Zesta Engineering Limited

Temperature Controller

Auto-tune PID

Safe, Simple, Reliable

Temperature/Power Controllers

Features

- High accuracy 18-bit input A-D
- High accuracy 15-bit output D-A
- Fast input sampling rate (5 times/sec)
- Basic and full function
- User programmable menu
- Pump control
- Fuzzy + PID microprocessor-based control
- Automatic programming
- Differential control
- Auto-tune function
- Self-tune function
- Sleep mode self-tune function
- Soft-start ramp and dwell timer
- Programmable inputs (thermocouple, RTD, mA & VDC)
- Analog input for remote set point and CT
- Event input for changing functions & set point
- Programmable digital filter
- Hardware lockout + remote lockout protection
- Loop break alarm
- Heater break alarm
- Sensor break alarm + Bumpless transfer
- RS-485 or RS-232 communication
- Analog retransmission
- Signal conditioner DC power supply
- A wide variety of output modules available
- Safety UL/CSA/IEC1010-1
- EMC/CE EN61326

ISO 9001 2000

ZEL-4300

ZEL-8300

ZEL-9300

ZEL-2500

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ZESTA ENGINEERING LTD.

www.zesta.com

• Electrical Process Heaters • Temperature/Power Controllers • Control Panels • Temperature Sensors

Overview

The Fuzzy Logic plus PID microprocessor-based controller series, incorporates two bright, easy to read 4-digit LED displays, indicating the process value or the set point value. The Fuzzy Logic technology enables the process to reach a predetermined set point in the shortest time, with minimum overshoot during power-up or an external load disturbance.

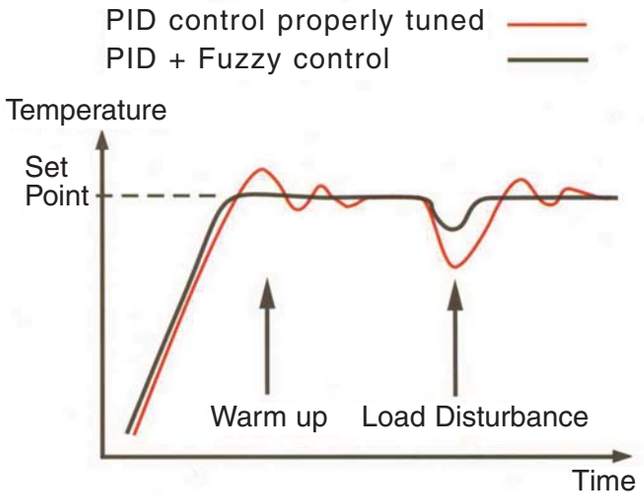
ZEL-9300 is a 1/16 DIN size panel mount controller,
ZEL-2500 is a 1/32 DIN size panel mount controller,
ZEL-8300 is a 1/8 DIN size panel mount controller,
and the ZEL-4300 is a 1/4 DIN size panel mount controller.

These units are powered by 11-26 VDC or 90-250 VAC supply, a control relay output is standard. Alternative output options include triac, 5 V logic output, linear current or linear voltage. The units are fully programmable for PT100 DIN as well as thermocouple types J, K, T, E, B, R, S, N and L. The input signal is digitized by using an 18-bit A to D converter. The fast sampling rate allows the unit to control rapidly changing processes.

Digital communications such as RS-485 or RS-232 are available as an additional option. The digital communication feature allows the units to be interfaced with supervisory control systems and software.

A programming port is available for automatic configuration, calibration and testing without the need to access the control via the front keypad directly.

By using proprietary Fuzzy modified PID technology, the control loop will minimize the overshoot and undershoot in the shortest time. The following diagram is a comparison of results with and without Fuzzy technology.



High Accuracy

The series are manufactured with custom designed ASIC (Application Specific Integrated Circuit) technology which contains an 18-bit A to D converter for high resolution measurement (true 0.1°F resolution for thermocouple and PT100) and an 15-bit D to A converter for linear current or voltage control output. The ASIC technology provides improved operating performance, low cost, enhanced reliability and higher density.

Fast Sampling Rate

The sampling rate of the input A to D converter is 5 times/second. This fast sampling rate allows the instrument to control rapidly changing processes.

Fuzzy Control

Fuzzy logic is empirically based. It relies on the controllers experience rather than the technical understanding of a problem to manipulate the output. The primary function of Fuzzy control is to make proactive adjustments of the PID parameters internally from time to time in order to make the control more flexible and adaptive to various processes. The result is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot or undershoot during power-up or during an external load disturbance.

