(Same as address 1405)**	SP L. SP H.	OC L F	OC L F	PV	
910	Target set point (in engineering units) **(Same as address 1401)**		O		PV	
911	Main volatile set point (in engineering units) **(Same as address 1404)**	SP L. SP H.	O	O	PV	

DEVICE MANAGEMENT GROUP (1000)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC
1000	Device mode Range: 0 = Operative mode 1 = Configuration mode 2 = Calibration mode 3 = reserved Note: When operative mode is set a "Parameter Check Operation" is automatically performed If an error is found the device answers with error code 10 and doesn't enable the new status. Otherwise the device stops any other address test, answers immediately, resets and restarts in operative mode The set in "Calibration" mode is allowed only from configuration mode		OC L F	OC L F	
1001	Execute the PCO (Parameter Check Operation). It returns 0 if no error was found, otherwise it returns the Modbus address of the first wrong parameter.		OC L F		
1002	Load default parameter values Range: 0 = No operation 1 = Load default European table (TB1) 2 = Load default American table (TB2) Note: Using this command, the parameters related with the serial link will change immediately but the new values will become operative only when the instrument comes back to the operative mode.			C	
1003	Manual reset of the alarm conditions Range: 0 = No operation 1 = Alarm Reset			O	
1004	Data Management in Operative Mode Range: 0 = Only valid data are transmitted 1 = All the data are transmitted		O	O	

PROCESS VARIABLE INPUT GROUP (1100)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1100	Measured value without filter (in engineering units) Notes: When an measure error is detected, the "Data field" contains one of these error codes: 30004 (7534h) = Under-range 30005 (7535h) = Over-range (or input open) 30014 (753Eh) = Error on reference junction temperature (<-25 °C or >75 °C) 30050 (7562h) = Error on internal auto-zero		O		PV	
1101	Filtered measured value (in engineering units) Note: See Measured value without filter [1100]		O		PV	
1102	Input type and range value for main input Range: 0 = Tc L (0 ~ 400.0 °C) 1 = Tc L (0 ~ 900 °C) 2 = Tc J (-100.0 ~ 400.0 °C) 3 = Tc J (-100 ~ 1000 °C) 4 = Tc K (-100.0 ~ 400.0 °C) 5 = Tc K (-100 ~ 1370 °C) 6 = Tc N (-100 ~ 1400 °C) 7 = Tc R (0 ~ 1760 °C) 8 = Tc S (0 ~ 1760 °C) 9 = RTD Pt100 (-200.0 ~ 400.0 °C) 10 = RTD Pt100 (-200 ~ 800 °C) 11 = Linear (0 ~ 60 mV) 12 = Linear (12 ~ 60 mv) 13 = Linear (0 ~ 20 mA) 14 = Linear (4 ~ 20 mA) 15 = (reserved) 16 = (reserved) 17 = (reserved) 18 = (reserved) 19 = Tc L (0 ~ 1650 °F) 20 = Tc J (-150 ~ 1830 °F) 21 = Tc K (-150 ~ 2500 °F) 22 = Tc N (-150 ~ 2550 °F) 23 = Tc R (0 ~ 3200 °F) 24 = Tc S (0 ~ 3200 °F) 25 = RTD Pt100 (-200.0 ~ 400.0 °F) 26 = RTD Pt100 (- 330 ~ 1470 °F) 27 = Tc T (-200.0 ~ 400.0 °C) 28 = Tc T (- 330 ~ 750 °F)		OC L F	C L F		TB1= 3 TB2= 20
1103	Initial scale value (*)	-2000/4000 (for linear) Range limits (for Tc/Rtd)	OC L F	C L F	PV	TB1=0 TB2=0

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1104	Full scale value (*)	-2000/4000 (for linear) Range limits (for Tc/Rtd)	OC L F	C L F	PV	TB1=400 TB2=1000
1105	Decimal point position PV (Process variable). Range: 0 = No decimal figure 1 = One decimal figure 2 = Two decimal figures 3 = Three decimal figures Note: The write command is enabled only for linear input.		OC L F	C L F		TB1 = 0 TB2 = 0
1106	Offset adjustment (in engineering units) Note: Not available for linear ranges	-199 / 199	OC L F	C L F	PV	TB1 = 0 TB2 = 0

(*) Note: The absolute value of the minimum input span ([Full scale value] – [Initial scale value]) must be greater than:

100 digits for linear input ranges
300°C (550°F) for TC input ranges
100°C (200°F) for Rtd input ranges

