815

CONTROLLER/ PROGRAMMER

EUROTHERM CONTROLS

Engineers Manual

815 Controller/Programmer

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Chapter 1.0
Standard Precautions

When designing any control system it is essential to consider what will happen if any individual part of the system malfunctions.

In a temperature control application, for example, the danger is that for some reason the heating system remains permanently switched on.

This could happen if:
1. Thermocouple or sensor becomes "detatched" from the system i.e. is no longer measuring the actual temperature achieved.

2. Thermocouple or thermocouple wiring becomes short circuited.

3. Component failure within the controller in such a way as to leave the output switched on.

4. Microprocessor or software failure in a system.

5. Failure of valve movement or valve linkage.

6. Remote setpoint to controller is faulty.

7. Operation by unauthorised personnel.
e.g. (a) Controller left in Manual with high output power set.
(b) Setpoint set too high.

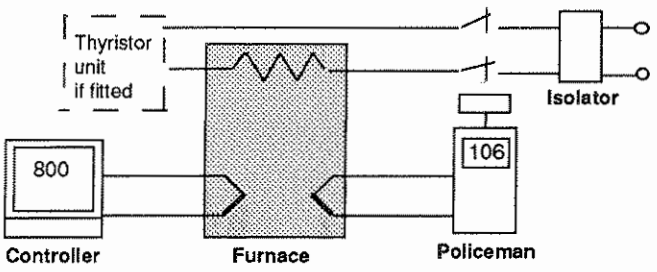
8. Any lack of maintenence in serviceable parts.

....and many other unforseen situations.

If leaving the heater on all the time can cause damage either to the plant itself or its contents, then an independent device must be provided.

The best form of protection is a completely independent 'policeman'. This is a seperate overtemperature alarm with its own thermocouple or sensor and, on alarm will pull out the main contactor or shut off the valve to ensure the plant's safety.

e.g.



A suitable policeman is the Eurotherm 106 overtemperature alarm.
Note that an alarm relay in the controller is not sufficient protection for all eventualities.

Before installing, operating or servicing industrial electronic equipment, please read the following which highlights some important parts of the proposed standards document IEC 801, currently in draft form.

1.1 GUIDELINES FOR SAFE USE OF ELECTRONIC EQUIPMENT

Note: *All Eurotherm equipment is designed to operate in harsh industrial environments and is thoroughly tested. These guidelines represent good engineering principles for safe and trouble-free operation and are recommended for all control equipment, whether from Eurotherm or any other supplier. They should be used in conjunction with local regulations.*

1.2 OVERCURRENT PROTECTION

It is recommended that AC power supplies to instruments be protected by fuses or automatic circuit breakers rated at not more than 2 Amperes, and must be separated from any load current circuits.

1.3 VOLTAGE RATINGS

Care must be taken to ensure that maximum voltage ratings are not exceeded.
Unless otherwise stated in the specification of any particular unit, the maximum voltage which may be applied between any two isolated circuits, or between any isolated circuit and earth, is limited to the highest rated supply voltage for that unit.
Take particular care not to connect AC supplies to low voltage control inputs such as sensor inputs, logic inputs and outputs.

1.4 ENCLOSURE OF LIVE PARTS

Some metal parts of certain types of equipment can become electrically "live" in some conditions of normal operation. Unless clearly intended to be panel mounted and accessible during normal operation, all units should be installed inside a suitable earthed metal enclosure to prevent live parts being accessible to human hands and metal tools.
It is recommended that rear terminal covers (available as an option on most Eurotherm units) be fitted wherever possible.

1.5 WIRING

It is important to connect all equipment correctly in accordance with the installation data provided for each type of unit.
Most connections to equipment require correct polarity to be maintained and due attention must be given to ensure this. Unlabelled terminals must not be used as "tie points" for other wires.
Conductors should be commensurate with voltage and current ratings of the units, and should conform to appropriate standards of good practice and local codes and regulations.
Any questions concerning the correct wiring of Eurotherm units should be directed to the nearest Eurotherm Sales and Service engineer.

1.6 ROUTING OF WIRING

Care should be taken to ensure maximum separation between low current control or signal wiring and power wiring.
Control wiring refers to those connections to the input of the controller, analogue or logic outputs, digital inputs, remote setpoint inputs and relays switching control signals.
Power wiring refers to those connections to relay or triac switched AC supplies, and wiring associated with external devices such as contactors, alarm relays or motor speed drives etc.
It is essential that control and power wiring are routed separately through the cabinets and plant.
This requires that the mechanical design must take into account all the different items to be included and the type of wiring involved. The design layout should include the separation described above.

The AC supply to all the controllers should be taken from as close to the in-coming source as possible and should not under any circumstances be "daisy chained" from other equipment, especially if it is likely to generate, supply bourne, electrical noise.

For controllers with digital communications it is strongly recommended that screened cable is used and that only one end of the screen is earthed at the "cleanest" end, usually at the computer. The screened cable should be routed with the control wiring. Do not use 'spare' wires in the cable for other signals.

1.7 EARTHING

All earth terminals must be securely connected directly to a good local earth by conductors appropriate to the current ratings of the units.
Most Eurotherm instruments have internal circuits which are isolated or "floating". This is necessary to prevent the occurance of an "earth loop" in signal circuits. To avoid possible shock hazards in the event of an internal fault causing breakdown of insulation, it is recommended that all equipment connected to any Eurotherm unit be enclosed in an earthed metal enclosure. Sheaths of thermocouples (or other sensors) should be properly earthed by a separate conductor (instead of being dependent on earthing via the machine framework).

1.8 SUPPLY ISOLATORS

Every electrical system should be provided with means for isolating the system from the AC supply to allow safe working during repair and maintenance. Thyristors and triacs are not adequate means of isolating the supply and should always be backed by a suitable mechanical isolator.

1.9 SUPPLY IMPEDANCE

Control cabinets and equipment should be sited as close to the incoming supply as possible. This is essential on high power systems using thyristors driving large transformer loads. In all cases, both inside and outside the cabinet, long supply cables should be avoided. If they are unavoidable, conductors of an adequate rating must be used.
Avoid running instruments from a supply which has shared wiring with high current circuits, particularly if these are switched by contactors or thyristors.

1.10 PLANT AND PERSONNEL PROTECTION

On control applications it is essential to consider what will happen if any individual part of the system malfunctions. Where excessive deviation of a controlled parameter due to equipment failure could cause damage to machinery or materials, or injury to personnel, it is recommended that an additional separate unit, such as the Eurotherm 106, with its own separate sensor, be used to give alarm indication or to shut down the process or both, as may be appropriate.
Note: "Alarm relays" fitted inside the controller itself may not give sufficient protection in all possible circumstances. When "alarm units" or "alarm boards" are used they should be checked for correct operation and calibration at regular intervals.

1.11 HAZARDOUS ATMOSPHERES

No product should be connected to a circuit which passes into or through a hazardous area unless appropriate precautions are taken (even though the instrument itself may be located in a safe area). Such an installation should conform to the requirements of the relevant local regulations.
Unless categorically stated in the published specification of any particular unit, it should be assumed they are not suitable for direct use in areas subject to hazardous atmospheres.

1.12 PROCEDURE IN THE EVENT OF TROUBLE

Before beginning any investigation of a fault, the electrical supplies to all equipment concerned should be switched off and isolated. Units suspected of being faulty should be disconnected and removed to a properly equipped workshop for testing or returned to the manufacturer for repair. Any attempt to troubleshoot while installed could be hazardous to personnel and equipment.

IF IN DOUBT, ASK!

If you have any questions regarding any aspect of installing, operating or servicing your Eurotherm equipment, please contact your nearest Eurotherm Sales and Service engineer.

2.3 ALARMS (2)

Relays:-
264V 2A maximum into resistive load, with spark suppression. Minimum switched voltage- (30 volt rms or dc). Leakage current through spark suppression = 2mA at 264V ac 50Hz

Hysteresis:-
0.1-10.0% variable, in 0.1% resolution

Type:-
Full scale high and low ; deviation high and low; deviation band

Range:-
Alarms may be set over the complete instrument range

Option:-
One or both alarm outputs may be assigned to program segments on 815P.

2.4 GENERAL

Display

4 x 7 segment 12mm high fluorescent indicator. Display range + 8000 to -1999

Resolution:-
± 1 least significant digit

Error Bar:-
9 Bar indicator

Sensitivity:-
<±0.5%; 0.5-1%; 1-2%; >5% of instrument span

Calibration

Error:-
Better than ± 0.25% of display range max. (see section 3)

Control Parameters

Auto/Manual:-
Bumpless procedure auto to manual and manual to auto when SP track is set. Bumpless procedure auto to manual when SP hold is set
Manual output variable from 0 to 100% for heat outputs and -100% to +100% for heat and cool instruments.

Local/remote:-
Local SP = SP1.
Remote SP = Either full scale remote or
Full scale remote + local trim (LSP) or
Remote Trim + Full scale local(LSP)
Not available with programme running, or ST

Commissioning Parameters

*Proportional Band (PB):-
0.1 to 999.9% based on the range ' display max' - ' display min ' or 1 to span in Engineering Unit

Integral Time (ti):-
off,1 to 9999 secs or 1-150 mins

Manual reset (RES):-
-100 or 0 to + 100% (automatically selected if integral time is 'off')

Derivative time:-
off, 0.1 to 999.9 secs or 1-15 mins

Cut Back (CBL/CBH):-
off,0.1 to display range for both low and high

Heat output limit (HL):-
0 to 100%

Cool output limit (CL):-
0 to - 100%

Heat cycle time (HC):-
0.3 to 100 seconds (10 to 100 secs for relay)

Cool cycle time (Cc):-
0.3 to 100 seconds (10 to 100 secs for relay)

*Relative cool gain (Cr):-
0.1 to 20.0% of proportional band (PB)

Heat-cool deadband (DB):-
-5 to +5% of proportional band

Setpoint rate limit (Pr):-
1 to 1999 units per min or hour with decimal position as display eg: XX.XX display gives 0.01 to 19.99

Sensor break power (SbP):-
0 to 100% (heat only) or -100% to 100% (heat/cool) activated by 10% over or under range.

* For ON/OFF Outputs proportional band and/or relative cool gain are replaced by dead band and relative dead band.

2.5 COMMUNICATIONS

Digital

Protocol:-
Variable speed link, ASCII format RS232 or RS422/485 protocol ANS1 X 3.28 (1976) 2.5 A4, at baud rates variable from 300, 600, 1200, 2400, 3600, 4800 and 9600.

Isolation:-
Between communication link and all other inputs and outputs meets IEC348, UL 1092, VDE, 411 and BS4743 standards.

Format:-
Start bit - seven data bits - even parity bit - one stop bit.

Address:-
Two digits

Digital input:-
Overrides, the digital communication link and holds 'keylock' and 'parameter security' disabled.

2.6 LOGIC INPUTS (1 on 815S, 2 on 815P) (Standard on all instruments).

Drive :-
Pulled up to +5 volts in rest state : must be pulled down to 0 volts with an impedance of <100 ohms to activate.

Isolation:-
Logic inputs not isolated from one another or measured value input but isolated from all other inputs and outputs to IEC348, UL1092, VDE411 and BS4743 standards.

