

User's Manual

For

MSSMD-50-20

Digital DC Servo Driver

Version 1.0

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Attention: Please read this manual carefully before using driver!



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1. Introduction, Features and Applications

1.1 Introduction

MSSMD-50-20 is a new digital DC servo driver developed with the advanced 21-century technology in the world today. In position control, it's easy for the end user to change the step driver to MSSMD-50-20 without changing control system, because its input command is PUL/DIR signal, which is compatible with that of step driver. In velocity control, the position feedback of the encoder can effectively eliminate the "zero-speed drift" phenomenon when the analog servo is standstill. In the low power motion control applications, performances of DC servo systems using MSSMD-50-20 are better than those of digital AC servo systems in velocity, precision, noise, stability and some other aspects, at least as good as those of digital AC servo systems. Synchronously the price of MSSMD-50-20 stays at the price line of step driver, namely far lower than that of AC servo.

1.2 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

1.3 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 which expected to be low noise, high precision and high velocity.

2. Specifications and Operating Environment

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

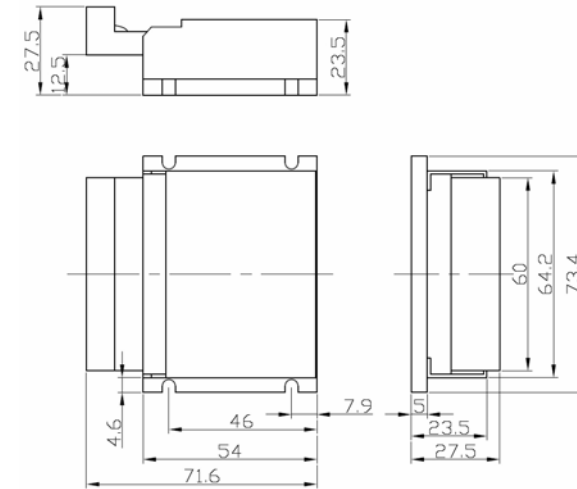


Figure 1: Mechanical specifications

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

Parameters	MSSMD-50-20			Unit
	Min.	Typical	Max.	
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

2.3 Operating Environment and Parameters

Cooling-down Method	Natural cooling or forced cooling	
Operating Environment	Environment	Avoid dust, oil frost and corrosive gases
	Ambient Temperature	0°C — 50°C
	Humidity	40 — 95%RH
	Vibration	5.9 m/s2 Max
Storage Temperature	-20°C — +65°C	
Weight	Approx. 100 grams (3.53 oz)	

3. Connections

3.1 Connector Configuration

Pin Number (Term.)	Function	Pin Number (Term.)	Function
1	POWER GROUND	7	E+5V
2	+18 TO +50VDC	8	PHASE A
3	MOTOR+	9	PHASE B
4	MOTOR-	10	DIR
5	ERR/RES	11	STEP
6	EGND	12	+5V

3.2 Control Signal Connection

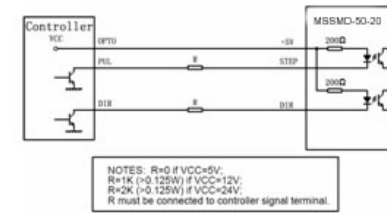


Figure 2: Control signal connection

3.3 Typical Connections

If the encoder drains less than 50mA, MSSMD-50-20 can supply the encoder directly, and connect it as Figure 3. If the encoder drains more than 50mA, use an external +5VDC supply, and connect it as Figure 4.

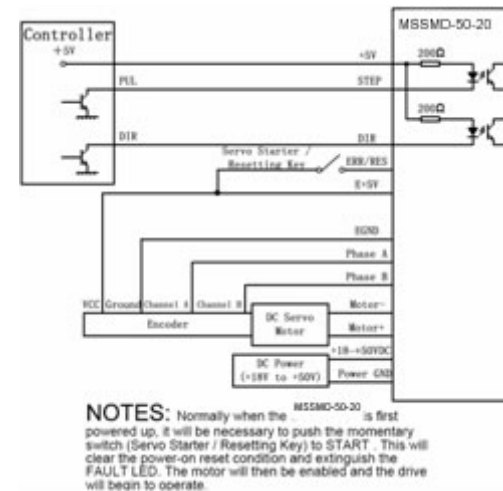


Figure 3: Typical connection (MSSMD-50-20 supply the encoder directly)

either the motor is wired backwards 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

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.

