◢ PEAKTRONICS

DMC-102

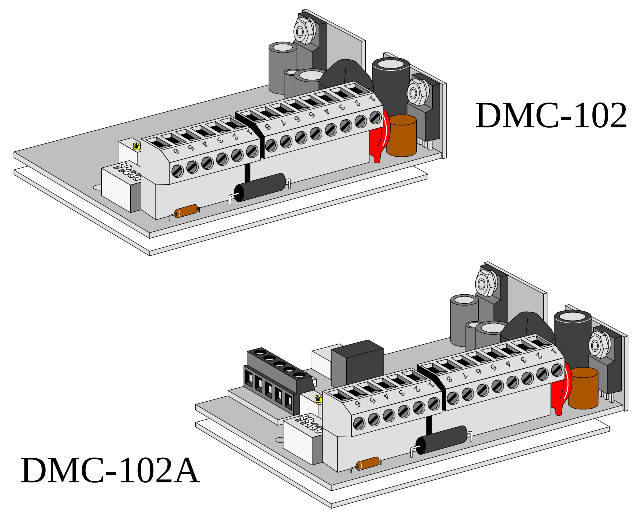
DC Motor Controllers

The Peaktronics DMC-102 DC Motor Controllers are used for proportional positioning of actuators that use either DC motors or DC solenoids. The wide operating range of the DMC-102 (10 to 30 VDC and loads up to 10A continuous or 60A locked rotor) allows operation in a variety of actuator applications. An external command signal of 0-5V, 0-10V, 1-5V, 2-10V, or 4-20mA can be used to compare to a feedback signal from a potentiometer. The MOTOR 1 or MOTOR 2 output will energize, which powers the actuator motor or solenoids, until the feedback signal matches the command signal, at which time the controller's motor output is turned off and the actuator stops.

When using a 1-5V, 2-10V, or 4-20mA command signal, the unit detects a loss of command signal and can be configured to respond in one of three ways: fail in place, move to the zero position, or move to the span position. The non-interactive Zero and Span trimmers can be set to any position within the useable range of the feedback potentiometer. This allows the unit to be calibrated for direct or reversing acting applications without any rewiring.

The unit has a selectable *log rate* feature that prevents continuous modulating applications from over heating the actuator motor. In this mode, the desired position is approached logarithmically by continuously varying duty cycle. The unit also has a current trip feature to protect the motor outputs from damage from excessive loads.

All input and output options are easily set using the on-board DIP switches. The unit has on-board LED indicators to indicate a variety of conditions: motor output on, limit switch reached, feedback signal out of range, low battery voltage, and battery over voltage.

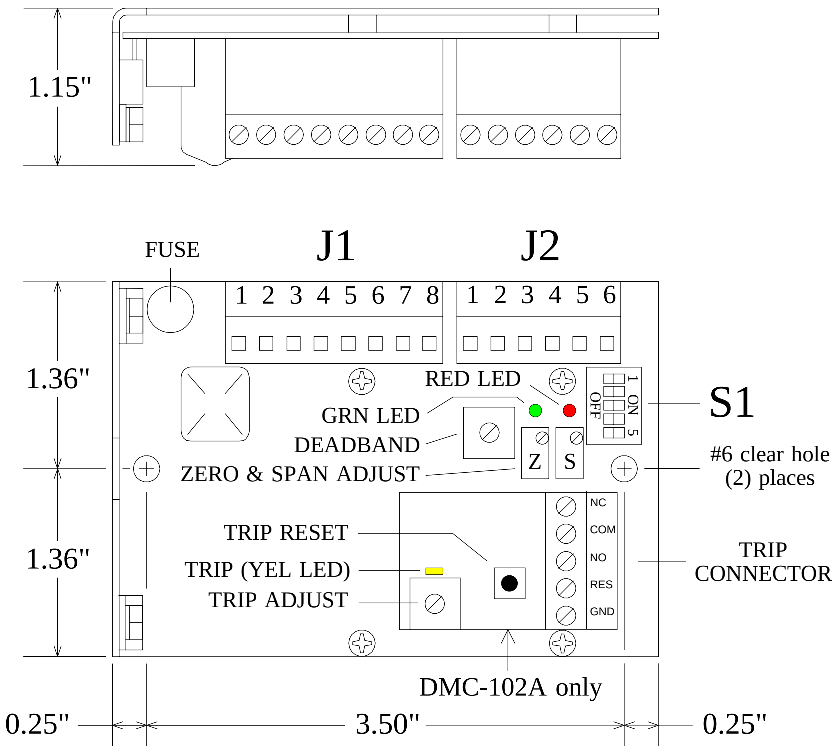


The DMC-102 has a fixed current trip threshold of 12A. The DMC-102A has an adjustable current trip feature (adjustable from 0 to 12A) that is useful for limiting torque to the load or to protect motors that have less than 12A locked rotor current. The DMC-102A also has a yellow LED trip indicator and a set of form-C contacts that can be used to power external alarms or lights.

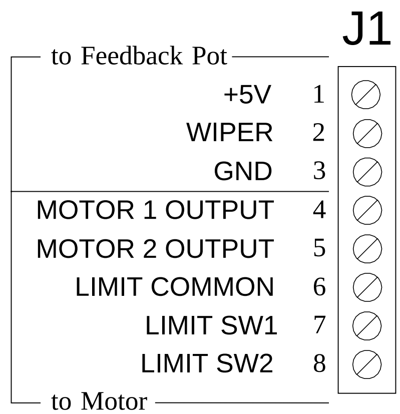
ADDITIONAL FEATURES

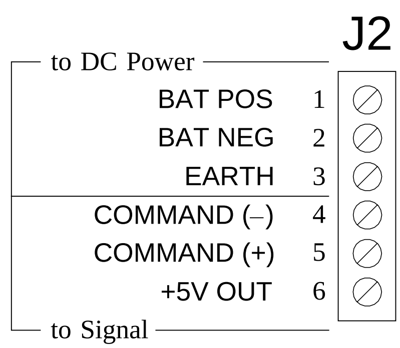
- **Electronic Brake** feature can eliminate mechanical brake.
- **Electronic Surge Limiting** reduces wire size and battery/power supply requirements to 20% of locked rotor current.
- Low standby current (38mA typical) when actuator is not in operation.
- Multiple units are easily connected in parallel to a common command signal.

