Total Energy Controls

TEC Energy Master Installation & Programming Manual

Contents

Installation

General Notes

The installation of all TEC units should be carried out by a qualified electrical engineer familiar with heating systems and control wiring.

All control circuits of TEC units are ‘volt free’ and may be used to switch 240V AC or low voltage control systems.

Extreme care must be taken to ensure that all wiring is correct before applying power, as irrepairable damage to the PCB could result due to incorrect connections.

Fixing the Enclosure

Select a suitable position for the Energy Master adjacent to the boiler, away from any high heat source, i.e. flue etc.

Fasten the rear enclosure to the wall and drill cable entry holes as required to accept cables (heat resistant) either via 12mm (max) self adhesive plastic trunking or other suitable means. Strip off 15-20cm of outer insulation on all cables to give flexibility and to avoid tension on the PCB terminals.

Once all cables have been installed as described in the following sections, fit the front enclosure with the supplied screws and attach the 4 blanking plugs.

Mains Wiring

A 240V AC 1Ph 50Hz supply may be taken from the existing time clock switched or permanent supply, or direct from the boiler mains input connections (where available), which ever is the most suitable. The 240V connection for the Energy Master is shown in Fig.1 below.

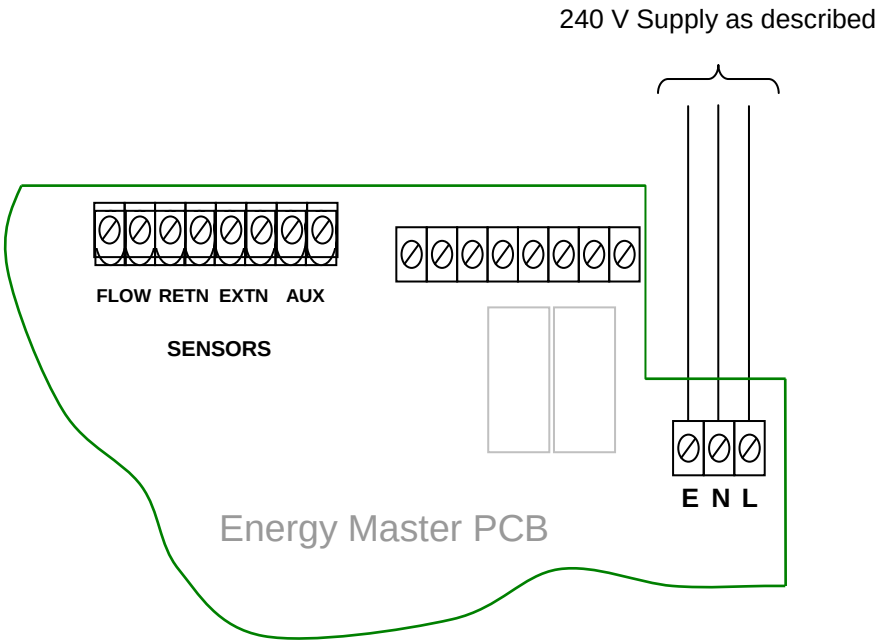


Fig. 1

Control Wiring

Many boilers are provided with an accessible mains terminal block. Most have a pair of connections (usually unused) for use with external controls. These connections will have a link which needs to be removed so that the Energy Master control wires can be connected as shown in Fig.2.

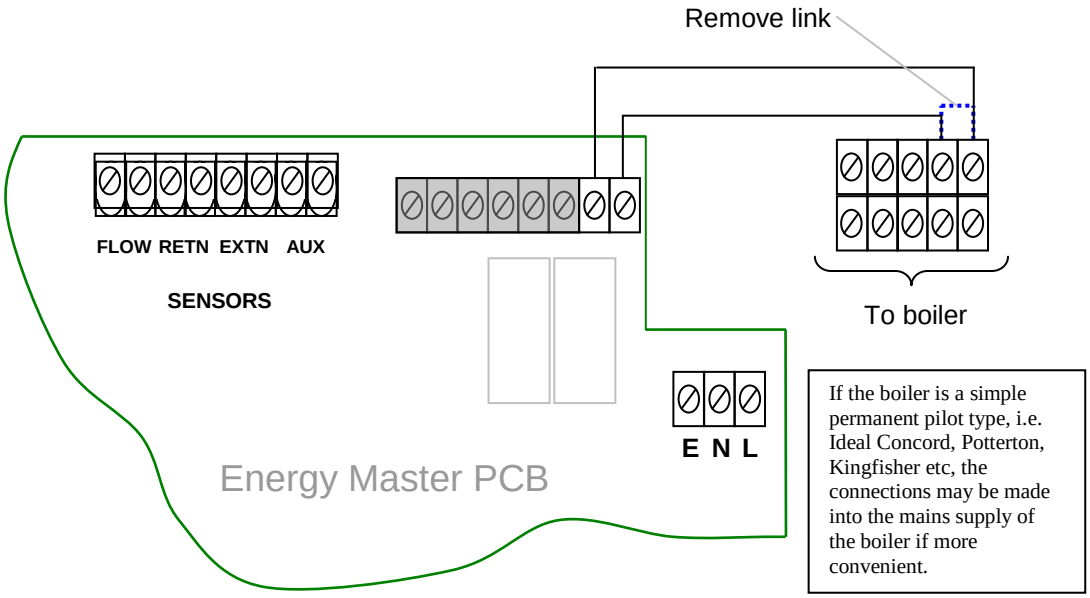


Fig. 2

Note: A 5-core heat resistant flex is ideal for connecting the Energy Master to the boiler. The recommended connection method is via 12mm self adhesive conduit to house the cable. A separate 2-core cable will be required should the pump control circuit be used.

