Table -1 Single or Cascade Loop Controller – Loop 1 Output Functionality and Restrictions

Output Alg. Selection	Output #2 Option	Function of Output #2	1st Current Output	2nd Current Output*	Relay #3	Relay #4	Relay #5
Time Simplex or ON-OFF Simplex	Single Relay	HEAT	INU	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Third Current Output	N/A	N/A	N/A	N/A	N/A	N/A
	Dual Relay	HEAT	INU	Not Needed	Alarm 3	Alarm 2	Alarm 1
	None	N/A	N/A	N/A	N/A	N/A	N/A
Time Duplex or ON-OFF Duplex or TPSC or Position Proportional **	Single Relay	N/A	N/A	N/A	N/A	N/A	N/A
	Third Current Output	N/A	N/A	N/A	N/A	N/A	N/A
	Dual Relay	HEAT and COOL	INU	Not Needed	Alarm 3	Alarm 2	Alarm 1
	None	N/A	N/A	N/A	N/A	N/A	N/A
Current Simplex	Single Relay	Alarm 4	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Third Current Output	INU	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Dual Relay	Alarm 4	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
	None	N/A	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
Current Duplex 100 % 1st Current Output = COOL and HEAT	Single Relay	Alarm 4	HEAT and COOL	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Third Current Output	INU	HEAT and COOL	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Dual Relay	Alarm 4	HEAT and COOL	Not Needed	Alarm 3	Alarm 2	Alarm 1
	None	N/A	HEAT and COOL	Not Needed	Alarm 3	Alarm 2	Alarm 1
Current Duplex 50 % *** Cur #1 = HEAT Cur #2 or #3 = COOL	Single Relay	Alarm 4	HEAT	COOL	Alarm 3	Alarm 2	Alarm 1
	Third Current Output	COOL	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Dual Relay	Alarm 4	HEAT	COOL	Alarm 3	Alarm 2	Alarm 1
	None	N/A	HEAT	COOL	Alarm 3	Alarm 2	Alarm 1
Current/Time First Current Out = COOL Time = HEAT	Single Relay	HEAT	COOL	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Third Current Output	N/A	N/A	N/A	N/A	N/A	N/A
	Dual Relay	HEAT	COOL	Not Needed	Alarm 3	Alarm 2	Alarm 1
	None	N/A	N/A	N/A	N/A	N/A	N/A
Time/Current Time = COOL First Current Out = HEAT	Single Relay	COOL	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
	Third Current Output	N/A	N/A	N/A	N/A	N/A	N/A
	Dual Relay	COOL	HEAT	Not Needed	Alarm 3	Alarm 2	Alarm 1
	None	N/A	N/A	N/A	N/A	N/A	N/A

TPSC = Three Position Step Control

N/A = The output form or the individual output is Not Available, not operable or is not used for this Output #2 Option selection.

INU = Installed, Not Used – The installed Output is not used to provide the desired output function. The First Current Output and the Third Current Output may be used to perform an Auxiliary Output function or as a Loop 2 Output if listed as INU.

Not Needed = The Second Current Output is Not Needed for this output form and does not have to be installed. If it is installed, then it can be used to perform an Auxiliary Output function.

Table -2 Dual Loop Controller – Loop 2 Output Functionality and Restrictions

Loop 2 Output Algorithm Selection	Output #2 Option	Function of Output #2	1st Current Output	2nd Current Output*	Relay #3	Relay #4	Relay #5
Time Simplex or ON-OFF Simplex	Third Current Output	NUL2	NUL2	Not Needed	Loop 2 HEAT	Alarm 2	Alarm 1
	All Other Options	NUL2	NUL2	Not Needed	Loop 2 HEAT	Alarm 2	Alarm 1
Time Duplex or ON-OFF Duplex	Third Current Output	NUL2	NUL2	Not Needed	Loop 2 HEAT	Loop 2 COOL	Alarm 1
	All Other Options	NUL2	NUL2	Not Needed	Loop 2 HEAT	Loop 2 COOL	Alarm 1
Current Simplex	Third Current Output	Loop 2 HEAT	NUL2	Not Needed	Alarm 3	Alarm 2	Alarm 1
	All Other Options	NUL2	NUL2	Loop 2 HEAT	Alarm 3	Alarm 2	Alarm 1
Current Duplex 100 % Second or Third Current Out = COOL and HEAT	Third Current Output	Loop 2 HEAT and COOL	NUL2	Not Needed	Alarm 3	Alarm 2	Alarm 1
	All Other Options	NUL2	NUL2	Loop 2 HEAT and COOL	Alarm 3	Alarm 2	Alarm 1
Current Duplex 50 % *** Second Current = HEAT Third Current = COOL	Third Current Output	Loop 2 HEAT	NUL2	Loop 2 COOL	Alarm 3	Alarm 2	Alarm 1
	All Other Options	N/A2	N/A2	N/A2	N/A2	N/A2	N/A2
Current/Time Second or Third Current = COOL Time = HEAT	Third Current Output	Loop 2 HEAT	NUL2	Not Needed	Loop 2 HEAT	Alarm 2	Alarm 1
	All Other Options	NUL2	NUL2	Loop 2 COOL	Loop 2 HEAT	Alarm 2	Alarm 1
Time/Current Time = COOL Second or Third Current = HEAT	Third Current Output	Loop 2 HEAT	NUL2	Not Needed	Loop 2 COOL	Alarm 2	Alarm 1
	All Other Options	NUL2	NUL2	Loop 2 HEAT	Loop 2 COOL	Alarm 2	Alarm 1

TPSC = Three Position Step Control

NUL2 = Not Used on Loop 2 – This particular output is not used for the selected Second Loop Output type, but it may be used for the First Loop Output type. Refer to the selection made in Table **-1**.

N/A2 = Current Duplex 50% is Not Available on Loop 2 unless the Third Current Output is installed.

Not Needed = The Second Current Output is Not Needed for this Loop 2 Output. If it is installed, and it is not used for Loop 1 Output, then it can be used to perform an Auxiliary Output function. Refer to the selection made in Table **-1**.

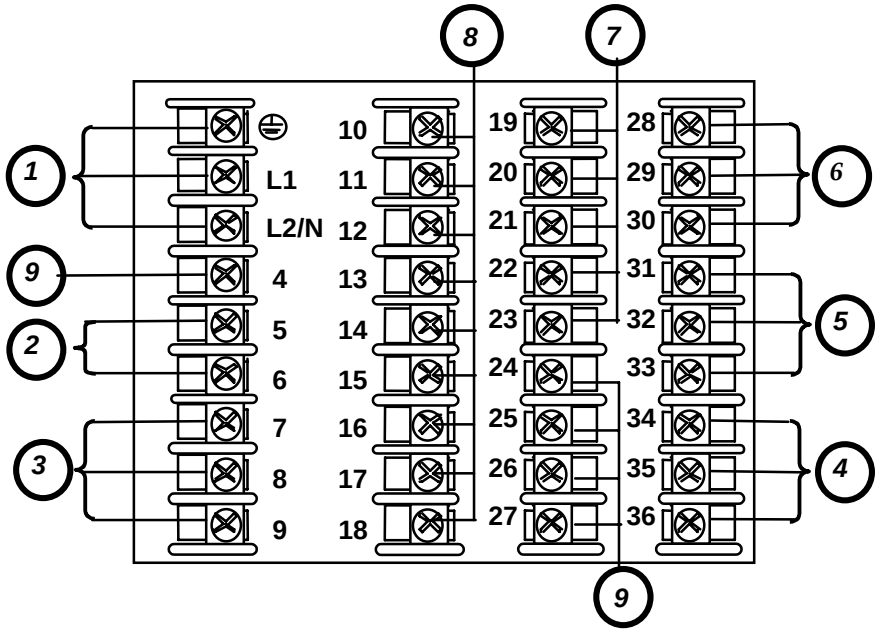
* The Second Current Output and Ethernet Communications are mutually exclusive.