Voltage Level Limits:-
For logic input active the input level must be less than 0.70 volts for logic input in-active the input level must be greater than 4.00 volts.

Input current:-
0.5mA maximum

Configuration:-
(one only per logic input)

Auto/manual	*Ramp enable.*
Remote/local	*Run/Hold*
Self tune	*Reset*
Keylock	*Parameter modification security*
Skip Segment	

Trigger:-
All are level triggered except self tune and skip current segment which are edge triggered.

2.7 SELF-TUNE

Self tune (ST)

Operation

A single shot approach which exercises the output in an on/off mode measuring the response of the measured value and installing values of PID, cycle time relative cool gain and,under certain conditions, cutback. During the routine the output is turned off and on to force the self tune routine into a single cycle of oscillation.

Enhancements:-

A) If integral turned off unit tunes as a PD controller.

B) If integral and derivative turned off unit tunes as a P. controller.

Suspension:-

If the instrument is switched to manual whilst in self tune the self tune will be suspended. On reverting to ' auto' the unit will recommence the self tune routine from the start.

Limitation:-

The instrument will not self tune when configured in the on/off mode or when ramp or programme in enabled.

Abort:-

'Stop' will be flashed into the top display alternating with the measured value if the instrument is unsuccessful in self tuning the loop. Under these circumstances the 'ST' feature should be terminated by manually switching 'off'.

2.8 RAMP

Ramp rate is set in units/minute or hour, this being configured in the instrument software. The range of the ramp rate is dependent upon the decimal point position in the display as shown below.

	Decimal Point Position of Display.			
	XXXX	XXX.X	XX.XX	X.XXX
Ramp Rate Limit in Units/ Minute or hour	1 to 1999	0.1 to 1999	0.01 to 199.9	00.001 to 19.99

Limitations:-

The ramp is not operative whilst remote, self tune or programme are enabled.

2.9 PROGRAMMING (815P only)

Number of programmes:-

One

Programme length:-

Maximum of two segments of ramp plus dwell

Ramp setting:-

Ramps set as rates : variable from 1 to max. Display increment/ min or hour.

All ramp setting also have step, none, and end in scroll .

Dwell Setting:-

Dwell variable from 0.1 to 999.9 mins or hours, plus 0= no dwell and end.

Programme cycles:-

Maximum of 999

Holdback:-

Can be configured for whole program as deviation band. Variable from 'off', 1- display range.

Run/Hold:-

Operation by toggle action of front push button or by a configured digital input or via the digital communications link.

Reset:-

Operative throughout the programme or at the 'end' state. Enabled by pressing the 'up ' and 'down' buttons together or by a configured digital input or via the digital communications link.

Programme parameters:-

Can only be changed when the programme is reset or in hold. Elapsed time for dwells can be varied by viewing the elapse time with 'Hold' enabled and scrolling using the ' up' and ' down ' buttons.

Suspension:-

Switching to 'manual' whilst a programme is running will enable 'hold' . 'Hold 'will remain set when 'auto' is again enabled. The 'run/hold' button must be pressed to restart programme.

Limitations:-

Run cannot be selected when 'remote', or 'manual ' are enabled.

Power/failure:-

A running programme will be placed into 'Hold 'on power failure. Recovery on re-instatng the power will be as follows:-

A) In ramp- servo start at the ramp rate.

B) In dwell - servo start, ramping at previous segment ramp rate. (Time remaining will decrement from re-instating power if holdback is off. With holdback set, time remaining does not start to decrement until measured value is within holdback value of dwell level).

C) With track set working setpoint will track measured value in 'manual' and power failure.

Outputs:-

One or both alarm outputs can be driven from segments of the programme.

2.10 PRIORITY

Most functions of the instrument can be switched from three sources, the front push button, configured digital inputs or by the digital communications link. Priority of these sources are as follows:-

A) Digital inputs have the highest priority unless these have been locked out by the digital communications.

B) Front push buttons and the digital communications have equal priority except where the front push buttons have been locked out by the digital communication.

C) Operation from the digital inputs are level triggered and will therefore override the front pushbuttons. The only exception to this is 'self tune' and 'skip segment' which are edge triggered.

2.11 SETPOINTS

Instruments can operate on one of the following setpoints:-

Setpoint	Source	Level	Enabling parameter
SP1	Internal	Fixed	(default)
Programmer	Internal	Variable	Run button,digital input or digital comms
Ramp	Internal	Variable	Run button,digital input or digital comms
rsP	External	Fixed or Variable	Remote button,digital input or digital comms
LSP + rsP	Internal + External	Fixed or Variable	Remote button,digital input or digital comms.

The current value of the selected setpoint is displayed against the legend 'S.P' in the short scroll.

2.12 SWITCHING MODES

Current Mode	Next Mode (Valid Switching) via		Next Mode (Invalid Switching) via any means
	Digital input	Push Buttons or Digital Comms	
Manual	Auto Run Remote 2 ST	Auto (1) Run Remote (2) ST	
Remote (Auto)	Not remote Manual	Not remote (1) Manual	Run ST
Programmer (Run,Auto)	Hold Reset Manual	Hold (3) Reset (3) Manual	Remote ST
Programmer (Hold) Assuming programme was in Run & Auto	Run Reset Manual	Run (4) Reset (4) Manual	Remote ST
Ramp (Auto)	Remote Manual ST	Remote Manual ST Reset	
ST (Auto)	Not ST Manual	Not ST (1) Manual	Run Remote

1) Valid only if current mode was selected via front panel buttons or comms.

2) Will select 'remote' on exiting from the 'manual' mode.

3) Available only if digital input configured for HOLD ACTIVE.

4) Available only if digital input configured for RUN ACTIVE.

2.13 ENVIRONMENTAL

Supply Voltage :-
85 -264Vac

Supply frequency:-
48 - 62Hz

Power consumption:-
8.5 watts

Supply fuse:-
500mA (anti surge).

Interference:-
VDE 0871 specification, curve A for conducted EMI in range 150K Hz to 30M Hz.

Creepage:-
Clearances conform to IEC 348, UL 1092 and VDE 411 and BS4743 standards.

Relative humidity:-
0-90% non-condensing.

Operating temperature:-
0 to 55° C.

Storage temperature:-
-10 to 70° C.

Panel sealing:-
The instrument fascia meets IP64 when mounted into a cut-out as defined below.

Electrical safety:-
IEC 348 class 1 (250 Volt max) UL 1092 (3mm creepage and clearance) and VDE 411 and BS4743 standards.

Customer connections:-
Screw terminals with terminal cover (fastons an option).

Ambient temperature coefficient:-
Typically ± 50 ppm/° C of instrument input span. Excluding CJC on thermocouple instruments.

Warm up drift:-
<±0.5% of display range (from 1 to 30 mins).

Supply voltage coefficient:-
<±0.1% of display range over full supply voltage range.

Mounting:-
Plug-in with panel mounting sleeve. Panel cut-out 92 x 92mm + 0.8-0.0mm to DIN 43710.

Weight:-
1.2 Kg (2.6lbs) including sleeve and clamp.

Rear Cover:-
Gives electrical safety to rear terminals.

Chapter 4.0
Configuration

The 815 controller is microprocessor based and therefore most of the changes to the input, outputs, alarms and options are performed in software (configuration). Some of these software changes are also accompanied by hardware (printed circuit board or switch link) changes.
Changes to the configuration are under the security of a hardware switch. However, the configuration can be read without operating the switch and whilst the instrument is still controlling. To enter the 'read only mode' of the configuration, scroll down through the long scroll until the mnemonic " Sbr" appears on the display. With the 'scroll' button still depressed also depress the 'down' button 'CONF' will appear on the display. Press the 'scroll' button and the first of the configuration mnemonic "CI" will appear on the display. To reveal the numerical value of "CI" depress either the 'up' or 'down' button.
The scroll button will index through the configuration mnemonics. Use the 'up' or 'down' button to reveal the numerical value of any mnemonic.
Values or mnemonics in the configuration list will time out in the same way as the long scroll.
A complete list of the configuration mnemonics with their function is given below.

MNEMONIC	FUNCTION	
C1	Input,CJC units and ti+td times	
C2	PID or on/off outputs and power feedback	
C3	Alarm definitions	
C4	Digital inputs,ADC and security definition	
C5	Communications	
C6	Programmer/Ramp Options	
idn	Output hardware definition	
dsL	Limits of display range	low
dsh	"	high
SPL	Limits of main setpoint	low
SPh	"	high
LSL	Limits of local setpoint	low
LSh	"	high
Ah1	Alarm hysteresis AL1	
Ah2	Alarm hysteresis AL2	
Add	Instrument address	
C1L	Range of output 1 when analogue	low
C1h	"	high
C2L	Range of output 2 when analogue	low
C2h	"	high
riL	Range of remote input to	low
rih	d.c. input board	high
i20*	These paramenters are associated with calibration and no attempt should be made to alter them without first referring to the maintenance manual part no HA020172	
i50*		
tr*		
cJc*		
rtL*		
rth*		
IcL*		
Ich*		
CLr*	Clears error flags and sets system	

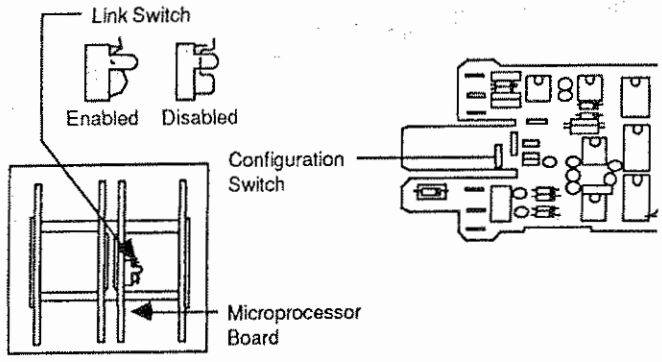
*These mnemonics above are not included in the read only configuration scroll list.

4.1 CONFIGURATION CHANGES (General Operating Procedure)

To change the configuration, of an instrument it is essential tha this procedure is followed exactly. If in any doubt, contact you local Eurotherm engineer.

1. Switch off power to the instrument and remove it from its sleeve.

2. Enable the configuration switch as shown



Note This operation can be simplified by using a configuration key, part no JB022111, in which case it is not necessary to remove the instrument from its sleeve, only to turn the power off while the key is being inserted.

3. Return the instrument to its sleeve and switch on the power.

Note that in this mode the instrument no longer controls, the control outputs are disabled.

4. The display now reads CONF. Press the 'scroll' button to display the first configuration mnemonic C1.
   The up or down buttons enable the current value to be shown and it may be adjusted as required.

Note: The value of 'C1' to 'C6' appears in the form of a 4 character number referred to as "ABCD".

   a) There is no "time out" in this mode, the parameter will remain on the display until the scroll button is pressed again.
   b) If an invalid code is entered an "E" will be displayed and the same parameter will remain on the display for correction. Press the 'up' or 'down' button to return to the code and re-enter a valid code.
   c) If one digit of a configuration word is to be changed, say C, it is essential that the other three, A,B and D are remembered as they will have to be re-entered.

5. The scroll button enables other configuration parame ters to be selected and they may be adjusted as above. The RUN/HOLD button operates as a reverse scroll button but it does not auto-repeat.

