

Troubleshooting the Mini Lathe Variable Speed Drive

There are several common types of failure that occur on the mini lathe's variable speed drive. Find the symptoms your lathe exhibits, and follow the steps to diagnose the problem.

This document covers the following mini lathes:

- Grizzly Industrial model G8688
- Harbor Freight (Central Machinery) model 33684
- Micro-Mark MicroLux models 82500 and 82710
- Homier Speedway model 03911 (current production, not the early Speedway with the SCR controller)

How It Should Work

First, let's start by describing the proper operation of the mini lathe.

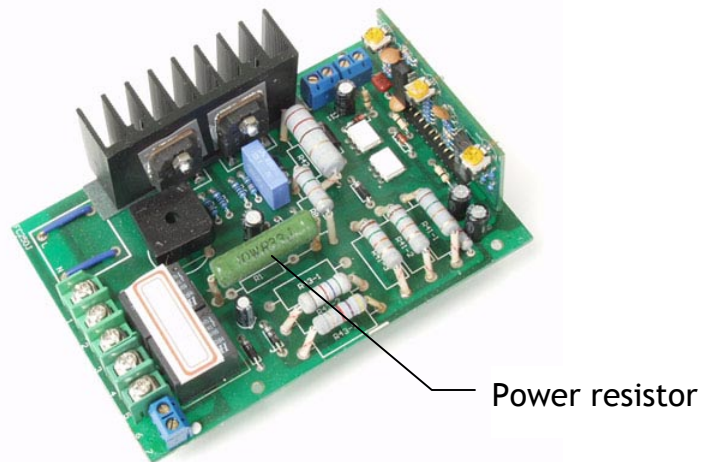
1. Turn on the power. Either "open" the big red emergency switch or press the illuminated rocker switch so it is lit.
2. Turn the speed control knob to zero. On machines with an emergency switch, there is an interlock that prevents the motor from starting unless the knob has been turned to zero after the power is on. On all machines it is a good idea to always start from zero speed.
3. Put the direction switch in forward or reverse.
4. Turn the speed control knob clockwise to start the motor turning.

Motor Will Not Run at All

If the motor will not run at all, make the following checks:

1. Check that there is power to the receptacle from which the lathe is powered.
2. Check the fuse on the control panel. The required fuse is a 5-amp, fast-acting 5 mm x 20 mm fuse. See [Testing the fuse and fuse holder](#).
3. Check the fuse holder. They are prone to breaking.
4. Check the motor brushes to ensure that they are making good contact with the commutator. In general, this means checking that the caps that secure the brushes are tight.
5. Check all wire terminations inside the electrical box, especially the slip-on connectors.

6. Check the switches and potentiometer for signs of physical failure. Test them as described below. See [Component Tests](#).
7. Check the MOSFETs on the speed control board. See [Testing a MOSFET in circuit](#).
8. Check the leads on the large power resistor near the center of the speed control board to ensure that a lead has not broken. If you find a broken lead, repair it with solder. Brace the resistor by placing a small blob of RTV silicone under it.



Motor Runs Only at Full Speed

If the motor runs at full speed no matter the position of the speed control knob, one or both MOSFETs on the speed control board have failed in a shorted condition. See [Testing a MOSFET in circuit](#).

Replace both MOSFETs. They are in parallel and must be matched (that is, the same part number from the same manufacturer) or one will take the entire load and fail prematurely.

Motor Runs Irregularly

If the motor runs irregularly or makes arcing or popping noises, it might be a failure of a brush connection.

Remove the caps that retain the motor brushes and inspect the brushes to ensure that the braided copper wire connects the carbon brush to the brass contact cap. Repair or replace failed brushes.



Fuse Blows When Power Is Turned On

1. Check all wire terminations inside the electrical box, especially the slip-on connectors.
2. Check the switches and potentiometer for signs of physical failure. See [Component Tests](#).
3. Check the MOSFETs on the speed control board. See [Testing a MOSFET in circuit](#).

Component Tests

Following are specific tests for some components of the variable speed drive system. These procedures assume that you have and know how to use a volt/ohm/milliampmeter.

- [Testing the fuse and fuse holder](#)
- [Testing the emergency stop switch](#)
- [Testing the illuminated on-off switch](#)
- [Testing the speed control potentiometer](#)
- [Testing the forward/off/reverse switch](#)
- [Testing a MOSFET in circuit](#)

To test the components you have to unscrew the four Philips head screws that retain the control box. Do not disconnect any of the wires, unless you need to for a particular test. With the control box loose, you can work inside it to test the components.