CURRENT TRANSFORMER INPUT AND ALARM GROUP (1200)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1200	CT alarm status (Load and Leakage alarms) Range: 0 = No alarm 1 = Alarm Note: Available only when the option is programmed		O			
1201	OUT 1 Leakage current measured value (in Ampere) Note: Available only when the option is programmed		O		CT	
1202	OUT 1 Leakage current measure updating flag Range: 0 = Measure updated 1 = Measure not updated Notes: 1) Available only when the option is programmed. 2) If the OFF period is lower than 150 ms, the instrument is not able to perform this measure. This flag shows the status of the measure		O			
1203	OUT 1 Load current measured value (in Ampere) Note: Available only when the option is programmed		O		CT	
1204	OUT 1 Load current measure updating flag Range: 0 = Measure updated 1 = Measure not updated Notes: 1) Available only when the option is programmed. 2) If the ON period is lower than 150 ms, the instrument is not able to perform this measure. This flag shows the status of the measure		O			
1205	Threshold for alarm on Leakage current (in Ampere) Note: Available only when the option is programmed	0 / H. Scale	OC LF	OC LF	CT	TB1 = 50 TB2 = 50
1206	Threshold for alarm on Load current (in Ampere) Note: Available only when the option is programmed	0 / H. Scale	OC LF	OC LF	CT	TB1 = 100 TB2 = 100

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1207	Active period of the load (for the current transformer) Range: 0 = Option not provided 1 = The load is energized when Out1 is active (Relay "ON" or SSR=1) 2 = The load is energized when Out1 is not active (Relay "OFF" or SSR=0)		OC L F	C L F		TB1 = 0 TB2 = 0
1208	CT Alarm reset type Range: 0 = Automatic reset 1 = Manual reset Note: Available only when the option is programmed		OC L F	C L F		TB1 = 0 TB2 = 0
1209	CT Alarm action Range: 0 = Direct action (relay energized in alarm condition) 1 = Reverse action (relay de-energized in alarm condition) Note: Available only when the option is programmed This configuration is the same made by address 1806.		OC L F	C L F		TB1 = 1 TB2 = 1
1210	CT range (in Ampere) It is the nominal primary current of the current transformer used. Note: Available only when the option is	10 / 100	OC L F	C L F	0	TB1 = 10 TB2 = 10
1211	Number of decimal figures for the CT measurement The accuracy of the CT measurement is equal to: - 0.1 A if the CT range is lower than 20 A - 1 A if the CT range is higher than 20 A So that: - When [1210] parameter is lower than 20 (A), the [1211] parameter will be equal to 1 - When [1210] parameter is higher than 20 (A), the [1211] parameter will be equal to 0		OC L F			TB1 = 1 TB2 = 1

NOTE: The CT Alarm and Alarm 2 are in an OR condition on Output 3.

DIGITAL INPUT GROUP (1300)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1300	Digital input status Range 0 = Input not active (contact open) 1 = Input active (contact closed)		OC L F			
1301	Digital input function Range 0 = Option not used 1 = Digital input used for "main set point"/"auxiliary set point" selection (Input active means Auxiliary set point). 2 = Digital input used to hold the set point ramp execution (Input active means ramp hold).		OC L F	C L F		TB1 = 0 TB2 = 0

SETPOINT GROUP (1400)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1400	Selected set point Range: 0 = Main set point 1 = Auxiliary set point		O			
1401	Target set point (in engineering units)		O		PV	
1402	Working set point (in engineering units)		O		PV	
1403	Main set point (in engineering units)	SP L. Limit / SP H. Limit	OC L F	OC L F	PV	TB1 = 0 TB2 = 0
1404	Volatile set point (in engineering units)	SP L. Limit / SP H. Limit	O	O	PV	TB1 = 0 TB2 = 0
1405	Auxiliary set point (in engineering units) Note: Available only if selectable	SP L. Limit / SP H. Limit	OC L F	OC L F	PV	TB1 = 0 TB2 = 0
1406	Set point high limit (in engineering units)	SP L. Limit / H. Scale	OC L F	OC L F	PV	TB1 = 400 TB2 = 1000
1407	Set point low limit (in engineering units)	L. Scale / SP H. Limit	OC L F	OC L F	PV	TB1 = 0 TB2 = 0
1408	Rate of change for positive set point variation (in engineering units per minute)	1 / 100 32767 (7FFFh) for step change	OC L F	OC L F	PV	TB1 = 7FFFh TB2 = 7FFFh
1409	Rate of change for negative set point variation (in engineering units per minute)	1 / 100 32767 (7FFFh) for step change	OC L F	OC L F	PV	TB1 = 7FFFh TB2 = 7FFFh
1410	Operative set point alignment at start-up Range: 0 = The operative set point will be aligned to the set point selected by digital input or by the serial link 1 = The operative set point will be aligned to the actual measured value and then it will reach the selected set point with the programmed ramp (Address 1408 / 1409). NOTE: if the instrument detect an out of range or an error condition on the measured value, it will operate as described for [1410] = 0		OC L F	C L F		TB1 = 0 TB2 = 0

