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2416

MODEL

invensys
EUROTHERM



Programmer/Controller

Product data

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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

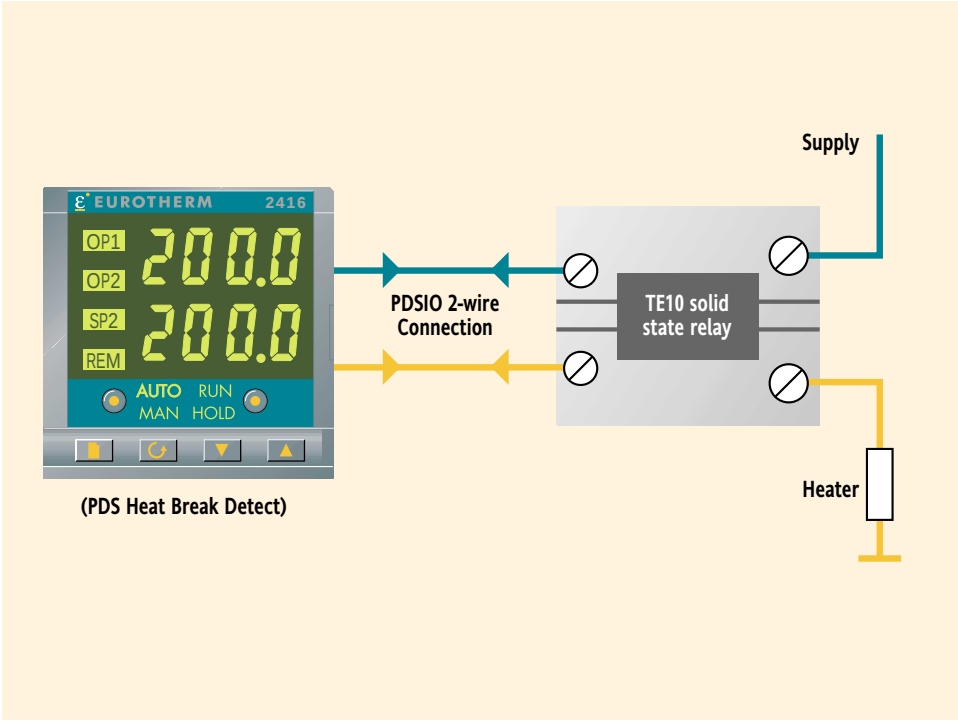
Up to four process alarms can be combined onto a single output. They can be full scale high or low, deviation from setpoint, rate of change or load failure alarms. Alarm messages are flashed on the main display. Alarms can be configured as latching or non-latching and also as 'blocking' type alarms, 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.

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PDSIO Load diagnostic

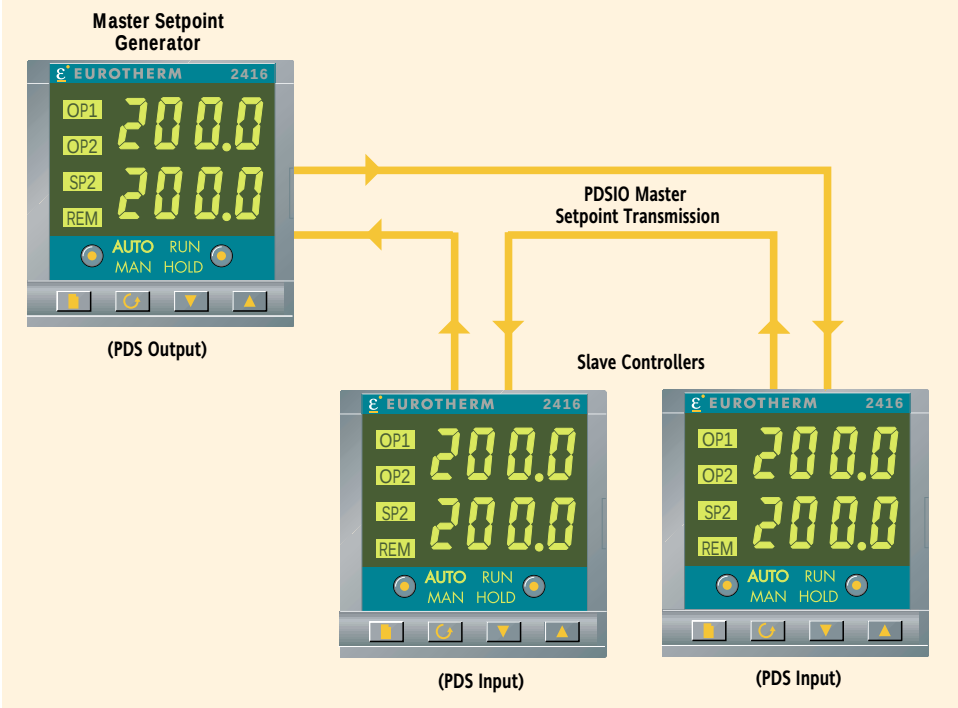


PDSIO Load diagnostics

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.

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Technical specification

Inputs

General	Range	± 100mV and 0 to 10Vdc (auto ranging)
	Sample rate	9Hz (110mS)
	Calibration accuracy	0.2% of reading, ±1 LSD, ±1°C/F
	Resolution	<1.6µV for ± 100mV range, <0.2mV for 10Vdc range
	Linearisation accuracy	No discernable error
	Zero drift with ambient temperature	< 0.1µV per °C for ±100mV range, 0.1mV per °C on 10Vdc range
	Gain drift with ambient temperature	< 0.004% of reading per °C
	Input filter	OFF to 999.9 secs
	Zero and span offset	User adjustable over the full display range
Thermocouple	Types	See sensor inputs table
	Cold junction compensation	Automatic compensation typically >30 to 1 rejection of ambient temperature change External references 0, 45 and 50°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	±100mV, 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 600Ω 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

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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.