Where a terminal block arrangement as shown in Fig.2 is not available, the control wiring should be connected directly into the boiler thermostat wiring as shown in Fig.3.

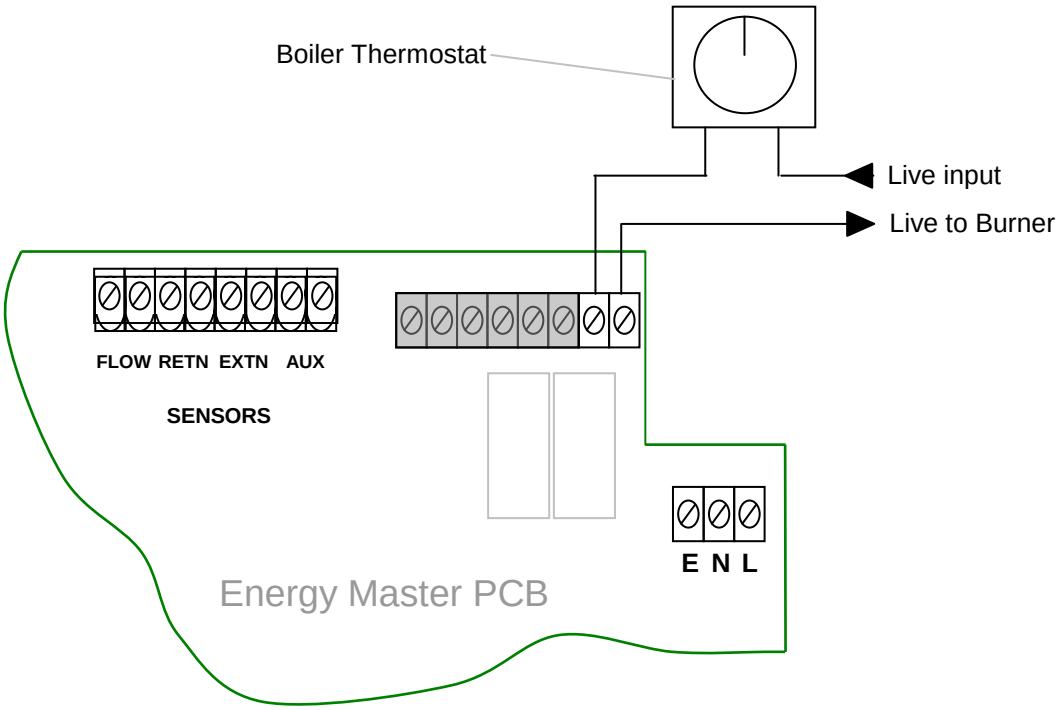


Fig. 3

The left hand relay on the Energy Master is the **Pump Relay** which may be used to control a circulating pump. Connections are as shown in Fig.4 on the next page.