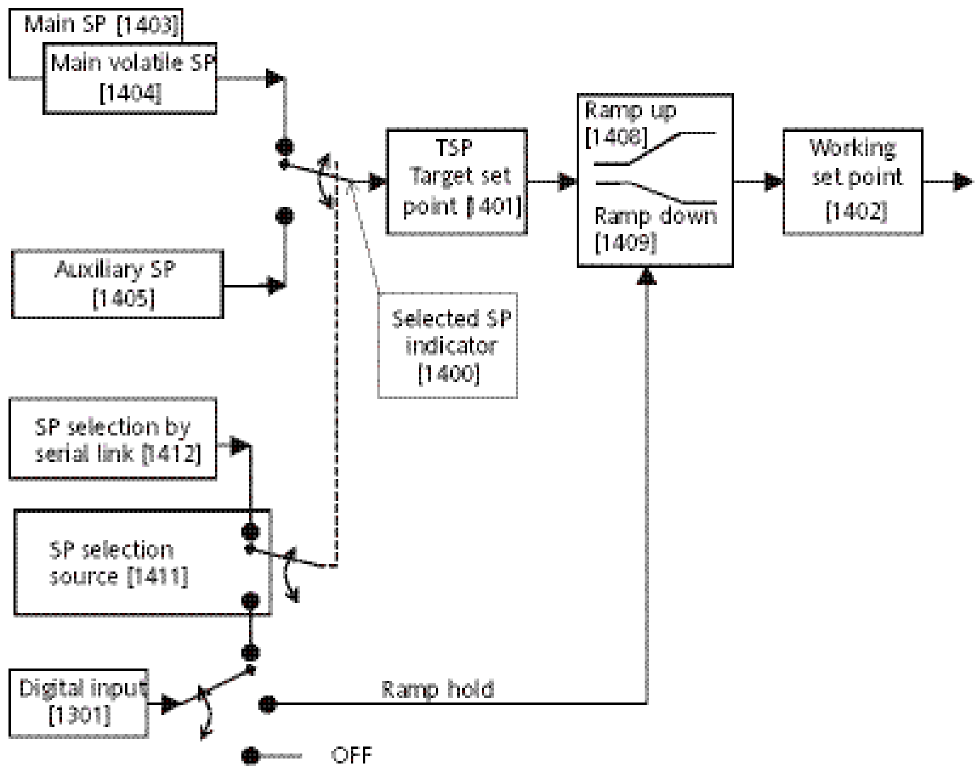
Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1411	Set point selection source Range: 0 = Set point selected by digital input. 1 = Set point selected by serial link (address 1412)		OCLF	OCLF		TB1 = 0 TB2 = 0
1412	Set point selected by serial link Range: 0 = Main set point 1 = Auxiliary set point		OCLF	OCLF		TB1 = 0 TB2 = 0
1413	Delta applied to the Main set point (in engineering units) This value will be algebraically added to the main set point (address 1403) and then limited.	-6000 / 6000		O		
1414	Delta applied to the volatile set point (in engineering units) This value will be algebraically added to main set point (address 1404) and then limited.	-6000 / 6000		O		
1415	Delta applied to the Auxiliary set point (in engineering units) This value will be algebraically added to auxiliary set point (address 1405) and then limited.	-6000 / 6000		O		

Notes about setpoint management

NOTE 1

In order to make clear the result of different set of the various parameter, we have added the following diagram.

NOTE: the main SP (1403) is a value memorized in EEPROM, while the main volatile SP (1404) is a value memorized in RAM. For this reason, when you make a profile setting the setpoint value by serial link (e.g. with a supervisory system), it is advisable to use the main volatile SP, instead of the main SP (the EEPROM has a limited number of write actions allowed while the RAM has no limit).



NOTE 2

Parameters [1413], [1414] and [1415] allow you to increase or decrease a setpoint without knowing the current value.

This solution allows you to modify by the same amount the setpoints (Main setpoint, volatile setpoint or auxiliary setpoint, respectively) of different instruments at the same time.

