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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.

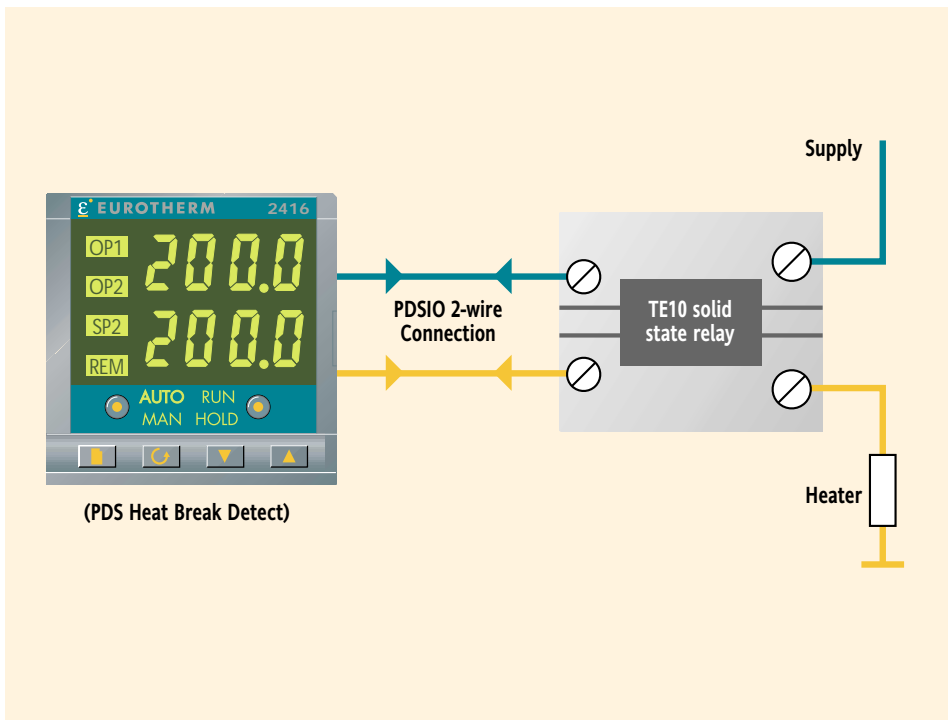
Alarms

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.

