483
Load Sequencer

Handbook

Bulletin 483 HB-1 Printed in England 0791 Part No. HA023770

483 Handbook

Contents

Welcome to your 483 Load Sequencing Unit

The 483 load sequencer is capable of being configured and operated in many different ways.

Simply follow the steps below to ensure the correct installation and operation of your unit.

Firstly in the yellow section,	Section 1 - **INSTALLATION** Check the code shown on the label on the side of the unit that the voltage specification for your unit is correct. Install and connect the unit as described in this section.
next in the blue section,	Section 2 - **CONFIGURATION** The unit will be supplied to a standard configuration. It is essential that the unit is configured to the exact requirements of your application.
and finally in the white section	Section 3 - **OPERATION** This section describes the operational modes and setting up procedure. **You are now ready to switch on** Follow the switch on procedure on page 19 and set up as desired.

Section 1 - **Installation**

Contents *Page*

1.0 GENERAL

This sequencing controller that you have selected type 483 is entirely configurable by links and jumpers. It is dispatched from the factory in the following standard configuration;
address 11 (slave)
number of outputs - 1
inputs 0-10V
modulation period 2.1s
control mode - incremental first mode
no power feedback
alarm output and healthy signal +15V

1.1 Coding Details

Units are normally dispatched in the standard configuration indicated unless otherwise specified.

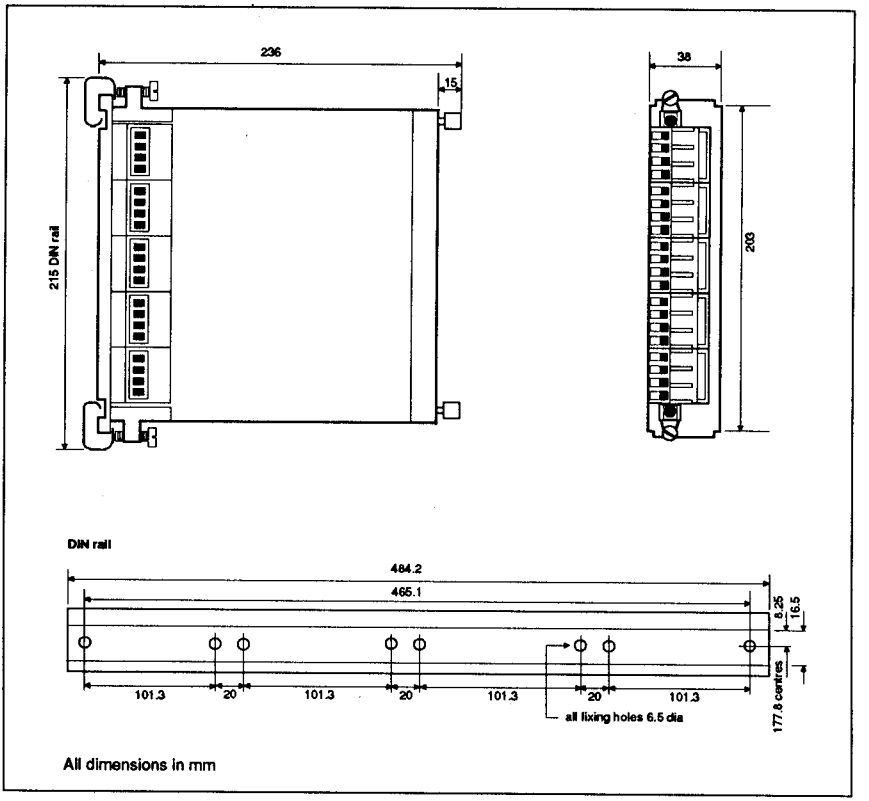
Basic Product	**Code**
483	483

Supply Voltage	**Code**
115V	11
230V	36

Options	**Code**
Without Backplate	76

Basic Product	Supply Voltage	Option	End
483			00

1.2 Installation and Dimensional Details



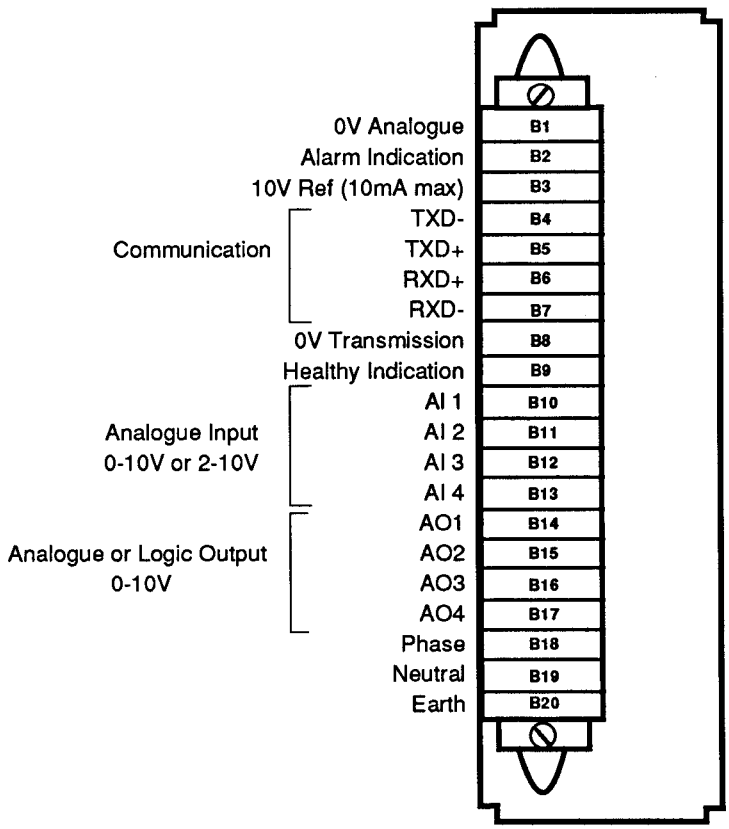
The 483 load sequencing controller is supplied complete with base plate, for mounting on to parallel DIN rails, or direct on to a control panel backplate. The unit should be mounted in a vertical plane. If fitting to DIN rails, release the top and bottom fixing screws 2 turns, drop onto rails, slide laterally into correct position and tighten up screws.

The module itself locks into the baseplate by means of the top and bottom quick release fittings. Rotate these 1/2 turn anticlockwise to release and 1/2 a turn clockwise to refasten in the plate.