5.2 Tuning the Servo

The optimum way to tune 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 behavior. 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 MSSMD-50-20. They are GAIN, DAMP and LIMIT separately for current setting, as shown in Figure 5.

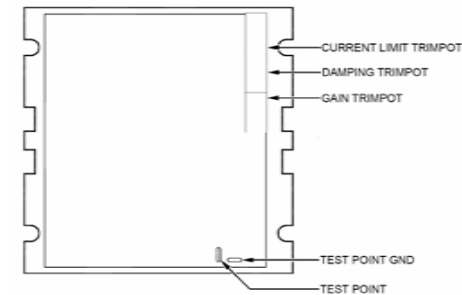


Figure 5: Sketch of MSSMD-50-20

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.

5.3 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.

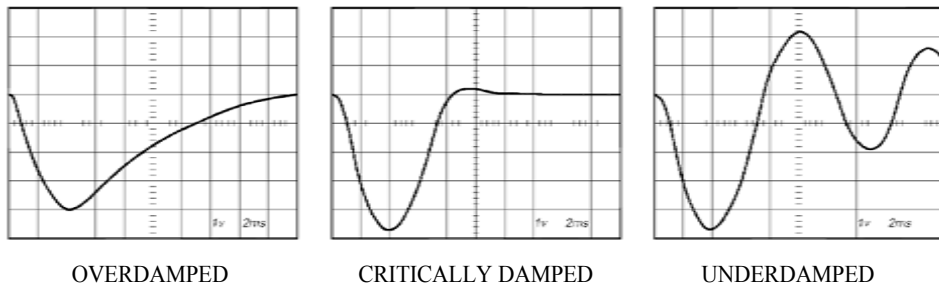


Figure 6: Response to an impulse load

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 users to turn, a test point is set inside of the MSSMD-50-20, as shown in Figure 5. Tune DAMPING and GAIN until performances of the servo are satisfying.

6. Using Tips

6.1 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.

6.2 Fault Indicator

Normally when the MSSMD-50-20 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 MSSMD-50-20 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 MSSMD-50-20.

At anytime the operator can push the switch to the “STOP” position to immediately halt the MSSMD-50-20 drive. Anytime the MSSMD-50-20 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.

6.3 Reversing Default Motor Direction

The MSSMD-50-20 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

6.4 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 MSSMD-50-20, 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 MSSMD-50-20. 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 MSSMD-50-20 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.

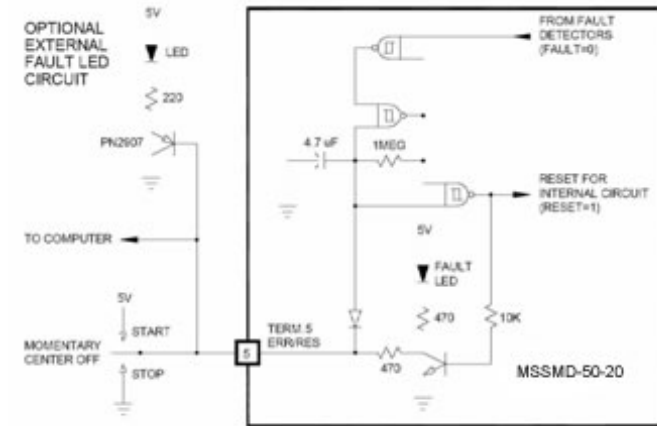


Figure 7: Error clear and Reset circuit of the MSSMD-50-20

The above circuit shows how to implement an external switch to clear an ERROR condition and RESET the MSSMD-50-20, 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 MSSMD-50-20 is desired.