OUTLINE



ELECTRICAL CONNECTIONS





S1

COMMAND INPUT SIGNAL CONFIGURATION

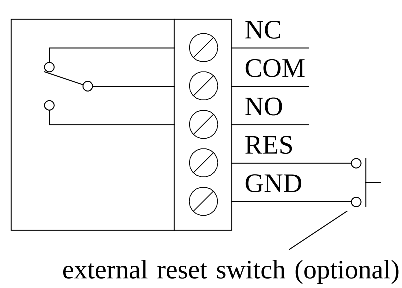
COMMAND TYPE	SW1	SW2	SW3	SW4	LOSS OF COMMAND OPERATION
4-20mA	ON	ON	ON	ON	Motor off
			ON	OFF	Close (Zero setting)
			OFF	ON	Open (Span setting)
1-5V	OFF	ON	ON	ON	Motor off
			ON	OFF	Close (Zero setting)
			OFF	ON	Open (Span setting)
2-10V	OFF	OFF	ON	ON	Motor off
			ON	OFF	Close (Zero setting)
			OFF	ON	Open (Span setting)
0-5V	OFF	ON	OFF	OFF	NA
0-10V	OFF	OFF	OFF	OFF	NA

NOTE: All other settings are not valid and can cause abnormal operation.

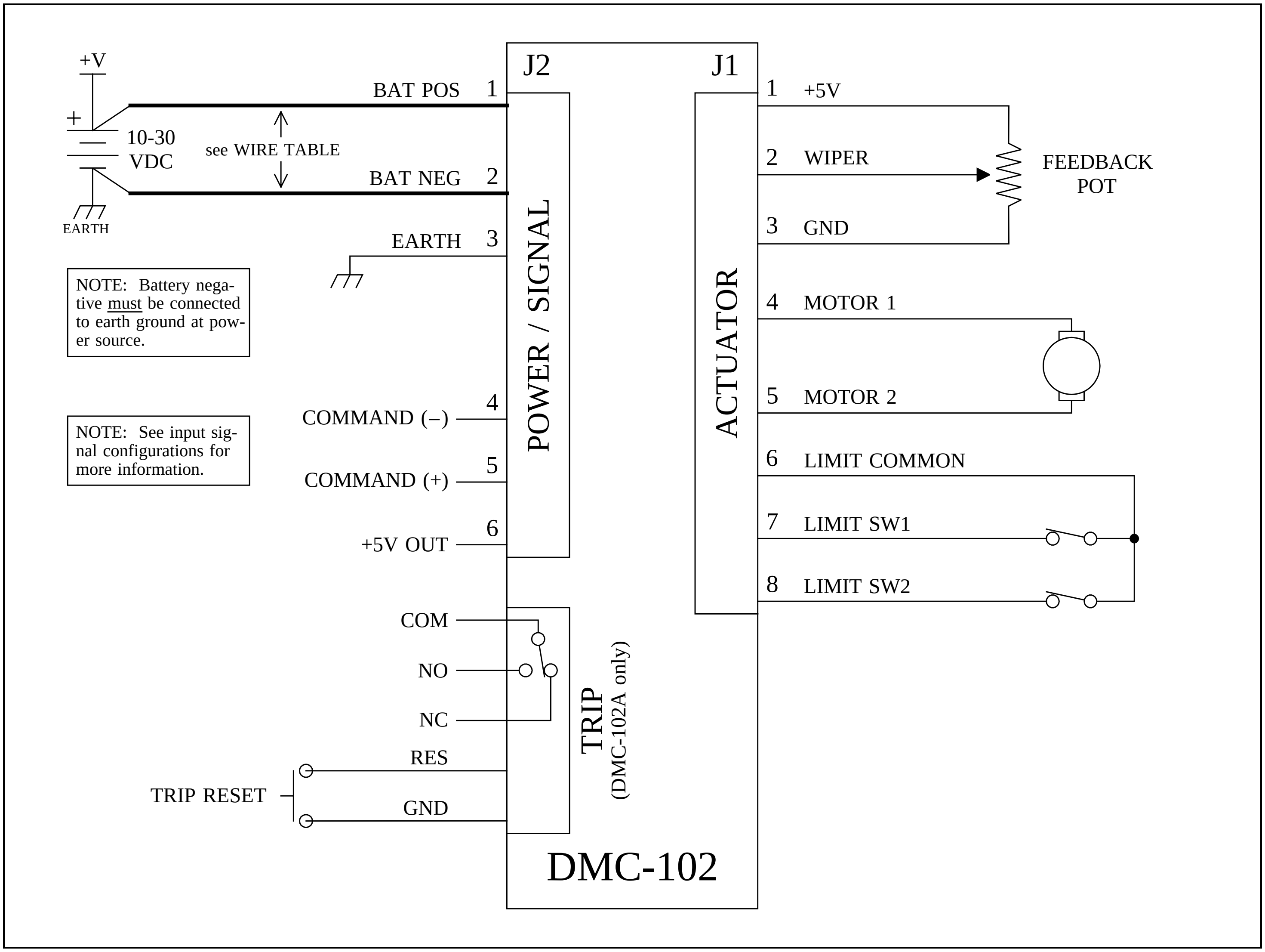
CONTROL FUNCTION	SW5
Calibrate/Normal	OFF
Log Rate	ON

TRIP CONNECTOR

(DMC-102A only)



BLOCK DIAGRAM



DESCRIPTION

The DMC-102 is rated for motors with up to 60A locked rotor or 10A running currents and has an operating voltage range from 10VDC to 30VDC. The unit is easily mounted with 2 screws and is equipped with removable screw terminals that provide for easy field wiring. The unit's size and mounting allows easy upgrade to a DHC-400 high resolution controller.

The DMC-102A includes an adjustable current trip feature and connections for an external *trip reset* switch and a form-C contact output. The DMC-102 has a fixed current trip setting of 12A (that protects the unit from excessive loads) which can be reset by reversing the motor direction. The DMC-102A can also be reset this way.

POWER / SIGNAL (J2)

The positive terminal of the DC power source is connected to pin 1 while the negative terminal connects to pin 2. When the DMC-102 is mounted to a metal bracket or directly to the actuator case, pin 3 provides a terminal for an earth ground connection to the actuator body. In applications where the actuator body is non-metallic or is electrically isolated from earth ground, pin 3 must be connected to earth ground to prevent static voltage buildups.