CONTROL (OUTPUT 1) GROUP (1500)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1500	OUT 1 value (in %)	0 / 100	O	O	OP	
1501	OUT 2 value (in %)	0 / 100	O	O	OP	
1502	Pid out value	-32767 / 32767	O	O	OP	
1503	Auto/manual function Range: 0 = Auto 1 = Manual		OC L F	OC L F		TB1 = 0 TB2 = 0
1504	Enable/disable control output Range: 0 = Control enabled 1 = Control disabled		OC L F	OC L F		TB1 = 0 TB2 = 0
1505	Proportional band (in % of the input span)	10 / 1000 (for H only) 15 / 1000 (for H/C) 0 (for ON/OFF)	OC L F	OC L F	1	TB1 = 40 TB2 = 40
1506	Hysteresis for ON / OFF control mode (in % of the input span) Note: Available only when Proportional band is set to zero.	1 / 100	OC L F	OC L F	1	TB1 = 5 TB2 = 5
1507	Integral time (in seconds) Note: The value 32767 (7FFFh) means that the integral action is excluded	1 / 1200	OC L F	OC L F	0	TB1 = 240 TB2 = 240
1508	Integral pre-load (in % of the output span)	0 / 100 (for H only) -100 / 100 (for H/C)	OC L F	OC L F	0	TB1 = 30 TB2 = 30
1509	Derivative time (in seconds)	0 / 600	OC L F	OC L F	0	TB1 = 60 TB2 = 60
1510	Out 1 Cycle time (in seconds)	1 / 200	OC L F	OC L F	0	TB1 = 15 TB2 = 15
1511	Relative cooling gain Note: Available only for HC control	20 / 100	OC L F	OC L F	2	TB1 = 100 TB2 = 100
1512	Dead band/overlap between H/C outputs (in % of the proportional band) Notes: 1) Available only for HC control 2) A negative value produces an dead band while a positive value produces an overlap	-20 / 50	OC L F	OC L F	0	TB1 = 0 TB2 = 0
1513	Out 2 Cycle time (in seconds) Note: Available only for HC control	1 / 200	OC L F	OC L F	0	TB1 = 10 TB2 = 10

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1514	Output high limiter (in %) (**)	0 / 100 (for H only) -100 / 100 (for H/C)	OC L F	OC L F	0P	TB1 = 100 TB2 = 100
1515	Time duration of the output power limiter (soft start) (in minutes) (**) Note: The value 32767 (7FFFh) means that the limiting action is always on	1 / 540	OC L F	OC L F	0	TB1 = 7FFFh TB2 = 7FFFh
1516	Control output max rate of rise (in percent of the output per second) Note: The value 32767 (7FFFh) means that no ramp limitation is imposed.	1 / 25	OC L F	OC L F	OP	TB1 = 7FFFh TB2 = 7FFFh
1517	Out 1 action Range: 0 = Direct 1 = Reverse		OC L F	C L F		TB1 = 1 TB2 = 1
1518	Control action type Range: 0 = The process is controlled by PID actions 1 = The process is controlled by PI actions		OC L F	C L F		TB1 = 0 TB2 = 0
1519	Threshold to enable the soft start (output power limiting) (in engineering units)	L. Scale / H. Scale	OC L F	C L F	PV	TB1 = 0 TB2 = 0
1520	Inhibit reset band extension (in % of the proportional band)	-30 / 30	OC L F	C L F	0	TB1 = 10 TB2 = 10
1521	Device status at instrument start up Range: 0 = It starts always in auto mode 1 = It starts in the same way it was left prior to the power shut down. If in manual mode the power output is set to 0 2 = It starts in the same way it was left prior to the power shut down. If in manual mode the power output will be equal to the last value used left prior to the power shut down. 3 = It starts always in manual mode with power output set to 0		OC L F	C L F		TB1 = 2 TB2 = 2

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1514	Output high limiter (in %) (**)	0 / 100 (for H only) -100 / 100 (for H/C)	OC L F	OC L F	0P	TB1 = 100 TB2 = 100
1515	Time duration of the output power limiter (soft start) (in minutes) (**) Note: The value 32767 (7FFFh) means that the limiting action is always on	1 / 540	OC L F	OC L F	0	TB1 = 7FFFh TB2 = 7FFFh
1516	Control output max rate of rise (in percent of the output per second) Note: The value 32767 (7FFFh) means that no ramp limitation is imposed.	1 / 25	OC L F	OC L F	OP	TB1 = 7FFFh TB2 = 7FFFh
1517	Out 1 action Range: 0 = Direct 1 = Reverse		OC L F	C L F		TB1 = 1 TB2 = 1
1518	Control action type Range: 0 = The process is controlled by PID actions 1 = The process is controlled by PI actions		OC L F	C L F		TB1 = 0 TB2 = 0
1519	Threshold to enable the soft start (output power limiting) (in engineering units)	L. Scale / H. Scale	OC L F	C L F	PV	TB1 = 0 TB2 = 0
1520	Inhibit reset band extension (in % of the proportional band)	-30 / 30	OC L F	C L F	0	TB1 = 10 TB2 = 10
1521	Device status at instrument start up Range: 0 = It starts always in auto mode 1 = It starts in the same way it was left prior to the power shut down. If in manual mode the power output is set to 0 2 = It starts in the same way it was left prior to the power shut down. If in manual mode the power output will be equal to the last value used left prior to the power shut down. 3 = It starts always in manual mode with power output set to 0		OC L F	C L F		TB1 = 2 TB2 = 2

(**) NOTE: the parameters [1514] and [1515] allow the soft start function to be set.