** TPSC and Position Proportional are available only on Loop 1.

*** Current Duplex 50% is available only on Loop 1 or Loop 2, it cannot be used on both loops.

Wiring the Controller

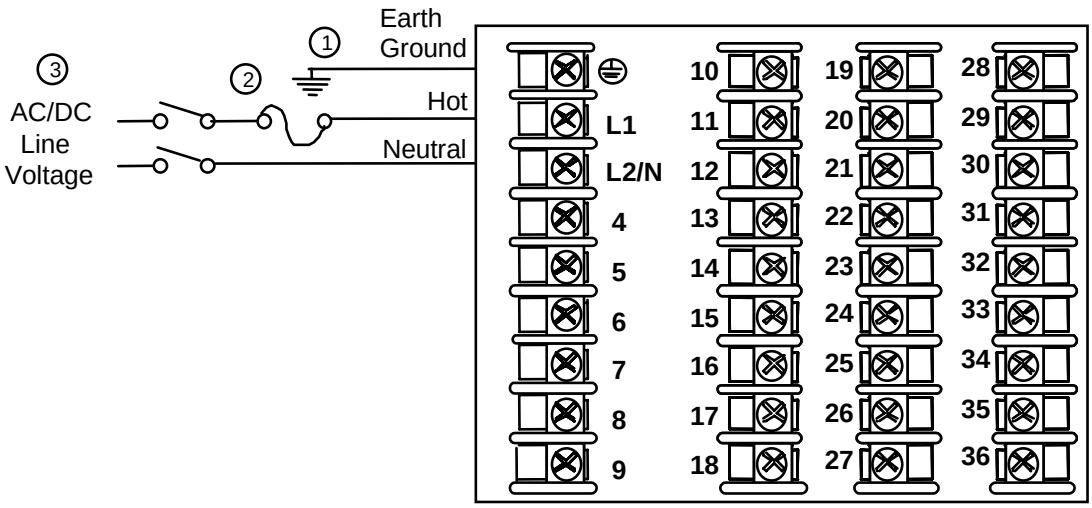
Using the information contained in the model number, select the appropriate wiring diagrams from the composite wiring diagram below. Refer to the individual diagrams listed to wire the controller according to your requirements.



See table for callout details

Figure 1 Composite Wiring Diagram

Callout	Details
1	AC/DC Line Voltage Terminals. See Figure-2.
2	First Current Output Terminals. See Figure -9.
3	Output 2 Option Terminals. See Figure -11 through Figure 16.
4	Input #1 Terminals. See Figure **-3**.
5	Input #2 Terminals. See Figure -4. Dual HLAI Inputs #2 and #4 Terminals. See Figure -6 and Figure **-8**.
6	Input #3 Terminals. See Figure **-5**. Dual HLAI Inputs #3 and #5 Terminals. See Figure -7 and Figure **-8**.
7	Digital Inputs Terminals. See Figure 19.
8	Optional Relays Terminals (Relays 3, 4 and 5). See Figure -20.
9	Optional Interface Second Current Output Terminals. See Figure **-10**. RS-485 Communications Terminals. See Figure **-17**. Ethernet Communications Terminals. See Figure -18.



① PROTECTIVE BONDING (grounding) of this controller and the enclosure in which it is installed, shall be in accordance with National and local electrical codes. To minimize electrical noise and transients that may adversely affect the system, supplementary bonding of the controller enclosure to local ground using a No. 12 (4 mm^2) copper conductor is recommended. Before powering the controller, see "Prelimnary Checks" in this section of the Product Manual.

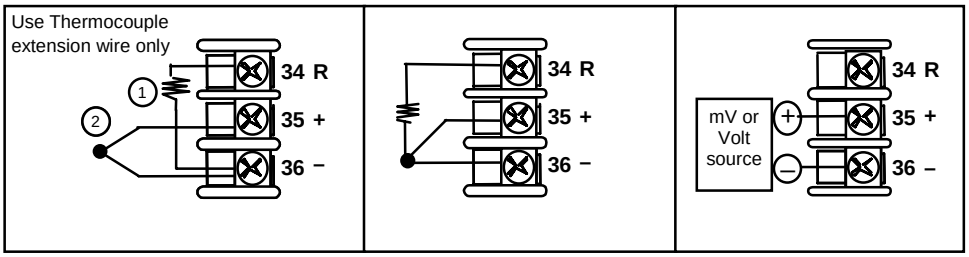
② It is the user's responsibility to provide a switch and non-time delay (North America), quick-acting, high breaking capacity, Type F (Europe), 1/2A, 250V fuse(s), or circuit-breaker for 90-264 Vac applications; or 2 A, 125 V fuse or circuit breaker for 24 Vac/dc applications, as part of the installation.

③ **CAUTION** **Applying 90-264 Vac to an instrument rated for 24 Vac/dc will severely damage the instrument and is a fire and smoke hazard.**

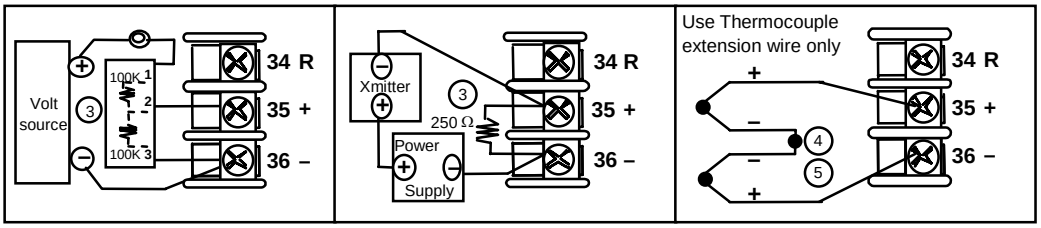
Figure-2 Mains Power Supply

Input #1

Thermocouple **RTD** **Carbon, Oxygen, Millivolt or Volts except 0 to 10 Volts or –1 to 1 Volts**



0-10 Volts or –1 to 1 Volts **Milliamps** **Thermocouple Differential**



(1) Remove the "R" terminal screw and install the C/J Sensor in its place. Connect the tang to the "–" terminal.

(2) This controller does not produce a steady current for burnout detection. For that reason, when a thermocouple is used in parallel with another instrument, it may be desirable to configure the burnout selection for this controller to "NOFS" and use the burnout current from the other instrument to also drive this controller. The Failsafe Output must be set to ensure proper operation when the thermocouple fails.

(3) The 250 ohm resistor for milliamp inputs or the voltage divider for 0 to10 Volt or –1 to 1Volt inputs are supplied with the controller when those inputs are specified. These items must be installed prior to start up when the controller is wired. For 0-20 mA, -1 to 1 Volt and 0-10 Volt applications, the resistor should be located at the transmitter terminals if Burnout detection is desired.

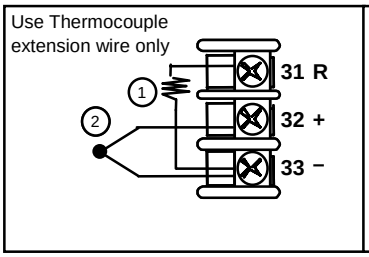
(4) Splice and tape this junction between the two thermocouples. This junction may be located anywhere between the thermocouples and the instrument terminals, it does not need to be close to the other thermocouple junctions. Both thermocouples must be of the same type. For the highest accuracy, the thermocouples should be matched or, preferably, made from the same batch of wire.

