

# 2416

MODEL



**Programmer/Controller**  
**Product data**

## Features

- **High stability control**
- **Up to four 16 segment programs**
- **Heating and cooling**
- **Motorised Valve control**
- **Customised operation**
- **Load diagnostics**
- **Heater current display**
- **Multiple alarms on a single output**
- **One-shot tuner with overshoot inhibition**
- **Adaptive tuning**
- **24V Supply option**
- **Auto/manual button**
- **Setpoint rate limit**
- **DC retransmission**
- **PDSIO setpoint input or retransmission**
- **Digital communications**
- **Plug-in from front**
- **IP65 panel sealing**
- **Compliant with European EMC and low voltage safety directives**
- **3 Year warranty**

The 2416 is a versatile, high stability, temperature or process controller, with self and adaptive tuning, in a 1/16 DIN size (48x48x150mm). It has a modular hardware construction which will accept up to three plug-in I/O modules and one communication module. The 2416 is fully configurable on-site.

The 2416 is also available in versions with a simple 8 segment setpoint profile or more powerful versions that will run one 16 segment program or store 4 programs of 16 segments.

### Precise control

An advanced PID control algorithm gives stable 'Straight-line' control of the process. A one-shot tuner is provided to set up the initial PID values and to calculate the overshoot inhibition parameters. In addition an adaptive tuner will handle processes with continually changing characteristics. On electrically heated loads, power feedback is used to stabilise the output power and hence the controlled temperature against supply voltage fluctuations. Dedicated cooling algorithms ensure optimum control of fan, water and oil cooled systems.

### Universal input

A universal input circuit with an advanced analogue to digital convertor samples the input at 9Hz and continuously corrects it for drift. This gives high stability and rapid response to process changes. High noise immunity is achieved by rejection of 50/60Hz pick-up and other sources of noise. Sensor diagnostics are also provided. The input will accept standard thermocouples, the Pt100 resistance thermometer and linear millivolts, milliamps or DC volts. Input filtering from OFF to 999.9 seconds is included.

### Customised operation

A custom LED display provides a bright, clear display of the process value and setpoint. Tactile push buttons ensure positive operation. Access to other parameters is simple and easy to understand and can be customised to present only those parameters that need to be viewed or adjusted. All other parameters are locked away under password protection. A front panel auto/manual button is provided.

