

# EUROTHERM

## POWER CONTROLLER 401 REMOTE SETPOINT UNIT 403 WATTMASTER POWER CONTROLLER 404

### INSTALLATION AND OPERATING INSTRUCTIO

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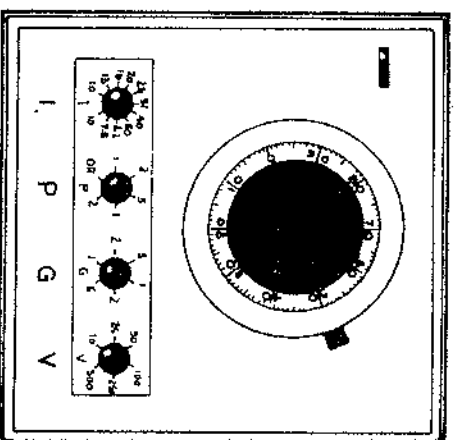
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Sales and Service in 32 countries.  
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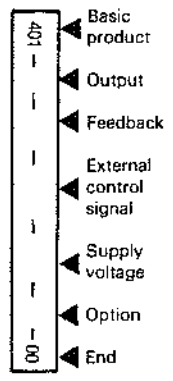
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## Ordering Information

### 401 Power Controller

Used for control of heater loads where it is difficult or not required to sense temperature. Offers five possible feedback modes. Outputs for driving most thyristor units.



Output	Basic product	Output Code
Fast-cycle firing pulse	401	-001
Phase-angle firing pulses		002
Isolated 0-5V (0.25mA max.)		008
Isolated 0-5V (10mA max.)		070
Isolated 0-10mA (20V max.)		071
Isolated 0-20mA (12V max.)		072
Isolated 4-20mA (12V max.)		073

Feedback Voltage	Code
Internally simulated	200
External 110/220V	221
External 115/240V	222
External 220/380V	223
External 240/415V	224
External 120/208V	225
Externally simulated 1/φ voltage only possible with phase angle or fast cycle.	

External Control Signal	Code
No external control signal	000
0-5V dc	008
0-20mA	072
4-20mA	073

Options	Code
Manual front panel setpoint, or Remote setpoint terminals	30
Auxiliary Rear panel setpoint, or Remote setpoint terminals	31
Faston terminals	34
Plug-in facility (sleeve required)	01
F/B voltage isolating transformer	19
Auto/manual switch	35
Panel Bezel	44
Panel sealing	65
	66

▲ May be mounted externally when option 30 required, and must be fitted when 401 is used with 403 instrument.  
 Excluded by option 44, which is required when external control signal is used with another setpoint.  
 Options 31 and 33 are mutually exclusive.

### 401/404 Supply Voltages

Code	Supply Voltage	Code	Supply Voltage	Tolerance
25	100/200V	03	220/380V	+10% -15% 50/60Hz
01	110/220V	04	240/415V	
02	115/240V			

## CONNECTIONS AND WIRING

### 401 Power Controller

#### Supply Voltage

The line supply (L1) should be connected to terminal 9 or terminal 11 whichever appropriate. The neutral connections on both the thyristor unit and the 401 controller terminal 7 should be taken from the neutral side of the load to compensate for line in voltage.

#### Thyristor Pulse Outputs -001, 002

Controllers with phase-angle or fast-cycle pulse outputs have pulse pairs brought on terminals 3, 4 and 5, 6. Pulse outputs are fed to an external thyristor unit employing devices connected in inverse parallel.

**Note:** When using phase-angle switching with inductive loads ensure that the circuit is made simultaneously with or before the supply to the instrument. The 'soft' start feature will then limit the inrush load current which could otherwise blow the semiconductor fuse.

#### Isolated dc Output - 008, 070, 071, 072, 073

With controllers providing dc analogue signals, the output is brought out to terminals 3 and 5. These outputs are suitable for use with external drivers or process controllers.

#### Feedback Mode Connections

**Mode 1 - V<sup>2</sup> feedback.** A connection is made from the line side of the load to terminal 10 or terminal 12, depending on voltage. With 3-phase systems an isolation transformer is necessary here.

**Mode 2 - I<sup>2</sup> feedback.** A connection is made between common on the thyristor and terminal 2 common on the 401. Also, between the 0-5V dc current feedback terminal on the thyristor unit and terminal 8 on the 401.