1.3 Electrical Connections

Caution: *When connecting or disconnecting the terminal blocks or control wiring, the unit must first be isolated from the supply.*

The module interconnection circuit is electrically isolated from the control circuit. To maintain isolation terminal B1 (0V Analogue) must NOT be connected to B8 (0V transmission). Use max. cable size 1·5mm².



Notes:
i) 0v analogue, and 0V communications must not be connected together.

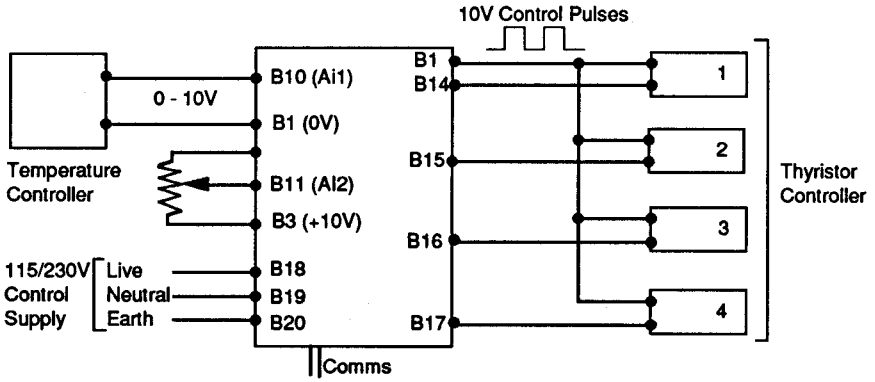
ii) If the power feedback option is being used the control supply should be driven from the same source as the power circuits. In this case an isolating transformer and appropriately rated control fuses should be used.

iii) The control supply should be externally fused at 2A.

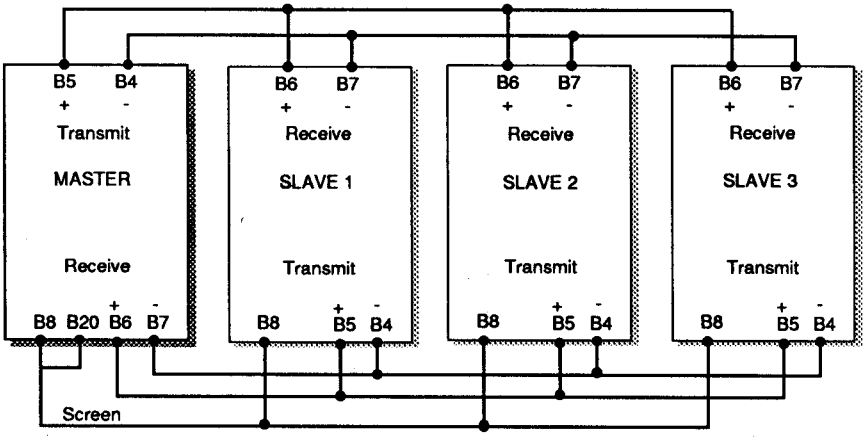
iv) A maximum of 4 units may be connected together using the RS422 serial link. Typical connections are shown in the following section.

1.4 Schematics

a) Control Connections



b) Communication Connections



Section 2 - **Configuration**

Contents *Page*

2.0 GENERAL

This section details the setting up of individual units to meet the specific requirements of the application. The operation section gives details of the specific functions of your unit.

2.1 Configuration Links

Configuration is set by the user, by means of an array of 15 plug in links, or jumpers. The links are alternatively set to position 1 (on) or 0 (off). The following table summarises the functions and factory fitted default positions:

Function		Default	
K1	Unit address	1	Slave address, 11
K2	Unit address	1	
K3	Outputs in use	0	1-output
K4	Outputs in use	0	
K5	Not used	0	
K6	Not used	0	
K7	Input 0-10V/2-10V	0	0-10V
K8	Cycle time base (T)	0	Fast, 2.1 secs
K9	Control mode	0	1st incremental mode
K10	Control mode	0	
K11	Control mode	0	
K12	Power feedback	0	No compensation
K13	Power feedback	0	
K14	Alarm signal voltage	1	15V
K15	Healthy signal voltage	1	15V

NB Links K5 and K6 may be used to replace lost links!

The following sections give detailed information regarding link positions:

2.1.1 Address of Each Unit

All units in a system must have a unique address.

K1	K2	
0	0	Master
0	1	Slave 1
1	0	Slave 2
1	1	Slave 3

2.1.2 Number of Outputs Used

This setting declares the number of outputs being used on a particular module. Order of priority is AO1, AO2, AO3, AO4.

K3	K4	Number of Outputs
0	0	1
0	1	2
1	0	3
1	1	4

2.1.3 Input Signal

The setting adjusts the input signal range to 0-10V or 2-10V.

K7 = 0	Input 0-10V
K7 = 1	Input 2-10V

For input signal of 4-20 mA, use 2-10V input in conjuction with 500 ohm external shunt.

2.1.4 Time Base

This setting adjusts for either fast or slow time base.

K8 = 0	Fast time base (2.1secs)
K8 = 1	Slow time base (8.9 mins)

2.1.5 Mode of Control

All units (max 4) on the same communication link must be set to the same mode of control.

K9	K10	K11	Mode	
0	0	0	First incremental mode	Logic
0	0	1	Second incremental mode	
0	1	0	Rotating incremental mode	
0	1	1	Distributed mode	
1	0	0	Distributed/incremental	
1	0	1	Rotating distributed/incremental	
1	1	0	Progressive incremental mode	Analogue
1	1	1	Rotating progressive/incremental	

2.1.6 Power Feedback Compensation

K12	K13	
0	0	No compensation
0	1	Power feedback

NB. Some analogue input Eurotherm thyristor controllers also provide voltage compensation. Take care not to use this feature in both instances!

2.1.7 Alarm Signal

K14 = 0	Signal 0-5V
K14 = 1	Signal 0-15V

2.1.8 Healthy Signal

K15 = 0	Signal 0-5V
K15 = 1	Signal 0-15V

2.1.9 Control Supply Voltage

The supply voltage is set by soldered links on the main control board.

230V	link 2
115V	links 1 and 3

Section 3 - **Operation**

Contents *Page*

3.0 GENERAL

The 483 Power Switching Controller is a control device used to resolve some of the problems associated with the switching of large electrical loads, in particular where several such loads are connected to a common supply... problems such as harmonic distortion, poor power factor and dipping of power supply voltages. The 483 offers a variety of user selectable operating modes to suit a variety of different applications.

The basic 483 is a 4 channel device with 4 analogue inputs (0-10V or 2-10V) and 4 dual purpose outputs (analogue 0-10V or pulsed logic).