6. If any output modules or communications boards have been added or changed then scroll to the parameter "Idn" and press the 'up' and 'down' buttons together.

Note: This is essential to secure the new hardware arrangement in the instrument.

7. When the necessary changes have been made scroll to the last parameter "CLr" and press both the 'up' and 'down' buttons together.
   This is essential to secure the new configuration in the instrument.

8. Switch off the instrument, remove from the sleeve and open the configuration switch. (See para. 2).

9. Replace the instrument in the sleeve and power up for normal operation.

4.2 HARDWARE CHANGES (General Operating Procedure)

1. Remove the instrument from its sleeve.

2. Place the instrument face down on a flat surface.

3. Release the catches of the board retainer by inserting a screwdriver into the slots of the square cut out on each side of the instrument.

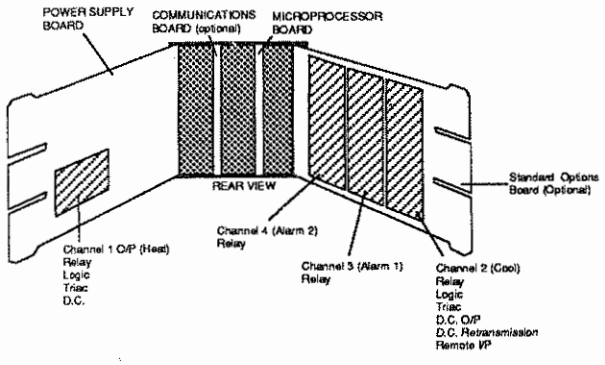
4. Push in towards the centre of the instrument and with the board retainers depressed slide them towards the rear.
5. The side cheeks can now be removed by hinging them about the edge nearest the bezel.

6. Once released the retainer can be slid off of the rear of the printed circuit boards by hand.

Note: The retainer is handed. When reassembling the instrument ensure that the connector on the retainer aligns with the stakes on the boards.

7. The daughter board to be removed can be withdrawn by pulling away from the bezel while pushing the remaining daughter boards into the bezel.

8. The diagram below shows the location of the various output modules and the communications boards in the instrument. If any of these boards are changed it is necessary to enter configuration as described in 4.1 above, scroll to "idn" and push the 'up' and 'down' buttons together. Then scroll on to the mnemonic "CLr" and again push the 'up' and 'down' buttons together.



Note: It is possible to read what boards are fitted in an instrument by reading parameter "Idn" as described in 4.1 above and referring to this table.
Idn= "ABCD"

Configuration	Function
A	Output Channel 4 (alarm 2)
B	Output Channel 3 (alarm1)
C	Output Channel 2 (cool)
D	Output Channel 1 (heat)

A, B, C, D will be set to the number corresponding to the output type fitted as shown in the table below.

Code Number	Function
0	none
1	relay
2	logic
3	triac
4	DC output or retransmission
5	Remote Input

9. To reassemble the unit carry out the above procedure in reverse, ensuring that the bright metal strip on the side cheeks is positioned at the bottom of the instrument.

4.3 TO CHANGE THE DISPLAY RANGE, DECIMAL POINT OR SENSOR TYPE

Hardware

i) No changes are required within the instrument when changing the display range, decimal point,or sensor type.
ii) If the display units are to be changed, the label on the top right hand corner of the bezel should be changed. (Strip of display unit labels. Part No GA021836.)
iii) Instruments with milli-amps, or voltages greater that 50mV into the main input, terminals 25 and 26, are fitted with an extra block mounted onto the rear of the sleeve. The part numbers of these blocks are given below:

Input into rear terminals	Part no. of Block
0-5 volts or 1-5 volts	LA021419U006
0-10 volts	LA021419U005
0-20 mA or 4-20 mA	LA021419U003

All other thermocouple, resistance thermometer or linear inputs have the input wired directly to the sleeve terminals.
Note: For the above changes it is NOT necessary to scroll through the configuration list to "idn" and enter this change.

Software

Sensor Type.

Carry out the procedure in paragraph 4.1 changing mnemonic "C1" characters 'C' and 'D' as given in the table below.

C1 (C & D)

CD	=	00	J	(01)
	=	01	JDIN	(02)
	=	02	K	(03)
	=	03	T	(04)
	=	04	R	(05)
	=	05	S	(06)
	=	06	Nisil	(45)
	=	07	RT100	(70)
	=	08	Linear to 20mV	
	=	09	Linear to 50mV	
	=	10	Linear to 20mV (20% offset)	
	=	11	Linear to 50mV (20% offset)	

Numbers in brackets are Eurotherm input code.

2. For ranges using a thermocouple as a sensor the cold junction compensation must be selected by setting character "A" of mnemonic "C1" as follows.

C1(A)

A	=	0	Internal CJC
	=	1	External O°C
	=	2	External 45°C
	=	3	External 50°C

Note: For all non thermocouple inputs any value of "A" may be set.

3. Ranges using either thermocouples or resistance thermometers as sensors, must have the display units set by mnemonic 'C1' character 'B', as follows:-

CI (B)

B	=	0	°C' ti and td in secs
	=	1	°F' ti and td in secs
	=	2	'K' ti and td in secs
	=	3	'°C' ti and td in mins
	=	4	'°F' ti and td in mins
	=	5	'K' ti and td in mins

NOTE:- For all other inputs the setting of 'B' has no significance except for setting the integral and derivative times.

Decimal Point

Using the procedure given in paragraph 4.1 change mnemonic 'C2' character 'A' as follows:-

C2 (A)

Decimal Point Position.

A	=	0	XXXX	T/C*	Linear
	=	1	XXX.X	or R.T.	
	=	2	XX.XX		
	=	3	X.XXX		

* Note: If a T/C instrument is modified to give 0.1 degree resolution it may also be necessary to modify the display range to ensure the values in the following table are not exceeded.

Display Range.

dSL
dSh

Again use the procedure given in paragraph 4.1 to change the mnemonic dsL, display lower limit, and dsh, display higher limit. The values of these mnemonics are in display units. The maximum and minimum span of the display range is shown in the table below:-

	Recommended Min & Max ranges	Max range if 0.1 dp set	Min Span
Linear	-1999 to 8000	*	
Iron /Constantan J	0C to 1000C	800.0	100C
Fe/Konst(DIN)J	0C to 900C	800.0	100C
Ni Cr/Ni Al K	0C to 1200C	800.0	125C
Cu/Con T	-250C to 400C	400.0	150C
Pt 13% Rh/Pt R	0C to 1600C	800.0	600C
Pt 10%Rh/Pt S	0C to1600C	800.0	600C
Nicrosil/Nisil	0C to 1300C	800.0	150C
RT 100 Ω at 0°C	-80C to 600C		50C

***Note**:For Linear inputs sensitivity must not be less than 5μV/digit.

Refer also to :-
Section 4.11 Security
Section 4.4 Setpoint Limit.

4.4 TO CHANGE THE SETPOINT LIMITS.

Hardware

There are no hardware changes associated with the setpoint limits.

Software.

SPL
SPh

LSL
LSh

i) Carry out the procedure in paragraph 4.1.
The limits of the working setpoint are set by 'SPL', lower limit, and 'SPh' higher limit. The working setpoint is the current setpoint which can be either SP1, remote setpoint or programmer setpoint. The limits apply to all these setpoints. The values of these limits are in display units. 'SPh' can be set to any value higher or equal to 'dsL' and 'SPL' can be set to any value lower or equal to 'dsh'.

ii)The limits of the local setpoint 'LSP' are set by the mnemonics 'LSL' and 'LSh' The value of both of the limits are in display units.
These limits can be set to any value within the complete range of the instrument i.e. - 1999 to 8000

Refer also to:-
Section 4.5 Remote Inputs
Section 4.11 Security

C1L
C1h
C2L
C2h

ii)Scroll onto the mnemonics 'CIL', 'CIh', 'C2L' and 'C2h' which are only used for d.c. output modules. CIL or CIh apply to channel 1 (the heat channel)'C2L', 'C2h' channel 2 (cool channel).

Note: For channel 2 (cool) use parameter in brackets. Scroll to C1L (C2L) and set the value to represent the minimum output as follows:-
0% for 0mA or 0 volts
20% for 4mA or 2 volts etc.
Scroll to C1h (C2h) and set the value to represent the maximum output as follows:-
50% for 10mA or 5 volts
100% for 20mA or 10 Volts etc.

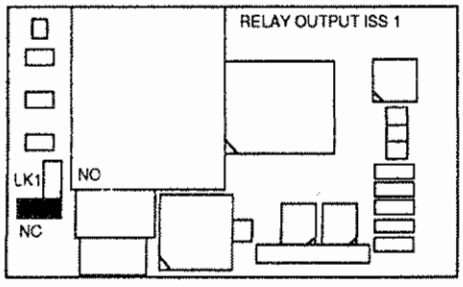
The actual % output used can be adjusted about these nominal values to give a more accurate setting, by monitoring the output with a D.V.M. and adjusting the value required with the up and down button.

Note: With non-d.c. output stages fitted the value set in these mnemonics is ignored by the instrument.
Refer also to:-
Section 4.8 Retransmission

4.7 TO CHANGE THE ALARMS

Hardware
The alarm output modules are situated on the options board. The controller has positions for two alarm modules. It is possible to configure an alarm without an output module as a "soft" alarm which will only indicate the alarm on the front display or be interrogated via the digital communications link. In all cases carry out the procedure outlined in section 4.2. before exiting after a change.

Fit the link in the required position on the relay module:



Snubber network (100 ohm resistor in series with 0.022µF capacitor) across normally closed contacts of relay.
Relay - De-energised in Alarm
Note for relay energised in alarm fit the link in the NO position.

Software.
Carry out the procedure outlined in paragraph 4.1 scrolling to mnemonic 'C3' and setting characters 'B' and 'C' to the value indicated in the table .

C3 (B&C)
Alarm 1 Alarm2
B C

= 0 No alarm
= 1 DH (Deviation High)
= 2 DL (Deviation Low)
= 3 DB (Deviation Band)
= 4 FSH (Full Scale High)
= 5 FSL (Full Scale Low)
= 6 Digital Output (Programme Segment Drive) 815P only.

Note : Setting a 0 or 6 for these characters will disable the alarm.
Note : Setting a '6' gives drives to the alarm relays from segments of the programme.

ii) Set also character 'D' of 'C3' as shown in the following table:-
C3(D)
Alarm Relay States.

D. = 0 A1 and A2 de-energised in alarm.
= 1 A1 de-energised,A2 energised in alarm.
= 2 A1 energised,A2 de-energised in alarm.
= 3 A1 and A2 energised in alarm.

Note: If 'O' or '6' is set for C3 ('B' or 'C') then the value given in C3(D)is ignored by the controller.

Ah1
Ah2

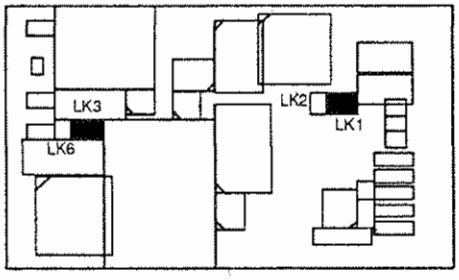
iii) Set mnemonics 'Ah1' and 'Ah2' to the hysteresis of alarm 1 and alarm 2 respectively. These mnemonics have a range of 0.1 to 10% of the display range.