Transferring DC power can be inefficient, therefore care should be taken to use appropriate wire sizes. The size wire required depends on the locked rotor motor current and the length of wire to be used. See the Wire Table for more information.

An appropriate command signal, either 0-5V, 0-10V, 1-5V, 2-10V, or 4-20mA, should be connected to pin 5 (as shown in the Block Diagram) while using pin 4 as the return *signal ground*. See Wiring Diagrams, Input Configurations, for wiring details. The DMC-102 must be configured for the type of command signal that is to be used (see COMMAND CONFIGURATION (S1)).

Pin 6 provides an auxiliary +5V output which can be used to connect a command potentiometer. By connecting one end of a potentiometer to pin 6, the other end to pin 4, and the wiper to pin 5, a local control knob can be implemented. Pin 4 will also need to be connected to pin 2 (BAT NEG) for this application.

ACTUATOR (J1)

The actuator motor and feedback potentiometer are connected to J1 as shown in the Block Diagram. The feedback potentiometer wiper must be connected to pin 2 (WIPER), while one end is connected to pin 1 (+5V) and the other end to pin 3 (GND). Pins 1 and 3 should be connected so that the voltage on the WIPER (in respect to GND) increases toward 5V when pin 4 (MOTOR 1) is positive. Conversely, the voltage on the WIPER should decrease toward 0V when pin 5 (MOTOR 2) is positive.

Since the feedback potentiometer is crucial for proper operation of the DMC-102, the following items should be carefully observed:

1 - Potentiometer resistance should be a value of 1K.

2 - The potentiometer should be a linear taper type.

3 - The potentiometer must be properly wired to provide the correct feedback signal.

4 - The potentiometer must be properly and securely mounted in order to provide a reliable feedback signal.

Many actuators include limit switches that are used to turn off the motor when the extreme ends of travel have been reached. Limit switches should be wired to pins 6, 7, and 8 as shown in the Block Diagram. If limit switches are not used, pins 7 and 8 must be connected to pin 6 (note, if pins 7 and 8 are not connected to pin 6, the DMC-102 will not be able to control the motor outputs).

As long as pin 7 (LIMIT SW1) is connected to pin 6 (LIMIT COMMON), the DMC-102 will connect MOTOR 1 to BAT POS (J2-1) and MOTOR 2 to BAT NEG (J2-2) to move the actuator in a direction that increases the WIPER toward 5V. Likewise, as long as pin 8 (LIMIT SW2) is connected to LIMIT COMMON, MOTOR 2 is connected to BAT POS and MOTOR 1 to BAT NEG to move the actuator in a direction that decreases the WIPER toward 0V. Since pins 4 and 5 are alternately connected to BAT POS and BAT NEG, care should be taken not to connect the motor output pins to any other terminals.

The DMC-102 provides a dynamic braking feature that can eliminate the need for a separate brake. When the DMC-102 turns off the motor outputs, pins 4 and 5 are internally connected to BAT NEG (J2-2); this has the effect of shorting the motor leads together, thus braking the motor motion. When power is removed from the DMC-102, the electronic braking feature is disabled. In some applications, a brake is required for mechanical reasons, such as avoiding back driving the motor. The DMC-102 is suitable for powering most brakes, however, consult the actuator manufacturer for more information.

COMMAND CONFIGURATION (S1)

In order to control the DMC-102, the five switches in the S1 switch bank (see OUTLINE), must be set for the desired *command type*, *loss of command* operation, and for *calibrate/normal* or *log rate* operation. To avoid adverse operation, the switches should be set prior to applying power to the unit.

A *zero* command signal (0V, 1V, 2V, or 4mA) is associated with the position set by the ZERO adjustment, while the *span* command signal (5V, 10V, or 20mA) is associated with the position set by the SPAN adjustment - see CALIBRATION for details. A *zero* signal is usually used to Close a valve, and the *span* signal is used to Open the valve - this is referred to as **Direct Acting**. However, some applications may require the opposite operation, which is referred to as **Reverse Acting**. The ZERO and SPAN adjustments can be set to any position within the feedback potentiometer's range, so Reverse Acting applications do not require wiring changes except when using an XMA-105 Feedback Transmitter.

When using a 1-5V, 2-10V, or 4-20mA command signal, the DMC-102 detects when the command signal is lost or disconnected. The unit can be configured to respond to a Loss of Command in one of three ways: turn the motor off (leaving the actuator in its last position at the time signal was lost), move the actuator to the position set by the *zero* adjustment, or move the actuator to the position set by the *span* adjustment. <u>Do not</u> set both SW3 and SW4 to their "off" positions for these command types. When using a 0-5V or 0-10V command signal, the unit <u>cannot</u> detect a loss of command, and both SW3 and SW4 <u>must</u> be set to their "off" positions.

SW5 is used to set the unit for either *calibrate/normal* operation or *log rate* operation. In applications where the PID control signal is not stable or causes the actuator to constantly move to achieve a desired position, the *log rate* operation may be desirable. By averaging rapidly changing input signals, the *log rate* operation approaches position logarithmically by continuously varying duty cycle. This has the effect of extending the actuator process time to 75 seconds. *Log rate* operation is also useful in reducing water hammer.

INDICATORS and FAULT CONDITIONS

The on-board green and red LED indicators provide the user with information about various conditions about the actuator. The table below provides a summary of the indications which is followed by a description of each condition.

GRN	RED	CONDITION
-	ON	MOTOR 1 on (+)
ON	-	MOTOR 2 on (+)
-	flash	LIMIT SW1 disconnected
flash	-	LIMIT SW2 disconnected
blink	OFF	Feedback WIPER < 0.25V
OFF	blink	Feedback WIPER > 4.75V
blink	blink	Low Battery Voltage
ON	ON	Overvoltage

Motor Output ON - When conditions are normal, the red LED indicator turns on when the MOTOR 1 output is positive, and the green LED turns on when the MOTOR 2 output is positive. For **Direct Acting** applications, the red LED indicates when the actuator is moving toward *open*, and conversely, for **Reverse Acting** applications, the red LED indicates when the actuator is moving toward *closed*.

