

Problem:

Why does my CPU board sporadically reboot?

Solution:

There are many reasons why a VersaLogic CPU board might sporadically reboot, but the most probable causes are power quality issues. Most cases are resolved by a thorough inspection of the power supply system. Click on the topics below to read about the possible causes of sporadic reboots:

[Power Quality](#)[Using PC/104 Power Supplies](#)[Voltage Monitoring Chip](#)[Pushbutton Reset](#)[Activity on the ISA Reset Signal](#)[Watchdog Timer Issues](#)[Watchdog Timer Enable Procedure](#)[CPU Chip Overheating](#)[CPU Not Seated Properly](#)[Bad Memory](#)[Electrostatic Discharge \(ESD\)](#)[Electromagnetic Interference \(EMI\)](#)[Software Related Resets](#)[Board Malfunction or Manufacturing Defect](#)[Unexpected Activity on IRQ or DMA Signals](#)[Bus Trouble](#)[Bad CPU Chip](#)**Power Quality**

VersaLogic CPU boards require constant +5.0V, +/-5%, for proper operation. They feature a voltage monitoring circuit which constantly watches Vcc. If the +5.0V supply voltage drops below +4.75V for greater than approximately 1 microsecond, the circuit will assert the system reset signal until voltage returns to normal levels. The minimum duration of the reset signal is 250 milliseconds.

The voltage monitoring circuit will also reset the CPU if it detects momentary power loss, which could happen if power mating connectors are jarred loose due to vibration. Mating connectors can wear out if plugged and unplugged many times.

If the voltage, best measured at the fan connector, is less than +5.0V, and you have an adjustable output power supply, you might consider increasing the voltage to about +5.1V to compensate for the voltage drop that naturally occurs in the power distribution conductors, mating connector(s), and circuit board traces. Also, be sure your power supply stays in spec and doesn't drift over temperature.

Larger gauge, shorter wires and use of the voltage sense feature of your power supply can also be used to minimize and compensate for excessive voltage drop in the supply wires. Power supply leads should be twisted together, and care must be taken to keep the wires physically separate from other high current/high voltage conductors, especially 115VAC circuits.

When making connection to the main power input connector on the CPU board, all +5V and GND pins should be used to keep the connection resistance as low as possible.

Another source of voltage dropout is large temporary power demand from the PC/104 stack, or from the CPU chip as it shifts in and out of various operating modes. If possible, make sure that electric current feeding external loads is not conducted through the same power supply wires serving the CPU board.

If your system starts to boot up, and resets at the same point every time, it could be that a large surge in current caused by hardware initialization or activation is causing Vcc to drop below spec.

High switched current loads on the PC/104-Plus stack or other peripherals are also suspect. Watch out for devices attached to Vcc that could cause voltage spikes (relays, or large loads that switch on and off).

Powering the CPU using PC/104 (ISA) DC/DC Power Supplies

There have been reports of instability when powering CPU boards using stack mounted DC/DC supplies. Most of the issues can be traced to voltage drops across the power and ground pins in the PC/104 (ISA) bus. To eliminate this problem, it is recommended that power wires be added between the output screw terminal strips on the DC/DC power supply and the main power input connector on the CPU board. This practice ensures a low resistance path for the power currents, and provides a much more stable power distribution scheme. VersaLogic does not guarantee proper operation of its CPU boards when powered only through the PC/104 (ISA) bus pins.

Although not related to sporadic resetting, there have been reports of DC/DC power supplies causing electromagnetic interference to sensitive A/D converter cards due to strong high frequency AC magnetic fields inducing unwanted voltages in the sensitive analog circuitry. This problem can be mitigated by shielding the power supply or increasing the physical distance between the power supply and the sensitive circuits.