Testing the fuse and fuse holder



1. Unplug the power cord.
2. Remove the fuse from the fuse holder.
3. Check continuity between the two metal ends of the fuse. There should be continuity.
4. Inspect the fuse holder for cracks or breakage.
5. Replace the fuse in the fuse holder.
6. Check continuity between the two terminals on the fuse holder. There should be continuity.

Testing the emergency stop switch



1. Unplug the power cord.
2. Orient the switch so that the hinge is horizontal at the top and the cover swings up and down.
3. Raise the cover.
4. Check continuity between the two top terminals. There should be continuity between these terminals.
5. Check continuity between the two bottom terminals. There should be continuity between these terminals.
6. Close and latch the cover.
7. Check continuity between the two top terminals. There should be no continuity between these terminals.
8. Check continuity between the two bottom terminals. There should be no continuity between these terminals.

These tests are summarized in the table below:

Terminals	Cover Open	Cover Closed
Top terminals	Connection	No connection
Bottom terminals	Connection	No connection

Testing the illuminated on-off switch



1. Unplug the power cord.
2. Place the switch in the off position, as shown above.
3. Check continuity between the terminal on the 0 end and the other two terminals. There should be no continuity between any of the terminals.
4. Check continuity between the terminal on the 1 end and the other two terminals. There should be no continuity between any of the terminals.
5. Place the switch in the on position, with the 1 end depressed.
6. Check continuity between the terminal on the 0 end and the center terminal. There should be continuity.

7. Check continuity between the terminal on the 0 end and the far terminal. There should be no continuity.
8. Check continuity between the terminal on the 1 end and the other two terminals. There should be no continuity between any of the terminals.

These tests are summarized in the table below:

Terminals	Switch Off	Switch On
0 to Center	No connection	Connection
0 to 1	No connection	No connection
1 to Center	No connection	No connection

Testing the speed control potentiometer



There are two versions of the speed control potentiometer. Some have a switch on the back (and have five terminals), and some don't (and have three terminals).

1. Unplug the power cord.
2. If there are five terminals, turn the potentiometer shaft all the way counterclockwise.
3. If there are five terminals, check continuity between the two terminals on the back of the potentiometer. There should be continuity.
4. If there are five terminals, turn the potentiometer shaft clockwise about 10 or 15 degrees. You should hear a click as the switch changes position. Check continuity between the two terminals on the back of the potentiometer. There should be no continuity.
5. Measure the resistance between the two outside terminals on the side of the potentiometer. The resistance should be between 3000 and 5000 ohms.
6. Measure the resistance between the center terminal and one of the outside terminals on the side of the potentiometer. The resistance should change smoothly from near the value you measured in step 5 to near zero ohms as you turn the potentiometer shaft from one stop to the other.
7. Measure the resistance between the center terminal and the other outside terminal on the side of the potentiometer. The resistance should change smoothly (but in the opposite direction from step 6) from near zero ohms to near the value you measured in step 5 as you turn the potentiometer shaft from one stop to the other.

These tests are summarized in the table below:

Terminals	Counterclockwise limit	Rotating	Clockwise limit
Switch	Connection	No connection	No connection
Outer potentiometer terminals	3-5K ohms	3-5K ohms	3-5K ohms
Left to Center potentiometer terminals	0 ohms	Varies from 0 to 3-5K ohms	3-5K ohms
Right to Center potentiometer terminals	3-5K ohms	Varies from 3-5K to 0 ohms	0 ohms

Testing the forward/off/reverse switch



There are several versions of the forward/off/reverse switch. Some have six terminals, some have nine and some have twelve terminals. The testing procedure is the same for all of them.

1. Unplug the power cord.
2. Looking at the terminal side of the switch, rotate it so that the handle moves up and down. There are vertical columns of three terminals.
3. Place the switch in the off (center) position.
4. In each column of terminals, check continuity between the center terminal and the other two terminals. There should be no continuity between any of the terminals.
5. In each column of terminals, check continuity between the top terminal and the bottom terminal. There should be no continuity between these terminals.
6. Move the handle so it is in the up position.
7. In each column of terminals, check continuity between the center terminal and the bottom terminal. In all the columns there should be continuity between the center and the bottom terminal.
8. In each column of terminals, check continuity between the center terminal and the top terminal. In all the columns there should be no continuity between the center and the top terminal.
9. In each column of terminals, check continuity between the top terminal and the bottom terminal. There should be no continuity between these terminals.
10. Move the handle so it is in the down position.