Limit Switch - Many actuators are equipped with limit switches at the *open* and *closed* positions which are intended to disconnect power to the motor to prevent mechanical damage. The actuator's limit switches should be set outside of the operating range set by *zero* and *span*. Limit switches exhibit wide variations, and the DMC-102 can position the actuator more precisely than the limit switches. A limit switch serves better as a failsafe device. When LIMIT SW1 disconnects J1 pin 7 from J1 pin 6, the red LED will flash and power to the MOTOR 1 output is disabled. Likewise, when LIMIT SW2 disconnects J1 pin 8 from J1 pin 6, the green LED will flash and power to the MOTOR 2 output is disabled.

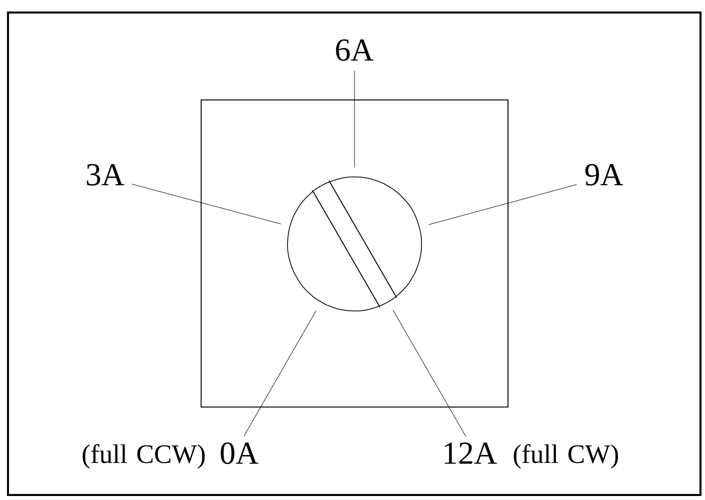
Feedback Signal Out of Range - The DMC-102 detects when the feedback potentiometer signal is out of range. If the voltage at the WIPER exceeds 4.75V, the MOTOR 1 output is disabled, the green LED is turned off, and the red LED will blink on and off. If the WIPER voltage is less than 0.25V, the MOTOR 2 output is disabled, the red LED turns off, and the green LED blinks.

Low Battery Voltage and **Overvoltage -** The DC power connected to J2 pins 1 and 2 are monitored continuously. If the voltage drops below 10V, the motor outputs are disabled and both LED's will blink on and off to indicate a Low Battery Voltage condition. The motor will remain off, and the LED's will blink, for 3 seconds after power returns to 10V or more. If the voltage exceeds 30V for more than 1 second, the motor outputs are disabled and both LED's will turn on to indicate an Overvoltage condition. The motor and LED's resume normal operation when power returns to 30V or less.

TRIP SETTING

The DMC-102 monitors the motor current and turns off the motor when the motor current exceeds 12A. The motor remains off until the actuator is commanded to move in the opposite direction from the one that caused the current trip condition.

For actuators using smaller motors that draw less than 12A stall current, it may be desirable to use the DMC-102A unit which allows the trip current to be adjusted. The **Trip Setting** is also useful for limiting the torque applied to the actuator's load. The DMC-102A also has a yellow LED to indicate a trip condition and an isolated set of form-C contacts for use by an external device. The TRIP ADJUST pot sets the **Trip Setting** as shown below. See OUTLINE and BLOCK DIAGRAM for more information.



The setting should be adjusted to a comfortable level above the running current expected for the actuator and its load. When the motor current exceeds the **Trip Setting**, the motor is turned off, the yellow LED is turned on, and the form-C contact switches.

While the **Electronic Surge Limiting** feature of the DMC-102 and DMC-102A reduces the high in-rush currents during motor starts, the trip setting is used to reduce the current required from the battery/power supply when the motor stalls or encounters an excessive load. Without the trip setting, a costly high capacity battery/power supply would be needed to avoid collapse of the battery/power supply voltage. The combination of the trip setting and electronic surge limiting allows the use of a more moderate battery/power supply and smaller gauge wires for a given length (see WIRE TABLE).

If the **Trip Setting** is used to limit torque, note that the actuator and valve components (gears, couplings, seats, etc.) also place a load on the motor. These components will vary with temperature and age, and therefore the torque on the load will vary accordingly.

CALIBRATION

The non-interactive zero and span adjustments of the DMC-102 allow for easy calibration once the unit is installed. After insuring that the feedback potentiometer and motor outputs are wired to provide a proper feedback signal, as described under "ACTUATOR (J1)", follow the steps below to calibrate the unit (see OUTLINE for the location of the adjustments).

If an XMA-105 Feedback Transmitter is used for a **Reversing Acting** application, the following wiring changes must be made before calibrating the unit:

a - Reverse feedback potentiometer wires connected to J1-1 and J1-3.

b- Reverse motor wires connected to J1-4 and J1-5.

c - Reverse open and close limit switch wires connected to J1-7 and J1-8.

1 - Set the S1 switch bank as needed. If using the *log rate* feature, set SW5 to its "off" position until calibration is completed. Apply DC power to the unit, and set the command input signal to minimum:

0V for 0-5V and 0-10V command types
1V for 1-5V command type
2V for 2-10V command type
4mA for 4-20mA command type

2 - Adjust the "Zero" adjustment so that the actuator moves to the desired position. Insure that the desired position does not cause a limit switch to be reached and that the feedback potentiometer is in range (see INDICATORS and FAULT CONDITIONS).

3 - If the actuator is hunting for position, turn the "Deadband" adjustment clockwise until hunting stops. If the actuator is not hunting for position, turn the "Deadband" adjustment counterclockwise until the actuator begins to hunt; then turn the "Deadband" adjustment slightly clockwise until hunting stops.

WARNING! Actuator failure may occur if the "Deadband" adjustment is set to allow continuous hunting. This can cause excessive wear of motor bearings, geartrain, brake, and feedback potentiometer. Hunting can cause the internal temperature of the actuator housing to rise to a level that exceeds the DMC-102 maximum rating of 60^{o}C.

4 - Set the command input signal to maximum:

5V for 0-5V and 1-5V command types
10V for 0-10V and 2-10V command types
20mA for 4-20mA command type

5 - Adjust the "Span" adjustment so that the actuator moves to the desired position. Insure that the desired position does not cause a limit switch to be reached and that the feedback potentiometer is in range.

6 - To check proper operation and linearity, set the command signal to halfway:

2.5V for 0-5V command type
3V for 1-5V command type
5V for 0-10V command type
6V for 2-10V command type
12mA for 4-20mA command type

Verify that the actuator's position is midway between the *zero* and *span* positions.