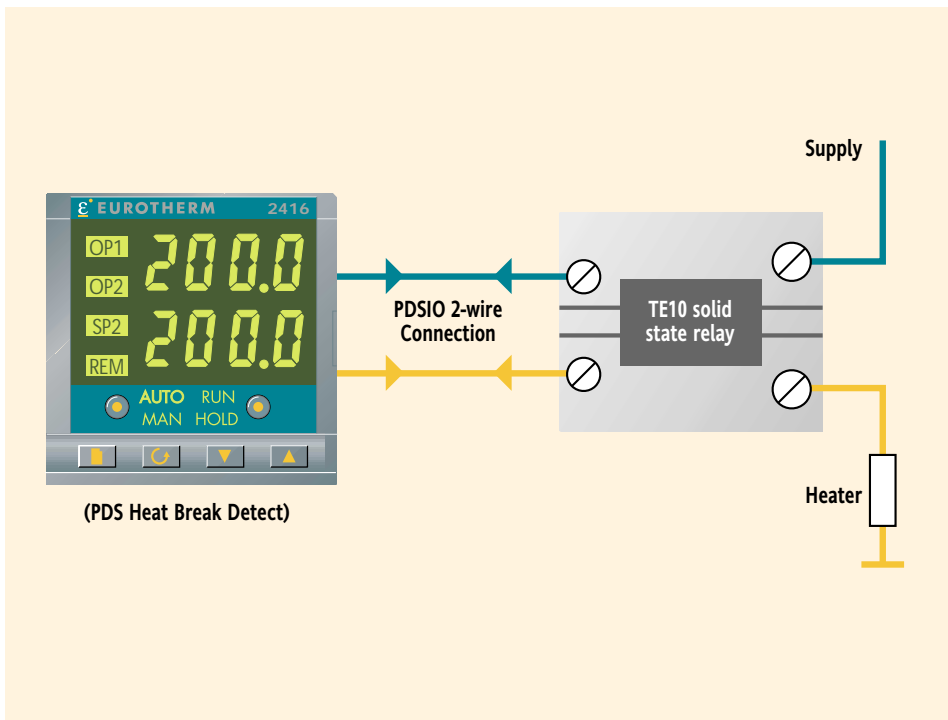
### Alarms

Up to four process alarms can be combined onto a single output. They can be full scale high or low, deviation from setpoint, rate of change or load failure alarms. Alarm messages are flashed on the main display. Alarms can be configured as latching or non-latching and also as 'blocking' type alarms, this means that they will become active only after they have first entered a safe state.

### Digital communications

Available with either EIA485 2 wire or 4 wire or EIA232. With industry-standard protocols including: Modbus®, Eurotherm Bisync, and SPI.

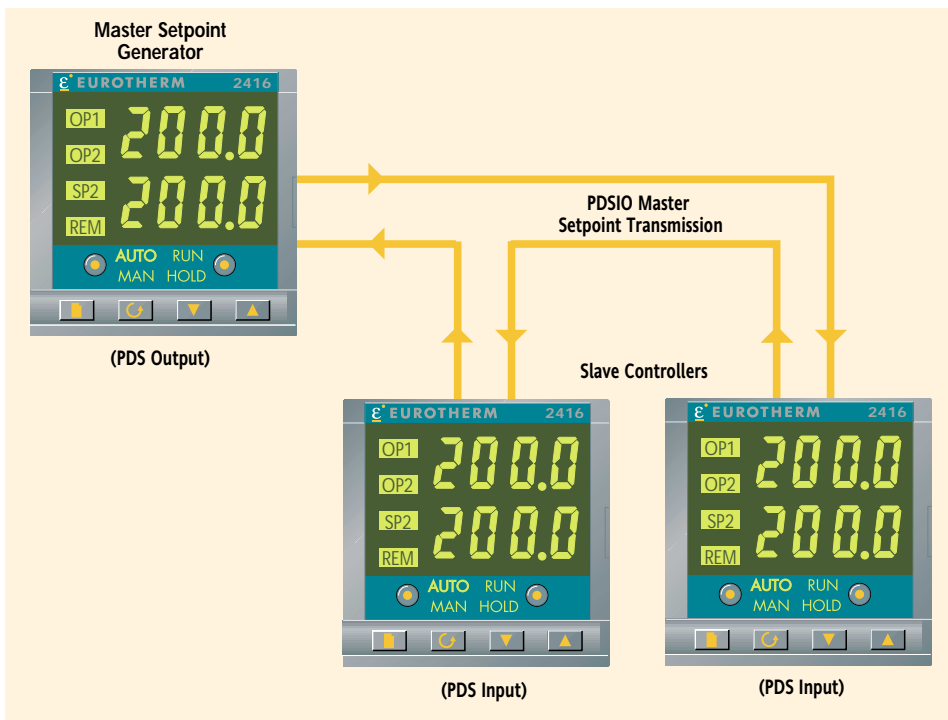
## PDSIO Load diagnostic



### PDSIO Load diagnostics

PDSIO (Pulse Density Signalling I/O) is a major innovation in the 2416. When used in combination with a Eurotherm TE10 solid state relay (SSR), it allows the logic output of a 2416 to transmit the power demand signal and simultaneously read back load fault alarms. These alarms will be flashed as messages on the controller front panel. Two alarm conditions will be detected, either SSR failure indicating an open or short circuit condition in the SSR and heater circuit failure indicating either fuse failure, heater open circuit or line supply absent.

## PDSIO Setpoint transmission



### PDSIO master setpoint transmission

PDSIO can be used to digitally transmit the setpoint profile to a number of slave Series 2000 controllers. If any slave zone departs from the required setpoint by more than a pre-settable amount, a signal from any slave can be transmitted back to the master causing the program to freeze until the error is corrected. Digital accuracy is preserved using PDSIO.