Refer also to :-
Section 4.8 Retransmission
Section 4.5 Remote input
Section 4.11 Security.

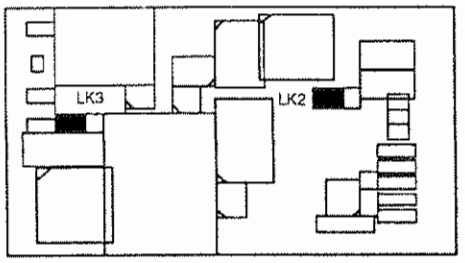
4.8. TO CHANGE A RETRANSMISSION OUTPUT

Hardware.
One retransmission output only may be obtained from the instrument. This output is available from the cool output (channel 2)
i) For retransmission signals from the cool output, fit a d.c. retransmission output module into the cool site.
Note: Eurotherm part numbers of the output modules are given in chapter 8.0.
ii) Set the links on this board to give the type of output required i.e. current or voltage, as diagram below.

D.C. OUTPUT (RETRANSMISSION) BOARD



Position of links for current output



Position of links for voltage output

iii) Carry out the procedure in chapter 4.2.

Software.
Carry out the procedure in chapter 4.1 inserting the following mnemonics:-

C2(D) i)The mnemonic C2(D) must be set to either a '0' or a '5' as shown in the table below.

C2(D)	= 0	PID heat	no cool
	= 1	PID heat	PID cool (LINEAR)
	= 2	PID heat	PID cool (NON-LINEAR)
	= 3	PID heat	ON/OFF cool
	= 4	ON/OFF heat	ON/OFF cool
	= 5	ON/OFF HEAT	no cool

C2L iv) Set the scalers 'C2L ' and C2h' to determine the range of the output voltage or current. The range of these scalers is 0-100%.
100% for voltage outputs = 10 volts.
100% for current outputs = 20mA.

vi) The full range of the retransmission current or voltage will represent:-
either the full span range of the setpoint or the full span range of the linearised measured value.

vi) Set mnemonic'C5' character 'B' as in the table below:-

C5(B)	= 5	Retransmission of PV
	= 6	Retransmission of SP

Refer also to :-
Section 4.6 Outputs
Section 4.7 Alarms

4.9 TO CHANGE THE DIGITAL INPUTS

Hardware.
No hardware changes are required to change or implement this function.

Software
Carry out the procedure given in section 4.1 changing the mnemonics 'C4' characters 'C' and 'D' as shown in the table below:-
Digital Input 2

C4(C)	= 0	none
	= 1	reset program (815P only)
	= 2	skip current programme segment (815P only)

Digital Input 1

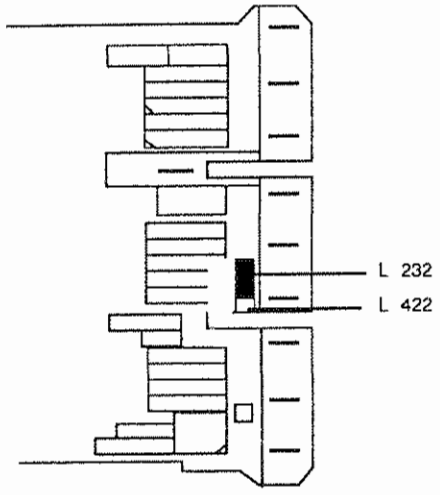
C4(D)	= 0	none
	= 1	auto/manual
	= 2	remote analogue input enable
	= 3	self tune
	= 4	ramp function
	= 5	run/hold (815P only)
	= 6	hold/run (815P only)
	= 7	keylock
	= 8	parameter modification security
	= 9	skip current segment (815P only)

Refer also to:-
Section 4.5 . Remote Input
Section 4.11 Security
Section 4.13 Ramp

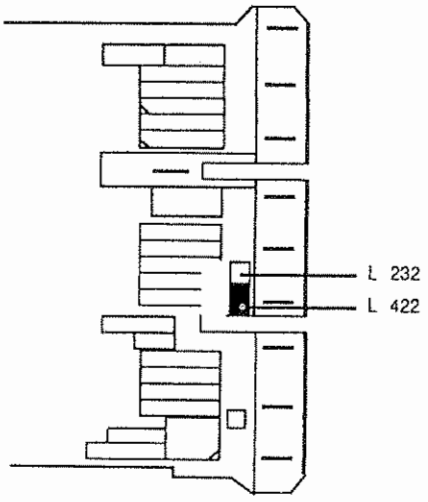
4.10 T0 CHANGE THE DIGITAL COMMUNICATIONS

Hardware.
i) Carry out the procedure as in section 4.2 to install the digital communications board Eurotherm part no. SUB-SPARE-DIGCOMM-BOARD. This is plugged into communications board position on the mother board.
ii) The link on the back of the digital communications board should be set to the communications standard, RS232 or RS422/485 as shown in the diagram below:-

Digital Communications Board



Link position for RS 232 communications



Link position for RS 422, (485) communications

Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-

i) Set mnemonic 'C5' character 'A' to select the baud rate of communications as shown in the table below:-

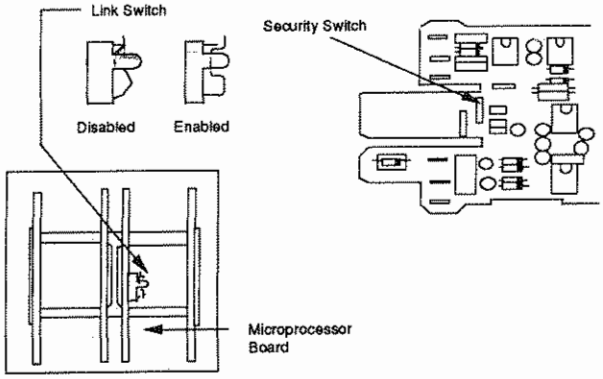
DIGITAL COMMS SPEED

C5(A)	=	0	9600 Baud
	=	1	4800 Baud
	=	2	3600 Baud
	=	3	2400 Baud
	=	4	1200 Baud
	=	5	600 Baud
	=	6	300 Baud

'Add' ii) Set mnemonic 'Add' to the required address for this particular instrument. The value of the address can be varied for 0.0 to 9.9.

4.11 TO CHANGE THE SECURITY

Hardware
One feature of the security, making certain values in the commissioning list read only, can be enabled by a switch on the rear of the microprocessor board, see diagram below, or a digital input or via the communications bus.



Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-
i) Select the commissioning values that are required to be read only by setting mnemonic 'C4' character 'B' in the table below:-

PARAMETER MODIFICATION Security

C4(B)	=	0	no modification of any parameter is possible
	=	1	modification of SP1, LSP only
	=	2	modification of SP1,LSP,AL1,and AL2 only.
	=	3	modification of SP1,LSP and programmer or ramp rate parameters
	=	4	modification of SP1,LSP, AL1,AL2 and programmer or ramp rate parameters
	=	5	all parameters may be modified.

ii) Set mnemonic'C4' character "D" to the value given in the table below. This selects digital input 1 to switch either the 'keylock' or the 'parameter modification security' feature, described in (i) above.

DIGITAL INPUT1

C4(D)	=	0	none
	=	1	auto/manual
	=	2	remote anaolgue input enable
	=	3	self tune
	=	4	ramp function
	=	5	run/hold (815P only)
	=	6	hold/run (815P only)
	=	7	keylock
	=	8	parameter modification security
	=	9	skip current segment (815P only)

iii) The auto/manual switching facility can be disabled by setting the mnemonic 'C2 ' character 'B' as shown below.

AUTO MANUAL SELECTION

C2(B)	=	0	no power feedback, no manual
	=	1	no power feedback, manual front/rear
	=	2	no power feedback, manual rear only
	=	3	power feedback, no manual
	=	4	power feedback, manual front/rear
	=	5	power feedback, manual rear only

REMOTE ANALOGUE INPUT

C5(B)	=	0	None
	=	1	working S.P/remote SP + LSP (front/rear)
	=	2	working SP/remote SP + LSP (rear only)
	=	3	working S.P/remote SP only (front/rear)
	=	4	working S.P/remote SP only (rear only)

v) The self tune facility can be disabled from the front push buttons by setting the mnemonic 'C6' character 'A' as shown below.

SELF TUNE
C6(A) 0 = none
1 = self tune (front/rear)
2 = self tune (rear only)

vi) The run/hold button to operate the ramp facility can be disabled by setting mnemonic 'C6' character 'C' as shown below:-

RUN/HOLD, SELECTION
C6(C) = 0 run (front/rear)
= 1 run (rear only)

vii) The 'run/hold' button and the 'reset' feature, i.e. depressing both the up and down buttons, can be disabled, on the 815P by setting the mnemonic 'C6' character'C' as shown below:-

RUN/HOLD, RESET, SELECTION
C6(C) = 0 run/hold front/rear: (reset front/rear)
= 1 run/hold rear only : (reset front/rear)
= 2 run/hold front/rear: (reset rear only)
= 3 run/hold rear only : (reset rear only)

Refer also to:-
Section 4.5 Remote input
Section 4.9 Digital inputs
Section 4.13 Ramps
Section 4.14 Programming.

4.12 TO CHANGE THE TRACK/HOLD FACILITY

Hardware
No hardware changes are required to modify this feature.

Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-

i) The value of the mnemonic 'C5' character 'C' sets the track or hold facility for both auto/manual and local/remote as shown below:-

SETPOINT TRACK MODE
C5(C) = 0 while in remote, hold SP1
while in manual, hold working setpoint
= 1 while in remote SP, hold SP1
while in manual, working setpoint tracks PV
= 2 while in remote SP, SP1 tracks working setpoint
while in manual, hold working setpoint
= 3 while in remote SP, SP1 tracks working setpoint
while in manual, working setpoint tracks PV

4.13 TO CHANGE THE RAMP FUNCTION

Hardware
No hardware changes are required to modify this feature.

Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-
i) The value of mnemonic 'C6' character 'B' should be set as below to specify the ramp rate in display units per minute or per hour.

SEGMENT TIMES
C6(B) = 0 ramp in minutes
= 1 ramp in hours

ii) The value of mnemonic 'C6' character 'D' should be set as below:-

CONTROLLER ACTION
C6(D) = 0 no ramp function
= 1 ramp function

Refer also to section 4.9 digital input

4.14 TO CHANGE THE PROGRAMME FUNCTION ON A MODEL 815P

Hardware
No hardware changes are required to modify this feature

Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-
i) Set the mnemonic 'C6' character 'B' to select the ramp rates in display units/minute or/hour and the dwell times in hours or minutes as shown below:-

SEGMENT TIMES
C6(B) = 0 ramp in minutes : (dwell in minutes)
= 1 ramp in hours : (dwell in minutes)
= 2 ramp in minutes: (dwell in hours)
= 3 ramp in hours : (dwell in hours)

ii) Set the mnemonic 'C6' character D to select either a controller with none of these features or ramp feature only or the program feature with or without holdback. This mnemonic should be set as below:-

CONTROLLER ACTION
C6(D) = 0 no programmer or ramp function
= 1 ramp function
= 2 programmer function without holdback
= 3 programmer function with holdback

Note: Holdback is Deviation Band only

Refer also to:-
Section 4.9 Digital Input

4.15 TO CHANGE THE SCALING OF THE PROPORTIONAL BAND

Hardware
No hardware changes are necessary to modify this feature.

