

710 SERIES REFERENCE MANUAL

PLEASE READ FIRST BEFORE USING THE 710 SERIES:

If you are not familiar with DC servo drives please do the following setup instructions with the motor on the bench before mounting it on the mechanism it will eventually run. This will allow you to get a baseline motor behavior of what to expect.

Before you start, you must have a suitable encoder mounted and properly aligned on the motor. Follow the manufacturer's instructions on mounting and aligning the encoder if the motor doesn't already come with one.

Next you must have a DC power supply suitable for the motor. The power supply current rating must equal the maximum current you expect to run the motor at.

Finally, have a STEP and DIRECTION pulse source available.

Before going on, turn the "P", "I", "D", and LIMIT trim pots to the 11 o'clock position. The trim pots are single-turn so be careful not to over-torque them.

710 SERIES PINOUT

TERMINAL 1	Power Ground Connect the negative (black) lead of your power supply to this terminal.
TERMINAL 2	Power (+) Connect the positive (red) lead of your power supply to this terminal. It must be between +18VDC to +80VDC.
TERMINAL 3	Armature (-) Connect the red lead of your motor to this terminal.
TERMINAL 4	Armature (+) Connect the black lead of your motor to this terminal.
TERMINAL 5	ERR/RES This is the ERROR and RESET pin. For a full explanation read the section titled "ERROR/RESET PIN" on page 6.
TERMINAL 6	Encoder Ground Connect the encoder power supply ground to this terminal.
TERMINAL 7	Encoder +5VDC Connect the encoder +5VDC pin to this terminal.
TERMINAL 8	Channel A Connect the Channel A pin of your encoder to this terminal.
TERMINAL 9	Channel B Connect the Channel B pin of your encoder to this terminal.
TERMINAL 10	Direction Connect the DIRECTION signal to this terminal.
TERMINAL 11	Step Connect the STEP signal to this terminal.
TERMINAL 12	S/D Common Connect this terminal to either +5VDC or signal ground.

DIP SWITCH SETTINGS

The 710 SERIES has a 10 position DIP switch that is accessible through the cutout in the drive's cover. These switch settings control many of the features of the 710 SERIES and are labeled SW1 through SW10.

EXPLANATION OF SWITCH FUNCTIONS

<u>SW1</u>	Not used
<u>SW2, SW3</u>	MUL1 and MUL0 respectively Sets the 710 SERIES pulse multiplier SW2 "ON" and SW3 "ON" = Step pulse times 1 (default) SW2 "ON" and SW3 "OFF" = Do Not Use SW2 "OFF" and SW3 "ON" = Do Not Use SW2 "OFF" and SW3 "OFF" = Do Not Use
<u>SW4, SW5</u>	SR1 and SR0 respectively Sets the 710 SERIES following error limit SW4 "ON" and SW5 "ON" = +/- 256 count following error limit (default) SW4 "OFF" and SW5 "ON" = +/- 512 count following error limit SW4 "ON" and SW5 "OFF" = +/- 1024 count following error limit

SW4 "OFF" and SW5 "OFF" = +/- 2048 count following error limit

<u>SW6</u>	HEDS SW6 "OFF" = Default SW6 "ON" = Turned on if using encoders with HEDS optical heads or open collector encoders. Disables encoder failure detection allowing user to run encoders that don't have line drivers or active pullup.
<u>SW7</u>	TORQ SW7 "OFF" = Use LIMIT trimpot setting only (default) SW7 "ON" = Allow 20A for 1 second, then use LIMIT trimpot setting
<u>SW8, SW9, SW10</u>	GAIN2, GAIN1, and GAIN0 respectively Current mode servo gain SW8 "ON", SW9 "ON", SW10 "ON" = Lowest gain SW8 "ON", SW9 "OFF", SW10 "ON" = Low gain SW8 "ON", SW9 "ON", SW10 "OFF" = Medium-low gain SW8 "ON", SW9 "OFF", SW10 "OFF" = Medium gain 1 (default) SW8 "OFF", SW9 "ON", SW10 "ON" = Medium gain 2 SW8 "OFF", SW9 "OFF", SW10 "ON" = Medium-high gain SW8 "OFF", SW9 "ON", SW10 "OFF" = High gain SW8 "OFF", SW9 "OFF", SW10 "OFF" = Highest gain

710 SERIES TERMINAL WIRING:

IMPORTANT: When first testing the 710 SERIES, connect ERR/RES (Terminal 5) to ENC+ (Terminal 7).

