Series 96

Calibration Manual

1/16 DIN Temperature Controller

with Custom Toolbar (patent pending)

CE 97

TOTAL CUSTOMER SATISFACTION
3 Year Warranty

ISO 9001
Registered Company
Winona, Minnesota USA

WATLOW

Watlow Controls

1241 Bundy Blvd., P.O. Box 5580, Winona, Minnesota USA 55987-5580
Phone: (507) 454-5300, Fax: (507) 452-4507 http://www.watlow.com

January 1999
(1627)

Made in the U.S.A.

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Technical Assistance

If you encounter a problem with your Watlow controller, see the Trouble-shooting Table in the Appendix of the Series 96 User's Manual and review all of your configuration information to verify that your selections are consistent with your application: inputs; outputs; alarms; limits; etc. If the problem persists after checking the above, you can get technical assistance from your local Watlow representative, or by dialing (507) 454-5300, ext. 1111.

An applications engineer will discuss your application with you.

Please have the following information available when calling:

- Complete model number
- All configuration information
- User's Manual
- Diagnostic menu readings

Your Feedback

Your comments or suggestions on this manual are welcome. Please send them to: Technical Writer, Watlow Controls, 1241 Bundy Blvd., P.O. Box 5580, Winona, MN 55987-5580; phone: (507) 454-5300; fax: (507) 452-4507.

Calibrating the Series 96

Warm up the unit (20 minutes). To enter a calibration menu, enter the Factory Page by holding down the ⊙ and ⊙ keys for six seconds. Once in the Factory Page FctY use the Up-arrow ▲ or Down-arrow ▼ Key to select a menu. The last three menus on the Factory Page are Calibration 1 Menu c in1, Calibration 2 Menu c in2 and Process Output Calibration Menu cout.

You can restore the original factory calibration with Restore Factory Calibration rSt (Calibration 1 Menu) or revert to the default parameter range selections with Default Settings dFLt (Calibration 1 Menu).