(5) The millivolt values for the Thermocouple Differential Input are for a pair of J thermocouples at an ambient temperature mean of 450°F / 232°C. Cold Junction Compensation is not required for this input type.

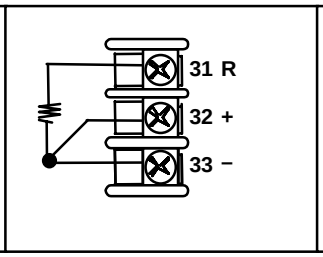
Figure -3 Input 1 Connections

Input #2

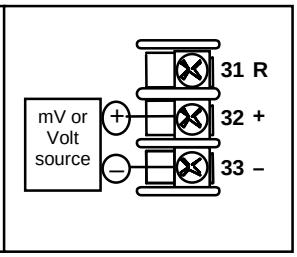
Thermocouple



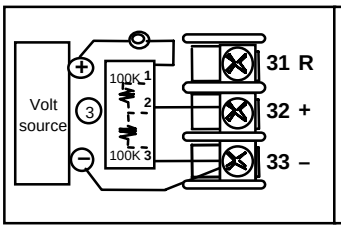
RTD



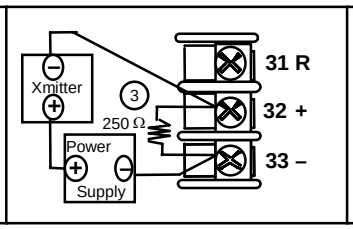
Millivolt or Volts except 0 to 10 Volts or –1 to 1 Volts



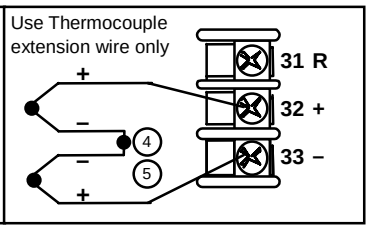
0-10 Volts or –1 to 1 Volts



Milliamps



Thermocouple Differential



(1) Remove the "R" terminal screw and install the C/J Sensor in its place. Connect the tang to the "–" terminal.

(2) This controller does not produce a steady current for burnout detection. For that reason, when a thermocouple is used in parallel with another instrument, it may be desirable to configure the burnout selection for this controller to "NOFS" and use the burnout current from the other instrument to also drive this controller. The Failsafe Output must be set to ensure proper operation when the thermocouple fails.

(3) The 250 ohm resistor for milliamp inputs or the voltage divider for 0 to10 Volt or –1 to 1Volt inputs are supplied with the controller when those inputs are specified. These items must be installed prior to start up when the controller is wired. For 0-20 mA, -1 to 1 Volt and 0-10 Volt applications, the resistor should be located at the transmitter terminals if Burnout detection is desired.

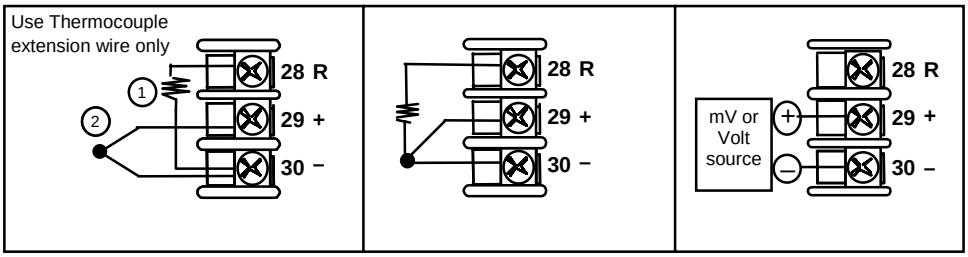
(4) Splice and tape this junction between the two thermocouples. This junction may be located anywhere between the thermocouples and the instrument terminals, it does not need to be close to the other thermocouple junctions. Both thermocouples must be of the same type. For the highest accuracy, the thermocouples should be matched or, preferably, made from the same batch of wire.

(5) The millivolt values for the Thermocouple Differential Input are for a pair of J thermocouples at an ambient temperature mean of 450°F / 232°C. Cold Junction Compensation is not required for this input type.

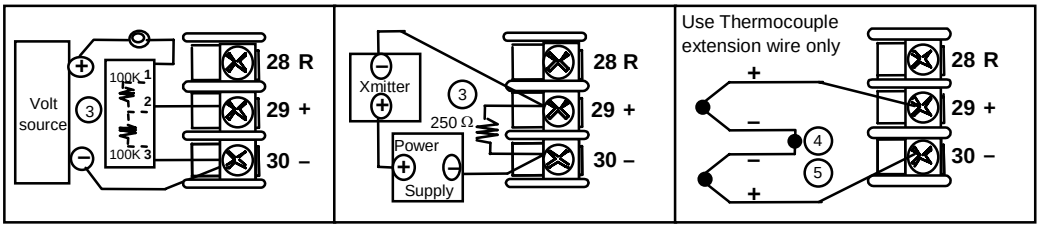
Figure -4 Input 2 Connections

Input #3

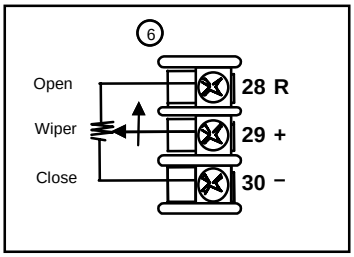
Thermocouple | **RTD** | **Millivolt or Volts except 0 to 10 Volts or –1 to 1 Volts**



0-10 Volts or –1 to 1 Volts | **Milliamps** | **Thermocouple Differential**



Slidewire Input
(for Position Proportional Control or Three Position Step Control)



(1) Remove the "R" terminal screw and install the C/J Sensor in its place. Connect the tang to the "–" terminal.

(2) This controller does not produce a steady current for burnout detection. For that reason, when a thermocouple is used in parallel with another instrument, it may be desirable to configure the burnout selection for this controller to "NOFS" and use the burnout current from the other instrument to also drive this controller. The Failsafe Output must be set to ensure proper operation when the thermocouple fails.

(3) The 250 ohm resistor for milliamp inputs or the voltage divider for 0 to10 Volt or –1 to 1Volt inputs are supplied with the controller when those inputs are specified. These items must be installed prior to start up when the controller is wired. For 0-20 mA, -1 to 1 Volt and 0-10 Volt applications, the resistor should be located at the transmitter terminals if Burnout detection is desired.

(4) Splice and tape this junction between the two thermocouples. This junction may be located anywhere between the thermocouples and the instrument terminals, it does not need to be close to the other thermocouple junctions. Both thermocouples must be of the same type. For the highest accuracy, the thermocouples should be matched or, preferably, made from the same batch of wire.

(5) The millivolt values for the Thermocouple Differential Input are for a pair of J thermocouples at an ambient temperature mean of 450°F / 232°C. Cold Junction Compensation is not required for this input type.

(6) Input 3 is used to measure the Slidewire Input for Position Proportional Control.