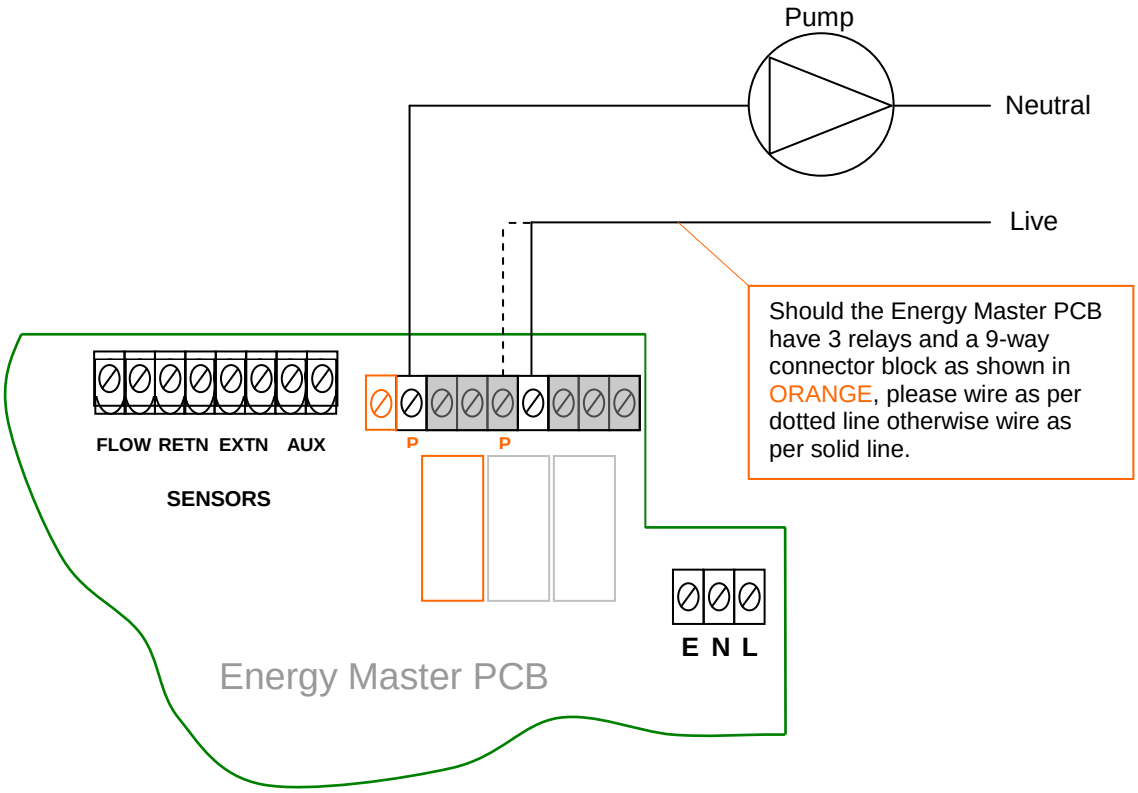


Fig. 4

Fitting and Wiring Temperature Sensors

The Energy Master has three temperature sensor inputs, these being **Flow, Return/Hot Water** and **External**. Connections are as shown in Fig.5.

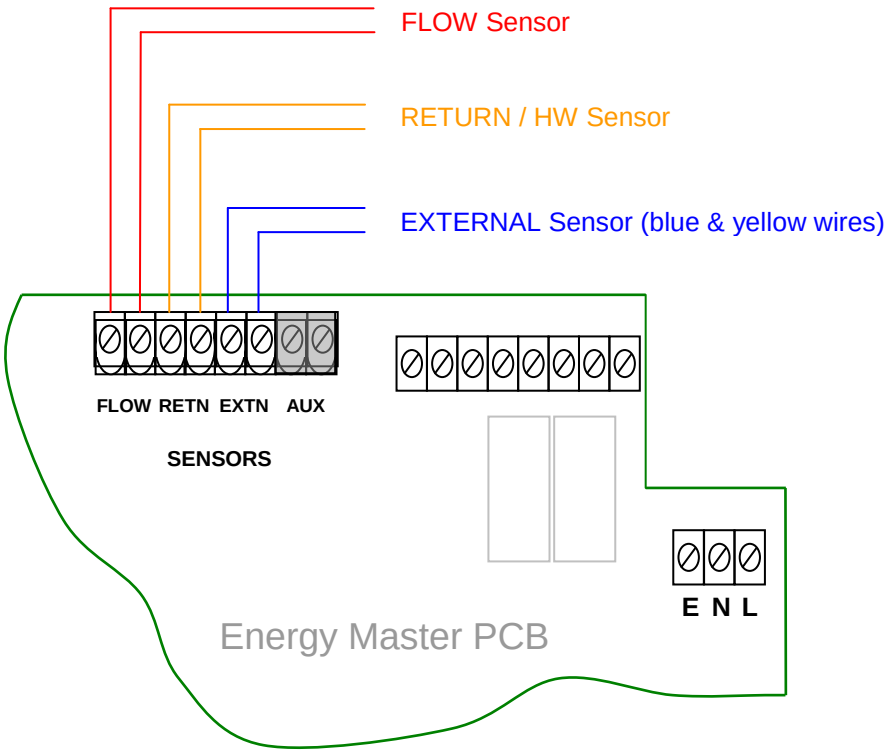


Fig. 5

Flow / Return Temperature Sensors (Cable Type)

Using **heat resistant** cloth tape, **tightly** strap the sensors to the relevant **flow** and **return** pipes, **close** to boiler, **before** any branching connections. Cover the sensors with heating pipe insulation and strap with ty-wraps or similar. See Fig.6.

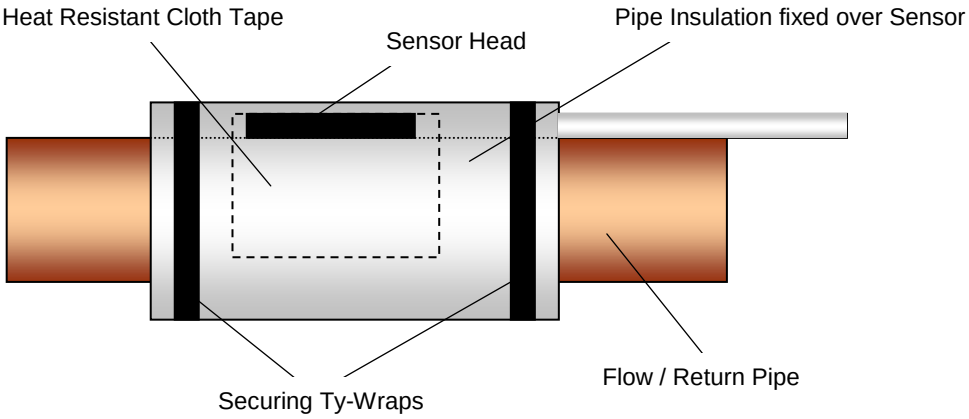


Fig. 6

Optional Hot Water Tank Sensor connections (replaces Return Temperature Sensor) are shown in Fig.7.