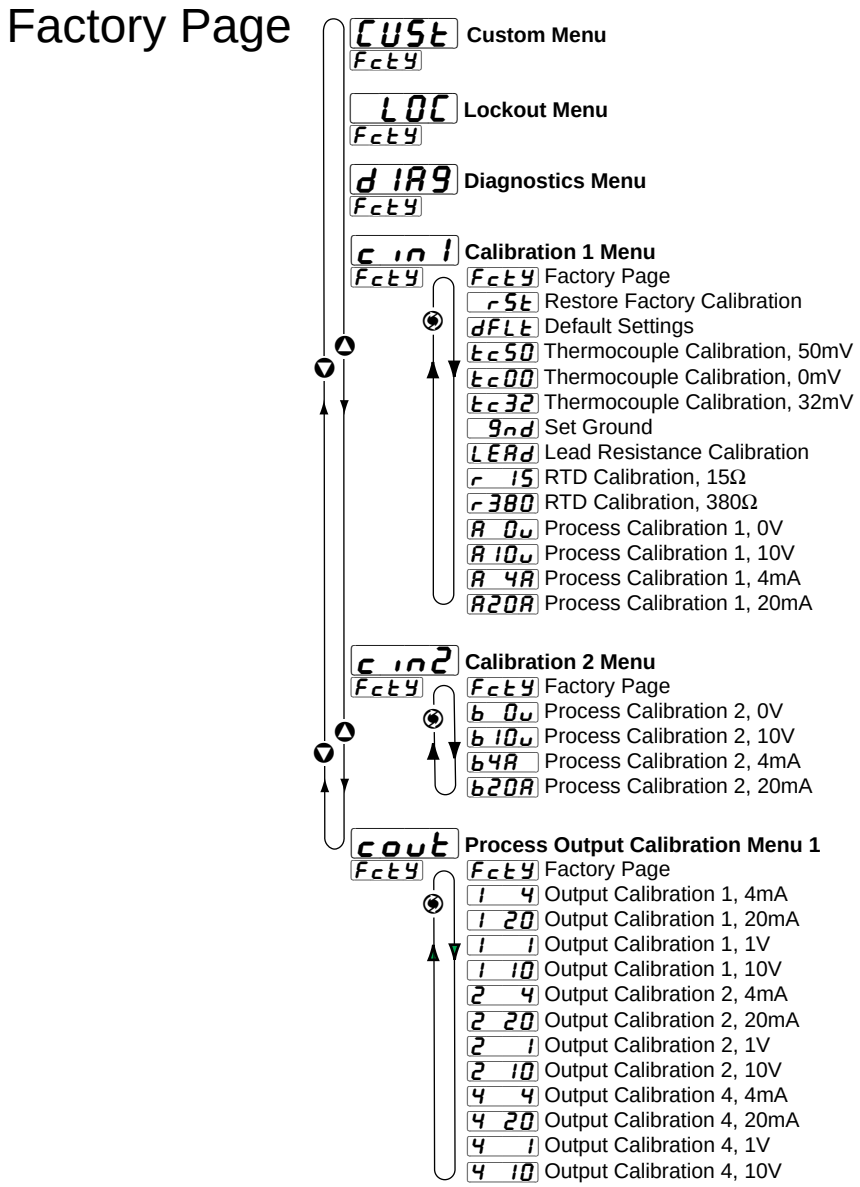

Figure 3 – The Calibration Menus.

Thermocouple Input Procedure

Equipment

- Type J reference compensator with reference junction at 32°F/0°C, or type J thermocouple calibrator to 32°F/0°C.
- Precision millivolt source, 0 to 50mV minimum range, 0.002mV resolution.

Input 1 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).
2. Connect the millivolt source to terminals 6 (-) and 7 (+) with copper wire.
3. Enter 50.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 50mV [tc50] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store 50.000mV input and move to the next prompt.
4. Enter 0.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 0mV [tc00] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store 0.000mV input and move to the next prompt.
5. Disconnect the millivolt source and connect the reference compensator or thermocouple calibrator to terminals 6 (-) and 7 (+). With type J thermocouple wire, if using a compensator, turn it on and short the input wires. When using a type J calibrator, set it to simulate 32°F/0°C. Allow 10 seconds for the controller to stabilize. Set Thermocouple Calibration, 32° [tc32] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store type J thermocouple calibration and move to the next prompt.
6. Rewire for operation and verify calibration.

RTD Input Procedure

Equipment Required

- 1kΩ decade box with 0.01Ω resolution.

Input 1 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).
2. Short terminals 5, 6 and 7 together with less than 0.1Ω. Set Ground [Gnd] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store ground input and move to the next prompt.
3. Short terminals 5 and 7 together with less than 0.5Ω. Set Lead Resistance Calibration [LEAd] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the lead resistance and move to the next prompt.
4. Connect the decade box to terminals 5 (S2), 6 (S3) and 7 (S1), with 20- to 24-gauge wire.
5. Enter 15.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 15Ω [r 15] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the 15.00Ω input and move to the next prompt.
6. Enter 380.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 380Ω [r380] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the 380.00Ω input and move to the next prompt.
7. Rewire for operation and verify calibration.

Voltage Process Input Procedure

Equipment

- Precision voltage source, 0 to 10V minimum range, with 0.001V resolution.

Input 1 and 2 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).

Input 1

2. Connect the voltage source to terminals 4 (+) and 6 (-) of the controller.
3. Enter 0.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 1, 0V [A 0u] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the 0.00V input and move to the next prompt.
4. Enter 10.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 1, 10V [A 10u] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the 10.00V input and move to the next prompt.

Input 2

5. Connect the voltage source to terminals 1 (-) and 3 (+) of the controller.
6. Enter 0.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 2, 0V [b 0u] (Calibration 2 Menu) to [YES]. Press the Advance Key ⊛ to store the 0.00V input and move to the next prompt.
7. Enter 10.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 2, 10V [b 10u] (Calibration 2 Menu) to [YES]. Press the Advance Key ⊛ to store the 10.00V input and move to the next prompt.
8. Rewire for operation and verify calibration.

Current Process Input Procedure

Equipment

- Precision current source, 0 to 20mA range, with 0.01mA resolution.

Input 1 and 2 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).

Input 1

2. Connect the current source to terminals 5 (+) and 6 (-).
3. Enter 4.00mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 1, 4mA [A 4A] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the 4mA input and move to the next prompt.
4. Enter 20.00mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 1, 20mA [A20A] (Calibration 1 Menu) to [YES]. Press the Advance Key ⊛ to store the 20mA input and move to the next prompt.