## Technical specification

### Inputs

General	Range	$\pm 100\text{mV}$ and 0 to 10Vdc (auto ranging)
	Sample rate	9Hz (110mS)
	Calibration accuracy	0.2% of reading, $\pm 1$ LSD, $\pm 1^\circ\text{C}/\text{F}$
	Resolution	$< 1.6\mu\text{V}$ for $\pm 100\text{mV}$ range, $< 0.2\text{mV}$ for 10Vdc range
	Linearisation accuracy	No discernable error
	Zero drift with ambient temperature	$< 0.1\mu\text{V}$ per $^\circ\text{C}$ for $\pm 100\text{mV}$ range, $0.1\text{mV}$ per $^\circ\text{C}$ on 10Vdc range
	Gain drift with ambient temperature	$< 0.004\%$ of reading per $^\circ\text{C}$
	Input filter	OFF to 999.9 secs
	Zero and span offset	User adjustable over the full display range
	Thermocouple	Types
Cold junction compensation		Automatic compensation typically $> 30$ to 1 rejection of ambient temperature change External references 0, 45 and $50^\circ\text{C}$
RTD/PT100	Type	3-wire, Pt100
	Bulb current	0.2mA
	Lead compensation	No error for up to 22 ohms balanced in all 3 leads
Process	Linear	$\pm 100\text{mV}$ , 0 to 20mA or 0 to 10Vdc (All configurable between limits)
	Non-linear	Square root or custom 8 point

### Outputs

Relay	Rating: 2-pin relay	Min: 12V, 100mA dc. Max: 2A, 264Vac resistive
	Application	Heating, cooling, process output, alarms or program event
Logic	Rating	18Vdc at 24mA (non-isolated)
	Application	Heating, cooling or program event PDSIO mode 1: Logic heating with load failure alarm PDSIO mode 2: Logic heating with load/SSR failure alarms and load current display
Triac	Rating	1A, 30 to 264Vac resistive
	Application	Heating, cooling or program event
Analogue	Range	Non-isolated 0 to 20mA (into $600\Omega$ max) 0 to 10Vdc (both configurable between limits)
	Application	Heating, cooling, process output

### Communications

Digital	Transmission standard	EIA 485 or EIA 232 at 1200, 2400, 4800, 9600, 19,200 baud
	Protocols	Modbus® or Eurotherm Bisync or SPI
PDSIO	Setpoint input	Setpoint input from master PDSIO controller. Holdback to master controller
	Setpoint output	Master setpoint retransmission to slave PDSIO controllers

### Control functions

Control	Modes	PID or PI with overshoot inhibition, PD, PI, P only or On/Off
	Application	Heating, cooling or process output
	Auto/manual	Bumpless transfer or forced manual output
	Setpoint rate limit	0.01 to 99.99 degrees or display units per second, minute or hour
	Cooling algorithms	Linear; Water (non-linear); Fan (minimum on time). Oil and proportional only
Tuning	One-shot tune	Automatic calculation of PID and overshoot inhibition parameters
	Adaptive Tune	Continuous assessment of the PID values
	Automatic droop compensation	Automatic calculation of manual reset value when using PD control
Alarms	Types	Full scale high or low. Deviation high, low, or band. Rate of change
	Modes	Latching or non-latching. Normal or blocking action
		Up to four process alarms can be combined onto a single output
Setpoint programming	Program size	One or four programs of 16 segments each
	Event outputs	Up to two – relay, logic or triac

### Programmer parameters

	Programs	Up to four programs
	Segments	16 segments per program
	Ramp	Ramp Rate or Time to Target Hours, Minutes or Seconds ( 0.1 to 999.9 )
	Dwell	Hours, Minutes or Seconds ( 0.0 to 999.9 )
	Holdback	Per Program or per Segment ( 0.0 to 999.9 )
	End Segment	Dwell, Reset or Set output level
	Cycles	Continuous or 1 to 999
	Event outputs	Up to eight – relay, logic or triac