IMPORTANT: Do not connect the motor to the 710 SERIES until STEP 6.

IMPORTANT: Please follow the next steps in the sequence they are given.

STEP 1: CONNECTING THE ENCODER

The encoder must be at minimum a 25 line-count digital quadrature encoder and must operate on a single +5VDC power supply. If the encoder supply current is more than 50 mA, use an external +5VDC supply. It may have an INDEX output, which will not be used. If it has differential outputs, use only the "+" phase outputs.

TERMINAL 6	Encoder Ground Connect the encoder power supply ground to this terminal.
TERMINAL 7	Encoder +5VDC Connect the encoder +5VDC to this terminal
TERMINAL 8	CH A Connect the encoder channel "A" to this terminal
TERMINAL 9	CH B Connect the encoder channel "B" to this terminal

STEP 2: CONNECTING THE POWER SUPPLY

IMPORTANT: Never put a switch on the DC side of the power supply! This will damage, if not destroy, your drive!

Keep the power supply leads short and use the largest wire gauge that will easily fit in the terminals. If the lead length is more than 18" use a 1000 uF capacitor across the 710 SERIES power supply terminals. Make sure your power supply can provide the peak current the motor may draw. The power supply voltage must be between 18 VDC and 80 VDC.

TERMINAL 1	POWER GROUND Connect the power supply (-) to this terminal.
TERMINAL 2	+18 TO 80 VDC Connect the power supply (+) to this terminal

STEP 3: TESTING THE ENCODER

At this point the encoder should be tested for functionality. You can test the encoder on the 710 SERIES by watching the indicator LEDs on the board.

Turn on the power supply. The FAULT indicator (red LED) should be on for 1 second and then turn off. The IN-POSITION indicator (green LED) should turn on and remain on. The POWER indicator (green LED) should always be on. Move the motor VERY slowly by hand. The IN-POSITION indicator (green LED) will turn off when you move the motor more than two encoder counts. The Warn indicator (yellow LED) will turn on when you have moved the motor more than 128 encoder counts. The FAULT indicator (red LED) will turn on when you move the motor past the following error limit (see option switch section). After 1 second the FAULT light will turn off and the IN-POSITION LED will come back on.

STEP 4: CONNECTING CONTROL INPUTS

The STEP and DIRECTION signal drivers must be 3.3V or 5V TTL signals and have edge transition times of 100 ns or faster. The COMMON input can be connected to signal ground or a +5VDC supply. The 710 SERIES default motor direction is CW when the DIRECTION pin is left unconnected.

TERMINAL 10	Direction Connect the DIRECTION line to this terminal.
TERMINAL 11	Step Connect the STEP line to this terminal.
TERMINAL 12	Common Connect this terminal to the signal ground or +5VDC.

STEP 5: TESTING THE STEP AND DIRECTION INPUTS

Set the STEP pulse generator to 40 pulses per second.. Turn on the power supply; the FAULT indicator (red) will turn off after 1 second and the IN-POSITION indicator (green) will turn on. Start sending step pulses (JOG). The IN-POSITION indicator (green) will turn off almost immediately, the WARN indicator (yellow) will turn on 3 seconds later and the FAULT indicator (red) will turn on 3 seconds after that. Once the FAULT indicator (red) turns on, stop sending step pulses. Send step pulses in the opposite DIRECTION and the above process should repeat.

STEP 6: CONNECTING THE MOTOR

Turn the power supply and the step pulse source off. Verify that the "P", "I", "D", and LIMIT trim pots are in the 11 o'clock position.

TERMINAL 3	Armature (-) Connect the BLACK motor lead to this terminal.
TERMINAL 4	Armature (+) Connect the RED motor lead to this terminal.

SETTING THE "P", "I", "D" TRIMMOTS

The "P" and "D" settings generally track each other. If you increase "P" for greater stiffness, an increase in "D" is needed as well to restore critical damping. Be careful, increasing "P" without increasing "D" may cause the motor to break out into violent oscillation.

The higher "P" is set, the noisier the motor will be when stopped. This is because higher gain causes more vigorous dithering between encoder counts at rest. There is a trade-off between high gain (high stiffness) on one hand and excessive dithering (noise and motor heating) on the other.