It is usually connected in the power demand signal circuits associated with the loads in question... for example between a temperature controller output and thyristor input.

Up to four 483's may be cascaded together using an RS422 serial link between them, allowing up to 16 individual loads to be controlled. The first in a group is referred to as the master, and the others as slaves one to three.

The 483 supports three basic control principles, which are combined to give eight distinct operating modes. The control principles are:

Incremental control... a single power demand signal switches on a multi section load in distinct stages or increments. At least one zone modulates to provide fine control.

Distributed control... a number of power demand signals operate an equal number of corresponding loads, in such a way that no loads switch on together.

Rotating control... used in conjunction with incremental or distributed control, ensures each load in a group sees a similar power pattern.

In most modes the outputs of the 483 operate in a logic mode, varying the mark-space ratio of the output in proportion to the power demand of that particular load. There are 2 selectable time bases used in these modes of operation:

Fast - 2.1 secs - for use with burst firing thyristors.
Slow - 8.9 mins - for use with electromagnetic contactors.

In some control modes, an auxiliary 0-10V signal may be used to adjust the filter time constant - allowing the user to select the rate at which power changes are made.

In certain modes of operation, the relative rating of connected loads is important. This is considered more fully in section 3.5.

3.1 Operating Modes

3.1.1 First Incremental Mode (Last Zone Modulating)

Principle:

This mode provides incremental control of between 2 and 16 zones, operating from a single analogue input. Increasing power demand signal causes the connected load outputs to be progressively energised, with the LAST output modulating. For example, with 5 connected loads and 50% power demand, outputs 1 and 2 would be fully on, output 3 modulating with a mark-space ratio of 50%, and outputs 4 and 5 would be off.

Typical Applications :

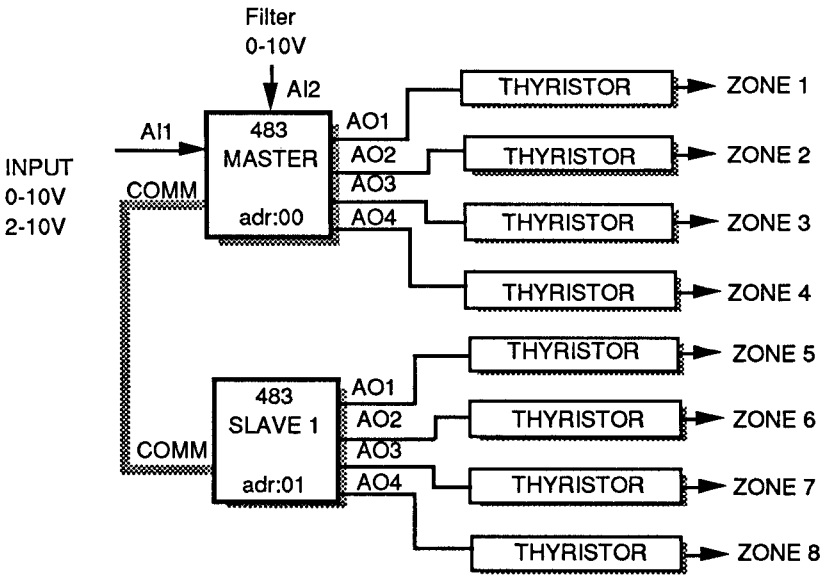
Multi section heating systems
Large compressors, refrigeration plants (slow time base)

Example :

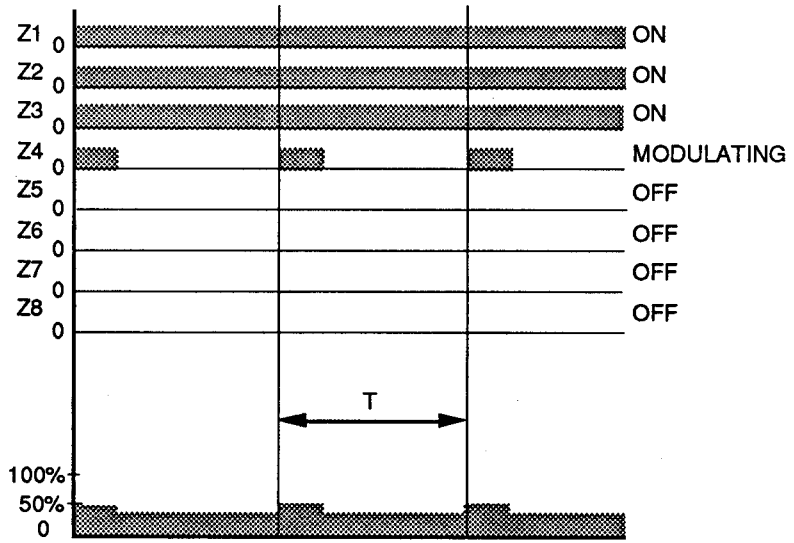
The example opposite shows the basic connections and power distribution diagram for an 8 zone heating system, each zone being controlled by a burst firing thyristor. If total load = 100% then each zone represents $\frac{100\%}{8}$ = 12·5% of the total power.

The example shows the power distribution corresponding to a power demand of approx. 40%.

a) Connections



b) Power Distribution



Peak Power = 50%: Mean Power = 40%
T = Time base (2.1 secs or 8.9 mins)

3.1.2 Second Incremental Mode (First Zone Modulating)

Principle:

This mode again provides incremental control of between 2 and 16 zones, operating from a single input. Increased power demand signal causes the connected load outputs to be progressively energised, with the FIRST output modulating at the appropriate rate. For example with 5 connected loads and 50% power demand, zone 1 would be modulating with a mark-space ratio of 50%, outputs 2 and 3 would be fully on and outputs 4 and 5 off.