### General

	Display	Dual, 4 digit x 7 segment high intensity LED
	Dimensions and weight	48W x 48H x 150D mm. 250g
	Supply	85 to 264Vac, 48 to 62Hz. or optionally 20 to 29V ac or dc
	Power consumption	10watts
	Temperature and RH	Operating: 0 to 55°C, RH: 5 to 95% non-condensing. Storage: -10 to 70°C
	Panel sealing	IP65
	Electromagnetic	Meets generic emissions standard EN50081-2 for industrial environments compatibility Meets general immunity requirements of EN50082-2(95) for industrial environments
	Safety standards	EN61010, installation category 2. (voltage transients must not exceed 2.5kV)
	Atmospheres	Electrically conductive pollution must be excluded from the cabinet in which this controller is mounted. This product is not suitable for use above 2000m or in corrosive or explosive atmospheres without further protection.

## Ordering information

## Hardware coding

Model Number	Function	Supply Voltage	Module 1	Module 2	Module 3	Comms 2	Manual
2416							

Function
<b>Standard PID control</b>
CC Controller only
CG 1 x 8 seg Prog
CP 1 x 16 seg Prog
P4 4 x 16 seg Prog
<b>On/Off Control</b>
NF Controller only
NG 1 x 8 seg Prog
NP 1 x 16 seg Prog
N4 4 x 16 seg Prog
<b>Motorised valve control</b>
VC Controller only
VG 1 x 8 seg Prog
VP 1 x 16 seg Prog
V4 4 x 16 seg Prog

Supply Voltage
VH 85-264Vac
VL 20-29Vac/dc

Module 1
XX None
<b>Relay: 2-pin</b>
R2 Fitted unconfigured
RH Heating output
RU Valve raise output
FH High alarm 1
FL Low alarm 1
DB Dev. band alarm 1
DL Dev. low alarm 1
DH Dev. high alarm 1
<b>Logic</b>
L2 Fitted unconfigured
LH Heating output
M1 PDS Heater break detect (note 1)
M2 PDS Current monitoring (note 2)
<b>Triac</b>
T2 Fitted unconfigured
TH Heating output
TU Valve raise output
<b>DC control (Non-isol)</b>
D2 Fitted unconfigured
H1 0-20mA PID heating
H2 4-20mA PID heating
H3 0-5V PID heating
H4 1-5V PID heating
H5 0-10V PID heating

Module 2
XX None
<b>Relay: 2-pin</b>
R2 Fitted unconfigured
RC Cooling output
RW Valve lower output
FH High alarm 2
FL Low alarm 2
DB Dev. band alarm 2
DL Dev. low alarm 2
DH Dev. high alarm 2
PO Program event 1 (not with 8-seg prog)
PE Program END output
<b>Logic</b>
L2 Fitted unconfigured
LC Cooling output
<b>Triac</b>
T2 Fitted unconfigured
TC Cooling output
TW Valve lower output
<b>DC control (Non-isol)</b>
D2 Fitted unconfigured
C1 0-20mA PID cooling
C2 4-20mA PID cooling
C3 0-5V PID cooling
C4 1-5V PID cooling
C5 0-10V PID cooling

Module 3
XX None
<b>Relay: 2-pin</b>
R2 Fitted unconfigured
FH High alarm 4
FL Low alarm 4
DB Dev. band alarm 4
DL Dev. low alarm 4
DH Dev. high alarm 4
RA Rate of change alarm
PO Program event 2 (not with 8-seg prog.)
PE Program END output
<b>PDS Alarms</b>
LF Heater break detect
HF Current monitoring heater break
SF Current monitoring SSR failure
<b>Logic</b>
L2 Fitted unconfigured
<b>Triac</b>
T2 Fitted unconfigured
<b>DC retrans (Non-isol)</b>
D2 Fitted unconfigured
First character
V- PV retrans
S- Setpoint retrans
O- Output retrans
Z- Error retrans
Second character
-1 0-20mA
-2 4-20mA
-3 0-5V
-4 1-5V
-5 0-10V