Input 2

5. Connect the current source to terminals 1 (-) and 2 (+).
6. Enter 4.00mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 2, 4mA [b 4A] (Calibration 2 Menu) to [YES]. Press the Advance Key ⊛ to store the 4mA input and move to the next prompt.
7. Enter 20.00mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Process Calibration 2, 20mA [b20A] (Calibration 2 Menu) to [YES]. Press the Advance Key ⊛ to store the 20mA input and move to the next prompt.
8. Rewire for operation and verify calibration.

Process Output Procedures

Equipment

- Precision volt/ammeter with 3.5-digit resolution.

Output 1 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).

Milliamperes

2. Connect the volt/ammeter (set to milliamperes) to terminals 13 (+) and 14 (-).
3. At Output Calibration 1, 4mA [1 4] (Process Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 4.00mA, ±0.1mA. Press the Advance Key ⊛ to store the value and move to the next prompt.
4. At Output Calibration 1, 20mA [1 20] (Process Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 20.00mA, ±0.1mA. Press the Advance Key ⊛ to store the value and move to the next prompt.

Volts

5. Connect the volt/ammeter (set to volts) to terminals 14 (-) and 15 (+).
6. At Output Calibration 1, 1V [1 1] (Process Output Calibration Menu) enter the reading from the voltmeter. The unit should stabilize within one second. Repeat until the voltmeter reads 1.00V, ±0.1V. Press the Advance Key ⊛ to store the value and move to the next prompt.
7. At Output Calibration 1, 10V [1 10] (Process Output Calibration Menu) enter the reading from the voltmeter. The unit should stabilize within one second. Repeat until the voltmeter reads 10.00V, ±0.1V. Press the Advance Key ⊛ to store the value and move to the next prompt.
8. Rewire for operation and verify calibration.

Output 2 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).

Milliamperes

2. Connect the volt/ammeter (set to milliamperes) to terminals 17 (-) and 18 (+).
3. At Output Calibration 2, 4mA [2 4] (Process Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 4.00mA, ±0.1mA. Press the Advance Key ⊛ to store the value and move to the next prompt.
4. At Output Calibration 2, 20mA [2 20] (Process Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 20.00mA, ±0.1mA. Press the Advance Key ⊛ to store the value and move to the next prompt.

Volts

5. Connect the volt/ammeter (set to volts) to terminals 16 (+) and 17 (-).
6. At Output Calibration 2, 1V [2 1] (Process Output Calibration Menu) enter the reading from the volt. The unit should stabilize within one second. Repeat until the voltmeter reads 1.00V, ±0.1V. Press the Advance Key ⊛ to store the value and move to the next prompt.
7. At Output Calibration 2, 10V [2 10] (Process Output Calibration Menu) enter the reading from the volt. The unit should stabilize within one second. Repeat until the voltmeter reads 10.00V, ±0.1V. Press the Advance Key ⊛ to store the value and move to the next prompt.

Output 4 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Series 96 User's Manual).

Milliamperes

2. Connect the volt/ammeter (set to milliamperes) to terminals 20 (-) and 21 (+).

3. At Output Calibration 4, 4mA [4 4] (Process Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 4.00mA, ±0.1mA. Press the Advance Key ⊛ to store the value and move to the next prompt.

4. At Output Calibration 4, 20mA [4 20] (Process Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 20.00mA, ±0.1mA. Press the Advance Key ⊛ to store the value and move to the next prompt.

Volts

5. Connect the volt/ammeter (set to volts) to terminals 19 (+) and 20 (-).

6. At Output Calibration 4, 1V [4 1] (Process Output Calibration Menu) enter the reading from the voltmeter. The unit should stabilize within one second. Repeat until the voltmeter reads 1.00V, ±0.1V. Press the Advance Key ⊛ to store the value and move to the next prompt.

7. At Output Calibration 4, 10V [4 10] (Process Output Calibration Menu) enter the reading from the voltmeter. The unit should stabilize within one second. Repeat until the voltmeter reads 10.00V, ±0.1V. Press the Advance Key ⊛ to store the value and move to the next prompt.

8. Rewire for operation and verify calibration.

Series 96 Factory Page Calibration Parameters

The resting-state display shows one of the following sets of data, depending on controller setup. The first prompt appears in the top display, the second in the bottom.

To enter the calibration mode, first enter the diagnostics mode; send value 1789 to register 1512. Once in Diagnostics mode, to enter calibration mode, send 1415 to register 1600.

To restore factory calibration settings, send value 1 to register 1601.