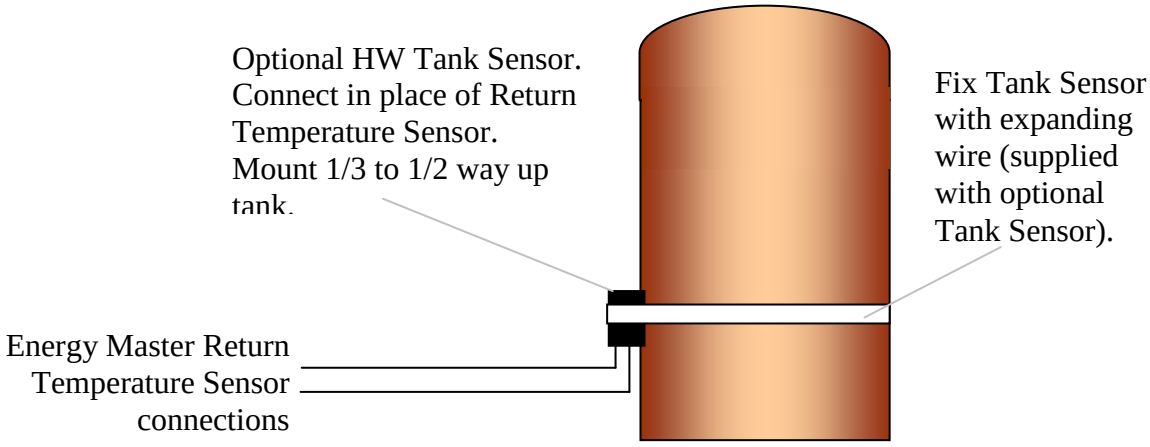


Fig. 7

If the hot water tank is a distance from the boiler, wiring to it may be impractical.

If hot water priority is important then the **Return Sensor** should be fitted to the **Hot Water Tank Return Pipe**. If this is also impractical, then fit as normal to the main **Return Pipe** and set the **Minimum Return Temperature** to provide an adequate level of hot water supply.

Where the tank option is used, set the **Minimum Return Temperature** to the stored water temperature requirement.

External Sensor

The **External Sensor** should preferably be positioned on a north facing exterior wall, and connected to the appropriate terminals of the Energy Master using the blue and yellow wires of the 4-core cable provided. On long cable runs the remaining cores should be earthed to prevent interference.

If it is not possible to mount the sensor on a north facing wall, then mount in a shaded position, under eaves, and away from boiler house vent grilles etc.

Temperature Display Calibration

When required, the temperatures as displayed on the Energy Master may be adjusted to cater for heat losses on pipework, losses on external temperature sensor etc. Program 11 (see page 25) can be used to calibrate the temperature display by -10ºC/+20ºC.

Commissioning - Introduction

The Energy Master Digital has 12 main programs, these being:

1.	Calendar	
2.	On/Off Times	(Two On/Off Periods per day)
3.	Frequency	(Once, Twice, 24 Hours)
4.	Select Days	(Every Day, Weekends, Week Days)
5.	Maximum Flow Temperature	(30ºC to 85ºC)
6.	Minimum Flow Temperature	(25ºC to 85ºC)
7.	Minimum Return/HW Temperature	(20ºC to 65ºC)
8.	Night Temperature	(0ºC to 85ºC)
9.	Frost Temperature	(0ºC to 35ºC)
10.	Ext Cut Off Temp / HTG+HW Mode	(0ºC to 35ºC)
11.	Calibration (Engineers Only)	(-10ºC/+20ºC)
12.	Hot Water Boost / HW 24 Hours	(Yes or No)

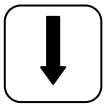
Keypad and Running Mode Overview

PROGRAM

Used to enter Programming Mode from normal running mode, and to access Change Mode for the selected program.

SELECT

Used to cycle through the program list when in Programming Mode and to change program settings when in Change Mode.



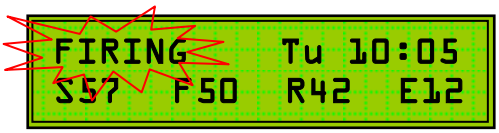
RETURN

Used to cycle through the program list when in Programming Mode and to change program settings when in Change Mode.

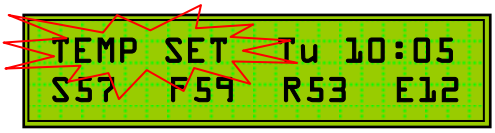
ENTER

Used to confirm a programming change and to exit from the Programming Mode.

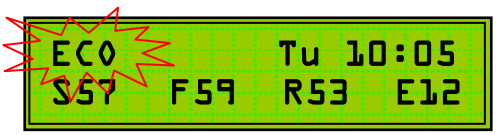
Firing mode indicates that the boiler is firing.



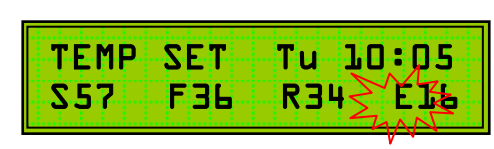
Temp Set indicates that the **actual Flow Temp** is above the **system set temperature**. The boiler will **not** be firing at this point.



Economising indicate that the Energy Master has entered self learning mode and is making economies. The boiler will **not** be firing at this point.