At powerup the instrument limits the power output (using [1514]) for a programmed time (set by [1515].

This function allows gradual warmup the machine during startup.

SMART GROUP (1600)P

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1600	Tune status Range: 0 = No tune 1 = Tune		O			
1601	Adaptive status Range: 0 = No adaptive 1 = Adaptive		O			
1602	Smart enable/disable Range: 0 = Disable 1 = Enable Note: Reading, this bit is logical "or" between Tune and Adaptive status		OC L F	OC L F		TB1 = 0 TB2 = 0
1603	Relative cooling gain calculated by the smart algorithm Range: 0 = Smart does not calculate R.C.G. 1 = Smart calculates R.C.G. Note: Available only for HC control		OC L F	C L F		TB1 = 0 TB2 = 0
1604	Type of cooling media Range 0 = Air is used as cooling media 1 = Oil is used as cooling media 2 = Direct water is used as cooling media Changing [1604], the instrument forces the cycle time and relative cooling gain parameter to the default value related with the chosen cooling media When [1604] = Air - Cy2 = 10 s and rC = 1.00 [1604] = OIL - Cy2 = 4 s and rC = 0.80 [1604] = H2O - Cy2 = 2 and rC = 0.40 Note: Available only for HC control		OC L F	C L F		TB1 = 0 TB2 = 0
1605	Max value of proportional band calculated by the smart algorithm	Min. Value / 1000	OC L F	C L F	1	TB1 = 300 TB2 = 300
1606	Min value of proportional band calculated by the smart algorithm Note: Not available for HC control	10 / Max. value	OC L F	C L F	1	TB1 = 15 TB2 = 15
1607	Min value of proportional band calculated by the smart algorithm Note: Available only for HC control	15 / Max. value	OC L F	C L F	1	TB1 = 10 TB2 = 10
1608	Min value of integral time calculated by the smart algorithm (in seconds)	1 / 120	OC L F	C L F	0	TB1 = 50 TB2 = 50

ALARM 1 (OUTPUT 2) GROUP (1700)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1700	Alarm 1 status Range: 0 = No alarm 1 = Alarm Note: Available only if AL1 is configure d		O			
1701	Alarm 1 threshold Note: Available only if AL1 is configure d	L. Scale / H. Scale (for Process alarm) 0 / 500 (for Band alarm) -500 / 500 (for deviation alarm)	OC L F	OC L F	PV	TB1 = 0 TB2 = 0
1702	Alarm 1 hysteresis (Range: from 0.1% to 10.0 % of the range selected with [1103] and [1104] parameters or 1 LSD). Note: Available only if AL1 is configure d	1 / 100	OC L F	OC L F	1	TB1 = 1 TB2 = 1
1703	Out 2 function Range: 0 = Output not used 1 = Output used as alarm 1 output (Process alarm) 2 = Output used as alarm 1 output (Band alarm) 3 = Output used as alarm 1 output (Deviation alarm) 4 = Output used as cooling output		OC L F	C L F		TB1 = 1 TB2 = 1
1704	Alarm 1 operating mode Range: 0 = High alarm (outside for band alarm) 1 = Low alarm (inside for band alarm) Note: Available only if AL1 is configure d		OC L F	C L F		TB1 = 0 TB2 = 0
1705	Alarm 1 reset type Range: 0 = Automatic reset 1 = Manual reset Note: Available only if AL1 is configure d		OC L F	C L F		TB1 = 0 TB2 = 0

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1706	Alarm 1 action Range: 0 = Direct action (relay energized in alarm condition) 1 = Reverse action (relay de-energized in alarm condition) Note: Available only if AL1 is configure d		OC L F	C L F		TB1 = 1 TB2 = 1
1707	Alarm 1 stand-by (mask) function Range: 0 = No standby function 1 = Standby function Notes: 1) Available only if AL1 is configured 2) If the alarm is programmed as band or deviation alarm, this function masks the alarm condition after a set point change or at the instrument start-up until the process variable reaches the alarm threshold plus or minus hysteresis. If the alarm is programmed as a process alarm, this function masks the alarm condition at instrument start-up until process variable reaches the alarm threshold plus or minus hysteresis.		OC L F	C L F		TB1 = 0 TB2 = 0

