

User's Manual

For

DB810-50V

Digital DC Servo Driver

Version 1.0

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Attention: Please read this manual carefully before using the driver!



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1. Introduction, Features and Applications

Introduction

The DB810-50V is a digital DC servo driver developed with one of the advanced 21-century technologies in the world today. In position control, it's easy for the end users to change stepping drivers to the DB810-50V without changing control systems, because its input command is PUL/DIR signal, which is compatible with that of stepping driver. In velocity control, the position feedback of the encoder can effectively eliminate the “zero-speed drift” phenomenon when the servo is standstill. In low power motion control applications, performances of DC servo systems using the DB810-50V are better than those of digital AC servo systems in velocity, precision, noise, stability and some other aspects, or at least as good as those of digital AC servo systems. However, the price of the DB810-50V stays at the price line of stepping driver, namely far lower than that of AC servo.

Features

- 18-50VDC, 0-20A, 20-400W
- PID feedback servo drive
- Feedback resolution X4 encoder line count
- Lock range +/- 128 count following error
- Opto-isolated step and direction inputs
- Small size
- Over-current and short-circuit protection

Applications

Suitable for a wide range of equipments and instruments such as mini type engraving machines, jet-ink machines, and etc. It performs better in equipments desired with low noise, high velocity and high precision.

2. Specifications and Operating Environment

Mechanical Specifications (unit:mm, 1 inch = 25.4 mm)

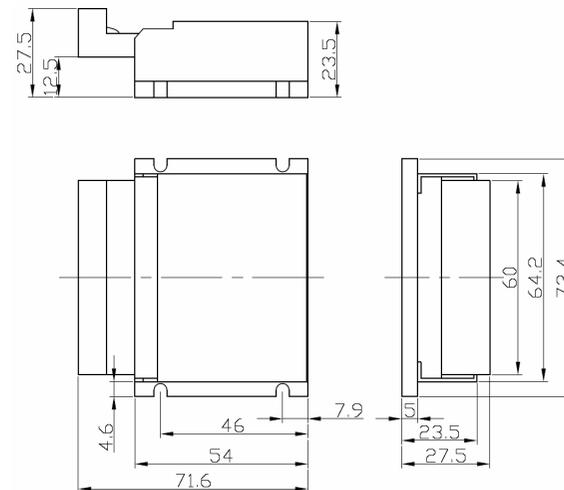


Figure 1: Mechanical specifications

Electrical Specifications ($T_j = 25^\circ\text{C}$)

Parameters	DB810-50V			
	Min.	Typical	Max.	Unit
Peak output current	0	-	20	Amps
Supply voltage	+18	-	+50	VDC
Logic signal current	6	12	20	mA
Pulse input frequency	0	-	250	KHz
Isolation resistance	500			MΩ
Current provided to encoder			50	mA

4. Servo Setup

Before you start servo, you can follow the following steps:

Install Encoder

You must have a suitable encoder properly mounted on the motor. Please assemble the encoder according to its factory manual.

Prepare Power Supply

You must have a DC power supply suitable for the motor. Do not use a power supply voltage more than 5 volts in excess of the rated voltage of the motor. The power supply current rating must equal the maximum current you expect to run the motor at. When the power supply leads are longer than 50 cm, a 1000uF/100V electrolytic capacitor should be connected between the “pin POWER GROUND” and the “pin +18 TO +50VDC”. Please note that the polarity can not be reversed.

Prepare Controller

Prepare a controller with STEP and DIR signal.

Initialize DB810-50V

Before going on, turn the current LIMIT trimpot a quarter to half of full scale. Turn the GAIN trimpot fully off and turn the DAMP trimpot to a quarter of full scale. The trimpots are single-turn, do not over-torque them with a screwdriver.

Motor Connection

Make sure that the power is off and the STEP pulse source is set to zero pulse per second. Check to see if the potentiometer settings are set according to the instructions. You may wish to secure the motor so it can't jump off the bench. Motor

may return to command position rapidly with little or no overshoot in the minimal amount of time. Please refer to “*Adjusting PID Coefficients*” in page 8.

5. Tuning the Servo

Testing the Servo

Turn on the power supply, the FAULT light should turn off after pushing the servo starter (a momentary switch).

If everything is correct you should hear the motor “singing”. This is normal. The motor is dithering or bouncing between adjacent encoder counts. The integral term in a PID loop has infinite DC gain over time and will amplify even the smallest position error. Because encoder feedback can only occur on count edges, the loop is “blind” until it encounters an encoder count edge. It then reverses the motor direction until another edge is found, then the process repeats.