Software
Carry out the procedure in section 4.1 to amend the following mnemonic:-
i) Set the mnemonic 'C3' character 'A' as below to set the proportional band either in percentage or display units.
Proportional Band
C3(A) = 0 prop band in percent
= 1 prop band in display units

4.16 TO CHANGE THE INTEGRAL AND DERIVATIVE TERMS

Hardware
No hardware changes are necessary to modify this feature.

Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-
i) Set the mnemonics 'C1' character 'B' as shown below:-
C1(B) = 0 °C ti and td in secs
= 1 °F ti and td in secs
= 2 'K' ti and td in secs
= 3 '°C' ti and td in mins
= 4 '°F' ti and td in mins
= 5 'K' ti and td in mins

4.17 TO CHANGE BANDWIDTH OF THE MEASURED VALUE INPUT FILTER

Hardware
No hardware changes are necessary to modify this feature

Software
Carry out the procedure in section 4.1 to amend the following mnemonics:-
i) Set mnemonic 'C4' character 'A' as shown below:-
SUPPLY FREQUENCY
C4(A) = 0 50Hz +/- 2Hz supply &
60Hz +/- 0.3Hz supply
= 1 60Hz +/- 2Hz supply

Chapter 5.0
Configuration Parameters and their Ranges

5.0 CONFIGURATION PARAMETERS AND THEIR RANGES

C1
INPUTS AND UNITS (C1) = 'ABCD'

(A)	=	0	internal CJC
	=	1	external 0°C
	=	2	external 45°C
	=	3	external 50°C
(B)	=	0	'°C' ti and td in secs
	=	1	'°F ti and td in secs
	=	2	'K' ti and td in secs
	=	3	'°C' ti and td in mins
	=	4	'°F' ti and td in mins
	=	5	'K' ti and td in mins

(CD)	=	00	J	(01)
	=	01	JDIN	(02)
	=	02	K	(03)
	=	03	T	(04)
	=	04	R	(05)
	=	05	S	(06)
	=	06	Nisil	(45)
	=	07	RT100	(70)
	=	08	Linear to 20mV	
	=	09	Linear to 50mV	
	=	10	Linear to 20mV (20% offset)	
	=	11	Linear to 50mV (20% offset)	

C2
PID AND OUTPUTS (C2) = 'ABCD'

DECIMAL POINT POSITION

A	=	0	XXXX Thermocouple Input	Linear Inputs
	=	1	XXX.X RT Inputs	
	=	2	XX.XX	
	=	3	X.XXX	

Sets the decimal point position for display

POWER FEEDBACK AND MANUAL SELECTION

(B)	=	0	no power feedback, no manual
	=	1	no power feedback, manual front/rear
	=	2	no power feedback, manual rear only
	=	3	power feedback, no manual
	=	4	power feedback, manual front/rear
	=	5	power feedback, manual rear only

OUTPUT SENSE

(C)	=	0	output 1- normal output 2- normal
	=	1	output 1- normal output 2- inverted
	=	2	output 1- inverted output 2- normal
	=	3	output 1- inverted output 2- inverted

OUTPUT TYPE

(D)	=	0	PID heat	no cool
	=	1	PID heat	PID cool (LINEAR)
	=	2	PID heat	PID cool (NON-LINEAR)
	=	3	PID heat	ON/OFF cool
	=	4	ON/OFF heat	ON/OFF cool
	=	5	ON/OFF HEAT	no cool

C3
ALARM DEFINITION (C3) = 'ABCD'

Proportional Band

(A)	=	0	Prop band in percent
	=	1	Prop band in display units

Alarm 1

(B)	=	0	no alarm 1
	=	1	DH (Deviation High)
	=	2	DL (Deviation Low)
	=	3	DB (Deviation Band)
	=	4	FSH (Full Scale High)
	=	5	FSL (Full Scale Low)
	=	6	Digital Output (Program segment drive) 815P only.

Alarm 2

(C)	=	0	No alarm 2
	=	1	DH (Deviation High)
	=	2	DL (Deviation Low)
	=	3	DB (Deviation Band)
	=	4	FSH (Full Scale High)
	=	5	FSL (Full Scale Low)
	=	6	Digital Output (Program segment drive) 815P only

Alarm Relay States

(D)	=	0	A1 and A2 de-energised in alarm
	=	1	A1 de-energised, A2 energised in alarm
	=	2	A1 energised, A2 de-energised in alarm
	=	3	A1 and A2 energised in alarm.

C4
DIGITAL INPUT ADC & SECURITY DEFINITION (C4) = 'ABCD'

Supply Frequency

(A)	=	0	50Hz +/-2Hz supply & 60Hz +/- 0.3Hz supply (default)
	=	1	60Hz +/-2Hz supply

Parameter Modification Security

(B)	=	0	no modification of any parameter is possible
	=	1	modification of SP1 AND LSP only
	=	2	modification of SP1, LSP, AL1,AL2 only.
	=	3	modification of SP1, LSP, and programmer or ramp rate parameters
	=	4	modification of SP1,LSP,AL1, AL2 and programmer or ramp rate parameters
	=	5	all parameters may be modified

Determines how many of the scroll parameters may be modified when the switch on the microprocessor board is open or digital input 1 configured to 8 is closed or the digital communication has engaged the feature.

DIGITAL INPUT 2
The function of the two digital inputs on the microprocessor board

(C)	=	0	none
	=	1	reset program (815P only)
	=	2	skip current program segment (815P only)

DIGITAL INPUT 1 '

(D)	=	0	none
	=	1	auto/manual
	=	2	remote analogue input enable
	=	3	self tune
	=	4	ramp function
	=	5	run/hold (815P only)
	=	6	Hold/Run (815P only)
	=	7	Keylock
	=	8	Parameter Modification security
	=	9	Skip Current Segment (815P only)

C5

COMMUNICATIONS (C5) = ' ABCD '

Digital Comms Speed

(A)	=	0	9600 Baud
	=	1	4800 Baud
	=	2	3600 Baud
	=	3	2400 Baud
	=	4	1200 Baud
	=	5	600 Baud
	=	6	300 Baud

Set the baud rate for digital communications

Remote Analogue Input and Retransmission

(B)	=	0	none	
	=	1	working S.P./remote SP + LSP	(front/rear)
	=	2	working S.P./remote SP + LSP	(rear only)
	=	3	working S.P./remote SP only	(front/rear)
	=	4	working S.P./remote SP only	(rear only)
	=	5	Retransmission of P.V.	
	=	6	Retransmission of S.P.	

Setpoint Track Mode

(C)	=	0	while in remote SP, hold SP1 while in manual, hold working S.P.
	=	1	while in remote SP, hold SP1 while in manual, working SP tracks PV
	=	2	while in remote SP, SP1 tracks working SP while in manual, hold working SP
	=	3	while in remote SP, SP1 tracks working SP while in manual, working SP tracks PV

Sets the value of working S.P. when the instrument is switched to manual and also when switched to remote. Working S.P. can either remain at the value manually entered (HOLD) or take the value of the measured value (PV).

Remote Analogue Input Offset

(D)	=	0	analogue input without offset
	=	1	analogue input with 20%offset

C6

PROGRAMS AND RAMPS (C6)='ABCD'

Self Tune

(A)	=	0	none
	=	1	self tune (front/rear)
	=	2	self tune (rear only)

Segment Times

(B)	=	0	ramp in minutes:*dwell in minutes*
	=	1	ramp in hours:*dwell in minutes*
	=	2	*ramp in minutes: dwell in hours*
	=	3	*ramp in hours:dwell in hours*

Run/Hold, Reset, Selection

(C)	=	0	run/hold front/rear: *reset front/rear*
	=	1	run/hold rear only:*reset front/rear*
	=	2	*run/hold front/rear:reset rear only*
	=	3	*run/hold rear only:reset rear only*

Controller Action

D	=	0	no programmer or ramp function
	=	1	ramp function
	=	2	*programmer without holdback*
	=	3	*programmer function with holdback*

Text in italics applies to model 815P only.

Idn

Output Hardware Idn = 'A, B, C, D,'

CH4
(Alarm 2)

=	0	none
=	1	relay
=	3	triac

CH3
(Alarm 1)

=	0	none
=	1	relay
=	3	triac

CH2
(Cool)

=	0	none
=	1	relay
=	2	logic
=	3	triac
=	4	d.c.
=	5	remote input signal

CH1.
(heat)

=	0	none
=	1	relay
=	2	logic
=	3	triac
=	4	d.c.

RANGE LIMITS

Mnemonic	Function	Default values when shipped from factory	Comments
dSL dSh	= Display low limit = Display high limit		Used to define the maximum operational span of the instrument. Maximum range - 1999 to 8000 Thermocouple and RT inputs are limited to the working range of the selected input type (see Section 3.0).
SPL SPh	= Setpoint 1/working Setpoint low Limit = Setpoint1 /working Setpoint high Limit	SPL = dSL SPh= dSh	Used to define the maximum operational span of the effective instrument setpoint. Maximum range -1999 to 8000
LSL LSh	= Local Setpoint low limit = Local Setpoint high limit	STD: LSL=dSL, LSh = dSh Local Trim: -10%dSh, + 10% dSh	Used to define the maximum operational span of the local setpoint parameter. Maximum range - 1999 to 8000.
Ah1 Ah2	= Alarm 1 hysteresis = Alarm 2 hysteresis	= 0.1%	Used to define the level of hysteresis to be employed for each of the two possible alarms. Maximum range 0.1 to 10% of input range.
Add	= Communications address	= 0.0	Instrument identifier used in conjunction with digital comms. Range 00 to 99.
c1L c1h c2L c2h	= Channel 1(output 1) Low range Scaler = Channel 1 (output 1) High range Scaler = Channel 2 (output 2) Low range Scaler = Channel 2 (output 2) High range Scaler		The hardware defines the maximum range of these outputs as 0-10 volts or 0-20mA. These hardware limits therefore define the limits of the software scalers for each output which is expressed as 0-100%. Accurate setting of the span and zero of retrans-mission outputs can be accomplished by fine tuning these parameters whilst observing the true output with a suitable digital meter. EXAMPLE :- For a 0-5 volt output requirement set the high range scaler to 50% and the low range scaler to 0%. For a 4-20mA output requirement set the high range scaler to 100% and the low range scaler to 20%.
riL rih	= Remote Input low range Scaler = Remote Input high range Scaler	Remote S/P+ Local Trim: ril = display min, rih = display max Remote Trim: ril = -10% (of display range), rih = +10%	Defines the change in the display units for the full change in the input voltage/current.

Chapter 6.0
Digital Communications

The 815 controller is designed to operate with either RS232 or RS422(485) digital communications.
Many of the modes of operation that can be set by the push buttons on the front of the instruments or the digital inputs at the rear of the instrument can be activated by the digital communications link.
Whilst the communications bus is active the legend on the display will be illuminated.
Two facilities, keylock and parameter modification, in the digital communications link can be disabled by a link into the rear terminals of the instrument. With the link open these facilities can be set by the digital communications.