Digital Communication

The units are equipped with a RS-485 or RS-232 interface card to provide digital communication. By using twisted pair wires up to 247 units may be connected together via RS-485 interface to a host computer.

Programming Port

An on board programming port can be used to connect the unit to a PC for quick configuration. The port also allows the control to be connected to an ATE system for automatic testing & calibration.

Auto-tune

The auto-tune function allows the user to simplify initial setup for a new system. An intelligent algorithm is provided to obtain an optimal set of control parameters for the process, and it may be applied either as the process is warming up (cold start) or as the process has been in steady state (warm start).

Lockout Protection

The parameters can be locked to prevent them from being changed by either using hardware lockout, remote lockout or both.

Bumpless Transfer

Bumpless transfer allows the controller to continue to control by using its previous parameters in the event of sensor break. This allows the process to continue operating until replacement of the sensor can be accomplished.

Soft-start Ramp

The ramping function is performed during power or any time the set point is changed. It can ramp up or ramp down. The process value will reach the final set point with a predetermined constant rate. This function is useful for process loads that are subject to thermal shock.

Digital Filter

A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain applications where the process value is dynamic or too unstable to read.

SEL Function

The control has the flexibility for the operator to select the parameters that are most significant to them. These selected parameters are placed in the front of display sequentially. The user may select up to five parameters to custom build their own display sequence.

Pump Control

The superior noise rejection capability in addition to the fast sampling rate of this series of controllers allows control of water pressure in a pump system, which is driven by a variable speed motor.

Specifications

Power
90-264 VAC, 47-63 Hz, 15 VA, 7 W maximum
11-26 VAC / VDC, 15 VA, 7 W maximum

Input 1
Resolution : 18-bits
Sampling Rate : 5 times / second
Maximum Rating : -2 VDC minimum, 12 VDC maximum (1 minute for mA input)
Temperature Effect : +/- 1.5 uV/°C for all inputs except mA input +/- 3.0 uV/°C for mA input
Sensor Break Detection :
Sensor open for TC, RTD and mV inputs,
below 1 mA for 4-20 mA input,
below 0.25 V for 1 - 5 V input,
unavailable for other inputs.

Characteristics

Type	Range
J	-120°C-1000°C (-184°F-1832°F)
K	-200°C-1370°C (-328°F-2498°F)
T	-250°C-400°C (-418°F-752°F)
E	-100°C-900°C (-148°F-1652°F)
B	0°C-1820°C (-32°F-3308°F)
R	0°C-1767.8°C (32°F-3214°F)
S	0°C-1767.8°C (32°F-3214°F)
N	-250°C-1300°C (-418°F-2372°F)
L	-200°C-900°C (-328°F-1652°F)
PT100^{DIN}	-210°C-700°C (-346°F-1292°F)
PT100^{JIS}	-200°C-600°C (-328°F-1112°F)
mV	-8 mV - 70 mV
mA	-3 mA - 27 mA
V	-1.3 V - 11.5 V

Input 2
Resolution : 18-bits
Sampling Rate : 1.66 times / second
Maximum Rating : -2 VDC minimum, 12 VDC maximum
Temperature Effect : +/- 1.5 uV/°C for all inputs except mA input +/- 3.0 uV/°C for mA input
Common Mode Rejection Ratio (CMRR) : 120 dB
Normal Mode Rejection Ratio (NMRR) : 55 dB
Sensor Break Detection :
Below 1 mA for 4-20 mA input,
below 0.25 V for 1 - 5 V input,
unavailable for other inputs.
Sensor Break Responding Time : 0.5 second

Characteristics

Type	Range	Accuracy	Input Impedance
ZEL-CT94-1	0-50.0 A	+/-2% of Reading +/-0.2 A	302 KΩ
mA	-3 mA-27 mA	+/-0.05 %	70.5 + 0.8 V / input current
V	-1.3 V-11.5 V	+/-0.05 %	302 KΩ

Input 3 (Event Input)
Logic Low : -10 V minimum, 0.8 V maximum
Logic High : 2 V minimum, 10 V maximum
External pull-down Resistance : 400 KΩ maximum
External pull-up Resistance : 1.5 MΩ minimum
Functions :
Select a second set point or PID, reset alarm 1 or alarm 2 or (reset alarms 1 and 2), disable output 1 or output 2 or (disable outputs 1 and 2) and remote lockout.