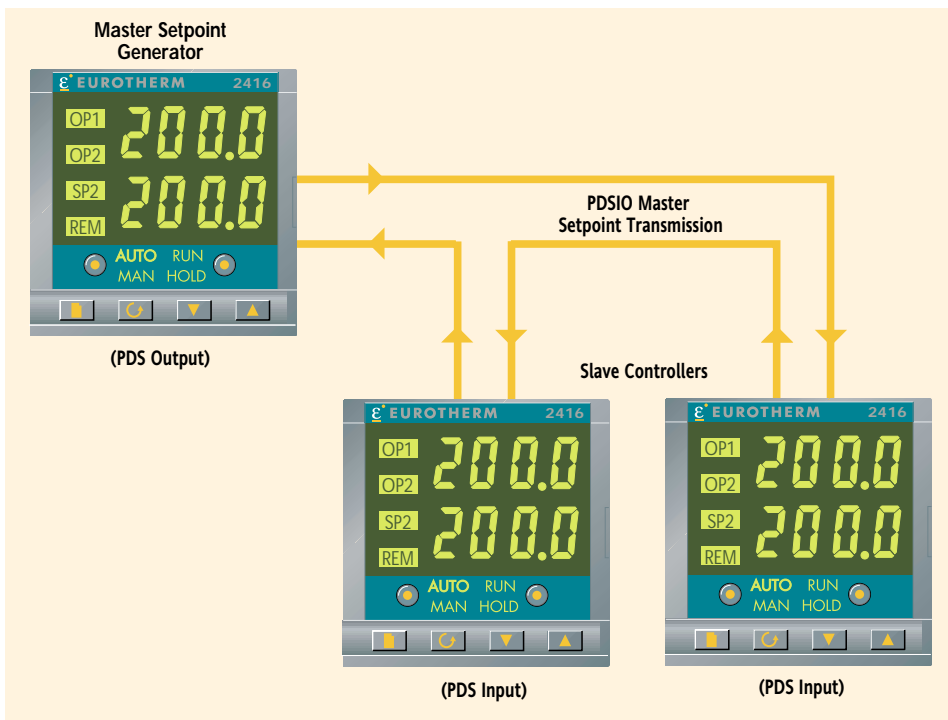
PDSIO Load diagnostic



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, ± 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, 0.1mV 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°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 |
| | Rating | 1A, 30 to 264Vac resistive |
| Triac | Application | Heating, cooling or program event |
| | Range | Non-isolated 0 to 20mA (into 600Ω max) 0 to 10Vdc (both configurable between limits) |
| Analogue | 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 | Supply Voltage | Module 1 | Module 2 | Module 3 | Comms | Manual |
|---|--|--|--|--|--|--|
| 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 | VH 85-264Vac VL 20-29Vac/dc | 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 | 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 | 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 retrans (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 | XX None 2 wire, RS485 Y2 Fitted unconfigured YM Modbus protocol YE El-Bisynch protocol RS232 A2 Fitted unconfigured AM Modbus protocol AE El-Bisynch protocol 4 wire, RS422 F2 Fitted unconfigured FM Modbus protocol FE El-Bisynch protocol PDS Input M6 Fitted unconfigured RS Setpoint input PDS Output M7 Fitted unconfigured PT PV retrans TS Setpoint retrans OT Output retrans | 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 |
|--|--------------|--------------|
| Standard Sensor Inputs | Min | 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 | 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 | 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 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.

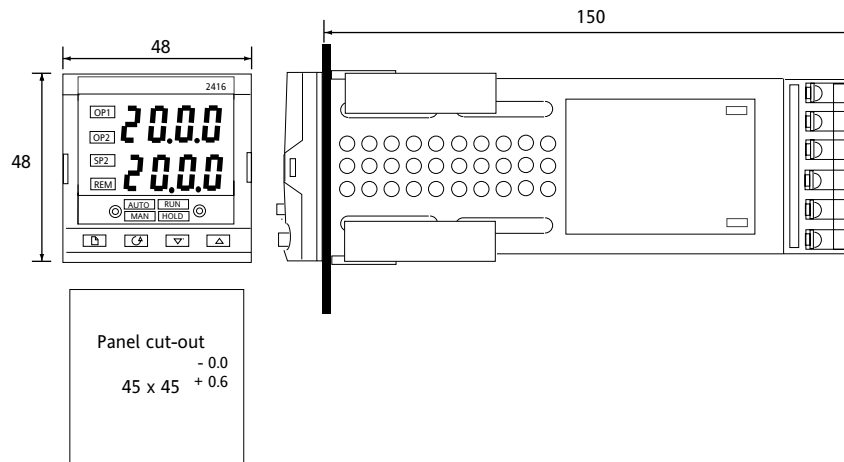
Example ordering code:

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

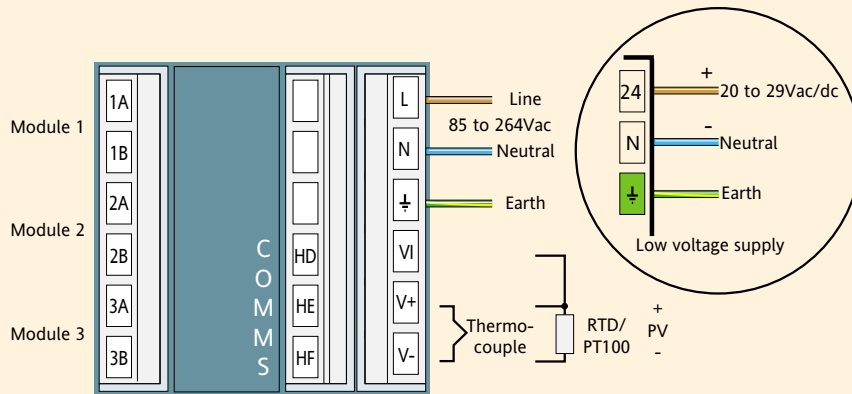
All dimensions in mm



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



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