SPECIFICATIONS

POWER REQUIREMENTS
Operating Voltage: 10 to 30 VDC
Operating Currrent (Motor ON): 82mA typical
Standby Current (Motor OFF): 38mA typical
Operating Current (Motor OFF, Trip ON):
65mA typical (DMC-102A only)
Fuse Type: 10A TR5 Time Lag 374 (replaceable)

COMMAND SIGNAL INPUT
Command Mode Voltage (all command types):
-13 to 30 VDC
Input Impedance (voltage command types):
13K ohms
Input Impedance (4-20mA command type):
250 ohms +/-1%

LOSS OF COMMAND SIGNAL THRESHOLDS
1-5V Command Type: < 0.75V
2-10V Command Type: < 1.50V
4-20mA Command Type: < 3mA

FEEDBACK SIGNAL INPUT
External Feedback Potentiometer: 1K ohm
Input Voltage: 0 to 5 VDC
Operating Range: 0.25 to 4.75 VDC

COMMAND POTENIOMETER POWER (J2-6)
5 VDC @ 5mA maximum

NOTE: Do not connect this output to other power supplies.

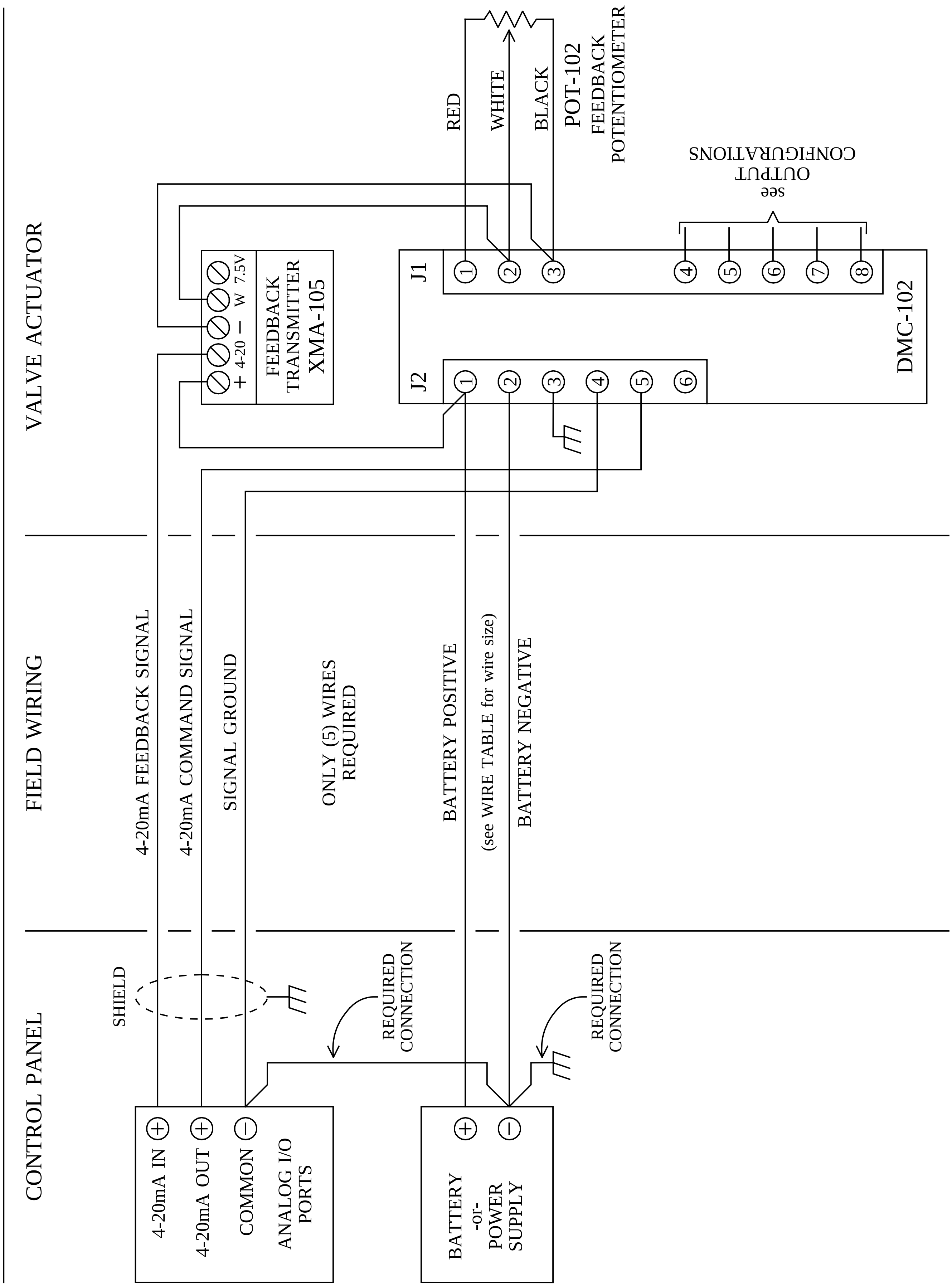
DC MOTOR OUTPUTS
Maximum Running Current: 10A
Motor Current Trip:
DMC-102: 12A (fixed)
DMC-102A: 0 to 12A (adjustable)
Motor Current Measurement Resolution:
85mA typical

TRIP CONNECTOR (DMC-102A only)
Trip Relay Output (Form-C Contacts):
1A @ 24VDC / 0.5A @ 125VAC
Trip Reset Switch (local): located on unit
External Trip Reset:
Normally Open Switch: 1mA @ 5VDC
Open Collector: V_{CE} < 0.5V @ 1mA

CONTROL ADJUSTMENTS
Zero: adjustable throughout feedback signal range
Span: adjustable throughout feedback signal range
Deadband: 6mV to 118mV of feedback signal