**Mode 3 - V<sup>2</sup>/I<sup>2</sup> transfer.** Connections are made for both mode 1 and mode 2 as above.  
**Mode 4 - (V + I)<sup>2</sup> feedback.** Connections are made as for V<sup>2</sup> feedback, mode 1 above. Also between feedback common on the thyristor unit and terminal 2 common on 401, and between the 0-5V dc current feedback signal from the thyristor unit terminal 1 current feedback V + I mode on the 401.

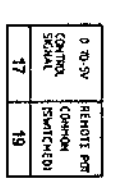
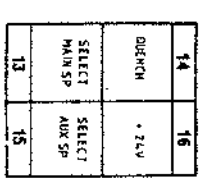
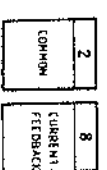
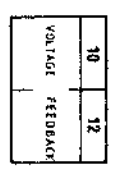
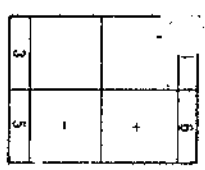
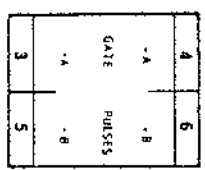
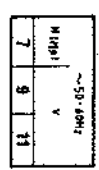
**Mode 5 - Internal simulated voltage feedback.** The connection to terminal 10 or omitted as it is made internally.

#### Setpoint Logic Circuitry and Quench

To select front setpoint, link terminals 16 and 13. To select rear setpoint, link terminals 16 and 15. The output will remain quenched (zero) until terminals 14 and 16 are fitted or when no setpoint is selected.

#### External Control Signal and Auto Manual Switch

An external 0 to -5V control signal should be connected between terminal 17 and 21 (+ve). It will only operate when the auto manual switch is in auto mode. (Also see 403 section).



## 401 — Use with 403 Remote Setpoint Unit.

See 403 section.

2	4
COMMON	

### Checking — 401 Unit.

Pulse outputs. May be measured with an ac voltmeter. This shows about 0.8V ac continuous at full power. If the control signal is reduced (or the setpoint potentiometer turned back) the output will decrease (002 phase angle) or will begin pulsing with decreasing ON time (001 fast cycle).  
 DC outputs. If an auto manual switch is fitted, switch to auto and check that the output increases linearly in proportion to a 0 to -5V input signal. Next, switch to manual and check that the output increases linearly as the front panel control is turned clockwise from its zero position. The appropriate feedback signal is required for this unit to operate correctly.

18	20
REMOTE POT WIPER	
REMOTE POT COMMON (SWITCHED)	
17	19

## 403 Remote Setpoint Unit

### Supply voltage

The reference supply for the 403 is taken from a 401 controller or thyristor unit which supplies -5V dc e.g. 401 Terminal 18. Terminal 1 on the 403 is the reference input (supply). Terminal 2 is common.

2	4
SETPOINT OUTPUT 2	
COMMON	
REF INPUT (-5V)	SETPOINT OUTPUT 1
1	3

### Auto input — 008, 072

Terminal 6 is for an external input, to be used in association with the auto/manual switch. Option 008 is 0 to 5V, option 072 is 0 to 20mA. (Converted to a 0 to 5V output signal).

6	
AUTO INPUT	
SETPOINT OUTPUT 3	
5	

### Setpoint Output

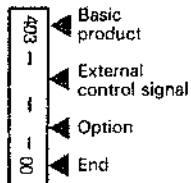
Three setpoint outputs are available. These may be used to run a 3-phase system, or singly on a single phase system. (Use terminal 30. The output signal is a 0 to 2.5V analogue level).

403 to 401 connections are:—

403/1 (-5V in)	401/18 (Remote pot ref -5V)
403/2 (Comm V+)	401/19 (Remote pot common, switched) for 401 with Front Panel Setpoint OR 401/2 (Common) for 401 with no Front Panel Setpoint
403/3 (O/P 1)	401/20 (Remote pot wiper)

See Typical Wiring Schemes.

For use with 401 Power Controller and Thyristor units.  
 Suitable for use on 3-phase systems.



### External Control Signal

No external control signal	403	000
5V	008	
20mA	072	

For other external control signals consult your local Eurotherm engineer.