Voltage Monitoring Chip

VersaLogic CPU boards feature a sensing circuit that monitors three vital conditions needed for proper operation: power supply voltage, proper software execution, and pushbutton reset. First, a precision temperature-compensated reference and comparator circuit monitors the status of Vcc. When an out-of-tolerance condition occurs (low Vcc), an internal power fail signal is generated that forces reset to the active state. When Vcc returns to an in-tolerance condition, the reset signal is kept in the active state for a minimum of 250 ms to allow the power supply and processor to stabilize. There is no voltage hysteresis in this circuit. The second function involves pushbutton reset signal conditioning. The chip debounces the pushbutton input and guarantees an active reset pulse width of 250 ms minimum. The third function is a watchdog timer. The chip includes an internal timer that forces the reset signals to the active state if the strobe input is not pulsed prior to watchdog timeout. The watchdog timer function is configured to operate on a timeout setting of approximately 600 ms (250 ms min., 1000 ms max.). This produces a CPU reset in the event of a software hang or runaway condition.

Pushbutton Reset

All VersaLogic CPU boards feature a pushbutton reset input designed to be connected to a momentary SPST switch. To reset the CPU, the signal is briefly connected to logic ground.

In some electrically noisy installations, sporadic CPU resetting has been traced to voltage transients and noise pulses on the pushbutton reset input signal. Most often, this happens when the pushbutton reset signal line is extended several feet away from the CPU board. Some customers have reported electrical noise on the Ethernet (CAT5) cable causing sporadic resetting. This was traced to inductive coupling between the Ethernet signals and the pushbutton reset input signal because the signal wires are in close proximity in the ribbon cable used in some breakout cables.

A 22 μ F to 50 μ F noise suppression capacitor can be added across the pushbutton reset terminals (i.e., from the pushbutton reset input signal to ground) to suppress this noise and squelch any EMI that might be triggering the board reset. Some customers have reported success by adding a 200 ohm (or greater) pull up resistor between the pushbutton reset input signal and +5 volts.

Anytime the pushbutton reset input signal is grounded the CPU will reset. There have been rare cases where the pushbutton reset contacts have inadvertently made contact in some high vibration environments.

Activity on the ISA Reset Signal

A normal CPU reset caused by low Vcc, pushbutton reset, or watchdog timeout will produce a 250 millisecond (or longer) HIGH level reset pulse on the PC/104 (ISA) RESETDRV B2 pin. This signal is used to reset the processor and all associated logic circuits. The CPU is the source of this signal, but if for some reason the RESETDRV signal was driven high by an external source (i.e., an expansion board), the system would also reset. There have been reports of short (4.5 millisecond) reset pulses seen on the RESETDRV signal. It was determined that a software reset (warm reboot) could cause this type of reset pulse.

For reasons that are unclear, some manufacturers of PC/104 (ISA) DC/DC power supplies place a 0.1 μ F cap from PC/104 (ISA) RESETDRV B2 pin to +5V. While one capacitor probably isn't much of a problem, the power supplies are designed so that multiple units can be stacked together on the PC/104 stack. If multiple power supplies are stacked, the caps would be connected in parallel, causing a dramatic increase of (unwanted) capacitance in the reset circuit.

Watchdog Timer Issues

Whenever the watchdog timer is enabled, special care must be taken to execute continuous watchdog timer reset instructions to prevent the watchdog timer from timing out and causing a system reset. In systems with an armed watchdog, any program hang or delay which "starves" the watchdog will result in a system reset. This could have the

appearance of a sporadic reset. To test for this condition, simply disable the watchdog to see if the problem goes away.

One customer discovered a software bug in an application program involving a timer that triggered a software routine to poll a COM port. There is only supposed to be one timer, but during a shutdown sequence, the software accidentally set up two timers. The result was a flood of data messages that clogged the software environment. This resulted in a hang (or long pause) that caused the watchdog timer to reset the CPU board. The problem disappeared when one of the timers was shut down. Using data supplied by VersaLogic, the customer examined the watchdog signal with an oscilloscope and concluded the Watchdog (not the Power Supply) was resetting the unit.

Determining the root cause of uncommanded CPU resetting is difficult, future CPU products will have test points to make field probing of reset causes easier to perform.