E 'flashing' indicates that the external temp is above the level set in the **Ext Cut-Off** program.

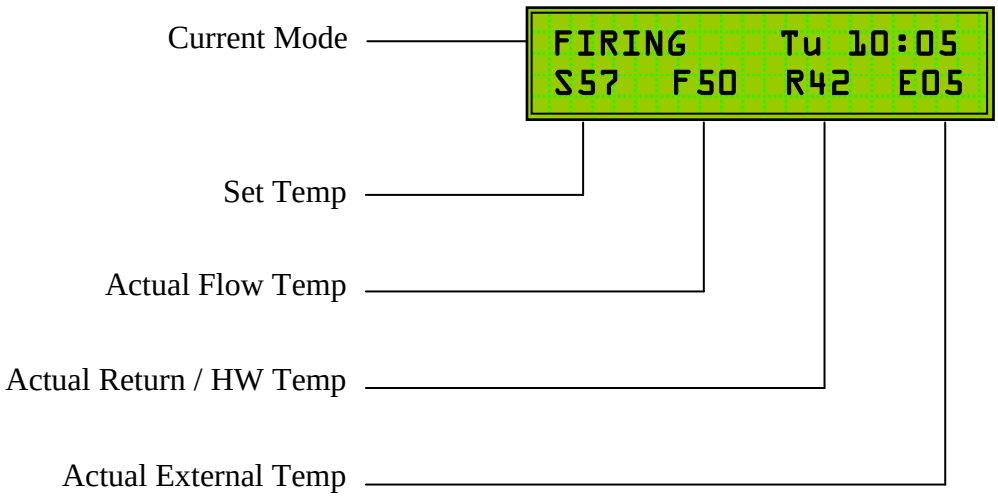


Establishing the System Maximum Flow Temp

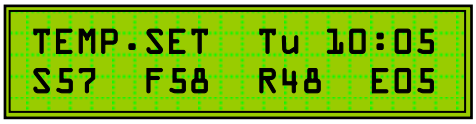
Switch on the power to the Energy Master.

1. Set the **Auto/Constant** switch to the constant position.
Allow the heating system to cycle twice at the normal winter setting of the boiler thermostat (see customer, plant engineer, caretaker etc to establish winter thermostat position).

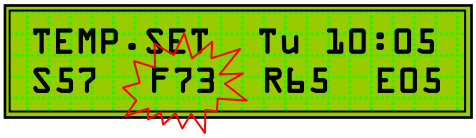
2. The display will show:



3. When the actual **Flow Temperature** exceeds the **Set Temperature**, the display will change:



4. When the boiler has cycled twice with the Energy Master in **constant mode**, observe the **actual flow temperature** as shown on the display:



In this example, the winter setting for the heating system (Energy Master maximum flow setting) should be set to 72ºC (73ºC - 1ºC).

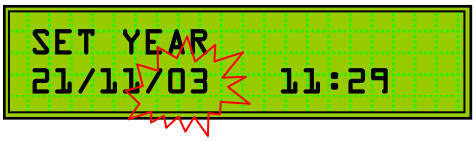
The Boiler Thermostat should now be set to a slightly higher setting to ensure correct operation of the Energy Master.

Setting the Programs

P1. Setting the Calendar (Factory Set)

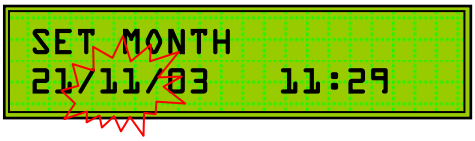
1. Press **P** PROGRAM to change display to:

2. Press **P** PROGRAM again to display:



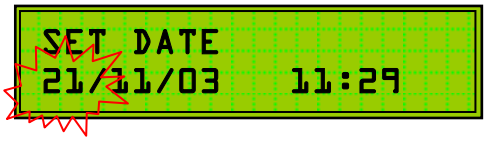
3. Press ↑ SELECT or ↓ RETURN to set the year.

4. Press **E** ENTER to change display to:



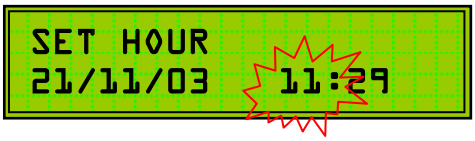
5. Press ↑ SELECT or ↓ RETURN to set the month.

6. Press **E** ENTER to change display to:



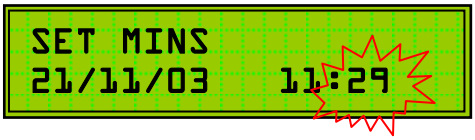
7. Press ↑ SELECT or ↓ RETURN to set the date.

8. Press **E** (ENTER) to change display to:



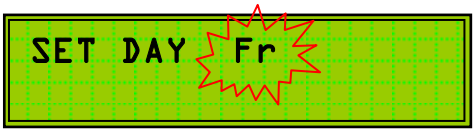
9. Press ↑ (SELECT) or ↓ (RETURN) to set the hour.