Figure -5 Input 3 Connections

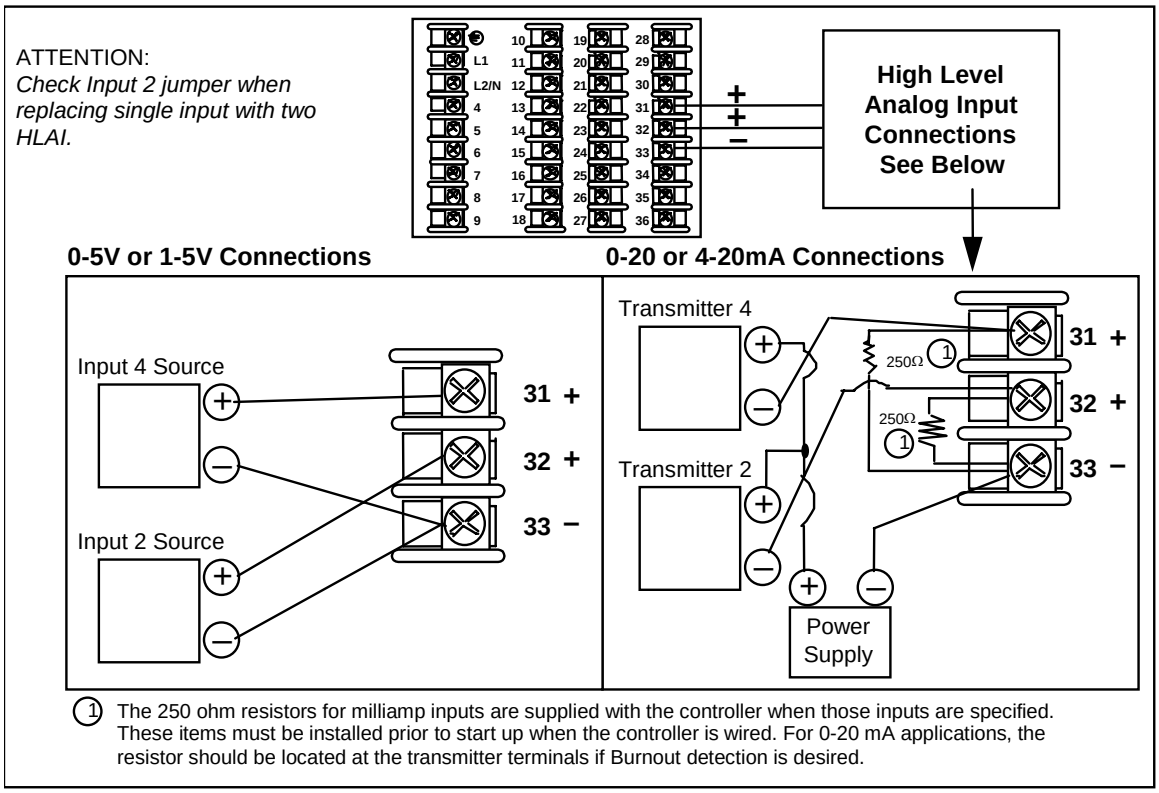


Figure -6 HLAI Inputs 2 and 4

See Figure -8 for Jumper Positions.

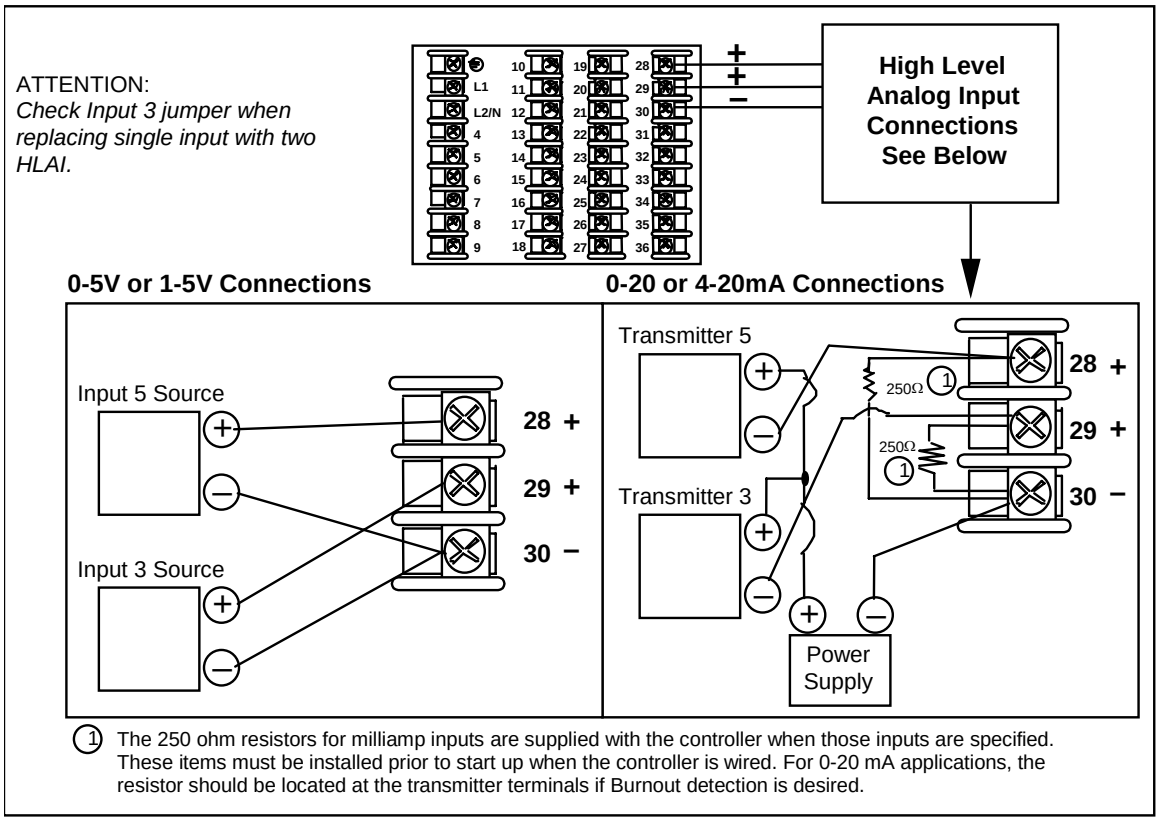
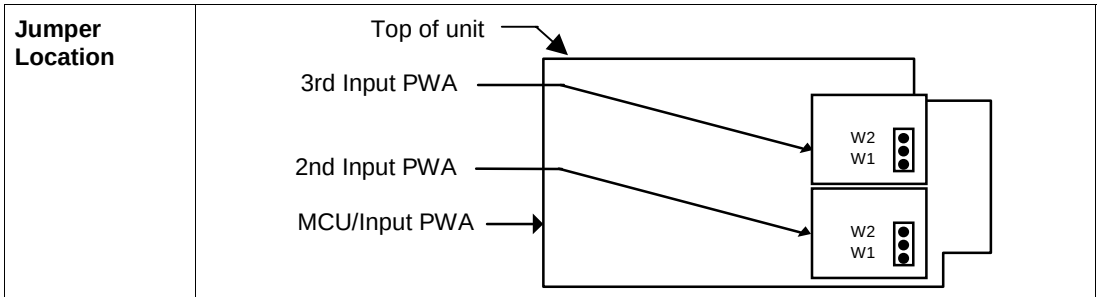


Figure -7 HLAI Inputs 3 and 5

See Figure -8 for Jumper Positions.