Output 1/Output 2
Relay Rating : 2 A/240 VAC, 200,00 cycles for resistive load
Pulsed Voltage : Source Voltage 5 V, current limiting resistance 66Ω

Linear Output Characteristics

Type	Zero Tolerance	Span Tolerance	Load Capacity
4-20 mA	3.8-4 mA	20-21 mA	500Ω max.
0-20 mA	0 mA	20-21 mA	500Ω max.
0-5 V	0 V	5-5.25 V	10 KΩ min.
1-5 V	0.95-1 V	5-5.25 V	10 KΩ min.
0-10 V	0 V	10-10.5 V	10 KΩ min.

Linear Output
Resolution : 15-bits
Output Regulation : 0.01% for full load change
Output Setting Time : 0.1 sec. (stable to 99.9%)
Isolation Breakdown Voltage : 1000 VAC
Temperature Effect : +/- 0.0025% of SPAN /0°C

Triac (SSR) Output
Rating : 1 A / 240 VAC
Inrush Current : 20 A for 1 cycle
Min. Load Current : 50 mA rms
Max. Off-state Leakage : 3 mA rms
Max. On-state Voltage : 1.5 V rms
Insulation Resistance : 1000 M ohms min. at (500 VDC)
Dielectric Strength : 2500 VAC for 1 minute

DC Voltage Supply Characteristics (Installed at Output 2)

Type	Tolerance	Max. Output Current	Ripple Voltage	Isolation Barrier
20 V	+/-0.5 V	25 mA	0.2 Vp-p	500 VAC
12 V	+/-0.3 V	40 mA	0.1 Vp-p	500 VAC
5 V	+/-0.15 V	80 mA	0.05 Vp-p	500 VAC

Alarm 1/Alarm 2 (Output ZEL-2500 & ZEL-9300 only)
Alarm 1 Relay : Form A or Form B for ZEL-9300, Form C for ZEL-4300, ZEL-8300, 5 V Logic output for ZEL-2500 Max. rating 2 A/240 VAC, 200,000 cycles for resistive load.
Alarm 2 Relay : Form A Max. rating 2 A/240 VAC, 200,000 cycles for resistive load.
Alarm Functions : Dwell timer, Deviation High / Low Alarm, Deviation Band High / Low Alarm, PV1 High / Low Alarm, PV2 High / Low Alarm, PV1 or PV2 High / Low Alarm, PV1-PV2 High / Low Alarm, Loop Break Alarm, Sensor Break Alarm.
Alarm Mode : Normal, Latching, Hold, Latching / Hold.
Dwell Timer : 0 - 6553.5 minutes

Data Communication
Interface : RS-232 (1 unit), RS-485 (up to 247 units)
Protocol : Modbus Protocol RTU mode
Address : 1-247
Baud Rate : 0.3 ~ 38.4 K bits/sec
Data Bits : 7 or 8 bits
Parity Bit : None, Even, or Odd
Stop Bit : 1 or 2 bits
Communication Buffer : 50 bytes

Analog Retransmission
Functions : PV1, PV2, PV1-PV2, PV2-PV1, Set Point, MV1, MV2, PV-SV deviation value
Output Signal : 4-20 mA, 0-20 mA, 0-1 V, 0-5 V, 1-5 V, 0-10 V
Resolution : 15-bits
Accuracy : +/-0.05% of span +/-0.0025%/°C
Load Resistance : 0-500 ohms (for current output) 10 K ohms minimum (for voltage output)
Output Regulation : 0.01% for full load change
Output Settling Time : 0.1 sec (stable to 99.9%)
Isolation Breakdown Voltage : 1000 VAC min.
Integral Linearity Error : +/-0.005% of span
Temperature Effect : +/-0.0025% of span/°C
Saturation Low : 0 mA (or 0 V)
Saturation High : 22.2 mA (or 5.55 V, 11.1 Vmin.)
Linear Output Range : 0-22.2 mA (0-20 mA or 4-20 mA),
0-5.55 V (0-5 V, or 1-5 V),
0-11.1 V (0-10 V),

User Interface
Dual 4-digit LED Displays :
ZEL-4300: Upper 0.55" (14 mm)
Lower 0.4" (10 mm)
ZEL-8300, ZEL-9300: Upper 0.4" (10 mm)
Lower 0.31" (8 mm)
ZEL-2500: (Single) 0.4" (10 mm)
Keypad : 4 keys
Programming Port : For automatic setup, calibration and testing
Communication Port : Connection to PC for supervisory control