8. Press **E** (ENTER) to change display to:



9. Press ↑ (SELECT) or ↓ (RETURN) to set the minutes.

10. Press **E** (ENTER) to change display to:



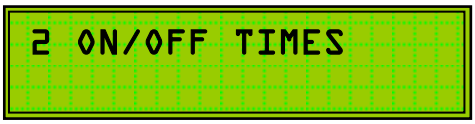
11. Press ↑ (SELECT) or ↓ (RETURN) to set the day.

12. Press **E** (ENTER) to confirm the program change and return to main menu.

13. Press ↑ (SELECT) to advance to next program.

P2. Programming the Time Clock (On/Off Times)

1. Press ↑ SELECT or ↓ RETURN to select program 2:



2. Press **P** PROGRAM again to display:

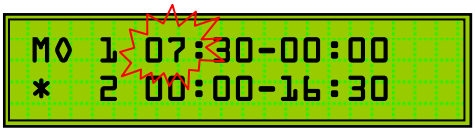
There are two (2) programmable On/Off times per day.

The second OFF time must ALWAYS be programmed, and set to a time after, but in the same 24 hour period as the first ON time.

3. To change On/Off Times select the required day with ↑ SELECT ↓ RETURN

4. Press **P** PROGRAM to enter programming mode for the chosen day:

5. Press **P** PROGRAM to set first ON time:

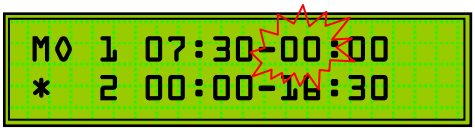


6. Press ↑ SELECT or ↓ RETURN to set the hour as required.

7. Press **E** ENTER to set first ON time minutes:

8. Press ↑ (SELECT) or ↓ (RETURN) to set the minutes as required.

9. Press **E** (ENTER) to set first OFF** time:



** If the FIRST OFF time is not required leave at 00:00.

Adjust HOUR and MINUTES in the same way as previously described.

10. Press **E** (ENTER) to set the second ON time and repeat as above.

11. Press **E** (ENTER) to set the second OFF time and repeat as above.

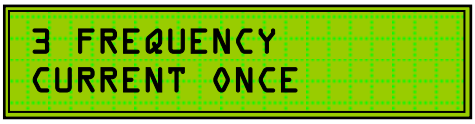
If different On/Off times are required for each day, then repeat the above instructions for each day's times.

To repeat a days On/Off times into the next day, select the next day as described above and press **P** (PROGRAM) followed by **E** (ENTER).

12. Press **E** (ENTER) to confirm program changes and return to main menu.

P3. Frequency (How the Time Clock operates)

1. Press ↑ SELECT or ↓ RETURN to select program 3:



2. Press **P** PROGRAM to display:

3. Press ↑ SELECT or ↓ RETURN to set as described below:

ONCE The time clock operates from the first ON time to the second OFF time.

TWICE The time clock operates on both ON and OFF times i.e. two On/Off periods per day.

24 HOUR The time clock operates 24 hours a day regardless of the On/Off settings.

4. Press **E** ENTER to confirm program changes and return to main menu.

P4. Select Days

1. Press ↑ SELECT or ↓ RETURN to select program 4:

2. Press **P** PROGRAM to display:

3. Press ↑ SELECT or ↓ RETURN to set as described below:

EVERY DAY The heating will operate everyday as set by the time clock On/Off times.

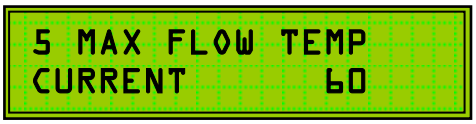
WEEK ENDS The heating will operate at week ends only as set by time clock On/Off time for Sat – Sun. If reduced heating is required at week ends then set the time clock for reduced hours during Saturday and Sunday, and then set program 4 to EVERY DAY.

WEEK DAYS The heating will operate during week days only as set by the time clock On/Off times Mon – Fri. The heating will be OFF at weekends.

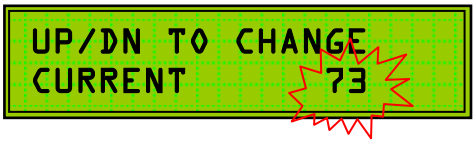
4. Press **E** ENTER to confirm program changes and return to main menu.

P5. Setting the Maximum Flow Temperature

1. Press ↑ SELECT or ↓ RETURN to select program 5:



2. Press P PROGRAM to change display to:

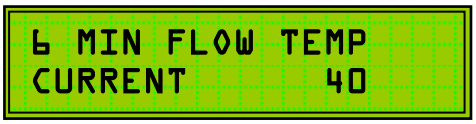


3. Press ↑ SELECT or ↓ RETURN to change the temperature setting to that required (i.e. 73ºC).

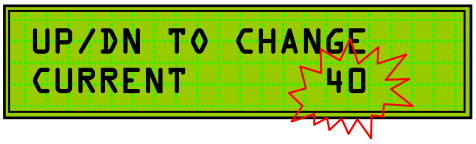
4. Press E ENTER to confirm the program changes and return to main menu.

P6. Setting the Minimum Flow Temperature

1. Press ↑ SELECT or ↓ RETURN to select program 6:



2. Press P PROGRAM to change display to:



3. Press ↑ SELECT or ↓ RETURN to change the temperature setting to that required.

4. Press E ENTER to confirm the program changes and return to main menu.

Setting a Minimum Flow Temperature is required to limit the effect of the Compensation. The flow temperature will not fall below that set in the Minimum Flow program (- differential), even if the compensated flow temperature is below this level.