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Ordering information

Hardware coding

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

Function

Standard PID control
- **CC** Controller only
- **CG** 1 x 8 seg Prog
- **CP** 1 x 16 seg Prog
- **P4** 4 x 16 seg Prog

On/Off Control
- **NF** Controller only
- **NG** 1 x 8 seg Prog
- **NP** 1 x 16 seg Prog
- **N4** 4 x 16 seg Prog

Motorised valve control
- **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

Relay: 2-pin
- **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

Logic
- **L2** Fitted unconfigured
- **LH** Heating output
- **M1** PDS Heater break detect (note 1)
- **M2** PDS Current monitoring (note 2)

Triac
- **T2** Fitted unconfigured
- **TH** Heating output
- **TU** Valve raise output

DC control (Non-isol)
- **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

Relay: 2-pin
- **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

Logic
- **L2** Fitted unconfigured
- **LC** Cooling output

Triac
- **T2** Fitted unconfigured
- **TC** Cooling output
- **TW** Valve lower output

DC control (Non-isol)
- **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

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.

Module 3

- **XX** None

Relay: 2-pin
- **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

PDS Alarms
- **LF** Heater break detect
- **HF** Current monitoring heater break
- **SF** Current monitoring SSR failure

Logic
- **L2** Fitted unconfigured

Triac
- **T2** Fitted unconfigured

DC retran (Non-isol)
- **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

2 wire, RS485
- **Y2** Fitted unconfigured
- **YM** Modbus protocol
- **YE** EI-Bisynch protocol

RS232
- **A2** Fitted unconfigured
- **AM** Modbus protocol
- **AE** EI-Bisynch protocol

4 wire, RS422
- **F2** Fitted unconfigured
- **FM** Modbus protocol
- **FE** EI-Bisynch protocol

PDS Input
- **M6** Fitted unconfigured
- **RS** Setpoint input

PDS Output
- **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

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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
Standard Sensor Inputs		**Min**	**°C Max**
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
Factory Downloaded Input		**Min**	**°C Max**
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
Process Inputs (Scaled to setpoint min and max)		**Min**	**°C Max**
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	
Control action	
XX	Reverse acting (standard)
DP	Direct acting
Power feedback	
XX	Enabled on logic, relay and triac heating outputs
PD	Feedback disabled
Cooling options	
XX	Linear cooling
CF	Fan cooling
CW	Water cooling
CL	Oil cooling
CO	On/Off cooling
Front panel buttons	
XX	Enabled
MD	Auto/manual disabled
MR	Auto/man & run/hold disabled
RD	Run/hold disabled
Programmer timing	
XX	Ramp and dwell in mins
HD	Dwell time in hours
HR	Ramp rate in units/hour

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

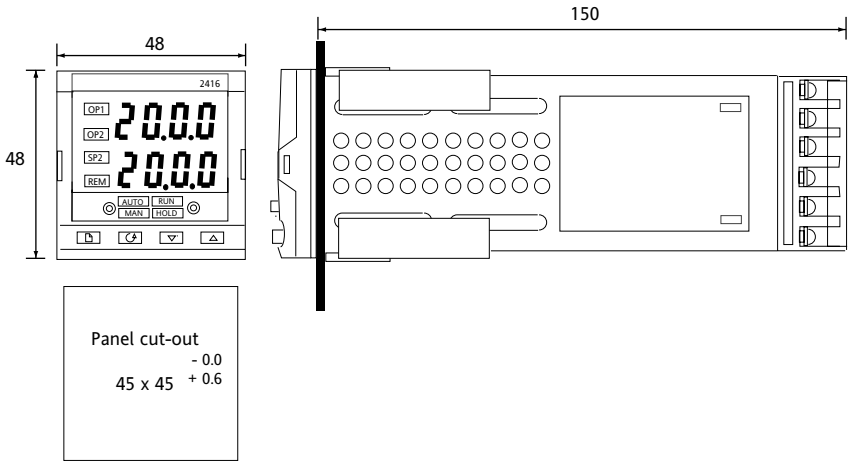
Note 4. An external 1% current sense resistor is supplied as standard. If greater accuracy is required, a 0.1% 2.49Ω can be ordered as part no. SUB2K/249R.1.

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 to1000°C, Manual button disabled.

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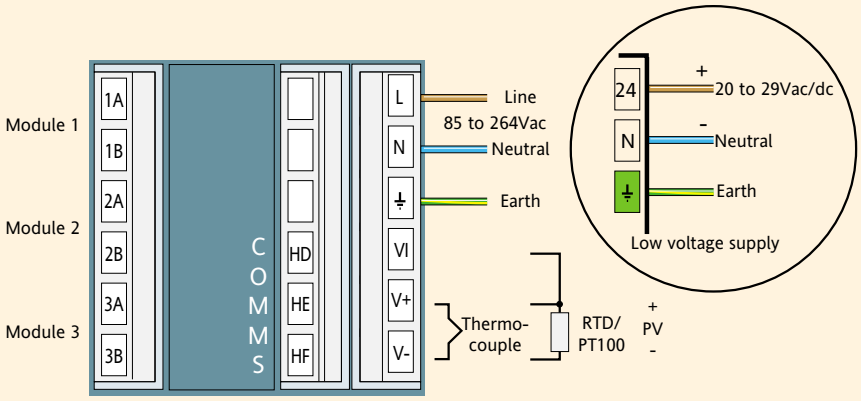
Dimensional details

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



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