Jumper Position	**W1 Single Input**	**W2 Two HLAI**
Input Types Available	Thermocouple, RTD, Volt, Millivolt, Milliamp, Radiamatic and (Input 3 only) Slidewire	2nd Input becomes HLAI Inputs 2 & 4 3rd Input becomes HLAI Inputs 3 & 5

Figure -8 Optional Analog Input Jumper Positions

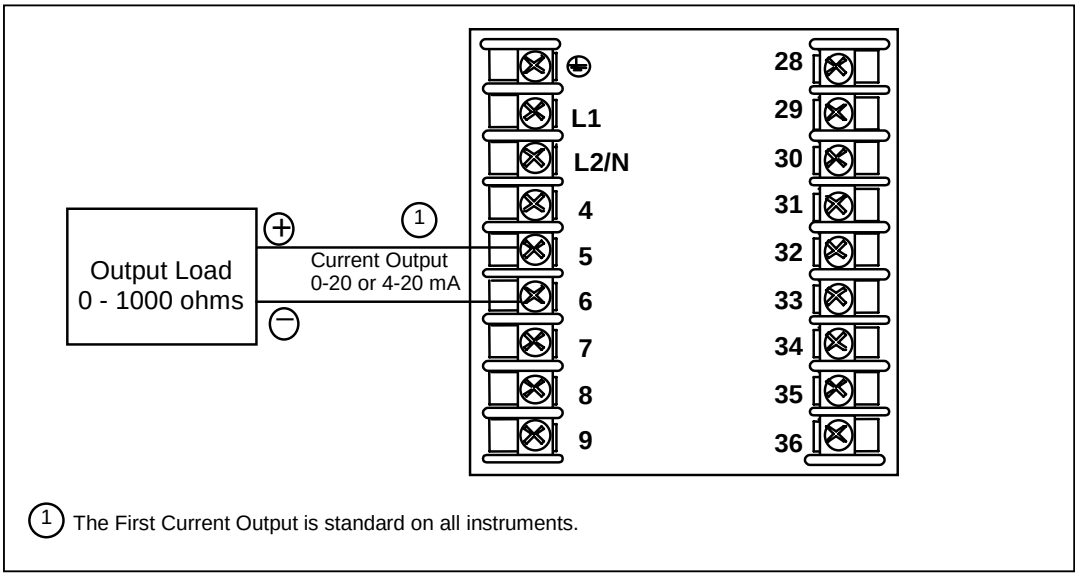


Figure -9

See Table **-1** and Table -2 for other information about output types.

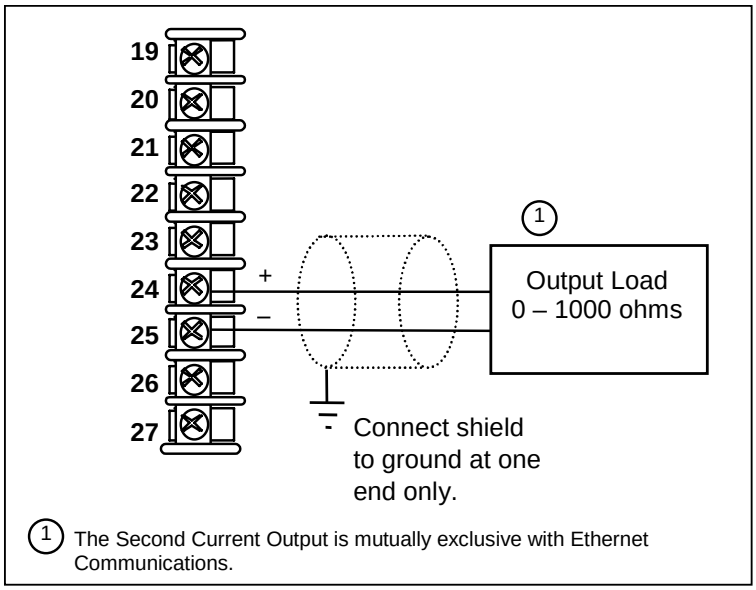
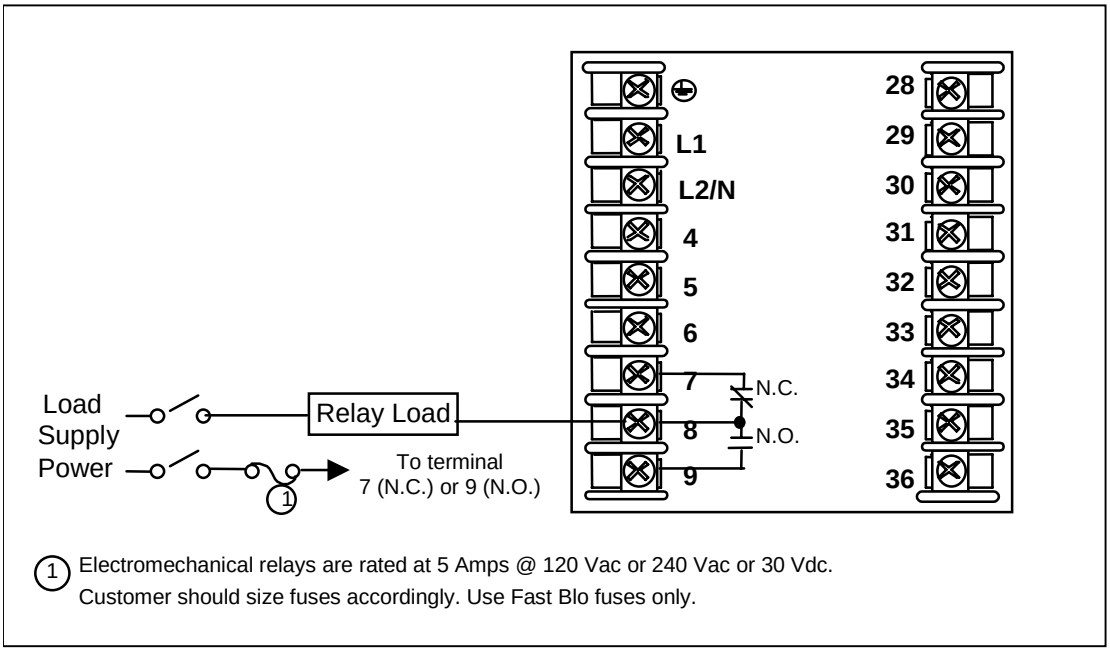


Figure -10 Second Current Output

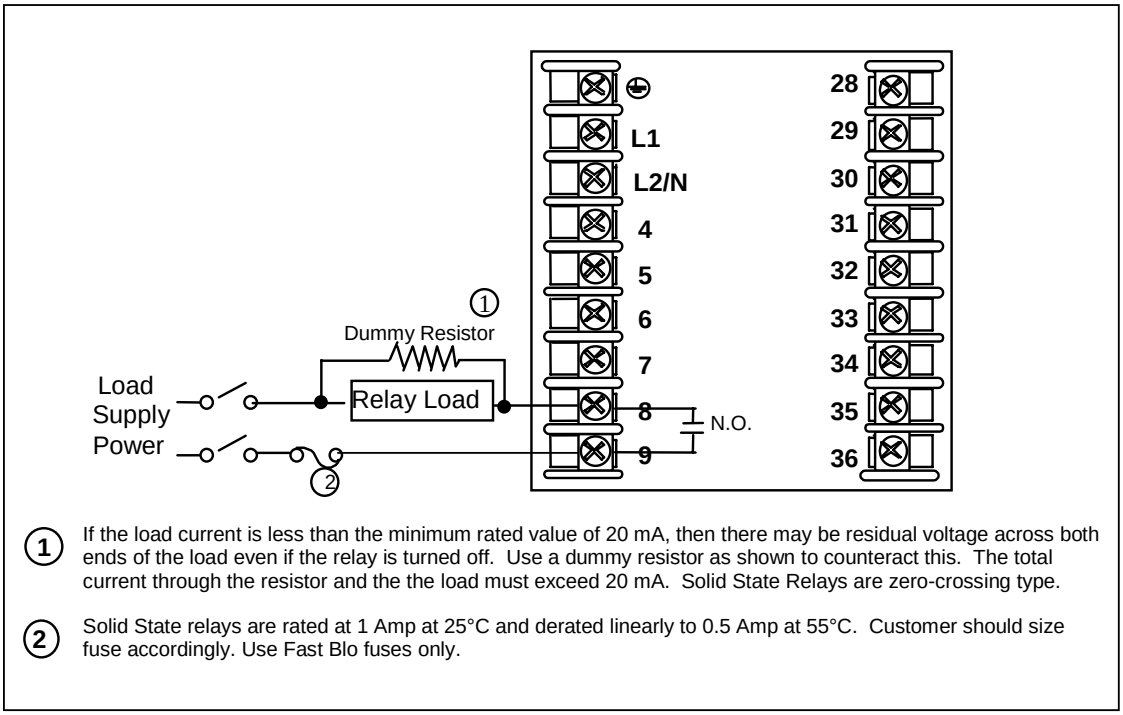
See Table **-1** and Table -2 for other information about output types.