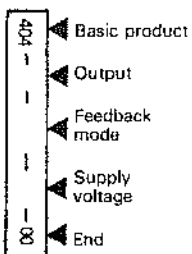
Auto/manual switch option 44 must be fitted when external control signal is specified. For 403 unit note that external control need not be specified on the power controllers since the external control signal is converted to a 5V level in the 403 unit and applied to the power controllers via the remote setpoint terminals.

### Options

Fastons	01
Auto/manual switch	44
Black bezel	65
Panel sealing	66
Plug-in facility (sleeve required)	19

## 404 Wattmaster RF Power Controller

Used to control RF Power Generators. Frequency range better than 1 MHz. Stability typical

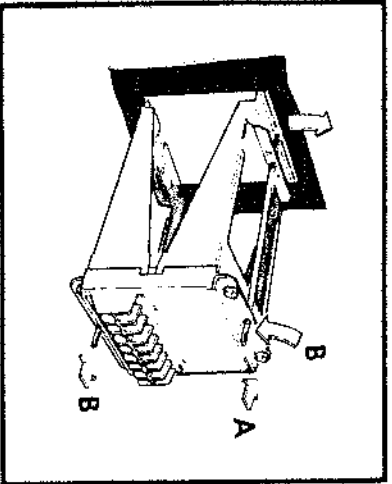
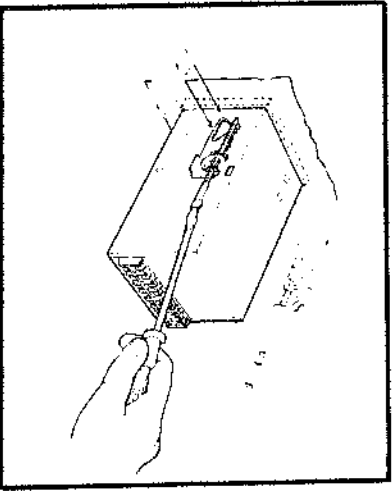
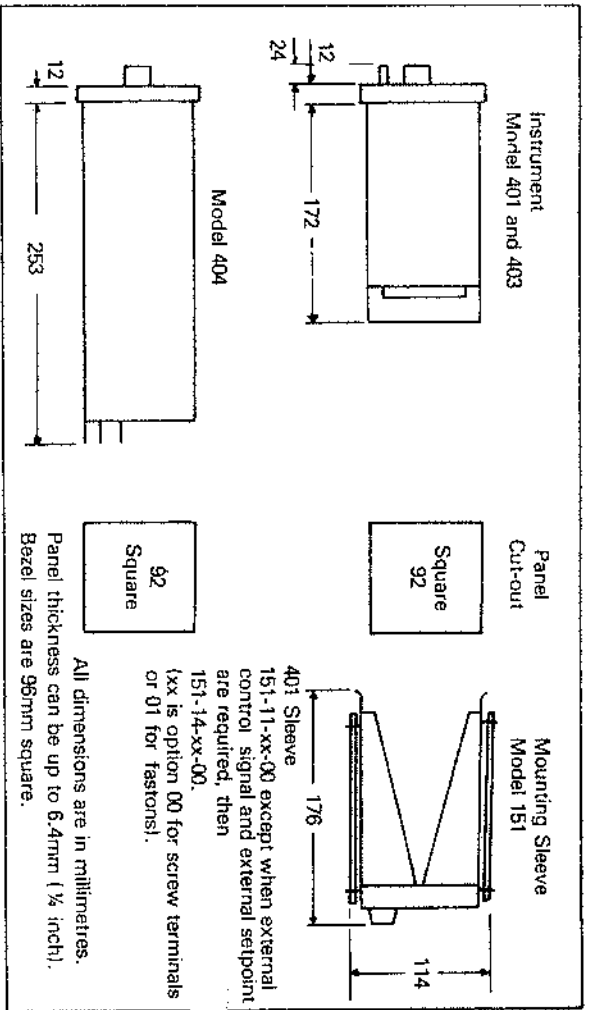


Output	Basic product	Output Code
0-5V dc (ImA max.)	404	019
0-1mA		029
0-10mA		015
4-20mA		013
10-50mA		040
Not isolated from internal dc power supply.		