Display	Parameter	Range (Modbus Value)	Default	Modbus Address Read/Write	Conditions for Parameters to Appear
cin1 FctY	Calibration 1 Menu Factory Page	To exit: 0 to 1414 and 1416 to 9999 To enter: 1415	0	1600 r/w	Active if the controller is in diagnostic mode for comms.
rSt	Restore Factory Calibration Restore factory calibration. Does not affect operations and setup parameters.	no no (0) YES yes (1)	no (0)	1601 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
dFLt	Default Settings Restore default settings.	no no (0) YES yes (800)	no (0)	1602 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
tc00	Thermocouple Calibration, 0mV Store 0.000mV calibration for input 1 thermocouple.	no no (0) YES yes (1)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
tc50	Thermocouple Calibration, 50mV Store 50.000mV calibration for input 1 thermocouple.	no no (0) YES yes (2)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
tc32	Thermocouple Calibration, 32º Store 32º F type J calibration.	no no (0) YES yes (3)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
Gnd	Set Ground Store calibration for ground.	no no (0) YES yes (4)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
LEAd	Lead Resistance Calibration Store calibration for lead resistance.	no no (0) YES yes (5)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
r 15	RTD Calibration, 15Ω Store 15.00Ω calibration for input 1 RTD.	no no (0) YES yes (6)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.

Display	Parameter	Range (Modbus Value)	Default	Modbus Address Read/Write	Conditions for Parameters to Appear
r380	RTD Calibration, 380Ω Store 380.00Ω calibration for input 1 RTD.	no (0) yes (7)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
A 0u	Process Calibration 1, 0V Store 0.000V calibration for input 1 process.	no (0) yes (8)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
A 10u	Process Calibration 1, 10V Store 10.000V calibration for input 1 process.	no (0) yes (9)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
A 4A	Process Calibration 1, 4mA Store 4.000mA calibration for input 1 process.	no (0) yes (10)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
A20A	Process Calibration 1, 20mA Store 20.000mA calibration for input 1 process.	no (0) yes (11)	no (0)	1603 w	Active if Calibration Lock (Lockout Menu) is not set to hidE.
c in2	Calibration 2 Menu**				
FctY	Factory Page				
b 0u	Process Calibration 2, 0V Store 0.000V calibration for input 2 process.	no (0) yes (1)	no (0)	1608 w	Active if input 2 is present (96 _1 _-_ _ _ _ -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
b 10u	Process Calibration 2, 10V Store 10.000V calibration for input 2 process.	no (0) yes (2)	no (0)	1608 w	Active if input 2 is present (96 _1 _-_ _ _ _ -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
b 4A	Process Calibration 2, 4mA Store 4.000mA calibration for input 2 process.	no (0) yes (3)	no (0)	1608 w	Active if input 2 is present (96 _1 _-_ _ _ _ -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
b20A	Process Calibration 2, 20mA Store 20.000mA calibration for input 2 process.	no (0) yes (4)	no (0)	1608 w	Active if input 2 is present (96 _1 _-_ _ _ _ -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.

****These parameters are not available if the ramping software option has been ordered (96 _ _ - _ _ _ _ - AA _ _)**

Display	Parameter	Range (Modbus Value)	Default	Modbus Address Read/Write	Conditions for Parameters to Appear
cout	Process Output Calibration Menu				
Fcty	Factory Page				
1 4	Output Calibration 1, 4mA Enter the output value in milliamps as measured.	0.00 to 99.99	4.00 (400)	1604 w	Active if output 1 is process (96 _ _-F _ _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
1 20	Output Calibration 1, 20mA Enter the output value in milliamps as measured.	0.00 to 99.99	20.00 (2000)	1605 w	Active if output 1 is process (96 _ _-F _ _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
1 1	Output Calibration 1, 1V Enter the output value in volts as measured.	0.00 to 99.99	1.00 (100)	1606 w	Active if output 1 is process (96 _ _-F _ _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
1 10	Output Calibration 1, 10V Enter the output value in volts as measured.	0.00 to 99.99	10.00 (1000)	1607 w	Active if output 1 is process (96 _ _-F _ _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
2 4	Output Calibration 2, 4mA Enter the output value in milliamps as measured.	0.00 to 99.99	4.00 (400)	1609 w	Active if output 2 is process (96 _ _ - _ F _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
2 20	Output Calibration 2, 20mA Enter the output value in milliamps as measured.	0.00 to 99.99	20.00 (2000)	1610 w	Active if output 2 is process (96 _ _ - _ F _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
2 1	Output Calibration 2, 1V Enter the output value in volts as measured.	0.00 to 99.99	1.00 (100)	1611 w	Active if output 2 is process (96 _ _ - _ F _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
2 10	Output Calibration 2, 10V Enter the output value in volts as measured.	0.00 to 99.99	10.00 (1000)	1612 w	Active if output 2 is process (96 _ _ - _ F _ _-_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
4 4	Output Calibration 4, 4mA Enter the output value in milliamps as measured.	0.00 to 99.99	4.00 (400)	1619 w	Active if output 4 is process (96 _ _- _ _ _ M -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.