The "I" setting takes out the remaining following error. Increasing the "I" setting will increase the servo stiffness; if it is increased too much the servo will oscillate.

CURRENT LIMIT

The current LIMIT trim pot sets maximum continuous current the motor is permitted to have. It is adjustable from 0 amps to 20 amps. The trim pot setting is proportional to current; if it is set to full scale it will be outputting 20A, half scale will output 10A, quarter scale will output 5A, and so on. The behavior of the trim pot is controlled by DIP SW 10. If SW 10 is on (default), the 710 SERIES will limit the current to the trim pot setting until it runs into an excessive load. It will then start a 1 second timer and limit the current draw to 20A; if it does not overcome the load it will limit at the trim pot set current. The load must drop below the trim pot setting to reset the timer. If SW 10 is off (compatibility mode), the 710 SERIES will constantly output what the LIMIT trim pot is set to. Normally the LIMIT trim pot is set to the motor's continuous rated current.

INDICATOR LEDs

The 710 SERIES has four indicator LEDs. These are:

IN-POSITION indicator (IN POS Green LED)
WARN indicator (WARN Yellow LED)
FAULT indicator (FAULT Red LED)
POWER indicator (POWER Green LED)

The FAULT indicator (red LED) is on while the drive is in power-on reset, the DISABLE input is held "low" or if the protection circuit is tripped due to a FAULT condition. All output switching stops are reset. The FAULT condition lasts for 1 second, and then self-resets to try again. If the 710 SERIES enters a FAULT condition it will dynamically brake the motor. This means if a FAULT occurs while the motor is moving the motor will very rapidly decelerate to a stop.

There are three conditions that will trip the protection circuit. One condition is if there is a short-circuit. The second condition is if there is no encoder attached; the 710 SERIES detects if one or more encoder wires are not connected. The third condition is if the POSITION ERROR exceeds the set following error limit. This condition can have several causes:

- 1) The loop settings are severely under-damped and the motor breaks out into oscillation.
- 2) Excessive motor load due to acceleration or workload.
- 3) The speed command in excess of what the motor can deliver.
- 4) The current LIMIT is set too low.
- 5) The power supply current is insufficient for the demand.
- 6) The power supply voltage is below 18 VDC.
- 7) The motor is wired backwards, is broken or disconnected.
- 8) Encoder failure

The IN-POSITION indicator (green LED) is lit when the motor is within 2 increments of motion of the commanded position. If the motor is out of position by more than two increments of motion the indicator will not be lit.

The Warn indicator (yellow LED) is lit whenever the motor is more than 128 counts off of the commanded position. Its purpose is to give warning that a large following error is probably developing and will result in the drive going into FAULT (red LED) if measures are not taken to arrest the increasing following error.

The Power indicator (green LED) is lit whenever there is power applied to the 710 SERIES.

ERROR / RESET PIN

This terminal functions as an ERROR output and as a RESET input. Because this terminal functions as both an input and an output, some detailed description is necessary.

When first testing the 710 SERIES, ERR/RES (Terminal 5) was connected to ENC+ (term. 7). It can be left that way if it is not necessary to read the state of the ERROR output. Otherwise, the following details are important.