### Feedback Mode

Multiplying	209
Squaring	210

# INSTALLATION AND DIMENSIONAL DETAILS

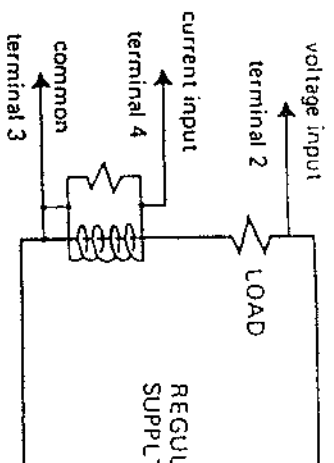


The instrument is intended for panel mounting in a DIN size 92 x 92 cut-out as illustrated. Remove the mounting clamps and insert the instrument through the cut-out from the front of the panel. Fit the clamps from the rear of the panel and tighten tightly with a screw-driver as shown.

When a plug-in sleeve is used it fits in the same 92 x 92 mm cut-out. Partially unscrew the flange bolts A insert it through the cut-out from behind the panel and tighten the flange bolts and clamp screw B with a screwdriver. Insert the controller fully into the sleeve from the front of the panel and secure by depressing the locking lever located in the lower right hand corner of the fascia. To withdraw the controller, raise the locking lever and pull the instrument out of the panel.

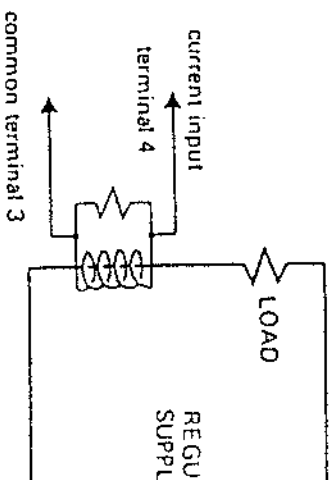
## Multiplying Mode

The current and voltage signals must be in the same quadrant as each other. The current input must also have zero average level. The current transformer connection shown allows both of these requirements to be met. In some applications a voltage transformer will be required to give isolation.



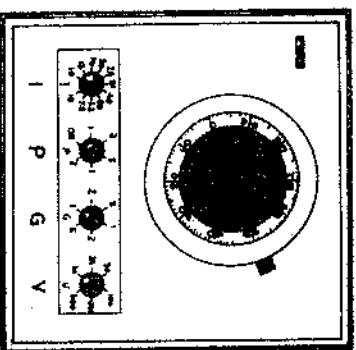
## Linear Mode

In this mode the controller gives constant mean-square voltage or current. The R.M.S. voltage or R.M.S. current is thus held constant whilst still giving linear power setting. This mode of control is essential for some applications. The voltage attenuator is omitted and the eleven step current attenuator used.



## Controls

- I. Current attenuator. The full scale voltage required at the current input can be adjusted from 1V to 10V in eleven steps.
- P. Proportional lift control. 'Off' and 0.1, 0.2, 0.5, 1, 2 sec time constants.
- G. Integral Gain control. 0.1, 0.2, 0.5, 1, 2, 5 sec time constants.
- V. Voltage attenuator. (Fitted to multiplying models only). 10V, 25V, 50V, 100V, 250V, 500V.