ALARM 2 (OUTPUT 3) GROUP (1800)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1800	Alarm 2 status Range: 0 = No alarm 1 = Alarm Note: Available only if AL2 is configure d		O			
1801	Alarm 2 threshold Note: Available only if AL2 is configure d	L. Scale / H. Scale (for process alarm) 0 / 500 (for band alarm) -500 / 500 (for deviation alarm)	OC LF	OC LF	PV	TB1 = 0 TB2 = 0
1802	Alarm 2 hysteresis (Range: from 0.1% to 10.0 % of the range selected with [1103] and [1104] parameters or 1 LSD). Note: Available only if AL2 is configure d	1 / 100	OC LF	OC LF	1	TB1 = 1 TB2 = 1
1803	Out 3 function Range: 0 = Output not used for alarm 2 1 = Output used as alarm 2 output (Process alarm) 2 = Output used as alarm 2 output (Band alarm) 3 = Output used as alarm 2 output (Deviation alarm) Note: Alarm 2 and CT alarm outputs are in OR condition.		OC LF	C LF		TB1 = 0 TB2 = 0
1804	Alarm 2 operating mode Range: 0 = High alarm (outside for band alarm) 1 = Low alarm (inside for band alarm) Note: Available only if AL2 is configure d		OC LF	C LF		TB1 = 0 TB2 = 0
1805	Alarm 2 reset type Range: 0 = Automatic reset 1 = Manual reset Note: Available only if AL2 is configure d		OC LF	C LF		TB1 = 0 TB2 = 0

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1806	Alarm 2 action Range: 0 = Direct action (relay energized in alarm condition) 1 = Reverse action (relay de-energized in alarm condition) Note: This configuration is the same of that at address 1209 Available only if AL2 is configured		OC L F	C L F		TB1 = 1 TB2 = 1
1807	Alarm 2 stand-by (mask) function Range: 0 = No standby function 1 = Standby function Notes: 1) Available only if AL2 is configured 2) If the alarm is programmed as band or deviation alarm, this function masks the alarm condition after a set point change or at the instrument start-up until the process variable reaches the alarm threshold plus or minus hysteresis. If the alarm is programmed as a process alarm, this function masks the alarm condition at instrument start-up until process variable reaches the alarm threshold plus or minus hysteresis.		OC L F	C L F		TB1 = 0 TB2 = 0

ALARM 3 (OUTPUT 4) GROUP (1900)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1900	Alarm 3 status Range: 0 = No alarm 1 = Alarm Note: Available only if AL3 is configure d		O			
1901	Alarm 3 threshold Note: Available only if AL3 is configure d	L. Scale / H. Scale (for Process alarm) 0 / 500 (for Band alarm) -500 / 500 (for deviation alarm)	OC L F	OC L F	PV	TB1 = 0 TB2 = 0
1902	Alarm 3 hysteresis (Range: from 0.1% to 10.0 % of the range selected with [1103] and [1104] parameters or 1 LSD). Note: Available only if AL3 is configure d	1 / 100	OC L F	OC L F	1	TB1 = 1 TB2 = 1
1903	Out 4 function Range: 0 = Output not used for alarm 3 1 = Output used as alarm 3 output (Process alarm) 2 = Output used as alarm 3 output (Band alarm) 3 = Output used as alarm 3 output (Deviation alarm)		OC L F	C L F		TB1 = 0 TB2 = 0
1904	Alarm 3 operating mode Range: 0 = High alarm (outside for band alarm) 1 = Low alarm (inside for band alarm) Note: Available only if AL3 is configure d		OC L F	C L F		TB1 = 0 TB2 = 0
1905	Alarm 3 reset type Range: 0 = Automatic reset 1 = Manual reset Note: Available only if AL3 is configure d		OC L F	C L F		TB1 = 0 TB2 = 0

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
1906	Alarm 3 action Range: 0 = Direct action (relay energized in alarm condition) 1 = Reverse action (relay de-energized in alarm condition) Note: Available only if AL3 is configure d		OC L F	C L F		TB1 = 1 TB2 = 1
1907	Alarm 3 stand-by (mask) function Range: 0 = No standby function 1 = Standby function Notes: 1) Available only if AL3 is configured 2) If the alarm is programmed as band or deviation alarm, this function masks the alarm condition after a set point change or at the instrument start-up until the process variable reaches the alarm threshold plus or minus hysteresis. If the alarm is programmed as a process alarm, this function masks the alarm condition at instrument start-up until process variable reaches the alarm threshold plus or minus hysteresis.		OC L F	C L F		TB1 = 0 TB2 = 0

DIGITAL OUTPUT GROUP (2000)

Modbus Address	DESCRIPTION	READ	WRITE	DEC
2000	Output 1 status Range 0 = Output not energized 1 = Output energized	OC L F	C L F	
2001	Output 2 status Range 0 = Output not energized 1 = Output energized Note: Writing to this parameter is allowed in operative mode only if the output is not driven by an internal function (like alarm).	OC L F	OC L F	
2002	Output 3 status Range and note: see "Status of output 2"	OC L F	OC L F	
2003	Output 4 status Range and note: see "Status of output 2"	OC L F	OC L F	

COMMUNICATION GROUP (2100)

