



# Service Bulletin

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**Product Identification:** All Tormach CNC Machine Tools using Mach3

**Overview:** This Service Bulletin focuses specifically on issues related to USB related motion failures whose origin lie in electrical noise. In this document we describe a software diagnostic tool Tormach has developed to indentify the problem. The latter section of this document provides information on ways to resolve the problem, should a problem exist.

**Note:** Electrical noise is not the only source for motion control problems. A more general Tormach Service Bulletin<sup>1</sup> regarding best practices when using Mach3 identifies additional sources of motion control issues related to PC control under Mach3.

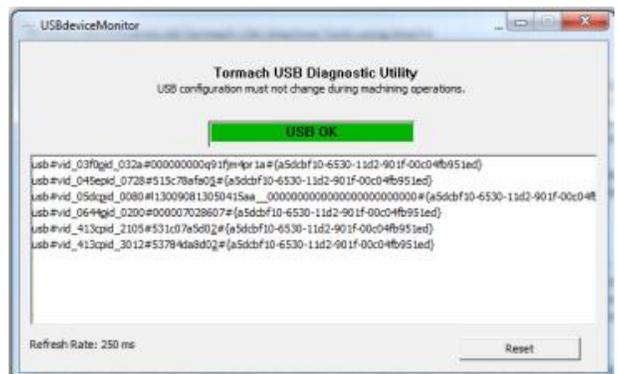
**Background:** Electrical noise can be generated by a variety of sources, but perhaps the most common source in industrial and machine tool applications is the situation where some electrical device (relay, switch, transistor, etc.) creates an immediate halt to the flow of electrical current through an inductive device (motor, relay coil, solenoid valve, etc). What happens electrically is similar to the mechanical problem of a water hammer, where a rapidly closed valve creates an immediate halt to the flow of water and generates a hydraulic shock that echoes back through the plumbing system.

In a PC electrical noise can create a communication disturbance that will result in one or more USB devices being automatically disconnected. It will appear to the operating system as though the USB device was removed. Usually, within very short order after the disturbance, the PC will scan the USB network and add the USB device back into the network. If the device is something like a mouse or keyboard, you may simply notice it goes dead for a few seconds and then starts working again.

The problem with this is that the USB registration process within Windows is computer intensive and high priority. If this USB reject/recover cycle occurs while Mach3 is moving the machine, then the CPU activity can disrupt the machining process, potentially causing a motion failure.

### Diagnostic Test:

Tormach has developed a special program that can be used to check your system for this occurrence. The program does not solve the problem, it only detects it. In order to run the test, download the Tormach utility program: USB-Sniffer.ZIP from the Tormach web site<sup>2</sup>. You will need to open the ZIP file and then run the program on the computer you are using with Mach3. You can run the program directly out of the ZIP file, or unpack it to the desktop and run it from there. The program comes up with a simple screen as shown to the right:



<sup>1</sup> Tormach service bulletins [http://www.tormach.com/tormach\\_service\\_bulletins.html](http://www.tormach.com/tormach_service_bulletins.html)

<sup>2</sup> Tormach software downloads <http://www.tormach.com/downloads.html>



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The inventory listed below the USB OK indicator is the list of USB devices found on the computer when you started the program. You can tell that the program is operating by removing and then replacing any USB device such as a thumb drive, mouse, or keyboard. If there are any changes in the USB configuration the green bar will turn red. Remember, there should never be changes in USB configuration during the machining process. This includes something as simple as removing a USB thumb drive.

If you unplug a USB device to test operation of the diagnostic program you can either restart the program or click on the Reset button in the lower right hand corner in order to restore the green bar.

## Performing the test:

Start the program and make sure you see the green bar. While the program is running, turn on your mill. With the mill on, but without Mach3 running, you'll need to toggle on and off any and all electrical loads in your shop. This will include inductive devices in the mill itself. Your tests should include:

1. Manually toggle the coolant pump on and off.
2. Manually turn on the spindle. While the spindle is running, turn the spindle disable key switch. You'll hear the spindle contactor drop out and then the spindle stops.
3. If you use a solenoid operated mist coolant, such as the Tormach Fog Buster, toggle it on and off.
4. If there is an air compressor in your shop, turn it on and make sure it goes through pressure cycle.
5. If you use a shop vac while the machine is running, try running the shop vac.
6. Run any other motors in the shop, such as drill press, bandsaw, tablesaw, or other devices.
7. If you have a refrigerator in your shop or on a nearby circuit, make sure the refrigeration compressor kicks in while the diagnostic program is running.
8. If you have a TIG welder, MIG welder, or plasma cutter in the shop we recommend that you do not run it while the machine is running. There's simply too much EMI/RFI interference broadcast by those types of devices.

Each of these tests should be run several times, as the impact of a switching even is somewhat random.<sup>3</sup> If any of these devices create enough electrical noise to upset the USB configuration in your computer, the green bar will turn red. This is a clear indication that you have a condition which should be resolved.