1 Electromechanical relays are rated at 5 Amps @ 120 Vac or 240 Vac or 30 Vdc. Customer should size fuses accordingly. Use Fast Blo fuses only.

Figure -11 Output #2 – Electromechanical Relay Output

See Table -**1** and Table -2 for other information about output types.



1 If the load current is less than the minimum rated value of 20 mA, then there may be residual voltage across both ends of the load even if the relay is turned off. Use a dummy resistor as shown to counteract this. The total current through the resistor and the the load must exceed 20 mA. Solid State Relays are zero-crossing type.

2 Solid State relays are rated at 1 Amp at 25°C and derated linearly to 0.5 Amp at 55°C. Customer should size fuse accordingly. Use Fast Blo fuses only.

Figure -12 Output #2 – Solid State Relay Output

See Table -**1** and Table -2 for other information about output types.

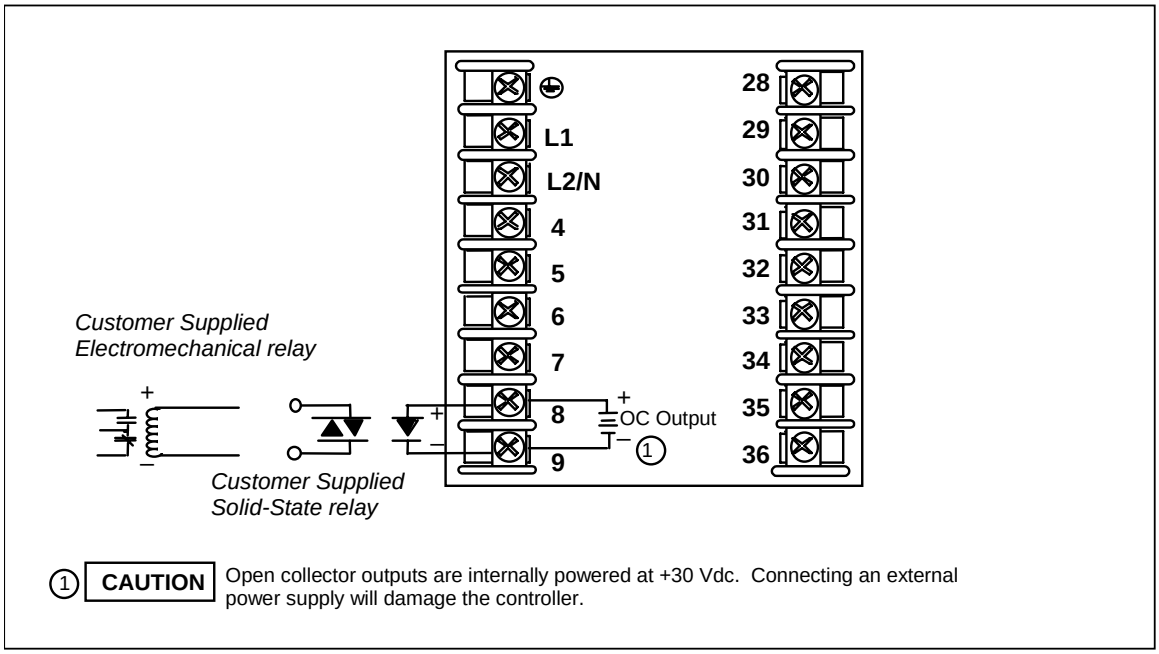


Figure -13 Output #2 – Open Collector Output

See Table **-1** and Table -2 for other information about output types.

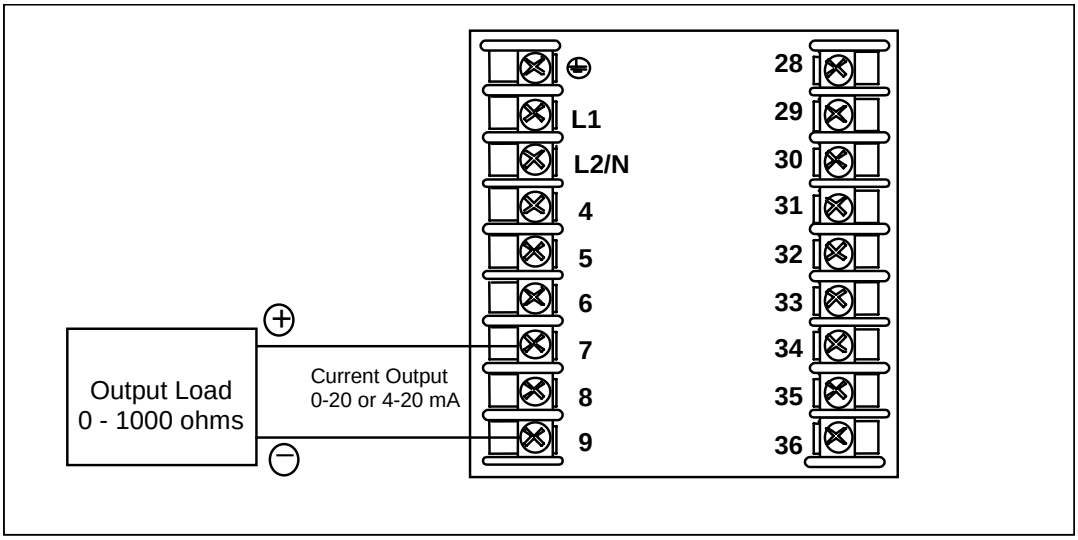


Figure -14 Output #2 – Third Current Output

See Table **-1** and Table -2 for other information about output types.