Comms
XX None
<b>2 wire, RS485</b>
Y2 Fitted unconfigured
YM Modbus protocol
YE El-Bisynch protocol
<b>RS232</b>
A2 Fitted unconfigured
AM Modbus protocol
AE El-Bisynch protocol
<b>4 wire, RS422</b>
F2 Fitted unconfigured
FM Modbus protocol
FE El-Bisynch protocol
<b>PDS Input</b>
M6 Fitted unconfigured
RS Setpoint input
<b>PDS Output</b>
M7 Fitted unconfigured
PT PV retrans
TS Setpoint retrans
OT Output retrans

Manual
XXX No manual
ENG English
FRA French
GER German
NED Dutch
SPA Spanish
SWE Swedish
ITA Italian

Note 1. PDS heater break detect will transmit the power demand to a TE10S Solid State Relay and read back a heater break alarm.

Note 2. PDS current monitoring will transmit the power demand signal to a TE10S Solid State Relay and read back load current and open and short circuit alarms.

## Configuration coding (optional)

Sensor Input	Setpoint Min	Setpoint Max	Display Units	Control	Power	Options Cooling	Buttons	Program
	note 3	note 3						

Sensor Input	Setpoint Min	Setpoint Max
<b>Standard Sensor Inputs</b>	<b>Min</b>	<b>Max</b>
J J Thermocouple	-210	1200
K K Thermocouple	-200	1372
T T Thermocouple	-200	400
L L Thermocouple	-200	900
N N Thermocouple-Nicrosil/Nisil	-250	1300
R R Thermocouple-Pt/Pt13%Rh	-50	1768
S S Thermocouple-Pt /Pt10%Rh	-50	1768
B B Thermocouple-Pt/Pt30%Rh -6%Rh	0	1820
P Platinel II Thermocouple	0	1369
Z RTD/PT100 DIN 43760	-200	850
<b>Factory Downloaded Input</b>	<b>Min</b>	<b>Max</b>
C C Thermocouple - W5%Re/W26%Re (Hoskins)	0	2319
D D Thermocouple - W3%Re/W25%Re	0	2399
E E Thermocouple	-250	1000
1 Ni/Ni18%Mo Thermocouple	0	1399
2 Pt20%Rh/Pt40%Rh Thermocouple	0	1870
3 W/W26%Re (Englehard) Thermocouple	0	2000
4 W/W26%Re (Hoskins) Thermocouple	0	2010
5 W5%Re/W26%Re (Engelhard) Thermocouple	10	2300
6 W5%Re/W26%Re (Bucose) Thermocouple	0	2000
7 Pt10%Rh/Pt40%Rh Thermocouple	200	1800
8 Exergen K80 I.R. pyrometer	-45	650
<b>Process Inputs (Scaled to setpoint min and max)</b>	<b>Min</b>	<b>Max</b>
F -100 to +100mV linear	-1999	9999
Y 0 to 20mA linear (note 4)	-1999	9999
A 4 to 20mA linear (note 4)	-1999	9999
W 0 to 5Vdc linear	-1999	9999
G 1 to 5Vdc linear	-1999	9999
V 0 to 10Vdc linear	-1999	9999

Display Units
C Celsius
F Fahrenheit
K Kelvin
X Blank

Options
<b>Control action</b>
XX Reverse acting (standard)
DP Direct acting
<b>Power feedback</b>
XX Enabled on logic, relay and triac heating outputs
PD Feedback disabled
<b>Cooling options</b>
XX Linear cooling
CF Fan cooling
CW Water cooling
CL Oil cooling
CO On/Off cooling
<b>Front panel buttons</b>
XX Enabled
MD Auto/manual disabled
MR Auto/man & run/hold disabled
RD Run/hold disabled
<b>Programmer timing</b>
XX Ramp and dwell in mins
HD Dwell time in hours
HR Ramp rate in units/hour

Note 3. Setpoint limits: Include the decimal position required in the displayed value. Up to one for temperature inputs, up to two for process inputs.