Modbus Address	DESCRIPTION	RANGE	READ	WRITE	DEC	Default Value
2100	Serial link device address Note: When you set a new value, it will become operative after an instrument resets or removing the CPI. If you made a request before the reset the device will reply the new value but it continue to use the old one. Keep attention to the data set because at the instrument start-up, if incompatible data are found, the serial line will be set with fixed parameters: Address 255 Baud rate 19200 Byte format 8 bits without parity	1 / 254	OC LF	OC LF		TB1 = 1 TB2 = 1
2101	Baud rate for serial link Range: 0 = 600 Baud 1 = 1200 Baud 2 = 2400 Baud 3 = 4800 Baud 4 = 9600 Baud 5 = 19200 Baud Note: See note on "Serial link device address" parameter.		OC LF	OC LF		TB1 = 5 TB2 = 5
2102	Byte format for serial link Range: 0 = 8 bits + even parity 1 = 8 bits + odd parity 2 = 8 bits without parity Note: See note on "Serial link device address" parameter.		OC LF	OC LF		TB1 = 2 TB2 = 2

GENERAL SPECIFICATIONS

Case: Polycarbonate dark grey color self-extinguishing degree: V2 according to UL 746C

Protection: IP20

Terminals: 23 screw terminals (M3 screw for cables from 0.25 to 2.5 mm^2 or from AWG 22 to AWG 14) with connection diagram

Dimensions: DIN 43700 120 x 101 x 22.5mm

Weight: - of the RFS = 140g

- of the common I/O unit = 110g

Power supply: 24 VAC/VDC (+10% of nominal)

Power consumption: 6 VA max. (4W)

Sample time: 250ms for linear inputs

500ms for TC and RTD inputs

Accuracy: + 0.2% f.s.v. + 1 digit @ 25°C ambient temperature

Common mode rejection: >120 dB @ 50/60 Hz

Normal mode rejection: >60 dB @ 50/60 Hz

Electromagnetic compatibility and safety requirements: This instrument is marked CE. Therefore, it conforms to council directives 89/336/EEC and to council directives 73/23/EEC and 93/68/EEC (reference harmonized standard EN 61010-1)

Installation category (over-voltage category): CAT II / 50V

Pollution degree: 2

Operating temperature: from 0 to 50°C (+32 to 122°F).

Storage temperature: -20 to +70°C (-4 to 158°F)

Humidity: from 20% to 85% RH, non-condensing

Operating altitude: up to 2000m

Inputs

A) Thermocouple

Type : L, J, K, N, R, S, T (°C/°F selectable)

External resistance: 100 ohms max.

Burnout: Shown as overrange (standard) or an underrange condition (selectable by cut and short)

TC sensor current: 150 nA

Cold junction: auto compensation 0 to 50°C

Cold junction accuracy: 0.1 °C/°C

Input impedance: > 1M ohm

	Type	STD	Eng unit	Range		Temp drift (PPM)
TC	J	IEC 584-1	°C	-100.0	400.0	400
				-100	1000	200
			°F	-150	1830	
	K	IEC 584-1	°C	-100.0	400.0	400
				-100	1370	200
			°F	-150	2500	
	L	DIN 43710 - 1977	°C	0.0	400.0	400
				0	900	200
			°F	0	1650	
	N	IEC 584-1	°C	-100	1400	200
			°F	-150	2550	
	R	IEC 584-1	°C	0	1760	500
			°F	0	3200	
	S	IEC 584-1	°C	0	1760	500
			°F	0	3200	
	T	IEC 584-1	°C	-200.0	400.0	400
			°F	-330	750	

B) RTD (Resistance Temperature Detector)

Type: Pt100, 3-wire connection

Line resistance: automatic compensation up to 20 ohms/wire with no measurable error

Engineering units: °C or °F programmable

RTD sensor current: 130 mA

Burnout: Upscale. NOTE: a special test is provided to signal OVERRANGE when input resistance is less than 12 ohms

	Type	STD	Eng unit	Range		Temp drift (PPM)
RTD	Pt100	DIN 43760	°C	-200.0	400.0	500
				-200	800	400
			°F	-200.0	400.0	800
				-330	1470	400

C) LINEAR INPUTS

Readout: programmable from -2000 to +4000

Decimal point: programmable to any position

Burnout: Shown as an underrange condition for 4-20 mA, 0-60 mV and 12-60 mV input types

Sensor	Type	Input impedance	Temp drift (ppm/°C of full span)
Current	0/20 mA	< 5 Ω	300
	4/20 mA	< 5 Ω	
Voltage	0/60 mV	> 1M Ω	300
	12/60 mV	> 1M Ω	

D) LOGIC INPUT

One programmable input from contact (voltage free)

NOTES:

1) Use an external dry contact capable of switching 5 mA, 7.5 VDC.
2) The instrument needs 100ms to recognize a contact status change.
3) The logic input is isolated from the measuring input.