Control Mode
Output 1 : Reverse (heating) or direct (cooling) action
Output 2 : PID cooling control, cooling P band 1 ~ 255% of PB
ON-OFF : 0.1 - 100.0 (°F) hysteresis control (P band = 0)
P or PD : 0 - 100.0% offset adjustment
PID : Fuzzy logic modified, Proportional band 0.1 ~ 900.0°F, Intergral time 0 - 1000 sec., Derivative time 0 - 360.0 sec.
Cycle Time : 0.1 - 100.0 seconds
Manual Control : Heat (MV1) and Cool (MV2)
Auto-tuning : Cold start and warm start
Self-tuning : Select None and Yes
Failure Mode : Auto-transfer to manual mode when sensor breaks or A-D converter damage
Sleep Mode : Enable or Disable
Ramping Control : 0 ~ 900.0°F/min. or 0 - 900.0°F/hour ramp rate
Power Limit : 0 - 100% output 1 and output 2
Pump/Pressure Control : Sophisticated functions provided
Remote Set Point : Programmable range for voltage or current input
Differential Control : Control PV1-PV2 at set point

Digital Filter
Function : PV Dampening
Time Constant : 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds programmable

Environmental & Physical
Operating Temperature : -10°C to 50°C
Storage Temperature : -40°C to 60°C
Humidity : 0 to 90% RH (non-condensing)
Insulation Resistance : 20 M ohms minimum (at 500 VDC)
Dielectric Strength : 2000 VAC, 50/60 Hz for 1 minute
Vibration Resistance : 10 - 55 Hz, 10 m/s^2 for 2 hours
Shock Resistance : 200 m/s^2 (20 g)
Molding : Flame retardant polycarbonate
Dimensions :
ZEL-4300 ---96 mm(W) X 96 mm(H) X 66 mm(D), 53 mm depth behind panel
ZEL-8300 ---48 mm(W) X 96 mm(H) X 80 mm(D), 65 mm depth behind panel
ZEL-9300 ---50.7 mm(W) X 50.7 mm(H) X 88.5 mm(D), 75 mm depth behind panel
ZEL-2500 ---50 mm(W) X 26.5 mm(H) X 110.5 mm(D), 98 mm depth behind panel

Approval Standards
Safety : UL873 (11th edition, 1994)
CSA C22.2 No. 24-93
EN61010-1 (IEC1010-1)
Protective Class : ZEL-8300, ZEL-4300:
IP20 housing & terminals with protective covers.
ZEL-2500, ZEL-9300:
NEMA 4 X & (IP65) front panel, IP20 housing and terminals.
All indoor use.
EMC : EN61326

Ordering Code

ZEL-2500 1/32 DIN □ □ □ □ □ □

Power Input
4: 90 - 264 VAC, 50/60 HZ
5: 11 - 26 VAC or VDC
9: Special Order

Signal Input
1: Standard input
Input 1-Universal Input
Thermocouple: J, K, T, E, B, R, S, N, L
RTD: PT100 DIN, PT100 JIS
Current: 4-20 mA, 0-20 mA
Voltage: 0-1 V, 0-5 V, 1-5 V, 0-10 V
Input 2-CT: 0-50 Amp. AC Current Transformer
Voltage Input: 0-1 V, 0-5 V, 1-5 V, 0-10 V
Event Input (EI)
9: Special Order

Output 1
0: None
1: Relay rated 2 A/240 VAC
2: Pulsed voltage to drive SSR, 5 V/30 mA
3: Isolated 4 - 20 mA / 0 - 20 mA
4: Isolated 1 - 5 V / 0 - 5 V
5: Isolated 0 - 10 V
6: Triac Output, 1 A / 240 VAC, SSR
C: Pulsed voltage to drive SSR, 14 V/40 mA
9: Special Order

Output 2/Alarm 2
0: None
1: Form A relay 2 A/240 VAC
2: Pulsed voltage to drive SSR, 5 V/30 mA
3: Isolated 4 - 20 mA / 0 - 20 mA
4: Isolated 1 - 5 V / 0 - 5 V
5: Isolated 0 - 10 V
6: Triac output, 1 A / 240 VAC, SSR
7: Isolated 20 V / 25 mA DC Output Power Supply
8: Isolated 12 V / 40 mA DC Output Power Supply
9: Isolated 5 V / 80 mA DC Output Power Supply
C: Pulsed voltage to drive SSR, 14 V/40 mA
A: Special Order

Alarm 1
1: 5 V Logic Output
9: Special Order

Communications
0: None
1: RS-485 Interface
2: RS-232 Interface
3: Retransmit 4-20 mA / 0-20 mA
4: Retransmit 1-5 V / 0-5 V
5: Retransmit 0-10 V
9: Special Order

Your Authorized Zesta Distributor Is :