11. In each column of terminals, check continuity between the center terminal and the top terminal. In all the columns there should be continuity between the center and the top terminal.
12. In each column of terminals, check continuity between the center terminal and the bottom terminal. In all the columns there should be no continuity between the center and the bottom terminal.
13. In each column of terminals, check continuity between the top terminal and the bottom terminal. There should be no continuity between these terminals.

These tests are summarized for each column of terminals in the table below:

Terminals	Switch Off	Switch Up	Switch Down
Center to Top	No connection	No connection	Connection
Center to Bottom	No connection	Connection	No connection
Top to Bottom	No connection	No connection	No connection

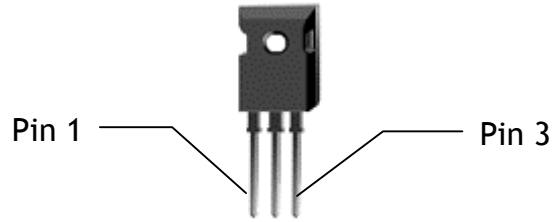
Testing a MOSFET in circuit

MOSFETs are very sensitive to static electricity. Here are the procedures the U. S. Navy recommends when testing them (out of circuit).

You must be extremely careful when working with MOSFETs because of their high degree of sensitivity to static voltages. As previously mentioned in this chapter, the soldering iron should be grounded. A metal plate should be placed on the workbench and grounded to the ship's hull through a 250-kilohm to 1-megohm resistor. You should also wear a bracelet with an attached ground strap and ground yourself to the ship's hull through a 250-kilohm to 1-megohm resistor. You should not allow a MOSFET to come into contact with your clothing, plastics, or cellophane-type materials. A vacuum plunger (solder sucker) must not be used because of the high electrostatic charges it can generate. Solder removal by wicking is recommended. It is also good practice to wrap MOSFETs in metal foil when they are out of a circuit. To ensure MOSFET safety under test, use a portable volt-ohm-milliammeter (vom) to make MOSFET resistance measurements. A vtmv must never be used in testing MOSFETs.

While you can follow most of these recommendations in your home shop (substituting a good ground for the ship's hull), in our experience you shouldn't have much trouble while testing them in circuit if you just use a little common sense (don't pat your cat while making these tests).

If the measurement between any two pins is 0 ohms, the MOSFET has failed.



1. Set the VOM to the 200K Ohms scale. If your VOM does not have a 200K ohms scale, set it to the nearest scale to 200K ohms.
2. Confirm that the red lead is in the red connector on the VOM and that the black lead is in the black connector.
3. With the red probe on the lower numbered pin, measure the resistance from pin 1 to pin 3. The reading should be about 50K ohms.
4. With the red probe on the lower numbered pin, measure the resistance from pin 1 to pin 2. The reading should show infinity.
5. With the red probe on the lower numbered pin, measure the resistance from pin 2 to pin 3. The reading should show infinity.
6. With the black probe on the lower numbered pin, measure the resistance from pin 1 to pin 3. The reading should be about 50K ohms.
7. With the black probe on the lower numbered pin, measure the resistance from pin 1 to pin 2. The reading should show infinity.
8. With the black probe on the lower numbered pin, measure the resistance from pin 2 to pin 3. The reading should be about 120K to 140K ohms.

These tests are summarized in the table below:

Between Pins	Red on lower numbered pin	Black on lower numbered pin
1–3	50K ohms*	50K ohms*
1–2	Infinity ohms	Infinity ohms
2–3	Infinity ohms	120K-140K ohms

*The 50K ohms readings between pins 1 and 3 are measuring resistance on the circuit board. This same measurement with the MOSFET out of the circuit will indicate infinity ohms.

Parts List

The following list provides the LittleMachineShop.com part numbers for the parts you might need.

1333	Fuse Holder
1524	Fuses, 3A
1217	Fuses, 5A
1687	Motor Brush Retainers

1686	Motor Brushes
1815	Motor Controller Upgrade Kit
1817	Motor Controller Upgrade Kit (HF)
1336	Motor Controller, Mini Lathe
1211	Motor Controller, Mini Mill
1311	Motor, Mini Lathe
1128	Motor, Mini Mill
1282	Potentiometer
1221	Power MOSFET transistor
1332	Switch, Emergency Stop
1335	Switch, F/O/R
1797	Switch, Power