C) CURRENT TRANSFORMER INPUT

Input current: 50mA rms 50/60 Hz

Readout: selectable between 10A or 100A

Resolution: 0.1 A for 20A range

1A for all the other ranges

Active period: for relay output: NO or NC programmable

for SSR drive output: logic level 1 or 0 programmable.

Minimum active period: 50 ms

SETPOINTS

Main SP and auxiliary SP (SP2)

Setpoint transfer: The transfer from one setpoint to another (or between two different setpoint values) can be by a step transfer or by a ramp with two different programmable rates-of-change (ramp up and ramp down)

Slope: 1 - 100 eng. units/min. or step

Setpoint limit: programmable

CONTROL ACTION

Control action: PID + SMART

Type: One (heating or cooling) or two (heating and cooling) control outputs

Proportional Band (Pb):

Range: 1.0% to 100.0% of the input span for one control output

1.5% to 100.0% of the input span for two control outputs. When Pb=0, the control action is ON/OFF.

Hysteresis: (for ON/OFF control) 0.1% to 10.0% of input span

Integral time (Ti): 1sec. to 20 minutes (or none)

Derivative time (Td): 0sec. to 10 minutes (or none)

Integral preload: 0 to 100% for one control output

-100% (cooling) to +100 % (heating) for two control outputs

SMART: enabling/disabling

Auto/Manual mode: selectable

Manual/Auto transfer: bumpless

OUTPUTS

Control output update: 250 ms for linear inputs

500 ms for TC or RTD inputs

Action: reverse/direct (programmable)

Output status indication: four indicators (OUT 1, 2, 3 and 4) are lit when the respective outputs are in the ON condition.

Output level limit: For one control output: from 0 to 100%

For two control outputs: from -100% to +100%

Cycle time: For Out 1: programmable from 1 to 200s

For Out 2: programmable from 1 to 200s

Relative cooling gain: programmable from 0.20 to 1.00

Overlap/deadband: programmable from - 20% to +50% of the proportional band

OUTPUT 1

Function:		programmable as heating or cooling output
Type:	a)	Relay output with SPST contact contact rating 3A/250VAC on resistive load.
	b)	Logic voltage for SSR drive *Logic status 1:* 24V +20% @ 1mA 14V +20% @ 20mA *Logic status 0:* <0.5 V

OUTPUT 2

Function:		programmable as: - Control output (cooling) - Alarm 1 output
Type:		
	a)	Relay output with SPST contact contact rating 3A/250VAC on resistive load
	b)	Logic voltage for SSR drive *Logic status 1:* 24V +20% @ 1mA 14V +20% @ 20mA *Logic status 0:* <0.5 V

OUTPUT 3

Function:	Alarm 2 output
Type:	relay with SPDT contact
Contact rated:	3A at 250VAC on resistive load

OUTPUT 4

Output type:	Open collector, optically isolated with respect to the other circuits
Rating:	10 mA max. at 48V

ALARMS

Action:	Direct or reverse acting
Alarm functions:	each alarm can be configured as process alarm, band alarm or deviation alarm
Alarm reset:	automatic or manual reset programmable on each alarm
Standby (mask) alarm:	each alarm can be configured with or without standby (mask) function. This function avoids false indication at startup or after a setpoint change

PROCESS ALARM:

Operating mode:	High or low programmable
Threshold:	programmable in engineering units within the input span
Hysteresis:	programmable from 0.1% to 10.0% of the input span

BAND ALARM

Operating mode:	Inside or outside programmable
Threshold:	programmable from 0 to 500 units
Hysteresis:	programmable from 0.1% to 10.0% of the input span

DEVIATION ALARM:

Operating mode:	High or low programmable
Threshold:	programmable from - 500 to +500 units
Hysteresis:	programmable from 0.1% to 10.0% of the input span

COMMUNICATION INTERFACE

Type:	RS-485, opto-isolated
Protocol:	Modbus RTU, device acts as slave
Baud rate:	600, 1200, 2400, 4800, 9600 or 19200 baud
Data format:	8 bit no parity; 8 bit even parity; or 8 bit odd parity
Slave number:	up to 120 RFS units can be connected to the same RS-485 network without using repeaters

MAINTENANCE

1) REMOVE POWER FROM THE POWER SUPPLY TERMINALS AND FROM RELAY OUTPUT TERMINALS
2) Using a vacuum cleaner or compressed air (max. 3 kg/cm2) to remove all dust and dirt which may be present on the louvers and on the internal circuits. Be careful not to damage the electronic components.
3) To clean external plastic or rubber parts use only a cloth moistened with:

   Ethyl Alcohol (pure or denatured) [C_2H_5OH]

   Isopropyl Alcohol (pure or denatured) [$(CH_3)_2CHOH$]

   Water (H_2O)
4) Tighten any loose terminals.
5) Before repowering the instrument make certain that it is perfectly dry.
6) Turn the instrument ON.

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