Display	Parameter	Range (Modbus Value)	Default	Modbus Address Read/Write	Conditions for Parameters to Appear
4 20	Output Calibration 4, 20mA Enter the output value in milliamps as measured.	0.00 to 99.99	20.00 (2000)	1620 w	Active if output 4 is process (96 _ _- _ _ _ M -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
4 1	Output Calibration 4, 1V Enter the output value in volts as measured.	0.00 to 99.99	1.00 (100)	1621 w	Active if output 4 is process (96 _ _- _ _ _ M -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.
4 10	Output Calibration 4, 10V Enter the output value in volts as measured.	0.00 to 99.99	10.00 (1000)	1622 w	Active if output 4 is process (96 _ _- _ _ _ M -_ _ _ _) and Calibration Lock (Lockout Menu) is not set to hidE.

Ordering Information (1551)

Series 96 **9 6 _ _ – _ _ _ _ – _ _ _ _**

Microprocessor-based
1/16 DIN with universal input 1.
Options include software, power supply, input 2, four outputs and display color

Power Supply
A = 100-240V≈ (ac/dc)
B = 24-28V≈ (ac/dc)

Input 2
0 = None
1 = Event input & 0-5V⎓ (dc)/ 4-20mA (remote set point input)

Output 1
C = Switched dc/open collector
D = Electromechanical relay, Form C, 2A, without RC suppression
F = Universal Process, range selectable: 0-20mA, 4-20mA, 0-5V⎓ (dc), 1-5V⎓ (dc), 0-10V⎓ (dc)
K = 0.5A solid-state relay without RC suppression

Output 2
A = None
C = Switched dc output/open collector
D = Electromechanical relay, Form C, 2A, without RC suppression
F = Universal Process, range selectable: 0-20mA, 4-20mA, 0-5V⎓ (dc), 1-5V⎓ (dc), 0-10V⎓ (dc)
K = 0.5A solid-state relay without RC suppression

Output 3
A = None
D = Electromechanical relay, Form C, 2A, without RC suppression

Output 4
A = None
D = Electromechanical relay, Form C, 2A, without RC suppression
R = 232 Communications
U = 485 Communications
M = Universal Retransmit, range selectable: 0-20mA, 4-20mA, 0-5V⎓ (dc), 1-5V⎓ (dc), 0-10V⎓ (dc)

Software/Preset Parameters
00 = Standard software
AA = Ramping

Display/Overlay
Upper/Lower
RR = Red/Red display
RG = Red/Green display
GR = Green/Red display
GG = Green/Green display

How to Reach Us

TOTAL CUSTOMER SATISFACTION
3 Year Warranty

Quality and Mission Statement:

Watlow Controls will be the world's best supplier of industrial temperature control products, services, and systems by exceeding our customers', employees', and shareholders' expectations.

Contact

- Phone: (507) 454-5300.
- Fax: (507) 452-4507.
- For technical support, ask for an Applications Engineer (ext. 1111).
- To place an order, ask for Customer Service.
- To discuss a custom option, ask for a Series 96 Product Manager.

Warranty

The Watlow Series 96 is warranted to be free of defects in material and workmanship for 36 months after delivery to the first purchaser for use, providing that the units have not been misapplied. Since Watlow has no control over their use, and sometimes misuse, we cannot guarantee against failure. Watlow's obligations hereunder, at Watlow's option, are limited to replacement, repair or refund of purchase price, and parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse, or abuse.

Returns

- Call or fax Customer Service for a Return Material Authorization (RMA) number before returning a controller.
- Put the RMA number on the shipping label, and also on a written description of the problem.
- A restocking charge of 20% of the net price is charged for all standard units returned to stock.

Watlow Controls, 1241 Bundy Blvd., P.O. Box 5580, Winona, MN USA 55987-5580,
Phone: (507) 454-5300, Fax: (507) 452-4507