ZEL-9300 1/16 DIN □ □ □ □ □ □

Power Input
4: 90 - 264 VAC, 50/60 HZ
5: 11 - 26 VAC or VDC
9: Special Order

Signal Input
1: Standard input
Input 1-Universal Input
Thermocouple: J, K, T, E, B, R, S, N, L
RTD: PT100 DIN, PT100 JIS
Current: 4-20 mA, 0-20 mA
Voltage: 0-1 V, 0-5 V, 1-5 V, 0-10 V
Input 2-CT and Analog Input
CT: 0-50 Amp. AC Current Transformer
Analog Input: 4-20 mA, 0-20 mA, 0-1 V, 0-5 V, 1-5 V, 0-10 V
Input 3-Event Input (EI)
9: Special Order

Output 1
0: None
1: Relay rated 2 A/240 VAC
2: Pulsed voltage to drive SSR, 5 V/30 mA
3: Isolated 4 - 20 mA / 0 - 20 mA
4: Isolated 1 - 5 V / 0 - 5 V
5: Isolated 0 - 10 V
6: Triac output, 1 A / 240 VAC, SSR
C: Pulsed voltage to drive SSR, 14 V/40 mA
9: Special Order

Output 2/Alarm 2
0: None
1: Form A relay 2 A/240 VAC
2: Pulsed voltage to drive SSR, 5 V/30mA
3: Isolated 4 - 20 mA / 0 - 20 mA
4: Isolated 1 - 5 V / 0 - 5 V
5: Isolated 0 - 10 V
6: Triac output, 1 A / 240 VAC, SSR
7: Isolated 20 V / 25 mA DC Output Power Supply
8: Isolated 12 V / 40 mA DC Output Power Supply
9: Isolated 5 V / 80 mA DC Output Power Supply
C: Pulsed voltage to drive SSR, 14 V/40 mA
A: Special Order

Alarm 1
0: None
1: Form A relay 2 A / 240 VAC
2: Form B relay 2 A / 240 VAC
9: Special Order

Communications
0: None
1: RS-485 Interface
2: RS-232 Interface
3: Retransmit 4-20 mA / 0-20 mA
4: Retransmit 1-5 V / 0-5 V
5: Retransmit 0-10 V
9: Special Order

ZEL-8300 1/8 DIN
ZEL-4300 1/4 DIN
□ □ □ □ □ □ □ □

Power Input
4: 90 - 264 VAC, 50/60 HZ
5: 11 - 26 VAC or VDC
9: Special Order

Signal Input
1: Standard input
Input 1-Universal Input
Thermocouple: J, K, T, E, B, R, S, N, L
RTD: PT100 DIN, PT100 JIS
Current: 4-20 mA, 0-20 mA
Voltage: 0-1 V, 0-5 V, 1-5 V, 0-10 V
Input 2-CT and Analog Input
CT: 0-50 Amp. AC Current Transformer
Analog Input: 4-20 mA, 0-20 mA, 0-1 V, 0-5 V, 1-5 V, 0-10 V
9: Special Order

Output 1
0: None
1: Relay rated 2 A/240 VAC
2: Pulsed voltage to drive SSR, 5 V /30 mA
3: Isolated 4 - 20 mA / 0 - 20 mA
4: Isolated 1 - 5 V / 0 - 5 V
5: Isolated 0 - 10 V
6: Triac output, 1 A / 240 VAC, SSR
C: Pulsed voltage to drive SSR, 14 V/40 mA
9: Special Order

Output 2
0: None
1: Relay 2 A/240 VAC
2: Pulsed voltage to drive SSR, 5 V/30 mA
3: Isolated 4 - 20 mA / 0 - 20 mA
4: Isolated 1 - 5 V / 0 - 5 V
5: Isolated 0 - 10 V
6: Triac output, 1 A / 240 VAC, SSR
7: Isolated 20 V / 25 mA DC Output Power Supply
8: Isolated 12 V / 40 mA DC Output Power Supply
9: Isolated 5 V / 80 mA DC Output Power Supply
C: Pulsed voltage to drive SSR, 14 V/40 mA
A: Special Order

Alarm 1
0: None
1: Form C relay 2 A / 240 VAC
9: Special Order

Alarm 2
0: None
1: Relay 2 A / 240 VAC
9: Special Order

Communications
0: None
1: RS-485 Interface
2: RS-232 Interface
3: Retransmit 4-20 mA / 0-20 mA
4: Retransmit 1-5 V / 0-5 V
5: Retransmit 0-10 V
9: Special Order

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