6.1 COMMUNICATIONS PROTOCOL

The type of protocol available on the 815 controller is ASCII BI-SYNCH

6.2 ASCII BI-SYNC COMMUNICATIONS PROTOCOL

Message structure

i) REQUEST FOR DATA

HOST	EOT	UNIT ADDRESS①	MNEMONIC②	ENQ	
815	STX	MNEMONIC②	DATA ③	ETX	BCC④

HOST EITHER REPEAT HOST MESSAGE ABOVE
or ACK (for polling mnemonics list)
or NAK (for repeat of mnemonic with latest value)

⊗See following notes

ii) REQUEST TO CHANGE VALUES

HOST	EOT	UNIT ADDRESS①	STX	MNEMONIC②	DATA③	ETX	BCC④

815 EITHER
ACK (Change has taken place)
or NAK (Change has been aborted)

HOST EITHER REPEATS MESSAGE ABOVE

OR STX | MNEMONIC② | DATA③ | ETX | BCC④ (for further changes in the same instruments)

⊗See following notes

Note ① UNIT ADDRESS
Four characters long, consisting of the instrument address, appearing under the configuration mnemonic 'Add', with each digit repeated. For example an instrument address of '53' would give a unit address of '5533'.

Note ② Communications Mnemonics
The order of the table is that which would be obtained if a fast poll was performed commencing from measured value (PV). Only parameters applicable to the particular instrument are displayed in the poll.

MNEMONIC	PARAMETER	AVAILABILITY
PV	Measured Value	Always available (R/O)
SP	Working Setpoint	Always available (R/O)
OP	Output	Always available(R/O in Auto)
SW	Status Word (See para. on Status Word)	Always available
OS	Opt'l Status Word (See para. on Status Word)	Always available
XS	Extend'd Status Word (See para. on Status Word)	Always available
1A	Alarm 1	Configuration dependent
2A	Alarm 2	Configuration dependent
ER	Error	Always available (R/O)
SL	Local Setpoint (SP1)	Configuration dependent
RT	Local Setpoint Trim	Configuration dependent
RI	Remote Input	Remote I/P Configures but not as Power Limit (R/O)
01	Status Word 1 (See para. on Status Words)	Programmer
02	Status Word 2 (See para. on Status Words)	Configured
03	Status Word 3 (See para. on Status Words)	
04	Status Word 4 (See para. on Status Words)	
TM	Time remaining in current programme segment	Programmer configured and a programme is running or in hold or Ramp function configured and ramp active
LR	Loops remaining for current programme	Programmer configured and a programme is running or in hold
r1	Ramp rate 1	Programmer configured
l1	Ramp level 1	Programmer configured
t1	Dwell time 1	Programmer configured
r2	Ramp rate 2	Programmer configured
l2	Ramp level 2	Programmer configured
t2	Dwell time 2	Programmer configured
Hb	Holdback value	Programmer configured with holdback
Lc	Loop count	Programmer configured
RR	Ramp rate	Ramp function configured
HO	Max.Heat	Controller with PID heat
LO	Max cool	Controller with PID cool
HS	Setpoint 1 maximum	Always available (R/0)
LS	Setpoint 1 minimum	Always available (R/0)
TH	Local trim maximum	Configuration dependent (R/O)
TL	Local trim minimum	Configuration dependent (R/O)
H3	Local setpoint Maximum	Configuration Dependent
L3	Local setpoint Minimum	Configuration Dependent
2H	Remote Max Scaler	Configuration Dependent
2L	Remote Min Scaler	Configuration Dependent
CH	Cycle time for channel 1	Channel 1 configured as time proportioning.
XP	Proportional band	PID heat configured
TI	Integral time	PID heat configured
MR	Manual Reset	On/Off,P or PD controller
TD	Derivative time	PID heat configured
HB	Cutback high	PID heat configured
LB	Cutback low	PID heat configured
RG	Reliative cool gain	PID heat/cool configured
HC	Heat cool deadband	Heat/cool instrument
CC	cool cycle time	Heat/cool instrument+ time proportioning O/P 2
C2	Channel 2 cycle time	Heat with dual O/P + time proportioning O/P 2
BP	Power level at sensor break	Always available
Vø	Software version	Always available (R/O)
II	Instrument identity	Always available (R/O)
1H	Display maximum	Always available (R/O)
1L	Display minimum	Always available (R/O)

Note 1 :-The true limit of PV are 1H + 10% of (1H - 1L) to 1L - 10% of (1H -1L)
Note 2 :- R/O = Read Only
Note 3 :- This is a complete list, the actual list will be a subset of this, defendent upon instrument configuration.

STATUS WORDS.

Digits ABCD are ASCII characters representing a hexadecimal digit (0-9, A-F).

STATUS WORDS (SW) in the format (> ABCD)

Digit	Bit	Function	Attribute	Clear/Set
D	0	Data Format	R/W	Free/Fixed
D	1	Sensor Break	R/O	No/Yes
D	2	Key Lock	R/W	Enabled/Disabled
D	3	N/A		
C	4	N/A		
C	5	Parameter changed via keys	R/C	No/Yes
C	6	N/A		
C	7	N/A		
B	8	Alarm 2 state	R/O	Off/On
B	9	N/A		
B	10	Alarm 1 state	R/O	Off/On
B	11	N/A		
A	12	Alarm active	R/O	No alarm/ New alarm 1 or 2
A	13	Spare		
A	14	Remote active	R/W	Local/Remote
A	15	Auto/Manual	R/W	Auto/Man

OPTIONAL STATUS WORD (OS) in the format (>ABCD)

Digit	Bit	Function	Attributes	Clear/Set
D	0	Prog Status	See note 2	
D	1	Prog Status	See note 2	
D	2	Prog Status	See note 2	
D	3	Prog Status(MSB)	See note 2	
C	4	Hold Logged	R/C	Continue/Hold
C	5	Skip current Segm't	R/W	Remain/Skip
C	6	Ramp/Dwell	R/O	Ramp/Dwell
C	7	Digital Input Lock	R/W	Enable/Disable
B	8	Segment No.(LSB)	See Note 1	
B	9	Segment No		
B	10	Segment No		
B	11	Segment No(MSB)		
A	12	Digital O/P2 (Channel 4)	R/O	Off/On
A	13	Digital O/P1 (Channel 3)	R/O	Off/On
A	14	Digital Input 2	R/O	Off/On
A	15	Digital Input 1	R/O	Off/On

Notes :-
1) Segment No. is a nibble having the value 1 to 8 read only
2) Program Status is a nibble having the value 0 to 6;

D = 0 Reset Programmer / Ramp Function. Read/Write
D = 1 N/A
D = 2 Run Programmer / Ramp Function. Read/Write
D = 3 Hold Programmer. Read/Write
D = 4 End Programmer. Read Only
D = 5 RMP Engaged. Read Only
D = 6 Program in Holdback. Read only.

EXTENSION STATUS WORD (XS) in the format (>ABCD)

Digit	Bit	Function	Attributes	Clear/Set
D	0	Self Tune	R/W	Off/On
D		Spare		
D		Spare		
D		Spare		
C		Spare		
C		Spare		
C		Spare		
C		Spare		
B		Spare		
B		Spare		
B		Spare		
B		Spare		
A		Spare		
A		Spare		
A		Spare		
A		Spare		

DIGITAL OUTPUT STATUS WORD 1 (01) in the format (>ABCD)

Digit	Bit	Function	Attributes	Clear/Set
D	0	ramp 1 to channel 3	R/W	Activate/no effect
D	1	dwell 1 to channel 3	R/W	Activate/no effect
D	2	ramp 2 to channel 3	R/W	Activate/no effect
D	3	dwell 2 to channel 3	R/W	Activate/no effect
C	4	spare		
C	5	spare		
C	6	spare		
C	7	spare		
B	8	spare		
B	9	spare		
B	10	spare		
B	11	spare		
A	12	spare		
A	13	spare		
A	14	spare		
A	15	spare		

DIGITAL OUTPUT WORD 2 (02) in the format (>ABCD)

Digit	Bit	Function	Attributes	Clear/Set
D	0	END to channel 3	R/W	Activate/no effect
D	1	Spare		
D	2	Spare		
D	3	Spare		
C	4	Spare		
C	5	Spare		
C	6	Spare		
C	7	Spare		
B	8	Spare		
B	9	Spare		
B	10	Spare		
B	11	Spare		
A	12	Spare		
A	13	Spare		
A	14	Spare		
A	15	Spare		

DIGITAL OUTPUT STATUS WORD 3 (03) in the format (>ABCD)

Digit	Bit	Function	Attributes	Clear/Set
D	0	ramp 1 to channel 4	R/W	Activate/no effect
D	1	dwell 1 to channel 4	R/W	Activate/no effect
D	2	ramp 2 to channel 4	R/W	Activate/no effect
D	3	dwell 2 to channel 4	R/W	Activate/no effect
C	4	spare		
C	5	spare		
C	6	spare		
C	7	spare		
B	8	spare		
B	9	spare		
B	10	spare		
B	11	spare		
A	12	spare		
A	13	spare		
A	14	spare		
A	15	spare		

DIGITAL OUTPUT WORD 4 (04) in the format (>ABCD)

Digit	Bit	Function	Attributes	Clear/Set
D	0	END to channel 4	R/W	Activate/no effect
D	1	Spare		
D	2	Spare		
D	3	Spare		
C	4	Spare		
C	5	Spare		
C	6	Spare		
C	7	Spare		
B	8	Spare		
B	9	Spare		
B	10	Spare		
B	11	Spare		
A	12	Spare		
A	13	Spare		
A	14	Spare		
A	15	Spare		

For further ingormation regarding the protocol and mnemonics used in the digital communciations link, refer to the communications instruction book part number HA020161.

Note ③ **:-**
Five or six character are assigned to data. Data can be either free or fixed format set by bit , '0' of character 'D' of the status word 'SW'.

Fixed Format:-
In this format all 5 character positions must be filled, and for negative values, the decimal point is replaced by a minus sign.

Therefore + 5.3 can be entered as :

(5.300)
(05.30)
or (005.3)

and -5.3 can be entered as :

(5-300)
(05-30)
(005-3)

This system has the advantage that you have the same resolution for positive and negative numbers.

Free Format:

In this system all six character positions need not be filled. A negative number is designated by a negative sign in front of the number, a value of 13.9 can be entered in any of the following form:

(0013.9)
(13.9)
(13.90)
(13.9)

and -2 can be entered as:

(-2.0)
(-2.0)
(-2)
(-2.)
(-2)
(-02.00)
(-2.000)

Status Word Data:
Again 5 character are used but the first character is always a '>' sign to signify that the other 4 character in the data are hexadecimal.

Note ④ B.C.C.:
Verification character which is the character generated by taking the exclusive OR of the ASC11 values of all the characters transmitted after and excluding (STX) up to and including (ETX).

Chapter 7.0
Calibration

The 815 controller can be calibrated whilst installed in its sleeve if the relevant wiring can be re-routed to the calibration device and the instrument is not configured for a high level voltage (greater than 60mV), or current input. Alternatively the instrument can be removed from its sleeve and calibrated on a bench, in which case it can either be plugged into an additional sleeve, part number LA021348 (faston connections) or LA021347 (screw connections), or be fitted with a number of individual connector blocks which are used in the make up of the sleeve. A set of three of these blocks, LA018341 (standard) LA021248 (Input) and LA018831 (mains) is required to calibrate the instrument fully.