If the motor jumps slightly and the FAULT LED immediately turn on, then either the motor is wired in reversal or the trimpots are misadjusted. Check the trimpot settings. If they are right then switch the motor leads and try again. If it still doesn't work after you followed all of the previous steps, please contact us at tech@leadshine.com.

Now turn on your step pulse source and ramp the speed up to see if the motor runs. It should run clockwise with a logical “1” on the direction input.

Tuning the Servo

The optimum way to turn the servo is to induce an impulse load on the motor while watching an oscilloscope to see how the motor behaves in response, then adjusting the PID coefficients for optimal performances. In all cases the motor should return to the command position, what matters is how it does it. The manner in which the

motor returns to its command position is called damping. At one extreme called overdamped response, the motor returns to position after a long, drawn out delay. At the other extreme called underdamped response, the motor returns to its position too rapidly, overshoots, returns and undershoots and so on until it finally settles at its command position. This is also caused ringing; when extreme, the over/undershoot builds in amplitude until the motor enters violent oscillation. Between the two extremes is the optimal response called critical damping. Here the motor rapidly returns to its position with little or no overshoot in the minimal amount of time.

There are three trimpots at the side of the DB810-50V. They are GAIN, DAMP and LIMIT separately for current setting, as shown in Figure 5.

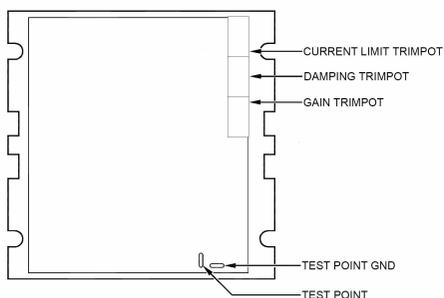


Figure 5: Sketch of DB810-50V

GAIN and DAMPING setting generally track each other. If you increase GAIN (greater stiffness), then increase DAMPING is needed as well to restore critical damping. Be careful, increasing GAIN without increasing DAMPING may cause the motor to break out into violent oscillation. The higher GAIN is set, the noisier the motor will be when stopped. This is because higher gain causes more vigorous dithering between encoder counts at rest.

Adjusting PID Coefficients

The error between servo actual position and pulse command position can be reduced by tuning servo parameters.

You can detect how the motor behaves in response to an impulse load by watching an oscilloscope, as shown in Figure 6. The easiest way to induce a disturbance is to switch the DIRECTION input while commanding a constant speed via the STEP input. The abrupt direction change puts just the momentary load needed on the motor while you watch how it responds. If you are using an oscilloscope, use channel 1 on the test point and channel 2 on the DIRECTION input. Set the trigger to “normal”, trigger source to channel 2 and trigger edge to “+”. You should see a single sweep for every clockwise change in direction.

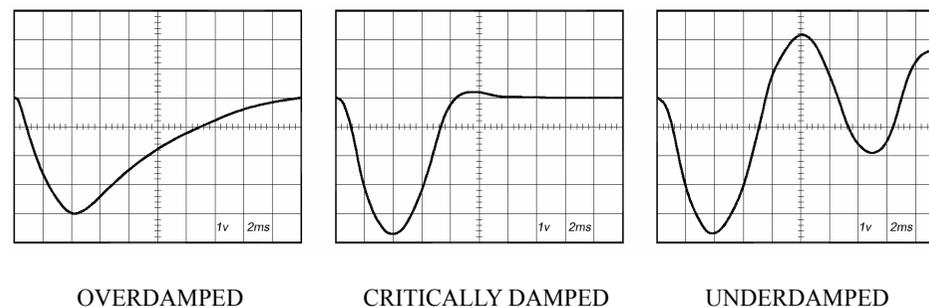


Figure 6: Response to an impulse load

Slowly increase STEP speed until you get a picture similar to one of the three above, and then do the following steps:

- ① OVERDAMPED: Decrease DAMPING or increase GAIN
- ② CRITICALLY DAMPED: Do nothing; you are here
- ③ UNDERDAMPED: Decrease GAIN or increase DAMPING

In order to make it convenient for the users to turn, a test point is set inside of the

DB810-50V, as shown in Figure 5. Tune DAMPING and GAIN until performances of the servo are satisfying.

6. Using Tips

Current LIMIT Setting

The current LIMIT trimpot sets maximum current the motor is permitted to have. It is adjustable from 0 amps to 20 amps. Normally the LIMIT trimpot is set to maximum (20 amps) unless you want to limit motor torque to a lower value.

More speed and position is unaffected by the current LIMIT setting unless the torque demand due to load exceeds this setting, then the motor position will fall behind the command position because of insufficient torque.