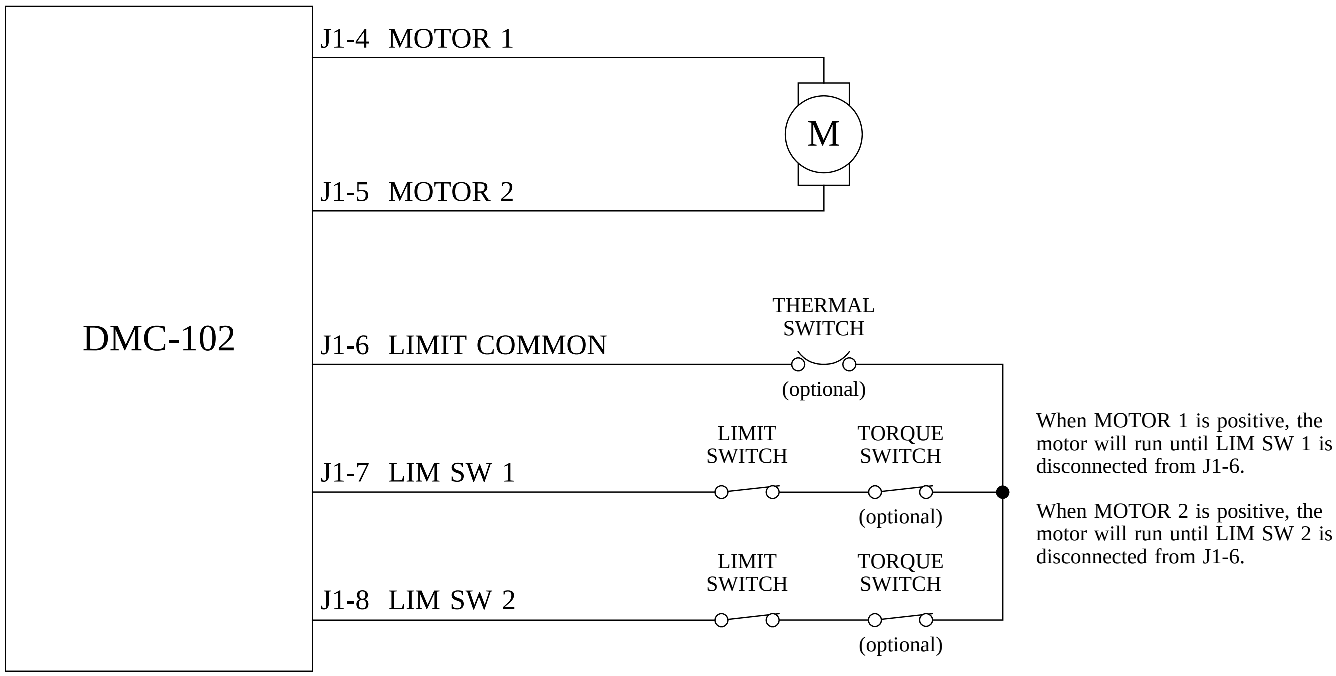
ENVIRONMENTAL
Operating Temperature Range: 0 °C to 60 °C
Storage Temperature Range: -40 °C to 85 °C
Relative Humidity Range: 0 to 90 % (noncondensing)