The Minimum Flow Temperature should be chosen to meet heating criteria.

P7. Setting the Minimum Return/HW Temperature

The **Minimum Return/HW** temperature will depend on the type of heating system:

Heating and Hot Water.

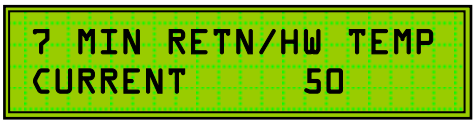
Where convenient, the return temperature sensor should be fitted to the hot water storage tank (see installation instructions), the hot water return pipework or the hot water circulating pipework.

The **minimum return temperature** should be set to provide normal hot water tank temperature, i.e. 60ºC.

Heating Only.

In this instance, the **minimum return temperature** should be set to the boiler manufacturers recommended level, i.e. 55ºC for oil fired systems, 50ºC or lower for gas fired systems. These figures are examples only. Refer to your boiler manual for manufacturer recommended settings.

1. Press ↑ SELECT or ↓ RETURN to select program 7:



2. Press P PROGRAM to change display to:

3. Press ↑ SELECT or ↓ RETURN to set the required temperature.

4. Press E ENTER to confirm program changes and return to main menu.

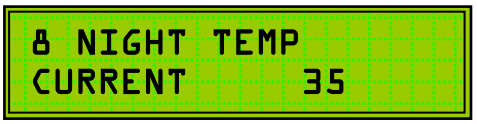
P8. Setting the Night Temperature

The **Night Temperature** can be used in 2 ways:

1. To provide basic **frost protection** in conjunction with the **frost temperature** (P9).

2. To provide night time economies on 24 hour systems by selecting a lower **flow temperature** during the programmed **off** periods.

1. Press ↑ SELECT or ↓ RETURN to select program 8:



2. Press **P** PROGRAM to change display to:

3. Press ↑ SELECT or ↓ RETURN to set the required temperature.

4. Press **E** ENTER to confirm program changes and return to main menu.

P9. Setting the Frost Temperature

The **Frost Temperature** can be set to cancel the **Night Temperature** (P8) at a programmed external temperature.

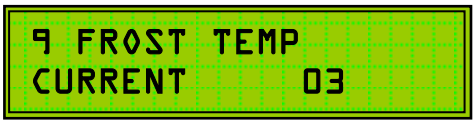
E.G. For **frost protection** only set P9 to say 1ºC.

The **night temperature** will not be activated until the external temperature falls to this level.

If the unit is installed in a nursing or residential home it may be possible to set P9 to 15ºC - 16ºC so that the **night temperature** will not be activated at temperatures above this and the heating will switch off.

If **night temperature** is required whatever the external temperature, set P9 to maximum, i.e. 35ºC. Discuss this aspect with the building manager / owner to establish the requirements.

1. Press ↑ **SELECT** or ↓ **RETURN** to select program 9:



2. Press **P** **PROGRAM** to change display to:

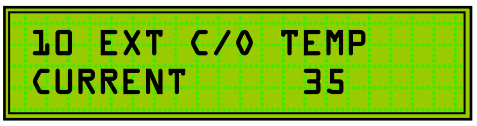
3. Press ↑ **SELECT** or ↓ **RETURN** to set the required temperature.

4. Press **E** **ENTER** to confirm program changes and return to main menu.

10. Setting the External Cut-Off Temperature

The **External Cut-Off Temperature** sets the outside temperature above which the heating system will switch off. This setting is also referred to as the Summer Cut-Off Temperature. The heating will come back on at 2ºC below the External Cut-Off Temperature.

1. Press ↑ SELECT or ↓ RETURN to select program 10:



2. Press P PROGRAM to change display to:

3. Press ↑ SELECT or ↓ RETURN to set the required temperature.

4. Press E ENTER to change display to:

5. Press ↑ SELECT or ↓ RETURN to set HTG ONLY or HTG+HW.

Set to **HTG+HW** for boilers that provide hot water during the summer months. If the boiler is for heating only then set to **HTG ONLY**.

6. Press E ENTER to confirm program changes and return to main menu.

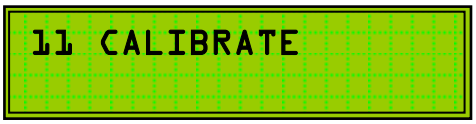
When **EXT C/O MODE** is set to **HTG ONLY** the **pump relay** controlling the heating pump will switch off when the **external cut-off** temperature is exceeded. This may ONLY be set if a separate HW pump is installed, or gravity flow to the hot water cylinder is used.

The Energy Master also has a manual **HTG/HW-HW ONLY** switch which can be used as required.

11. Calibration

Program 11 allows individual calibration of the Flow, Return and External temperature sensors. Each sensor reading can be adjusted by -10ºC/+20ºC.

1. Press ↑ SELECT or ↓ RETURN to select program 11:



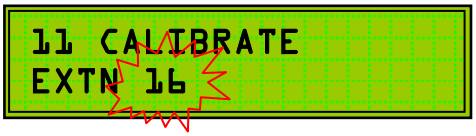
2. Press and hold P PROGRAM for approx 10 secs to display:

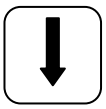
3. Press ↑ SELECT or ↓ RETURN to adjust the displayed temp (-10ºC/+20ºC).