To carry out the complete calibration of the 815 controller a number of instruments is required. These are listed below:-

a) A suitable stable millivolt and voltage source with the ability to switch 'in' and 'out' some means to compensate for the cold junction of thermocouples. The Eurotherm calibrator model 239 is suitable for this purpose.

b) A length of compensating cable suitable for the thermocouple to be used with the controller or type K.

c) A decade resistance box capable of being set to 50.00 and 250.00 ohms with an accuracy better than +/-0.01 ohms.

d) A digital voltmeter capable of indicating a maximum voltage of 10 volts dc with an accuracy of better than 0.05% and an input impedance higher than 5 Megohms.

e) A digital current meter capable of indicating a maximum of 20mA dc with an accuracy of better than 0.05% and an input impedance of less than 400 ohms.

When the 815 instrument is despatched from the factory it has been calibrated for all thermocouples, RTD; voltage and current inputs and if a remote input or retransmission has been specified in the ordering code these will also have been calibrated.

The recalibration procedure can either be performed for the configured input and output ranges only or for all ranges.

The table below shows which mnemonics have to be selected to calibrate a particular range and input.

Instrument Configured For	Mnemonics to be Selected
Voltage inputs where input span is < 20mV	i20
Voltage inputs where input span is > 20mV and is < 50mV	i50
Thermocouple inputs where input span is < 20mV	i20 & cJc
Thermocouple inputs where input span is > 20mV and is < 50mV	i50 & cJc
RTD Inputs	rtL & rth
Current Inputs	i50

When reconfiguring the instrument from one sensor type to another or one range to another it is not necessary to recalibrate the instrument, providing that the full calibration has not been corrupted.

The description below gives the full calibration procedure. To calibrate a single range use only those parts of the procedure containing the mnemonics in the above table.

7.1 FULL CALIBRATION PROCEDURE

7.2 Voltage and Thermocouple Inputs

To alter the calibration of the instrument the read/write configuration mode has to be entered.

1) Remove the instrument from the sleeve and make the lower of the two switches on the rear of the microboard (see paragraph 4.1).

2) Replace the instrument in its sleeve, or connect the terminal blocks.

3) Now connect the instrument as in diagram 1 and power up the instrument and the calibrator. Leave powered for at least 20 minutes before proceeding.

4) The display will now read 'CONF'. Press the scroll button and the display will indicate 'C1'.

NOTE:-This is the start of the configuration and is not required for calibration.

5) Press the scroll button repeatedly until the first mnemonic of the calibration procedure'i20' is indicated.

NOTE:-The full list of mnemonics that will have to be scrolled through to get to (i20)are shown below.

C1, C2, C3, C4, C5, C6, idn, dSL dSh, SPL, SPh, LSL, LSh, Ah1, Ah2, Add, C1L, C1h, C2L, C2h, riL, rih.

6) This is the start of the calibration procedure.

i20 Calibration Procedure

7) Set the 239 calibrator, output to 20.0mV and the compensator switch set to mV.

8) With the 'i20' mnemonic on the display the 'up' and 'down' buttons should both be pressed simultaneously.

9) The 'i20' will disappear and the top dot of the least significant digit (LSD) will flash for approximately 15 seconds.

10) The display will now indicate a m.V. reading of 20.00 a drift of more than a few μV's in this reading in 30 seconds indicates that the calibration procedure was unsuccessful.

11) If unsuccessful check the calibrator, instrument and interconnections.

12) Press the 'up' and 'down' buttons simultaneously repeating paragraphs 8,9, 10 and 11.

13) If the reading is to be accepted press the scroll key.

i50 Calibration Procedure

14) Depression of the scroll button will now indicate 'i50' and the procedure in paragraphs 7, 8, 9, 10, 11, 12 and 13 above is repeated again for a 50mV input.

15) Press the scroll button and 'tr' (zero trim) will be displayed. (During initial configuration this parameter is not adjusted and is left set to zero).

NOTE:- This mnemonic is not required during normal calibration but may be useful to give an offset to the input to allow for the calibration of the thermocouple, if known.

16) Use the up/down button to scroll this value to the desired number of μV .e.g. if the thermocouple calibration shows that its output is 20μV above the table value scroll this trim value to -20μV.

17) If this feature is not going to be used it must be set to zero.

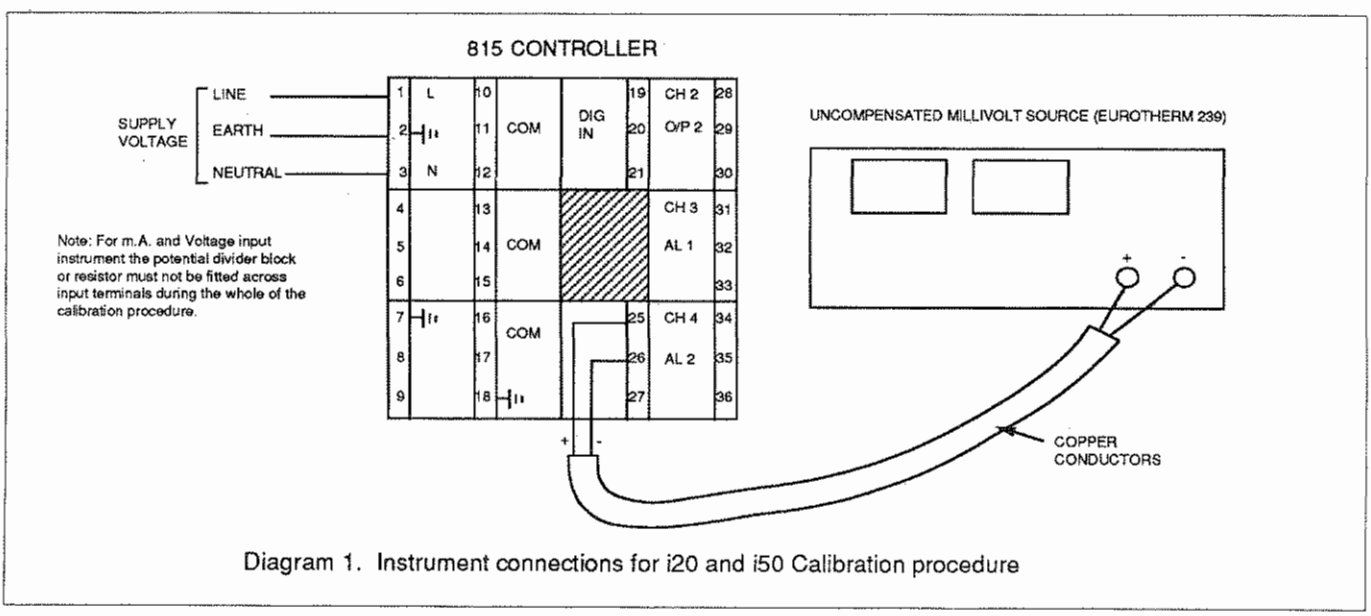


Diagram 1. Instrument connections for i20 and i50 Calibration procedure

7.3 THERMOCOUPLE COMPENSATION CALIBRATION (cJc)

1) The copper leads between the calibrator and the instrument should now be changed for compensating cable, as diagram 2.

2) If the instrument has been configured for a thermocouple input the compensating cable should be for this thermocouple type.

3) If the instrument has been configured for a non-thermocouple input, eg RTD, millivolts or current, then the compensating cable should be type K.

4) The compensation of the calibrator should be set to the same type as the compensating cable from the calibration to the instrument.

5) Set the output of the calibrator to a value that represents 25°C for the thermocouple of the compensation set in the calibrator.

6) Press the scroll button and cJc will be displayed.

7) The 'up' and 'down' buttons should now be pressed simultaneously and the cJc will disappear.

8) The top dot of the LSD will flash for approximately 15 seconds.

9) The display will now read the temperature in °C as 25.0.

10) If the reading drifts by more than a few tenths of a degree in 30 seconds the calibration of cJc has been unsucessful. Check the millivolt source, controller and compensating cable.

11) Press the 'up' and 'down' buttons simultaneously repeating paragraphs 7, 8 and 9 above.

12) If the reading is to be accepted press the scroll button.

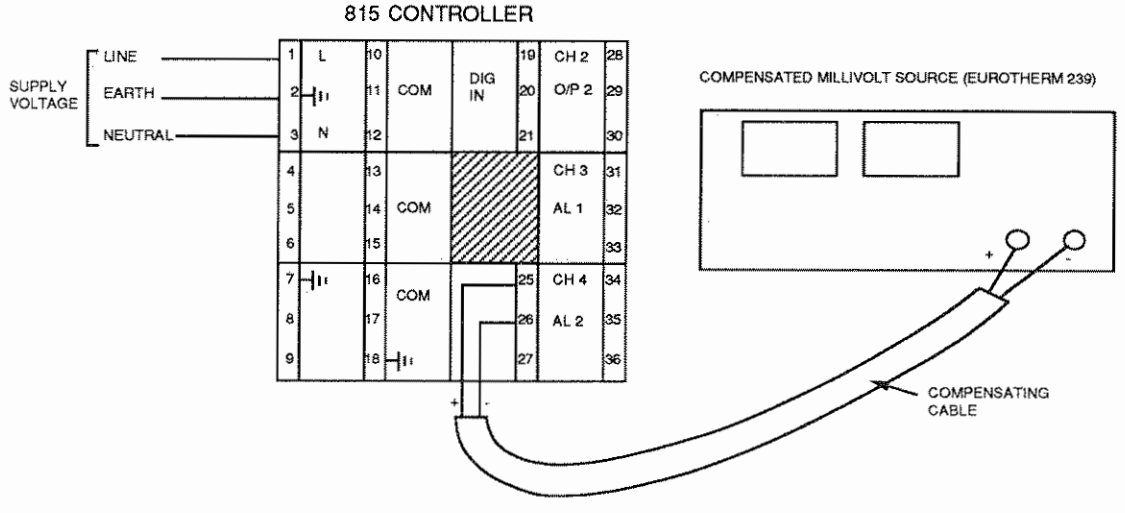


Diagram 2. Connections for C.J.C Calibration Procedure

7.4 RESISTANCE THERMOMETER CALIBRATION

1) The display will now read 'rtL'.

2) Connect the input of the instrument to the decade resistance box as shown in diagram 3.

3) Set the resistance box to 50 ohms.

4) Press the 'up' and 'down' buttons together and the top dot of the LSD of the display will flash for 15 seconds.

5) 'rtL' will now be displayed.

6) If it is suspected that this value is wrong readjust the decade resistance box and press the 'up' and 'down' buttons together.

7) Press the scroll button and 'rth' will be displayed.

8) Set the resistance box to 250 ohms

9) Press the 'up' and 'down' buttons simultaneously.

10) The 'rth' will disappear and the top dot of theLSD will flash for approximately 15 seconds.

11) The display will now read 250.0

12) If the value is wrong readjust the decade resistance box and repeat paragraphs 9, 10 and 11.

13) When the procedure gives the correct value press the scroll button.

This completes the calibration for the main input. If the instrument has a Remote Input, or Retransmission Output, fitted, then see section 7.5, otherwise scroll to 'CLr'. Press the 'up' and 'down' buttons together causing the display to blink before exiting the read/write configuration mode.