RECOMMENDED SYSTEM WIRING

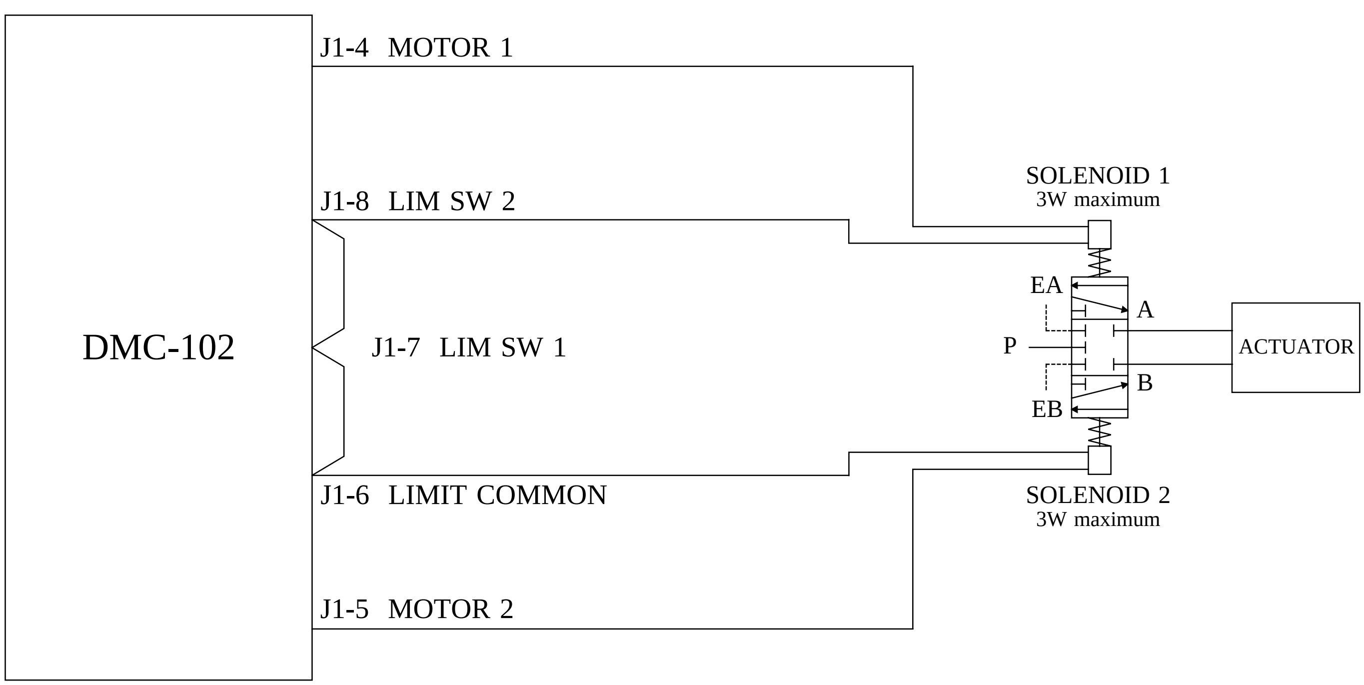


WIRING DIAGRAMS

Output Configurations



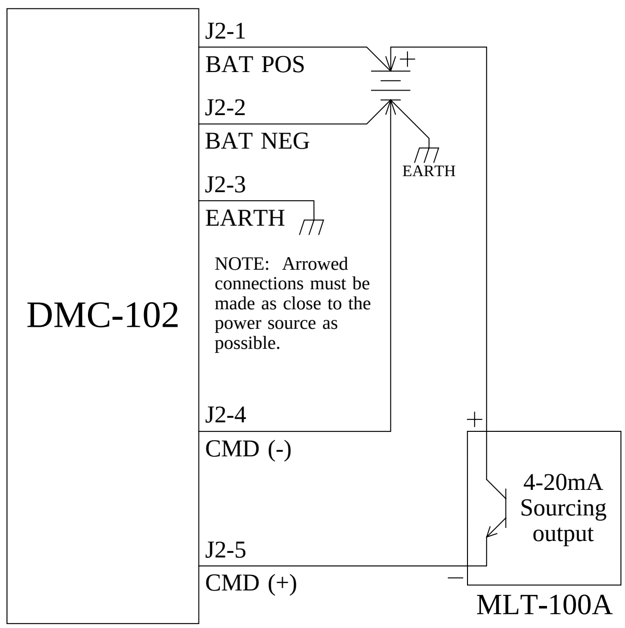
DC Motor Control Output



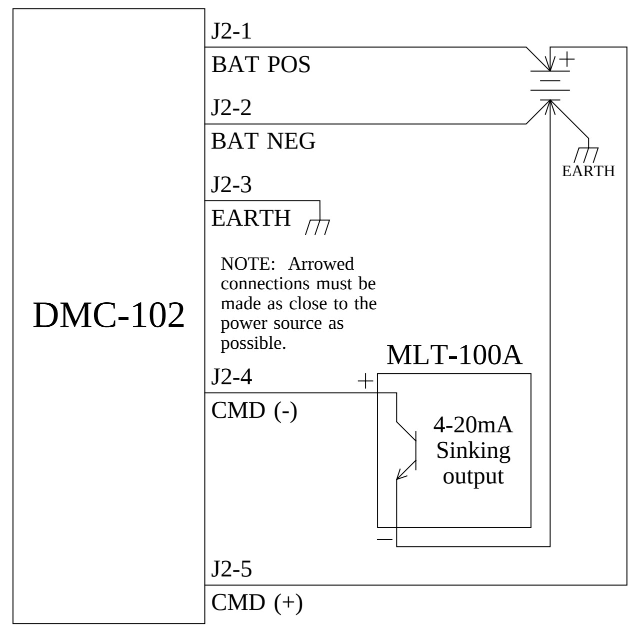
DC Solenoid Control Output

WIRING DIAGRAMS

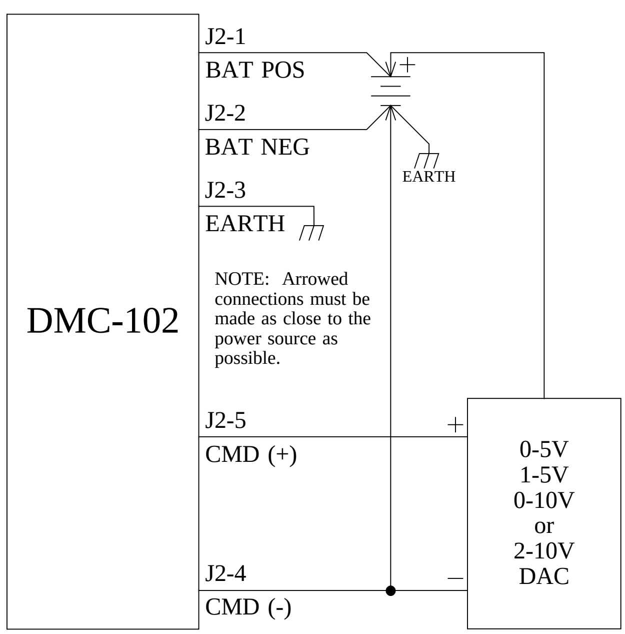
Input Signal Configurations



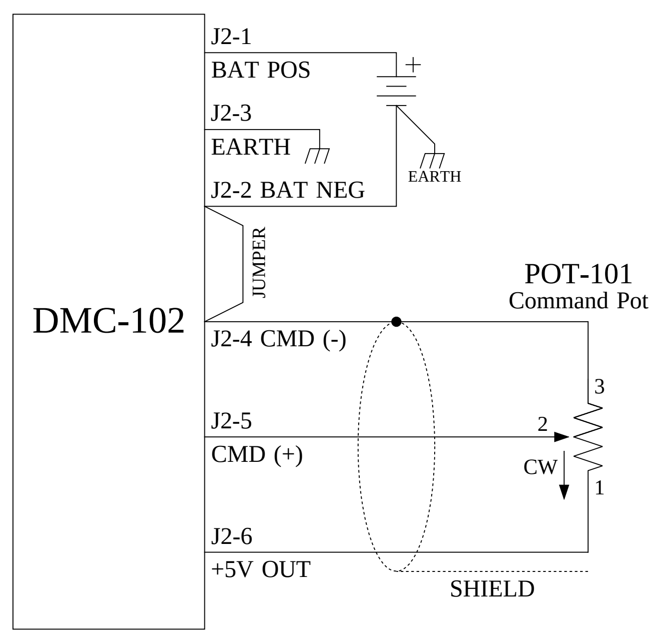
4-20mA Sourcing Input



4-20mA Sinking Input



Voltage Input using digital-to-analog card

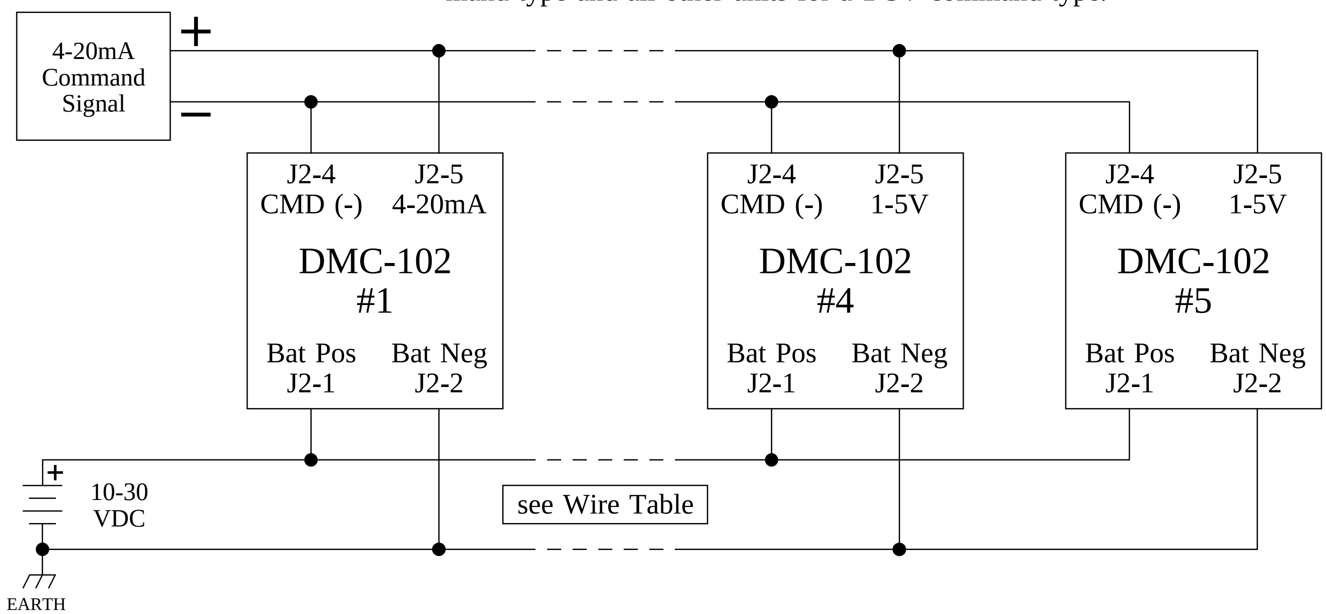


Command Pot using the 0-5V Input Signal

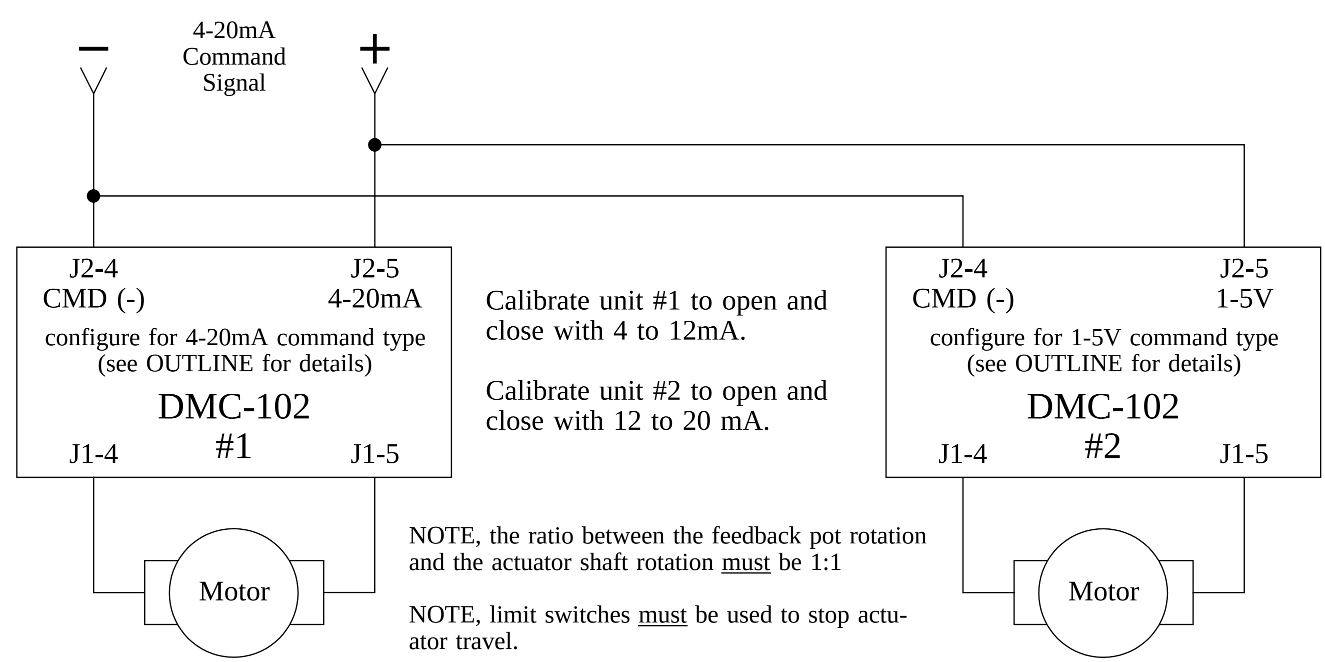
WIRING DIAGRAMS

Special Applications

Connect up to 5 controllers. Set S1 switches (see OUTLINE for details) to configure unit #1 for a 4-20mA command type and all other units for a 1-5V command type.



Controlling multiple units using a single 4-20mA signal



Split range control

WIRE TABLE

The table below shows the maximum recommended distance (in linear feet) between the power source and the DMC-102 unit. The maximum distance is limited by the wire size used and the locked rotor current of the motor. The surge limiting feature along with an appropriate motor current trip setting can reduce wire size and power source