## Fixing the Problem: Internal Sources

If the diagnostic test indicates that there is a USB problem occurring on item 1 or 2 of the list above you should install the Electrical Noise Suppression Kit, Tormach (PN 33059). If you're using an alternative coolant or misting system, as in item 3 above, then we suggest plugging your alternative coolant system into the coolant power outlet on the bottom of your PCNC mill in combination with the Electrical Noise Suppression kit. You may also find the Tormach Switched Outlet Kit (PN 33043) convenient as it allows the coolant outlet to be shared between the internal flood coolant and some external system, such as a mist coolant system.

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<sup>3</sup> The AC current that powers the machine is a sine wave. If the switching event happens as the wave is near zero there will be little electrical noise. Maximum electrical noise occurs only when the switching event occurs at the moment of peak current, at a high or low point on the wave. Switching multiple times is necessary to catch the wave at a peak.



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## Fixing the Problem: Outside Sources

Here we're talking about items 4 through 8 in the test list of the prior page, plus anything else you might have found triggered the fault indication of the diagnostic software. The Electrical Noise Suppression Kit, Tormach PN 33059, will provide some improvement but it may not be enough. Suppression works best by killing the electrical noise at the point of generation. The noise suppression kit will add suppression to the electrical network, but not at the optimum position.

For suppression of externally generated electrical noise we recommend the use of commercially available noise suppression devices. Some examples are listed below. Alternatives to suppression are to 1) decommission the offending device or 2) electrically isolate the device by powering it on a distant circuit. The further, in terms of wire length, a noise source is from the computer, the less impact it will have. The references below suggest some typical devices which may be useful, however we cannot provide any guarantee that they will resolve problems unique to your situation. If devices such as this do not eliminate your USB faults you should refer to a qualified local electrician. We also recommend reviewing the appendix notes regarding nomenclature and technology as a bit of buyer's guidance on the subject.

Brickwall Line Conditioners

(<http://www.brickwall.com/pages/line-conditioners>)

Simply Automated ZNF10A-P Noise Filter and Attenuation Isolator

(<http://cache.smarthome.com/images/22955big.jpg>)

Energy Smart Surge Protector with Noise Filter

(<http://www.peerless-av.com/en-us/consumer/products/PVP2000-PL4>)

Tripp-Lite ISOBAR2-6 All metal housing Isobar Surge Suppressor

(<http://www.tripplite.com/en/products/model.cfm?txtModelID=97>)

## Appendix Notes

When shopping for electrical protection devices you'll come across a lot of terminology, much of it irrelevant. There are a lot of different types of electrical protection and many do not address the type of electrical disturbance that creates USB dropout. Better protection devices offer a mixed bag, combining surge protection with noise protection. In some cases electrical noise protection is combined in an AVR or UPS system. The thing to look for is a reference to electrical noise protection. Be aware that electrical noise filters are relatively inexpensive, while AVR or UPS system can be quite expensive and their primary function, that is the expensive part of what they do, is irrelevant to the problem of USB and motion control.

### Related Terminology

**EMI/RFI** is electromagnetic interference and radio frequency interference. They differ in terms of frequency, but these are wave phenomena that come through the air, like broadcast radio or television. This is the noise you'll hear on an AM radio during a thunderstorm. Devices that claim EMI/RFI protection are useful for protection. Essentially what happens is that the power line or ground wire can act as an antenna and pick up the radio waves, translating the radio waves into local electrical noise. EMI/RFI filters will kill that noise.

**Electrical Noise** is a random fluctuation in an electrical signal. This is the root cause of the USB fault. Across AC lines it is generally filtered using an RC network. The RC network devices go under several names. They can be called snubbers, suppressors, spark arrestors, or AC noise filters. These are all different names for the same thing.

**Automatic Voltage Regulation (AVR)** devices are designed to stabilize wandering AC voltages. In some localities the line voltage is not stable and, instead of a steady 120 VAC, you can find you have a wandering voltage, potentially drifting from 90 volts to 150 volts. An AVR can resolve this, but it will not solve the USB failure issue unless it also contains filters for electrical noise.

**Surge Suppression** or **Surge Arrestor** should not be confused with noise suppression. Electrical noise is a low energy localized phenomena. It can travel several hundred feet through household electrical wiring before dissipating. An electrical surge is much larger in energy level and in scope, often associated with a lightning strike or major grid failure. Where electrical noise can impact a portion of your household wiring, a surge can impact an entire neighborhood. Products claiming to offer surge protection but do not mention electrical noise filters or EMI/RFI protection will not resolve problems associated with USB dropout.

**MOV** is Metal Oxide Varistor. This is the low cost device that is most commonly used in consumer surge protection products. An MOV is an effective device, but it can fail when subject to a high energy surge and failed devices are undetectable without specialized equipment. In other words, an MOV surge arrestor may catch the first incident but die as a result, leaving you with ineffective protection and vulnerable to subsequent surges.

**UPS** is Uninterruptable Power Supply. This is a device with battery backup that can provide AC power for a limited time despite a failure in the AC line.