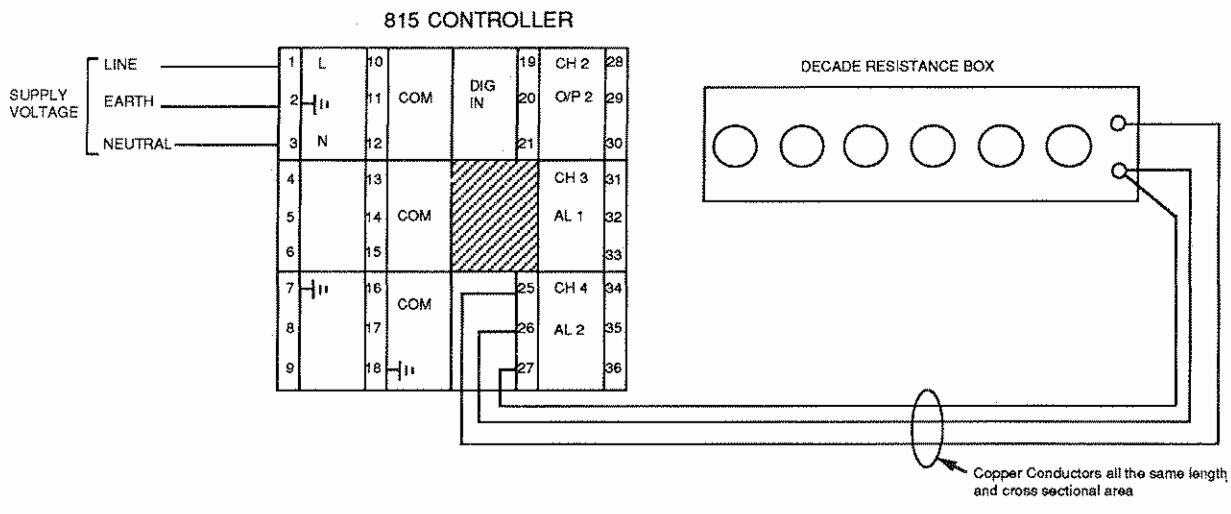


Diagram 3. Connections for rtl and rth Calibration procedures.

7.5 CALIBRATION OF REMOTE INPUT

If the controller is fitted with a dc remote input board and the input of this board requires calibration, use the next mnemonics in the configuration list 'icL' and 'ich' for this purpose. Note: If this input is a current input the burden resistor normally connected on the back of the sleeve must not be across terminals 29 and 30 during calibration. The voltages used for calibrating these inputs is the relevant current in amps multiplied by 50.

1) Remove the decade resistance box connections from terminals 25, 26 and 27.

2) Connect a voltage source such as the Eurotherm 239 to terminals 29 and 30 using copper wire as shown in diagram 4.

3) Press the scroll button and the display will now read 'icL'. Set the voltage source to the minimum input span.

NOTE:- If the instrument has been configured with a 20% offset i.e. configuration 'C5' character 'D' set to 1 then the setting must be zero.

4) Simultaneously press the 'up' and 'down' buttons together.

5) The top dot of the L.S.D. will flash for approximately 15 seconds.

6) IcL will then be displayed as a percentage of the max span.

7) If this value is incorrect reset the voltage source and repeat paragraphs 4, 5 and 6.

8) If the value is correct, press the scroll button and the display will now read 'Ich'.

9) Set the voltage source to the maximum input span volts.

10) Press the 'up' and 'down' buttons together.

11) The dot of the L.S.D. will flash for approximately 15 seconds.

12) Ich will then be displayed as a percentage of the max. span.

13) If this value is incorrect reset the voltage source and again repeat paragraphs 10, 11 and 12.

14) If the value is correct press the scroll button.

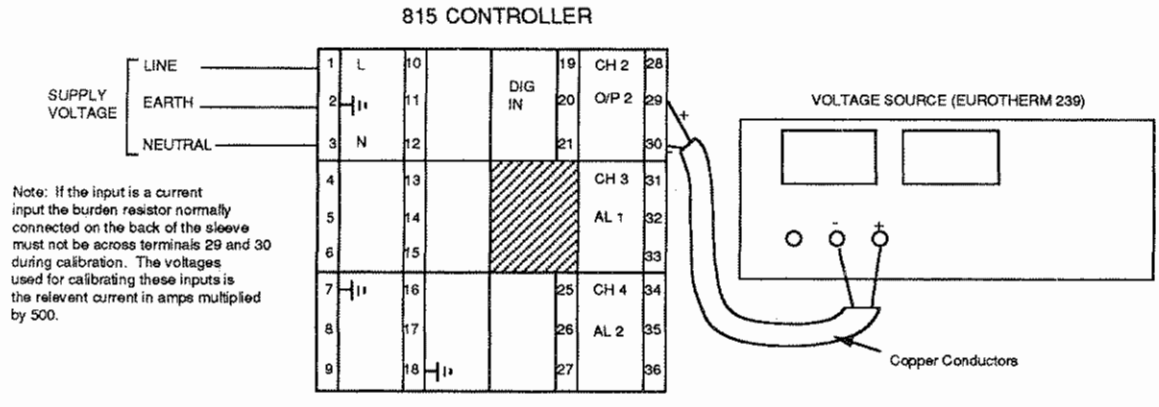


Diagram 4. Connections for icL and ich Calibration procedure

7.6 CALIBRATION OF THE RETRANSMISSION OUTPUT FROM CHANNEL 2

Wire terminals 29 and 30 to either a digital voltmeter for instruments configured for voltage output retransmission signal or a digital current meter for instruments configured for current output retransmission signal, as shown in diagram 5.

1) Scroll the display back using the Run/Hold button until C2L is displayed.

2) Note the digital meter reading.

3) Press either the 'up' or the'down' button to adjust the reading on the digital meter until it gives the required minimum retransmission output signal.

4) Press the scroll button and 'c2h' will be displayed.

5) Press either the 'up' or the 'down' button to adjust the reading on the digital meter to the maximum retransmission output signal.

6) Press the scroll button repeatedly until the mnemonic 'Clr' is displayed.

7) Pressing the 'up' and 'down' buttons together whilst this mnemonic is being viewed will cause it to blink.

NOTE:- This action causes a new check sum to be calculated and written into memory. Failure to carry out this procedure will cause an error message to appear on the display when returning to the operating mode.

The instrument calibration has now been completed and the instrument should be switched off and removed from its sleeve. The lower of the two switches at the rear of the microboard should now be open circuited and the instrument returned to its sleeve. The instrument will now function in normal operating mode.

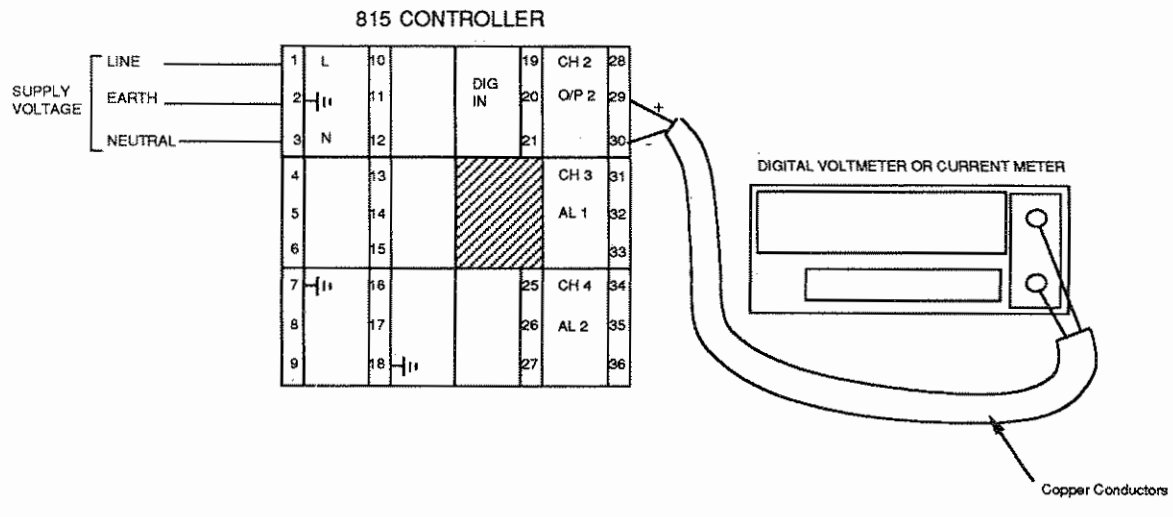


Diagram 5. Connections for c2L and c2h. Calibration procedure.

Chapter 8.0
Spares List

ITEM	PART NUMBER
Complete power supply PC board without output module (85-264V~ Input)	SUB818-SPARE-POWERSUP-BOARD
Complete power supply PC board without output module (18-40V~ or 20-40V dc Input)	SUB818-SPARE-24VOLT-BOARD
Complete microprocessor PC board with micro-processor, Xicor non volatile memory but without Eprom	SUB818-SPARE-MICRO-BOARD
Complete microprocessor PC board with micro-processor, DALLAS nonvolatile memory but without EPROM	SUB818-SPARE-DALLAS-BOARD
Complete Options board without output or alarm boards	SUB818-SPARE-OPTION-BOARD
Complete digital communications PC board	SUB818-SPARE-DIGCOMM-BOARD
Complete display PC board with display	SUB818-SPARE-DISPLAY 815-BOARD
Complete relay output module PC board	SUB818-SPARE-RELAY-BOARD
Complete Triac output module PC board	SUB818-SPARE-TRIAC-BOARD
Complete logic output module PC Board	SUB818-SPARE-LOGIC-BOARD
Complete DC/retransmission output module PC Board	SUB818-SPARE-RETRAN-BOARD
Complete DC Output Module PC Board	SUB818-SPARE-DCOUTPUT-BOARD
Complete DC Input Module PC Board	SUB818-SPARE-DCINPUT-BOARD
Bezel assembly complete with push buttons	LA021346
Microprocessor Intel 8032	CR200069
Eprom 27512 Programmer for 815S with XICOR non volatile memory	SUB818-SPARE-EPROM-815S-1.05
Eprom 27512 Programmer for 815S with DALLAS non volatile memory	SUB818-SPARE-EPROM-815S-2.03
Eprom 27512 Programmer for 815P with XICOR non volatile memory	SUB818-SPARE-EPROM-815P-1.05
Eprom 27512 Programmer for 815P with DALLAS non volatile memory	SUB818-SPARE-EPROM-815P-2.03
Non volatile memory (2004) XICOR	CR100040
Non volatile memory (DS1220) DALLAS	CR200088
Fuse 500mA 250V anti-surge	CS021199
Fuse 1.25A Anti-surge	CS022078
Links small	CI069127
Links large	CI020907
PC board retainer	LA021251
Covers (2 off)	LA021343
Instrument sleeve (faston)	LA021348
Instrument sleeve (screw)	LA021347
Behind panel fixing clips (kit of 2)	LA020067
Extender cable (set of 3)	LA021585
Rear terminal connector blocks (Screw)	
Standard	LA018341
Input (T/C and RTD)	LA021248
Mains (Red)	LA018831