4. Press E ENTER to confirm program changes and display:

5. Press ↑ SELECT or ↓ RETURN to adjust the displayed temp (-10ºC/+20ºC).

6. Press E ENTER to confirm program changes and display:



7. Press  or  to adjust the displayed temp (-10ºC/+20ºC).

SELECT RETURN

8. Press  to confirm program changes and return to main menu.

ENTER

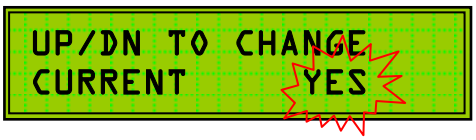
12. Hot Water Boost

Program 12 fires the boilers to the maximum flow temperature (P5) at 02:00 every Sunday morning in order to boost the hot water cylinder temperature. The Energy Master will go into Bypass mode for 2 hours.

A secondary program allows the Energy Master to prioritise for hot water either 24 hours a day (YES), or only during the programmed on periods (NO).

1. Press ↑ SELECT or ↓ RETURN to select program 12:

2. Press P PROGRAM to change display to:



3. Press ↑ SELECT or ↓ RETURN to set YES or NO.

4. Press E ENTER to confirm program changes and display:

5. Press ↑ SELECT or ↓ RETURN to set YES or NO.

6. Press E ENTER to confirm program changes and return to main menu.

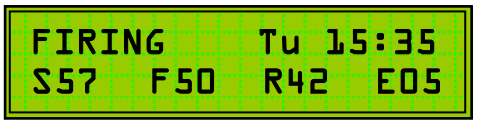
Exiting Programming Mode

To exit from the programming mode, first ensure that the display indicates you are in the main menu.

At this point, press **E** (ENTER) to exit programming mode.

The display will change to:

And then, after a few seconds to:



The display may show slightly different information depending on the current mode of operation, i.e. firing, economising etc.

Note: When in programming mode the Energy Master will revert to normal running mode if the keypad is not operated for a period of 30 seconds (4 minutes if in program change mode).

To access programming mode from normal running mode:

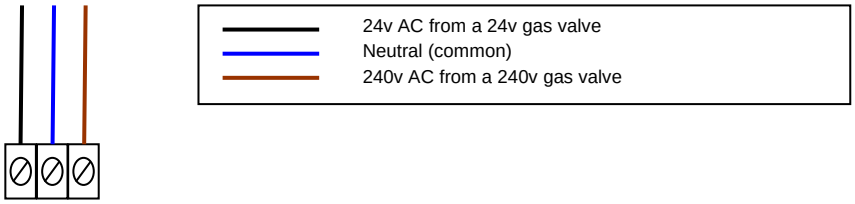
Press **P** (PROGRAM) and then select required program with ↑ (SELECT) ↓ (RETURN).

Make any program changes as described previously.

Monitoring Facility (monitoring relay module required)

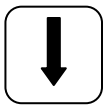
The Energy Master has an option for monitoring energy savings using the day on/day off test procedure when supplied with the monitoring relay module.

The monitoring relay module is prewired to a 3-way connector block as shown below:



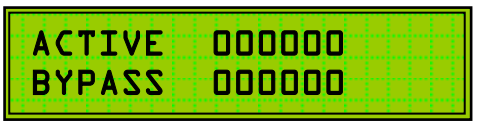
Connect gas valve supply (24v or 240v) to the 3-way connector as shown above. **DO NOT** connect a 240v gas valve supply to the 24v connection as permanent damage to the relay module will occur.

To enable the monitoring to function correctly, the 'Maximum Flow Temperature' (P5) must be set to coincide with normal boiler thermostat temperature setting. This is achieved by establishing the maximum flow temperature as described on page 11. The On/Off times in the Energy Master should be set to match those of the existing time clock / programmer and programs 9 and 10 should be set to maximum (35ºC) during the test period.

The test period is initiated by holding down 

for approx 5 seconds.

The display will change to:



After approx. 20 seconds or upon pressing 

the display will return to it's normal mode of operation.

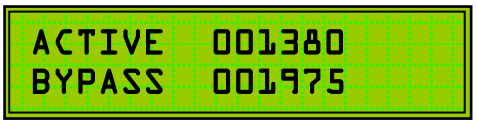
Monitoring will commence at midnight whereby the unit will assume the 'Bypass Mode'. The following midnight the Energy Master will revert to 'Active Mode' whereby all energy saving techniques will be utilised as programmed.

This will be repeated throughout the test period, alternating between 'Bypass' and 'Active' every other day. When the test is over the unit will assume the normal, active running mode.

To retrieve the monitored readings hold  for approx 5 seconds.

SELECT

The display will change to show the firing time for both running modes:



To calculate the percentage savings achieved apply the following formula:

$$\frac{\text{BYPASS} - \text{ACTIVE}}{\text{BYPASS}} \times 100$$

E.G. $$\frac{1975 - 1380}{1975} \times 100 = \mathbf{30.126\%}$$

To restart a test repeat the procedure as described which will zero the display and restart the test.