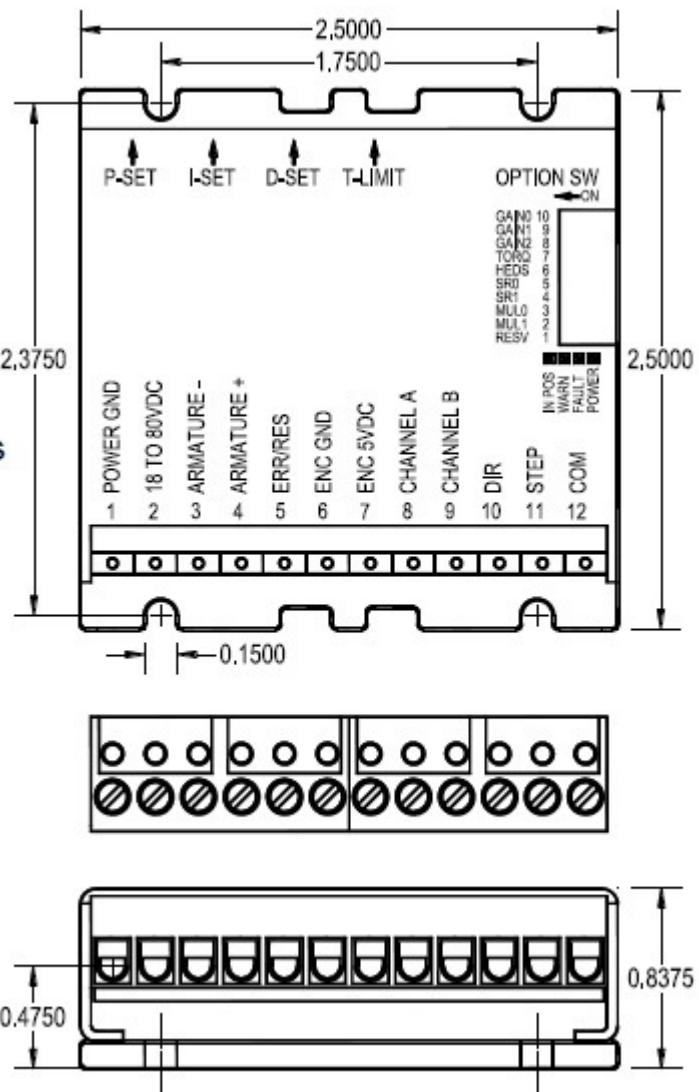
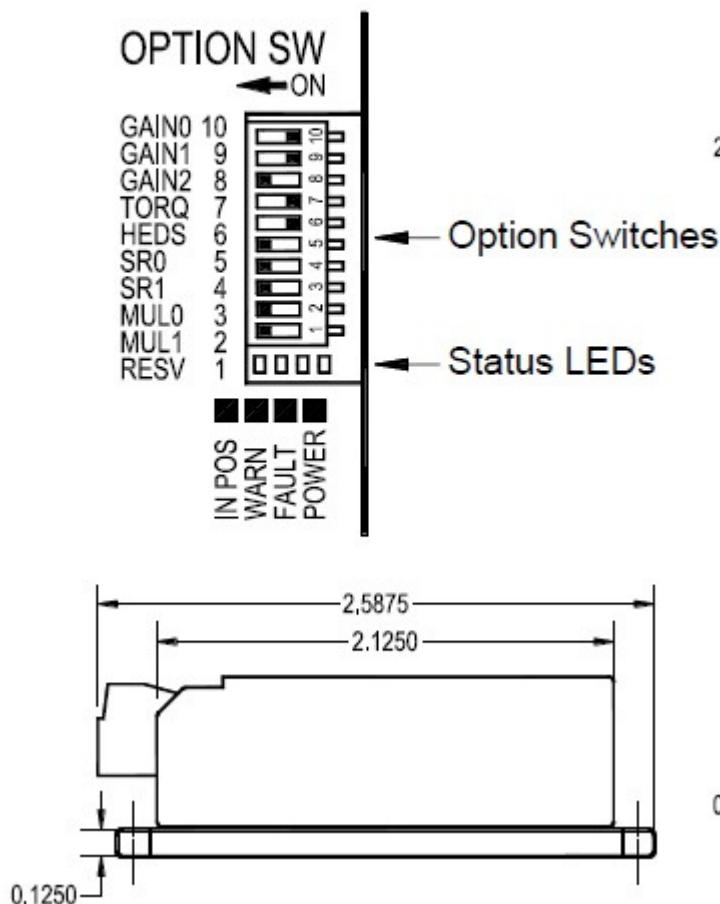
The ERROR output is latched in the "ERROR" state (Terminal 5 = "0") by the power-on reset circuitry in the 710 SERIES. It will stay in this state indefinitely until it is cleared by applying +5V to this terminal for at least 1 second.

The voltage on this terminal is +5VDC when the 710 SERIES is functioning normally. The voltage on this terminal goes to 0VDC whenever the FAULT indicator is lit. This output can be used to signal your controller that an error has occurred.

Normally when the 710 SERIES is first powered up, it will be necessary to push the momentary switch to START for 1 second. This will clear the power-on reset condition and extinguish the FAULT LED. The motor will then be enabled and the drive will begin to operate. If at any time after that a condition occurs that causes the 710 SERIES to "FAULT out", such as not being able to complete a step command, the ERR/RES terminal will go to "0", signaling to the controller an error has occurred. This will require the operator to correct the problem that caused the FAULT and then push the switch to "START" for 1 second to re-enable the 710 SERIES.