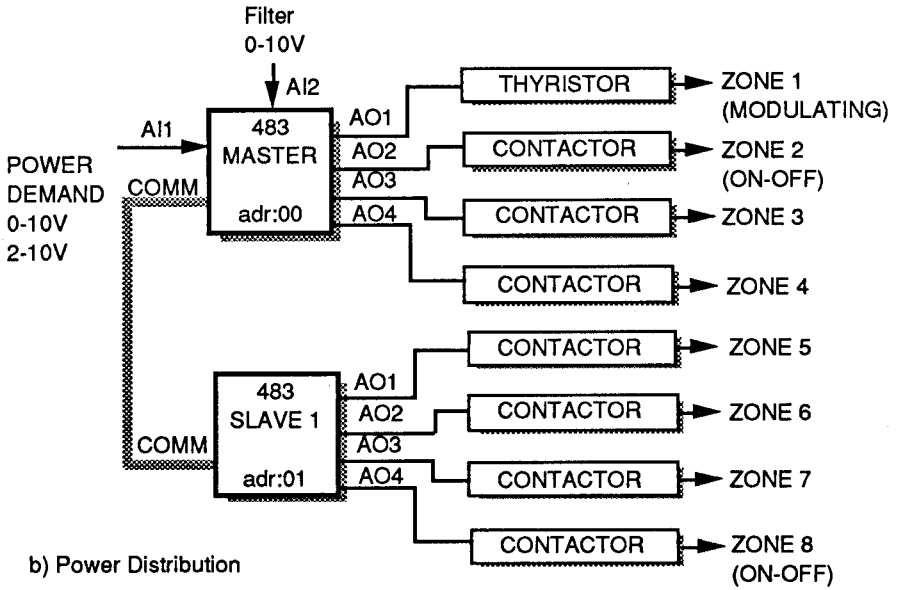
Typical Applications:

Multi section heating systems
Using a burst firing thyristor on the 1st (modulating) output, and ON/OFF contactors on all other outputs gives significant cost savings, without degradation of control.

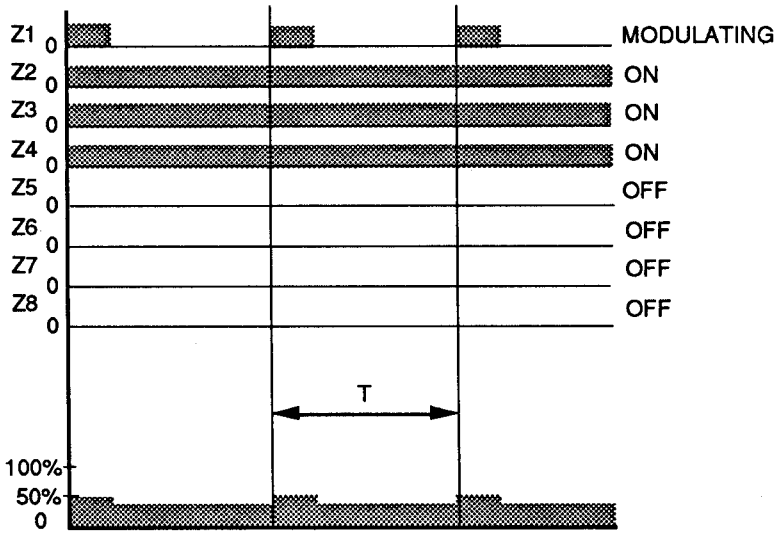
Example :

The example opposite shows the basic connections and power distribution diagram for an 8 zone heating system, zone 1 being thyristor controlled and zones 2-8 being controlled by contactors.
If total load = 100% then each zone represents $\frac{100\%}{8}$ = 12·5% of the total power.

The example shows the power distribution corresponding to a power demand of approx. 40%.



b) Power Distribution



Peak Power = 50%: Mean Power = 40%
T = Time base, 2.1 secs or 8.9 mins

3.1.3 Rotating Incremental Control (All Zones Modulating)

Principle:

This mode provides incremental control of between 2 and 16 outputs, operating from a single input. Each output modulates with an identical mark-space ratio determined by the power demand signal, but with each output separated from the adjacent output by the selected time base.
For example with 5 connected loads and 50% power demand, each of the 5 outputs would be modulating with a mark-space ratio of 50%, separated by 2.1 sec or 8.9 min depending on rate selected.

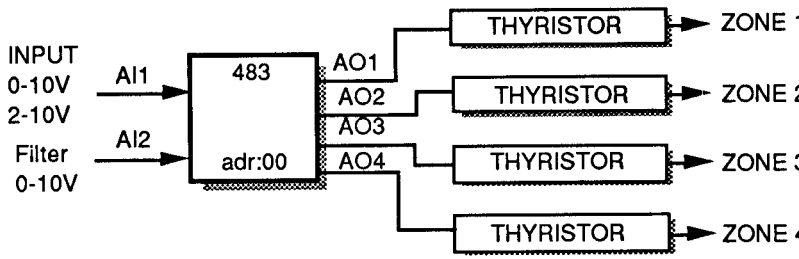
Typical Applications:

This mode is used to minimise load disturbances in heating or cooling systems, where it is necessary to ensure the load is shared evenly between all connected zones.

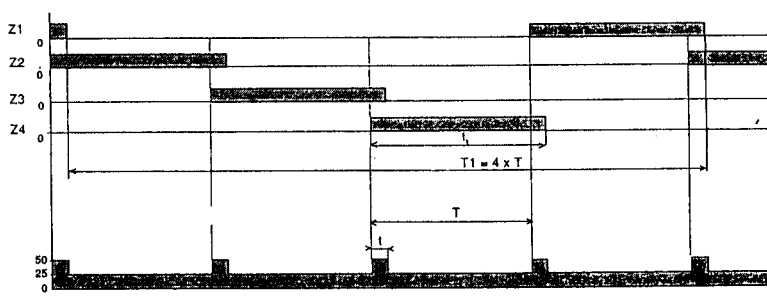
Example :

The example opposite shows the basic connections and power distribution for a 4 zone heating system, all zones being thyristor controlled.
If total load = 100% then each zone represents $\frac{100\%}{4}$ = 25% of the total power.
The example shows the zone power distribution for a power demand of approx. 27.5%.

a) Connections



b) Power Distribution



PEAK POWER = 50% MEAN POWER = 27.5%

T = Time base, 2.1 secs or 8.9 mins

3.1.4 Distributed Control

Principle:

This mode provides control of between 2 and 16 outputs from an equal number of independent inputs. Each output modulates with a mark-space ratio proportional to its corresponding input signal, but with the instant of switch-on between adjacent outputs distributed over the selected time cycle.