requirements to a minimum (see TRIP SETTING). The wire distance is calculated for a maximum voltage drop of 1VDC with 20% of the locked rotor current, and assumes that the full load running current is less than that. All signal wires on the DMC-102 should be connected with wire sizes ranging from 22 to 18 AWG.

ft	**Wire Size**						
Locked Rotor Current (Amps)	**18 AWG**	**16 AWG**	**14 AWG**	**12 AWG**	**10 AWG** (see Note 1)	**8 AWG** (see Note 1)	**6 AWG** (see Note 1)
1	333	529	842	1337	2119	3383	5376
2	167	264	421	668	1059	1692	2688
5	67	106	168	267	424	677	1075
10	33	53	84	138	212	338	538
15	22	35	56	89	141	226	358
20	17	26	42	67	106	169	269
30	11	18	28	45	71	113	179
40	8	13	21	33	53	85	134
50	7	11	17	27	42	68	108
60	6	9	14	22	35	56	90

NOTES

1) The DMC-102 terminal strip will not accept wire sizes larger than 12 AWG. Use a short run of 12 AWG from the DMC-102 to an auxiliary terminal block when larger wire is needed.

2) If the motor is located some distance from the DMC-102, add this length to the overall wire length; be sure to use an appropriate wire size to the motor.

3) When multiple actuators are powered by a common set of wires, use the sum of all the motor currents when determining wire size.