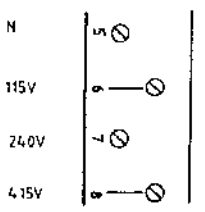
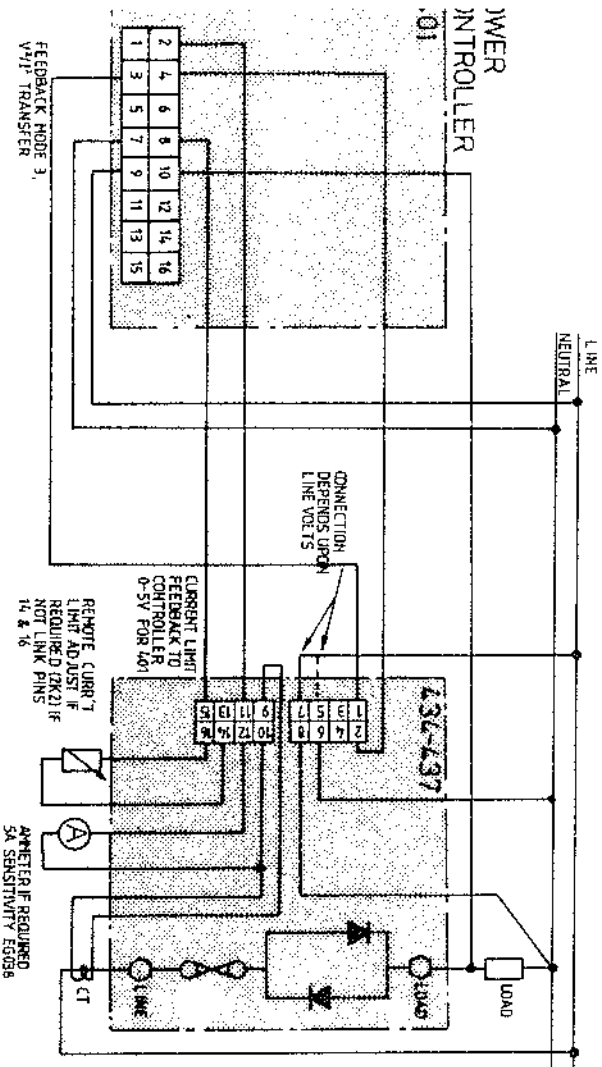


## Setting up procedure

- Set the current and voltage attenuators to the correct range.
- Set the power demand to zero.
- Set the control 'P' fully anti-clockwise (off).
- Set control 'G' fully clockwise (5 sec).
- Switch on the supply and gradually increase the power demand until a reasonable level of power is obtained. If instability occurs, this indicates that the system gain is too high. Turn the current and/or voltage attenuator clockwise until the instability disappears.
- Turn control 'G' anti-clockwise one step at a time until the system becomes unstable. Then turn 'G' clockwise until the system stabilises again.
- Turn control 'P' clockwise until the system becomes unstable. Then turn 'P' anti-clockwise until the system stabilises again.
- Test the system response to step power demand. If any instability exists, turn control 'G' one step clockwise and/or control 'P' one step anti-clockwise.

## TYPICAL WIRING SCHEMES

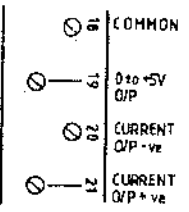
Single-phase thyristor controlled load — 401, 434 — 437.



### 404 Wattmaster Power Controller

#### Supply Voltage

The line supply should be connected to terminal 6, 7 or 8 whichever is appropriate neutral connection should be taken to terminal 5.



#### Output — 019, 039, 015, 013, 040

Voltage output — terminal 18 is common and terminal 19 is 0 to +5V output terminals 20 and 21 using a 1K ohm 1/4w resistor to use this output. Current output — terminal 20 is negative, terminal 21 is positive. Code 039 is 015 is 0-10mA, 013 is 4-20mA and 040 is 10-50mA.

#### Feedback mode connections — 209, 210

The feedback mode is defined by internal linking and is not externally selectable 209 is multiplying mode, 210 is squaring mode.

Multiplying mode — terminal 1 is common, terminal 2 is the voltage input. Terminal 3 is common, terminal 4 is the current input.

Squaring mode — terminal 3 is common, terminal 4 is the current input. See note 2.

#### Power Indication

Terminal 11 is common and terminal 12 is for connection of a power indicator (e.g. moving coil meter). Maximum load is 100µA at 5 volts. See note 2.

#### External Potentiometer

For control by an external potentiometer of 5K ohm or 403 unit, connections follows:

function	terminal
common	13
wiper	14
pot. reference supply	17

Note 1: When the front panel potentiometer is used, 15 is linked to 14 (demand) is linked to 16 (potentiometer). See note 2.

## Program input

Terminals 9 (common) and 10 program input will accept program control from Eurotherm programmers. (0-10V dc). The external signal is added to the internal setpoint and this becomes the net setpoint or the power loop.

note 2. Terminals 1, 3, 9, 11, 13, 18 are linked internally. Terminal 15 is connected to wiper of internal potentiometer. Terminal 16 is connected to maximum end of internal potentiometer.