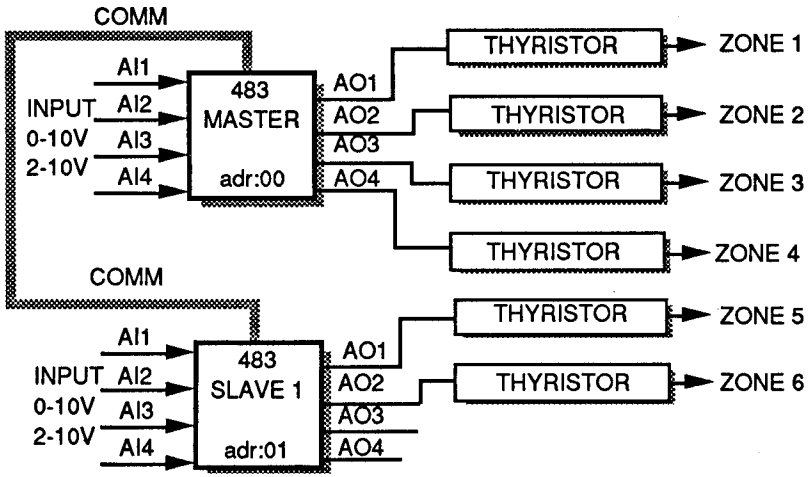
Typical Applications :

Used in multi zone heating systems, where simultaneous switching on of zones could give rise to load surges. e.g. when switching inductive loads such as transformer primaries.

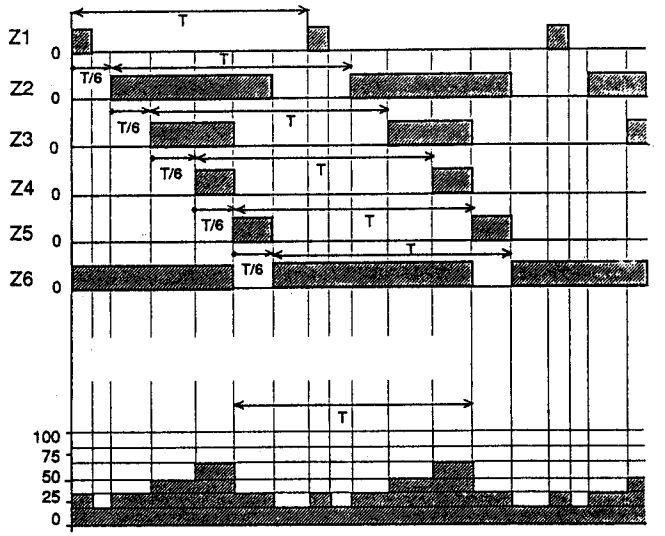
Example :

The example opposite shows the basic connections and power distribution for a 6 zone heating system, all zones being thyristor controlled.
Each zone has an individual power demand signal (Zone 1 = 10% etc.), and modulates accordingly.
The switch on points are separated by the time T/6, where T is the selected time base (usually the fast 2.1 second period with thyristors).

a) Connections



b) Power Distribution



Z1 ----------> 10%	Z4 ----------> 17%
Z2 ----------> 66%	Z5 ----------> 17%
Z3 ----------> 34%	Z6 ----------> 83%

3.1.5 Distributed and Incremental Control

Principle:

This mode provides control of between 2 and 4 groups of loads, each group being between 1 and 4 zones. Each group has a single power demand input, and operates as a second mode incremental group, with the first zone modulating, to maintain the selected power level. The instant of switch on in each group, is distributed over the selected cycle time.

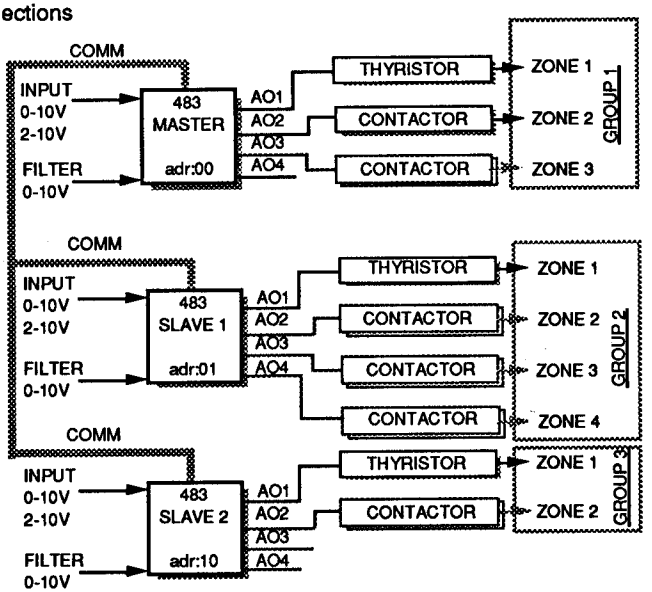
Typical Applications :

Primarily on heating loads consisting of multi sectioned groups of zones.

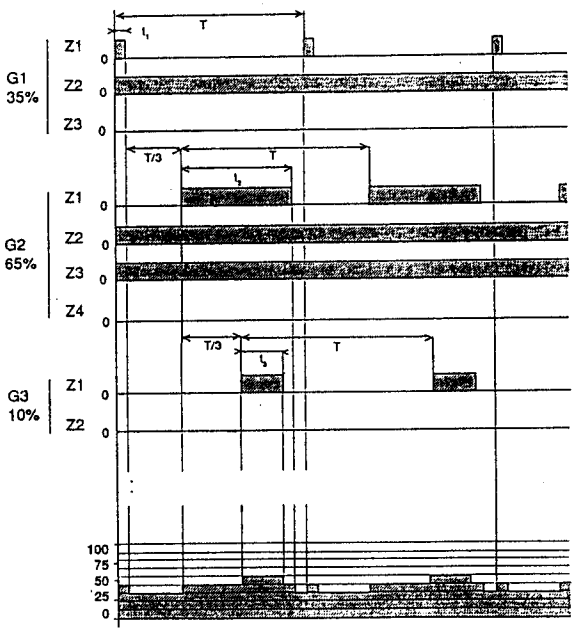
Example :

The example opposite shows the basic connections and power distribution for 3 groups of loads, each with varying numbers of zones.
The mark space ratio of the first zone in each group is determined by overall power demand, and the switch on points are separated by T/3 where T is the selected time base (usually the fast 2.1 second period with thyristors).

a) Connections



b) Power Distribution



3.1.6 Rotating Distributed and Incremental Control

Principle:

This mode provides control of between 2 and 4 groups of loads, each group being between 1 and 4 zones. Each group has a single power demand input, and operates in the rotating incremental mode described in section 3.1.3. with all zones modulating at an identical rate. The distributed aspect of this mode ensures that the instant of switch on in each group is distributed over the selected cycle time.