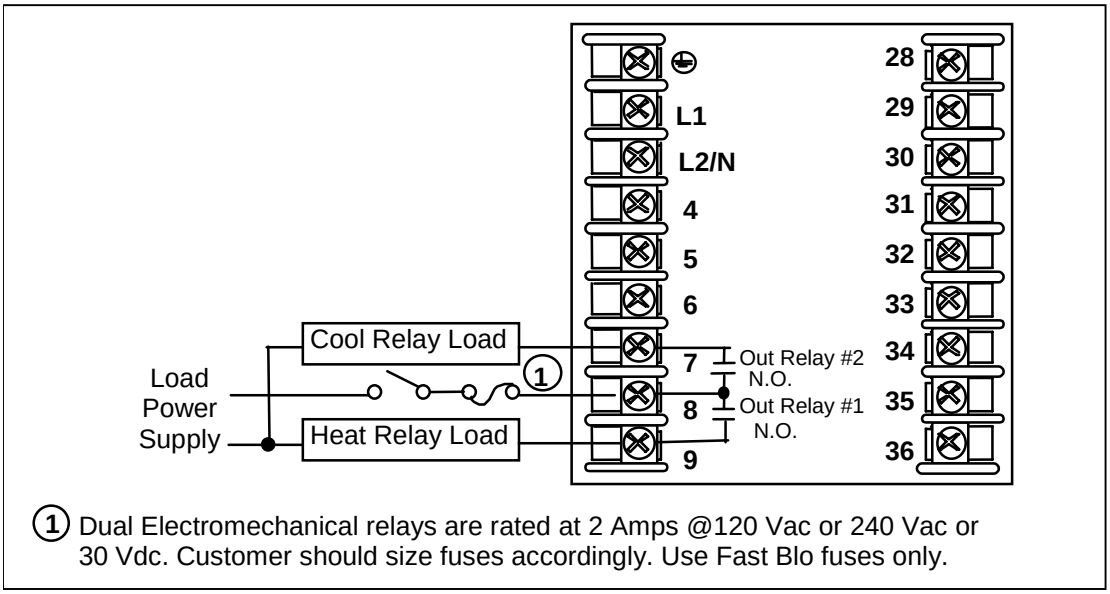


Figure 15 Output #2 – Dual Relay Output for Time Duplex

See Table -**1** and Table -2 for other information about output types.

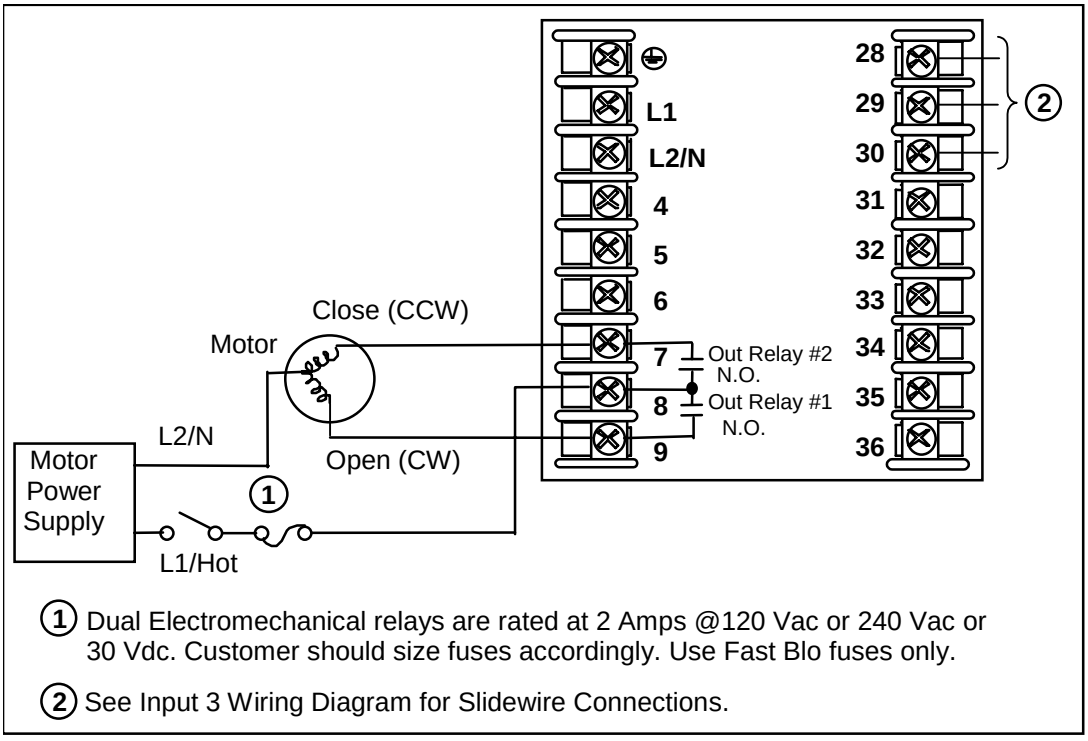


Figure 16 Output #2 – Dual Relay Output for Position Proportional or Three Position Step Control

See Table -**1** and Table -2 for other information about output types.

See Figure -5 for Slidewire connections.

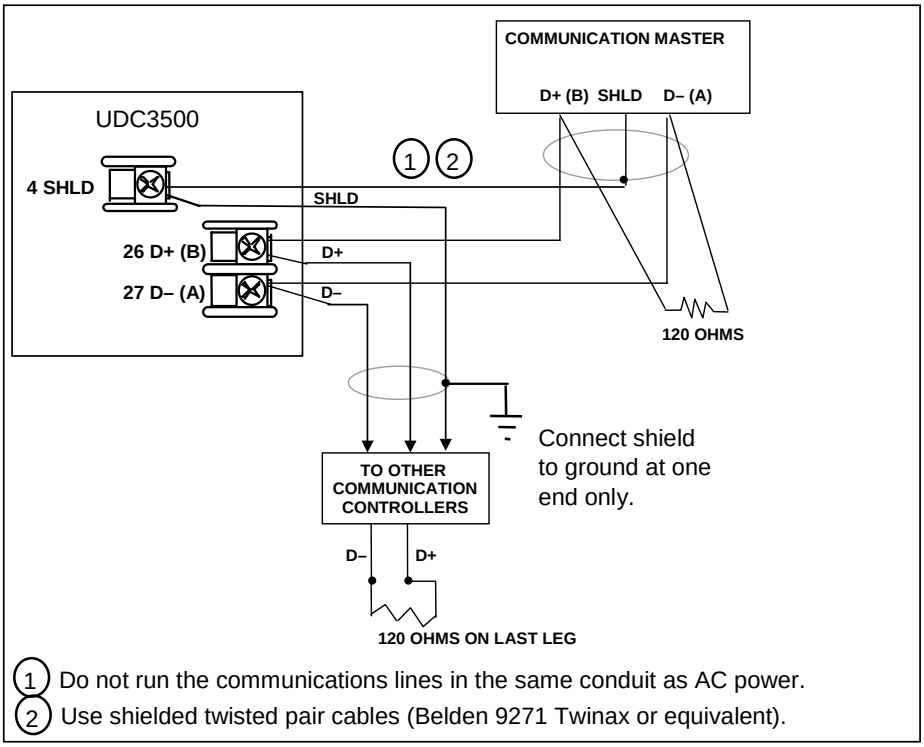


Figure -17 RS-422/485 Communications Option

RS-422/485 connections must be “daisy-chained,” T-drop connections are not allowed.