Note 4. An external 1% current sense resistor is supplied as standard. If greater accuracy is required, a 0.1% 2.49Ω can be ordered as part no. SUB2K/249R.1.

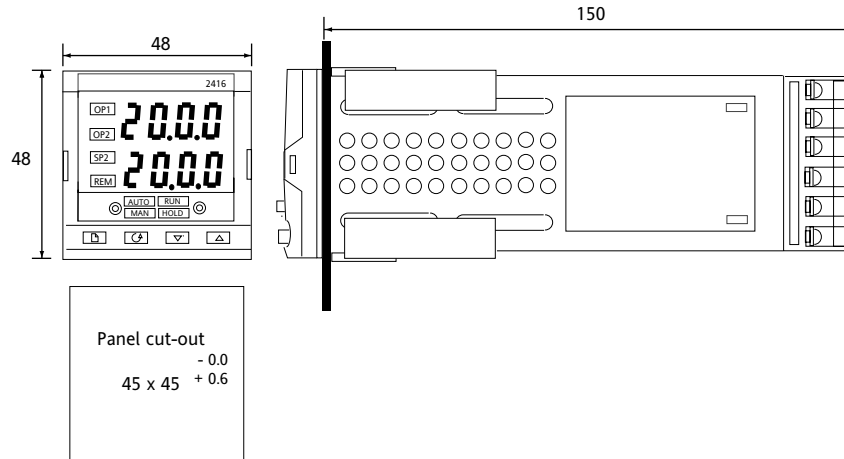
Example ordering code:

**2416 - CC - VH - LH - RC - FH - YM - ENG - K - 0 - 1000 - C - XX - XX - XX - MD - XX**

2416, Controller, 85 to 264Vac, Logic heating, Relay cooling, High alarm relay, RS485, Modbus comms, English manual, type K thermocouple, 0 to 1000°C, Manual button disabled.

## Dimensional details

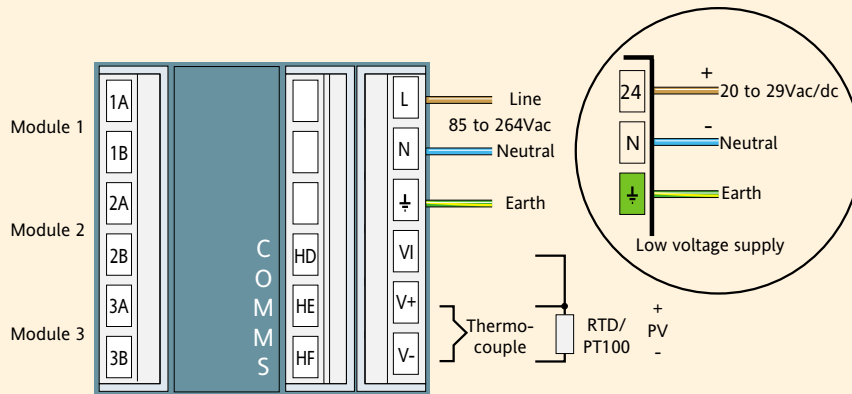
All dimensions in mm



## Rear terminal connections

Modules 1, 2 and 3 are plug-in modules.

They can be any one of the types shown in the ordering information on previous pages



### EUROTHERM LIMITED UK

Faraday Close Durrington Worthing BN13 3PL  
Tel. +44 (0)1903 268500 Fax +44 (0)1903 695666  
Email [info@eurotherm.co.uk](mailto:info@eurotherm.co.uk)  
[www.eurotherm.co.uk](http://www.eurotherm.co.uk)

### EUROTHERM US

741-F Miller Drive Leesburg VA 20175-8993  
Tel. 1-703-443-0000 Fax 1-703-669-1300  
Email [info@eurotherm.com](mailto:info@eurotherm.com)  
[www.eurotherm.com](http://www.eurotherm.com)

### EUROTHERM WORLDWIDE

[www.eurotherm.co.uk](http://www.eurotherm.co.uk)

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