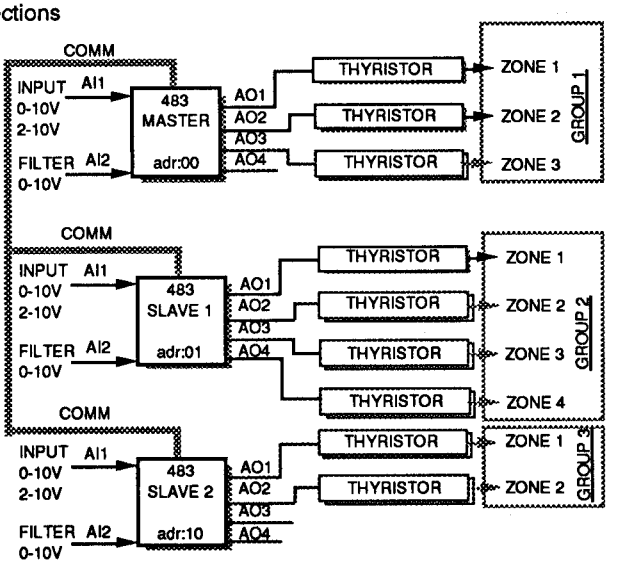
Typical Applications :

Large heating systems with multiple groups of zones, where it is necessary to ensure even loading between all the zones in any one group. This may be to achieve good thermal balance, or to ensure even ageing of certain types of elements.

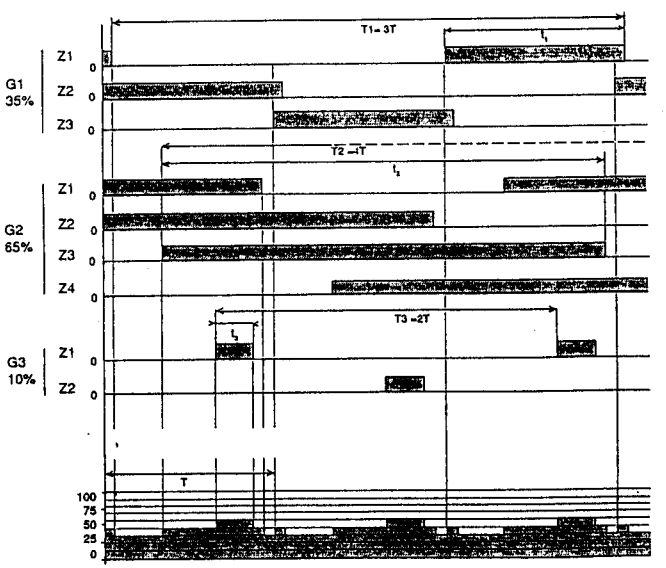
Example :

The example opposite shows the basic connections and power distribution for 3 groups of loads, each with a different number of zones.
Each zone within a group is modulating with a mark - space ratio equivalent to the group common power demand signal, the time between switch on of adjacent zones being T, where T is the selected time base.
The switch on point of zones within the other groups is separated by T/3.

a) Connections



b) Power Distribution



3.1.7 Progressive Incremental Control

Principle:

This mode provides incremental control of between 2 and 16 zones, operating from a single analogue input. It is similar to the first incremental control mode (see section 3.1.1), except that the output signals are now analogue 0 - 10V, instead of modulating logic signals. For example with 5 connected loads and 50% power demand, outputs 1 and 2 would be fully on, output 2 would be at 5V, and outputs 4 and 5 would be off.

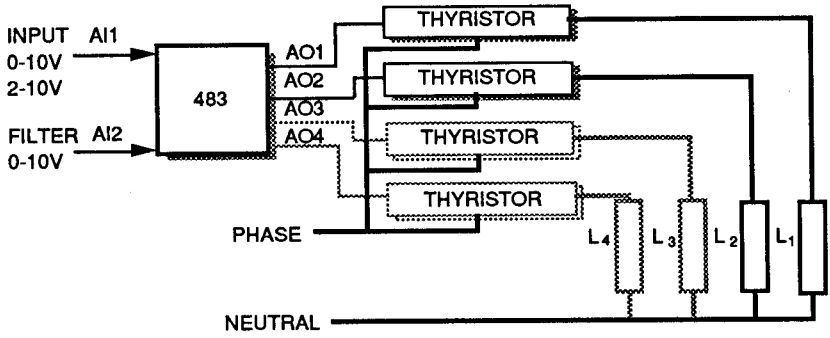
Typical Applications :

This mode of control is generally used in heating systems where thyristors are of necessity being operated in the phase angle mode. It ensures that only one section of the load is under phase angle control at any particular time, thus reducing the harmonic content in the overall line currents, and the apparent power factor.

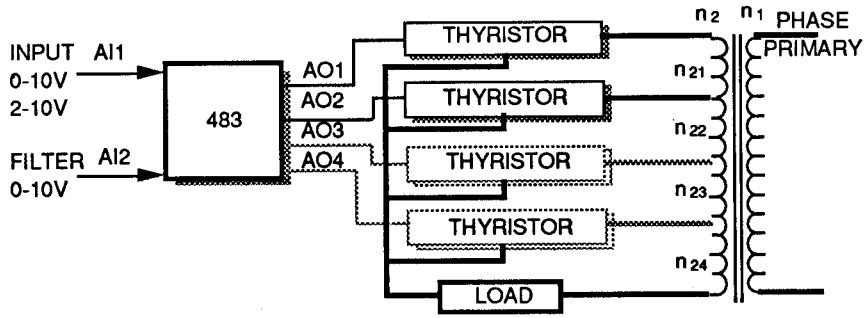
Example :

The 2 examples opposite show typical connections and power distribution for a 4 zone heating system, using thyristors operating in the phase angle mode, and also typical connections for a single load controlled by 4 stages of phase angle thyristors. The latter connection could be used in applications requiring good power factor control. The graph in appendix 4 shows how the power factor varies with actual power demanded, with varying numbers of stages of control (between 1 and 5).

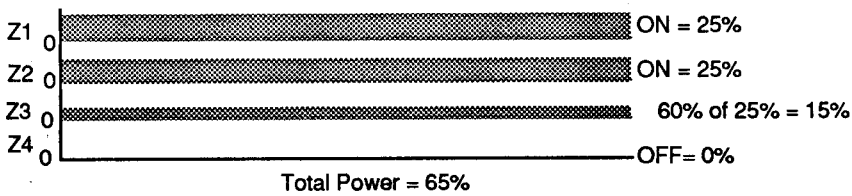
a) Connections 1



b) Connections 2



c) Power Distribution



3.1.8 Rotating Progressive Incremental Control

Principle:

This mode is similar to that described above for progressive incremental control. One zone is controlling in phase angle mode, and all other zones are either fully on or off. The power pattern increments by one zone on the completion of each time base.

