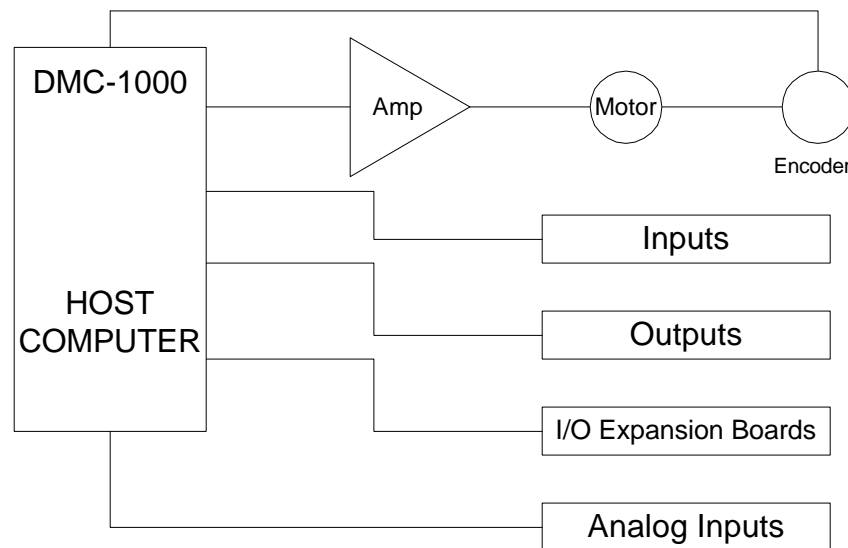


## Application Note 5413: Recommended Techniques to Minimize Noise

This document discusses recommended practices for connecting Galil controllers to other system elements. Primary considerations include:

1. Avoid ground loops.
2. Isolate low power signals and supplies.
3. Use shielded cables for low voltage signals and use proper termination for shielding.



### ***Avoid Ground Loops:***

Care must be taken to avoid ground loops where there are multiple paths to ground. Before connecting ground wires between two points, verify that the points are isolated. You may not always be able to avoid all ground loops, but it is important to eliminate as many as possible.

#### ***A. Connection between controller and amplifier input :***

Using an ohm meter, put one probe on the controller ground and the other on the amplifier input ground. You should measure OPEN. If there is a short (continuity), connecting the controller ground to amplifier ground will create a ground loop.

### ***B. Encoder connection :***

Place the ohm meter probes between the controller ground and encoder ground. If connection is open, connect grounds. If there is a short (continuity), connecting the controller ground to the encoder ground will create a ground loop.

### ***C. Analog Input Connection :***

For Analog inputs check for open or closed connection between grounds as above procedure.

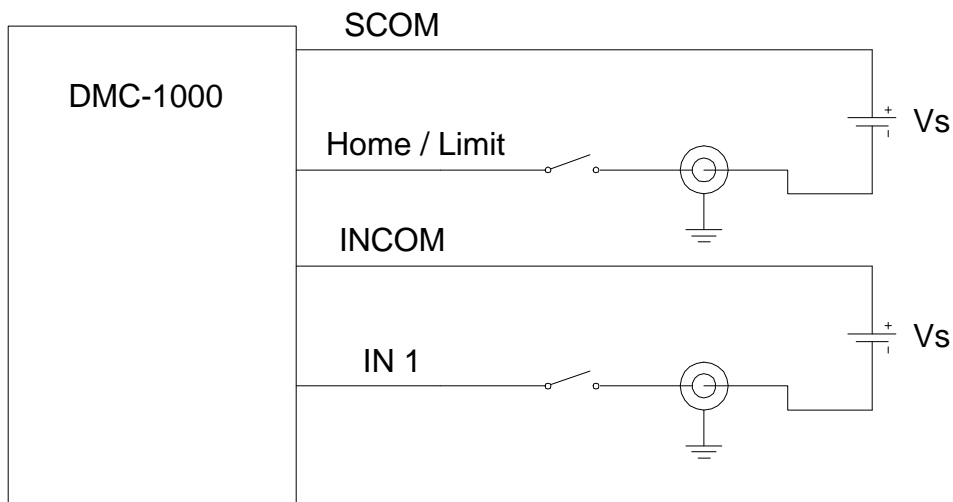
## ***Isolate low power signals.***

### ***A. Analog Inputs :***

Using an oscilloscope, check the noise level on the analog inputs and grounds of the controller. If significant noise is present, (e.g. above 50 mV. ), make sure that the wires for the analog signals are not running near the wires of any high current signals such as the amplifier to motor signals or solenoid - relays. You can filter the noise by using a non-polarized capacitor between the analog input and ground of the controller. A typical value of 0.01  $\mu\text{F}$  to 0.1  $\mu\text{F}$  can be used. The capacitor should be placed as closed to the controller as possible.

### ***B. Limits / Home / General Inputs :***

To power the optically isolated I/O, you must use an external isolated power supply. In this case, the GND point of the controller should not be connected to the isolated power supply. Typical connection should be as shown below.



### ***C. Cable Practices for low voltage signals :***

It is good practice to put low voltage signal cables in a separate conduit from high voltage / high current signals.

### ***Proper termination of shielded cables :***

When using shielded cables, make sure that the shields are terminated only on one end. A typical connection would be in a tree shaped structure. The main trunk from the power connection comes to a main distribution point in the panel. From this point, all the branches, shield from all of the cables, are connected.

#### ***A. Establish proper earth ground :***

If your facility lacks a good earth ground, you can create a local, good earth by inserting a 6-8 feet long copper rod into the floor and connecting all shield wires to the rod.

### ***Diagnostic Tips for isolating noise problem :***

If your controller demonstrates noise related symptoms such as controller reset or microprocessor crash, a series of tests can be performed to locate the source of the problem.

1. When system is powered-up, use an oscilloscope to check the quality of the logic supply (+5V) and the GND on the controller. If you see any noise, it is a good indication that the system has a ground loop. Check each ground connection and eliminate the ground loops as suggested above.
2. To avoid ground loops from the power supply connections, check the continuity between the return (-) terminals of the controller supply and any other supply. This is done with system power turned off. If there is a short, your supply is not isolated and the grounds should not be connected.