Fault Indicator

Normally when the DB810-50V is first powered up, it will be necessary to push the momentary switch to START for 5 seconds. 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 DB810-50V to “fault out”, such as not being able to complete a step command, the ERR/RES terminal will go to “0”, signaling the computer 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 5 seconds to re-enable the DB810-50V.

At anytime the operator can push the switch to the “STOP” position to immediately halt the DB810-50V drive. Anytime the DB810-50V is in the “FAULT” state (FAULT LED lit), all switching action stops and the motor freewheels and is unpowered. This will light the “FAULT” light.

The FAULT indicator 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 power MOSFETs are turned off and all internal counters are reset. The FAULT condition lasts for 3 seconds, and then self-resets to try again. If the protection circuit tripped it and the cause is not cleared, then it will immediately re-enter the FAULT state again and repeat the cycle.

There are two conditions that will trip the protection circuit. One condition is if a short-circuit occurs and current exceeds 20 amps.

The other condition is if the POSITION ERROR exceeds +/- 128 counts causing a break of the servo-lock. 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 motor is wired backwards, is broken or disconnected.
- 7). Encoder failure.

Reversing Default Motor Direction

The DB810-50V will turn the motor in the CW direction when the DIRECTION input is “high” (logical “1”, or +5VDC). If instead CCW is preferred, then:

- 1) Reverse the motor “+” and “-” leads
- 2) Reverse the encoder “Channel A” and “Channel B” leads

ERR/RES

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 DB810-50V, ERR/RES (term. 5) was connected to E+5V (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 (term. 5 = 0) by the power-on reset circuitry in the DB810-50V. It will stay in this state indefinitely until it is cleared by applying +5V to this terminal for at least 5 seconds.

The voltage on this terminal is +5VDC when the DB810-50V 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.

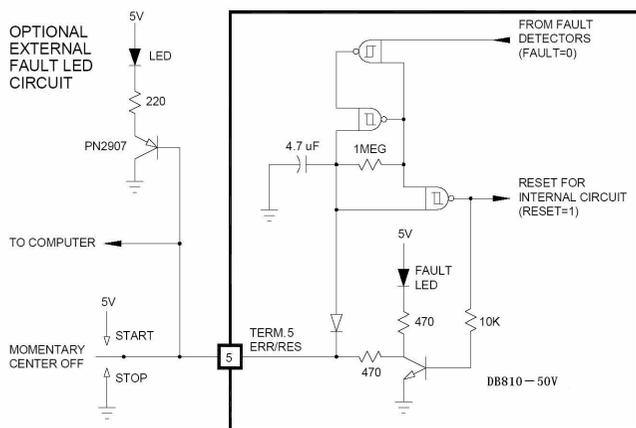


Figure 7: Error clear and Reset circuit of the DB810-50V

The above circuit shows how to implement an external switch to clear an ERROR condition and RESET the DB810-50V, while still being able to read the state of the

drive. It also includes an optional FAULT LED circuit if a remote indication of the state of the DB810-50V is desired.

APPENDIX

TWELVE MONTH LIMITED WARRANTY

Leadshine Technology Co., Ltd. warrants its products against defects in materials and workmanship for a period of 12 months from shipping date. During the warranty period, Leadshine will either, at its option, repair or replace products which proved to be defective.

EXCLUSIONS

The above warranty shall not apply to defects resulting from: improper or inadequate handling by customer; improper or inadequate customer wiring; unauthorized modification or misuse; or operation beyond the electrical specifications of the product and/or operation beyond environmental specifications for the product.

OBTAINING WARRANTY SERVICE

To obtain warranty service, a returned material authorization number (RMA) must be obtained from customer service at e-mail: tech@leadshine.com before returning product for service. Customer shall prepay shipping charges for products returned to Leadshine for warranty service, and Leadshine shall pay for return of products to customer.

WARRANTY LIMITATIONS

Leadshine makes no other warranty, either expressed or implied, with respect to the product. Leadshine specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. Some jurisdictions do not allow limitations on how long and implied warranty lasts, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited

to the 12-month duration of this written warranty.

SHIPPING FAILED PRODUCT

If your product should fail during the warranty period, e-mail customer service at tech@leadshine.com to obtain a returned material authorization number (RMA) before returning product for service. Please include a written description of the problem along with contact name and address. Send failed product to distributor in your area or: Leadshine Technology Co., Ltd. Floor 3, Block 2, Tianan Industry Park, Nanshan Dist, Shenzhen, China. Also enclose information regarding the circumstances prior to product failure.