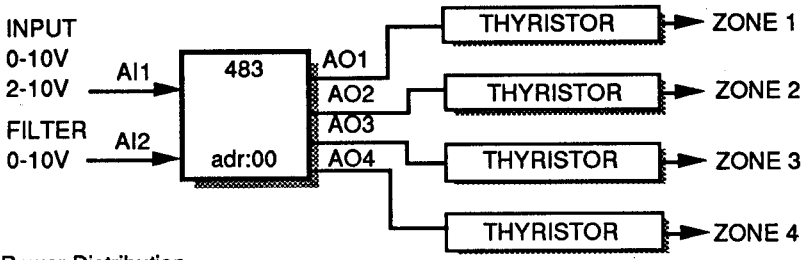
Typical Applications:

Systems requiring even distribution of power between the zones, to ensure good thermal balance, or consistent ageing of elements.

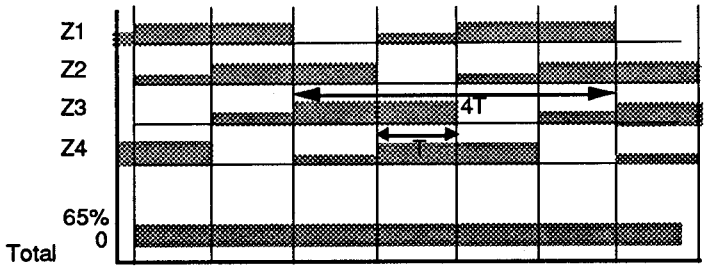
Example:

The example opposite shows typical connections and power distribution for a 4 zone heating system using thyristor regulators operating in the phase angle mode, with a power demand of 65%.
At any instant, 2 zones are fully on, one is operating in phase angle to contribute 15% total power and the 4th is off. This pattern increments at the selected time base rate, T.

a) Connections



b) Power Distribution



T = Time base (2.1 secs or 8.9 mins)

3.2 Input Filtering

An adjustable input filter is available, to limit the rate of change of power. The filter time constant is set by the value of a 0 - 10V signal applied to the 2nd analogue input of the system master module:

Input (A12)	Typical Value	Approx. Response Time
0V to 2.4V	0V (0 - 10V input) 2V (2 - 10V input)	20sec
2.4 to 2.5V	2.45V	50sec
2.5 to 2.6V	2.55V	100sec
2.7 to 2.9V	2.8V	3 min
3.0 to 3.5V	3.2V	7 min
3.6 to 4.8V	4.0V	13 min
4.9 to 7.3V	6.0V	27 min
7.5 to 10V	10.0V	54 min

The response time corresponds to a 0 to 100% power change.
In the case of incremental control modes, the filter is active on the first analogue input (AI1) to the master module.
In the case of the rotating distributed and incremental control mode, the filter is active on the first analogue input (AI1) to the master and slave modules.
In the case of the distributed control mode, the filter rate is fixed at approx. 50 secs.

3.3 Power Feedback

The 483 controller compensates for supply voltage changes in the range -15 to +10% nominal value, by increasing or decreasing the output signal in response to supply voltage changes. (Similar to the power feedback mode of Eurotherm temperature controllers). Compensation is link selectable to be operational in all control modes:
In the case of incremental modes, the compensation is active on the AI1 input to the master module.
In the case of distributed and incremental, and rotating distributed and incremental modes it is active on the AI1 input to all modules.
In the case of distributed control it is active on all inputs.

Initial Adjustment
With the supply voltage at the correct nominal value, e.g. 115, 230V adjust the compensation potentiometer on the fascia of the modules to give a nominal value of 2.5V at position 16 of the diagnostic unit type 260 (see appendix 3).

3.4 Ancillary Signals

3.4.1 Alarm Indication

An alarm signal is available on terminal B2, link selectable to +15V or +5V in the healthy state, and dropping to 0V in the event of alarm. The following conditions give rise to an alarm signal:

i) If the time base or the mode of control, on the master and associated slave units are different, the alarm is activated on the master and slave units.

ii) If a slave unit was present during initialisation, and subsequently fails to communicate, the alarm is activated for 2 secs.
If the slave fails completely, the master will reinitialise the system with the remaining modules. The faulty unit can then be changed. A 2 sec alarm is again given.
If a unit of valid configuration is added, the alarm again operates for 2 secs.

iii) The alarm is activated on a slave unit, if it fails to receive the synchronisation signal from the master.

3.4.2 Healthy Signal

Dependent on the setting of link 15, a 5V or 15V pulse, of duration 100ms appears on terminal B9 at the chosen time base interval.
In a system with several 483 units, if the master is faulty, none of the associated slave modules will give the healthy signal.

3.5 General Notes

1. When the long time base is selected, all the logic modes of operation (1 - 6) can be used in conjunction with electromagnetic contactors. Note that the 483 output (AO1 - AO4) can only supply 10V at 15mA, and therefore an interposing electronic relay should be used in this instance.

2. Because the 483 unit does not know the actual zone rating,it assumes all zones are of equal rating, although of course in practice this may not be the case.
In modes 1, 3, 4, 6, 7 and 8 the system operates correctly even if the zones are grossly unbalanced, in that total power always increases with increasing power demand signal, although the relationship may not be linear.
In modes 2 and 5, if the modulating zone (zone 1) is of a higher power rating than the other zones in the group, then increasing power demand will actually cause a dip in total power, as subsequent zones are switched in, and the modulating zone reverts to zero power.

3.6 Switch on Procedure

There are very few adjustments to be made to the 483 once it has been configured for a particular mode of operation. However, the following checklist should act as a guide to ensure that correct operation is achieved.

1. Check that the supply voltage for your unit is in accordance with the code.
2. Check that the input and output voltages are correctly selected.
3. Check that the input filter is set to a suitable value (see section 3.2 for settings in various operating modes).
4. Check that the power feedback compensation potentiometer P4 is correctly adjusted (if power feedback is selected) see section 3.3 for setting.
5. The unit can now be switched on and will operate in accordance with the mode selected.