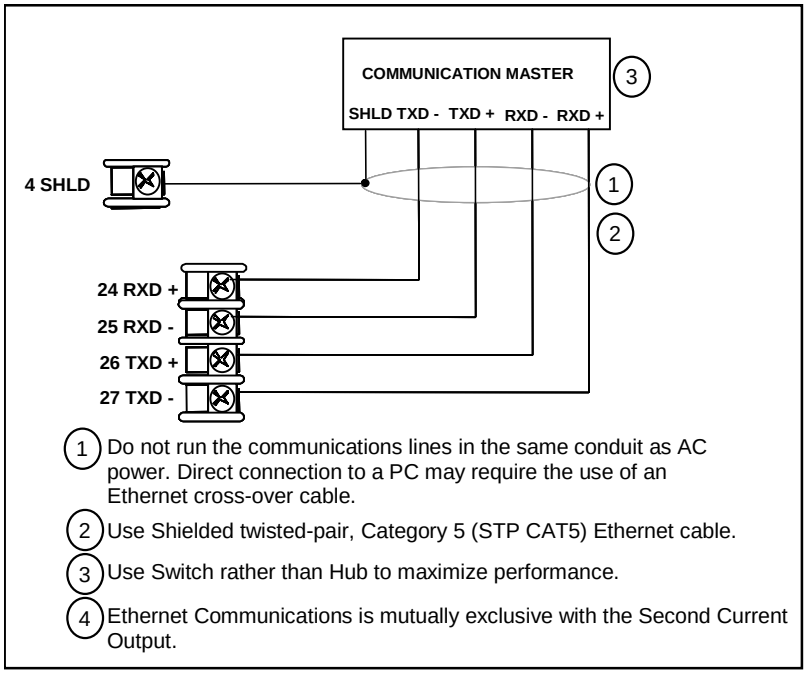


Figure -18 Ethernet Communications Option

Figure -18 and Table -3 shows how to connect a UDC to a MDI Compliant Hub or Switch utilizing a **straight-through cable** or for connecting a UDC to a PC utilizing a **crossover cable**.

Table -3 Terminals for connecting a UDC to a MDI Compliant Hub or Switch utilizing a cross-over cable

UDC Terminal	UDC Signal Name	RJ45 Socket Pin #	Switch Signal Name
Position 4	Shield	Shield	Shield
Position 24	RXD-	6	TXD-
Position 25	RXD+	3	TXD+
Position 26	TXD-	2	RXD-
Position 27	TXD+	1	RXD+

Table -4 shows how to connect a UDC directly to a PC utilizing a straight-through cable (wiring the UDC cable this way makes the necessary cross-over connections)

Table -4 Terminals for connecting a UDC directly to a PC utilizing a straight-through cable

UDC Terminal	UDC Signal Name	RJ45 Socket Pin #	PC Signal Name
Position 4	Shield	Shield	Shield
Position 24	RXD-	2	TXD-
Position 25	RXD+	1	TXD+
Position 26	TXD-	6	RXD-
Position 27	TXD+	3	RXD+

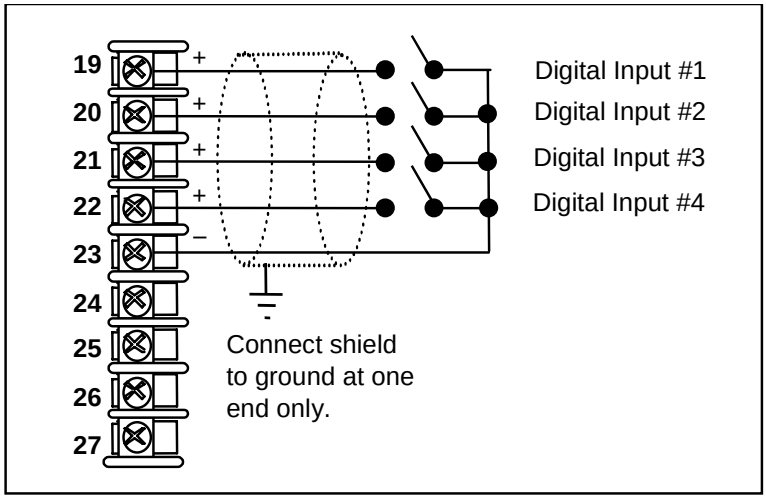


Figure 19 Digital Inputs

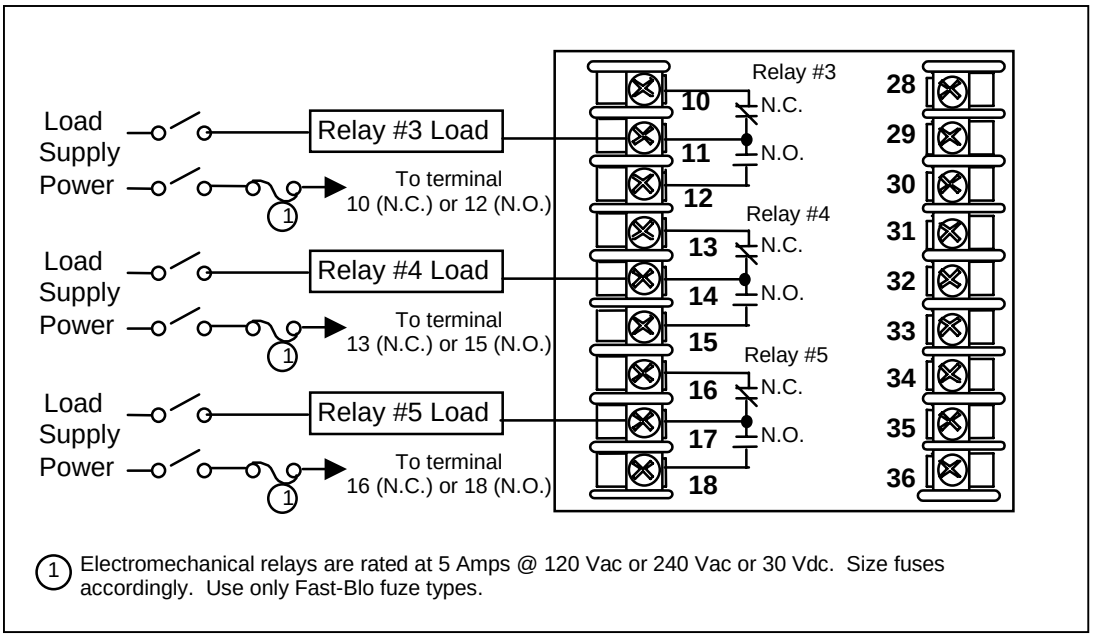


Figure -20 Optional Electromechanical Relay Outputs

See Table **-1** and Table -2 for other information about output types.

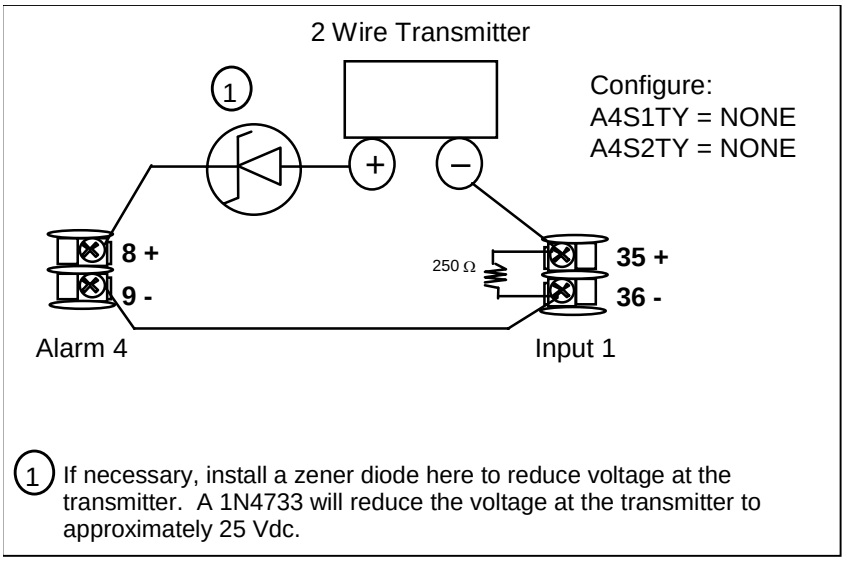


Figure 21 Transmitter Power for 4-20 mA — 2 wire Transmitter Using Open Collector Output