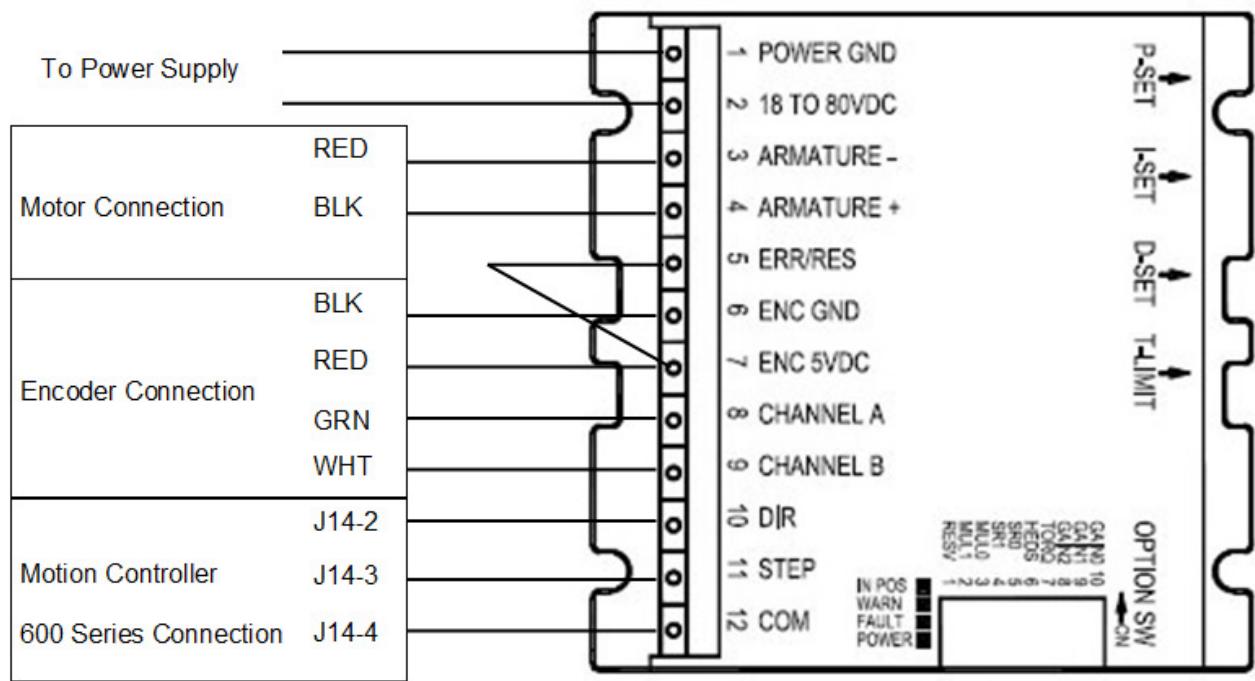
At anytime the operator can push the switch to the "STOP" position to immediately halt the 710 SERIES drive. Anytime the 710 SERIES is in the "FAULT" state (FAULT LED lit), all switching action stops, the motor freewheels and is unpowered.

Servodrive



710 SERIES SPECIFICATIONS

Power Supply:	+18VDC to +80VDC
Quiescent Current:	30mA
Motor Current:	0 to 20 Amps
Motor Inductance:	At least 1mH
Short Circuit Protect:	22A trip
Lock Range:	+/- 256, 512, 1024, or 2048
Feedback:	Quadrature TTL Encoder 5V Compatible
Feedback Resolution:	X4 Encoder Line Count
Feedback Voltages:	<1V for Logic 0 and >4V for Logic 1
Switching Frequency:	20kHz
Current Limit:	0 to 20 Amps Trimpot Adjustable
Analog PID:	Proportional, Derivative, Integral Coefficient Trimpots
Step Pulse Frequency:	0 to 300 KHz
Step LED "ON" Time (min):	1uS
Step LED "OFF" Time (min):	2.5uS
Size:	2.5" x 2.5" x 0.8375"
Package:	Blue aluminum anodized cover, black aluminum hard anodized bottom heatsink
Weight:	3.6 oz. (100g)
Encoder Supply:	+5VDC 50mA maximum



710 Series Wiring Diagram