Appendix

Contents *Page*

1 Diagnostic Points

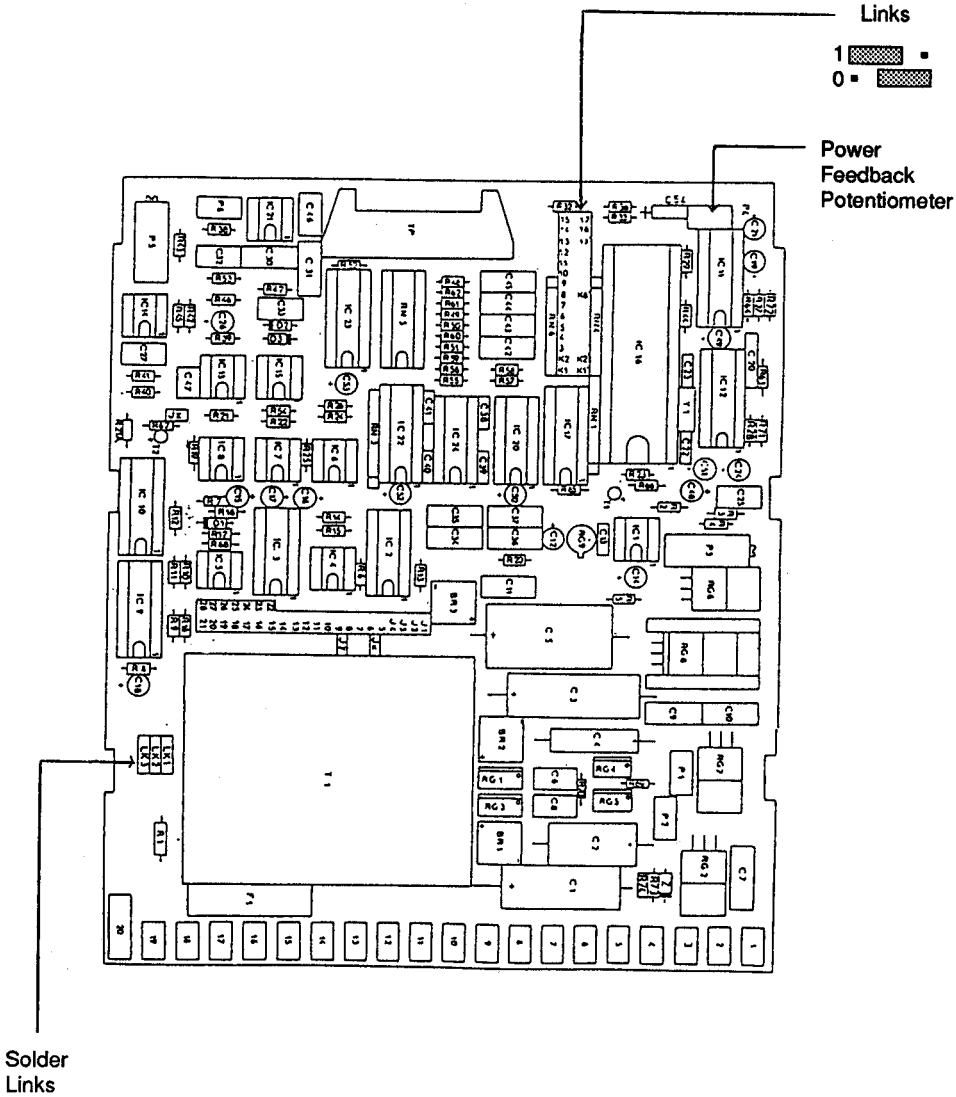
Eurotherm diagnostic unit type 260 plugs into the socket provided on the front of the unit.

The following table indicates the correct voltage or voltage range at each of the switched diagnostic positions.

Switch Position	Signal
1	+15V (Control supply)
2	+10V (Reference supply)
3	-15V (Control supply)
4	0V (Reference supply)
5	+5V (Control supply)
6	A04 (0-10V)
7	A03 (0-10V)
8	A02 (0-10V)
9	A01 (0-10V)
10	AI 1 (0-10V)
11	AI 2 (0-10V)
12	AI 3 (0-10V)
13	AI 4 (0-10V)
14	Healthy signal
15	Alarm signal
16	Power feedback
17	Not used
18	0V (Control)

2 Location of Links/Jumpers

Position of section links

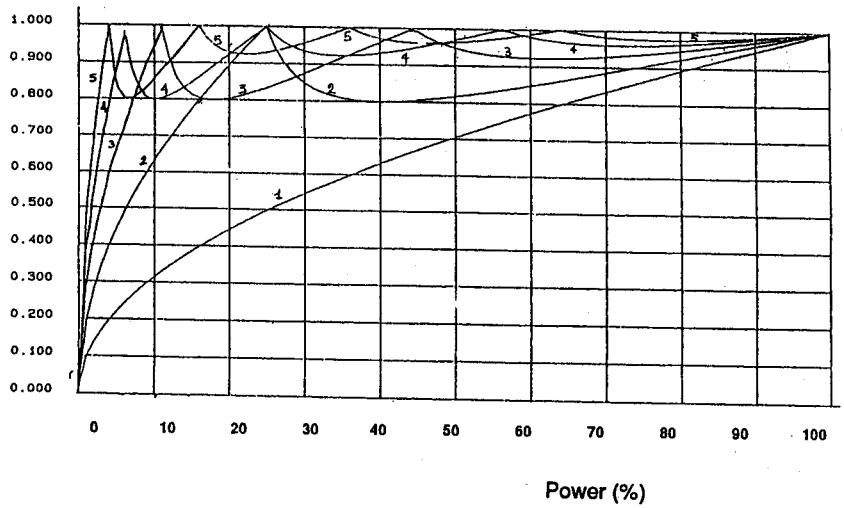


3 Technical Specification

Operating Temperature	0°C to 50°C
Supply Voltage	115 or 230V (+10, -15%), set by solder links
Inputs	4 analogue inputs, selectable 0-10V, 2-10V Impedance 100Kohms Accuracy 0.5% Fdr 4-20mA input, use 500 ohm resistor, 2-10V range Inputs active over range 2% to 98%
Outputs	4 analogue or logic outputs, 0-10V Short circuit protected, max current 10mA
Isolation	All inputs and outputs on any one unit share common 0V circuit
Time base	2.1 secs or 8.95 mins, link selectable Accuracy 1%
Communication Link	Max. of four units connected by RS422 serial link Electrical isolation between units 4 addresses, 00 to 11 configurable by user
Monitoring	Watchdog. Microprocessor automatically reset in the event of system malfunction Alarm. Fail safe alarm output, healthy state selectable to +5V or +15V. Max. current 8mA. Healthy signal. Pulsed output of duration 100ms, either +5V or +15V, at selected time base rate. Max. current 8mA.
Diagnostics	17 test points available by means of Eurotherm type 260 diagnostic meter. Plugs into front of unit.

4 Power Factor Curves

Power factor variation with multi tapped transformers



1 = 1 transformer tapping
2 = 2 transformer tapping
3 = 3 transformer tapping
4 = 4 transformer tapping