## OPERATION

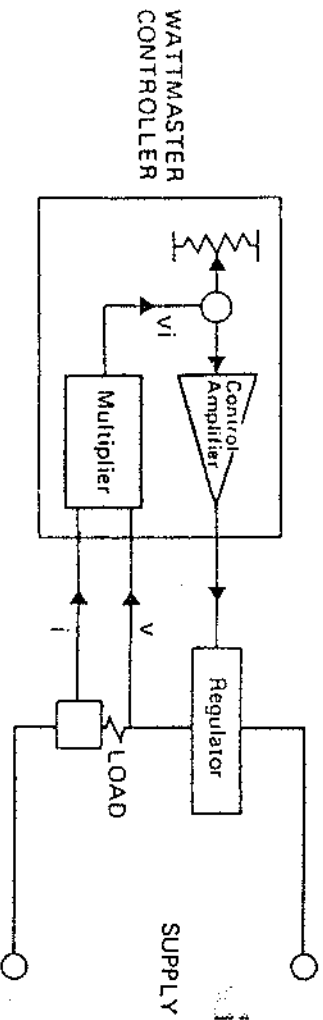
### Mode of Operation

The Eurotherm solid state WATTMASTER power controller is designed to give accurate power control in applications where the mains supply and load impedance are not constant, or where high operating frequency has previously dictated the use of less accurate methods of control.

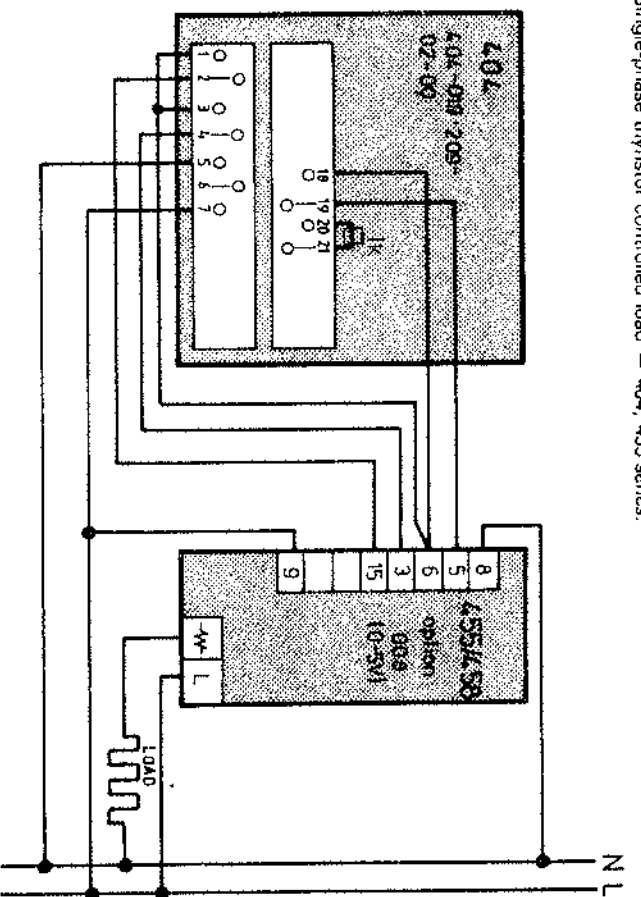
Linear power setting is achieved by a multi-turn potentiometer fitted with a turns-counting dial, giving a setting accuracy of 0.1% of full scale power. Power programming can be achieved by an external potentiometer or by an external voltage signal from a Eurotherm programmer.

Feedback is achieved by a wide band multiplying circuit which gives the instantaneous voltage-current product and thereby takes account of any phase difference between the voltage and current signals. Control of true power is thus achieved. Alternatively, the two inputs may be connected together to give control of the R.M.S. voltage or the R.M.S. current. The frequency response of the multiplying circuit extends well beyond 1MHz, making it suitable for control of high frequency power.

The error difference between the set power level and the measured power level is fed into a control amplifier which has been purpose designed for the type of applications in which the WATTMASTER is likely to be used; for example, loads fed from thyristors or saturable reactor regulators. Two switches provide combined adjustment of gain and time constants in such a way that optimum system response can be achieved very quickly and with a minimum amount of skill. The output of the amplifier can provide a variety of signals suitable for driving most types of external regulators. All models provide an additional signal suitable for driving Eurotherm thyristor regulators.



Single-phase thyristor controlled load — 404, 455 series.



Three Phase 4 wire Star Connected Load — 401, 403