Watchdog Timer Enable Procedure

There have been reports of occasional computer resets at the exact moment the watchdog is enabled. To prevent this problem, a very specific procedure must be followed to enable the watchdog timer. The correct watchdog enable sequence is documented in the Panther reference manual.

Also see related KnowledgeBase article [VT1377 - VSBC-8 Watchdog Timer Resets the CPU Immediately upon Arming.](#)

CPU Chip Overheating

Sporadic reset and CPU chip malfunction can be attributable to excessive die temperatures. The heatsink/fan assemblies used on VersaLogic CPU products are sufficient to conduct heat away from the CPU chip when the systems are operated within the specified ambient air temperatures defined on the datasheet. However, if the heatsink/fan assembly has been altered, damaged, or incorrectly assembled, or if the fan stops spinning or the airflow is blocked, a dangerous buildup of heat can occur that will cause the CPU to malfunction. Sporadic system resets are often the result.

Many CPU boards feature a die temperature thermometer which can be read digitally using a DOS based "hotdog" utility available from VersaLogic technical support.

CPU Not Seated Properly

In very rare cases CPU chips are not fully seated in the socket or have come loose due to high vibration conditions. We have never been able to establish a direct correlation with sporadic CPU resetting, but it is always a good idea to inspect your CPU chip to make sure it is firmly seated in it's socket.

Bad Memory

In one case, a customer reported sporadic resets that were ultimately traced to a bad DRAM module. When the module was replaced, the board worked normally.

In addition, it is possible for contamination to get into the memory socket, which can result in unreliable operation. To solve this problem, we recommend reseating the memory. The basic procedure involves removing the memory from its socket, cleaning the gold fingers, blowing out the empty socket, and reinserting the module.

Electrostatic Discharge (ESD)

Electronic circuitry can be damaged if subjected to high voltage ESD events. The exact nature of the damage depends on the physical location of the discharge and the affected circuitry. Care must be taken to handle all sensitive electronic components, such as CPU boards, using industry accepted static-dissipative practices. Almost all ESD damage is invisible and hidden.

See the related white paper [ESD and the OEM: Changing Needs in Industrial Control Systems](#).

Electromagnetic Interference (EMI)

There have been occasional reports of systems sporadically hanging or resetting due to voltage transients and spikes caused by the switching of inductive loads or operation in close proximity to Servo Amplifiers, SCR Drive Systems, Variable Frequency Drives, and Radio Transmitters. Shielding from EM generators and other safeguards should be used to protect the CPU board from excessive conducted and radiated EMI energy. Ferrite chokes can be used on AC power lines and other I/O signals to help mitigate this problem.

One customer wrote, "Our system has some wires routed close to the CPU, and these wires have the potential for voltage spikes, as they are the outputs of relay contacts which turn on solenoids. When these signals are activated, the computer shuts down, then reboots. The problem went away when I re-routed the wires away from the computer."

Control wiring carrying large amounts of current and/or voltage should always be kept as far away as possible from the relatively sensitive circuits of CPU boards. The solenoid coils produce a voltage spike called "inductive kickback" when the coil de-energizes. This voltage spike generates a brief, large magnetic field around the wires that power the solenoid coil. If these wires are physically near the CPU board, the rapidly expanding magnetic field will induce unwanted voltages on the circuit board and can briefly corrupt communication between chips. The CPU board depends on error-free communication, and does not have the necessary circuitry to detect and correct instantaneous malfunctions like this. Symptoms can include CPU reset, computational errors, system hangs, and improper operation. It is doubtful that the solenoid coil wires are causing permanent damage to CPU.

Software Related Resets

This is a huge topic which goes beyond the scope of this article. But suffice it to say that stack overflows, buffer overruns, and other bugs can cause the CPU to run "astray" and hang or reset. If the watchdog is armed, most hang conditions will be detected and



trigger a CPU reset. It's also worth mentioning that the CPU can be reset under software control using a wide variety of methods (jump to restart vector, sending commands to the chipset and/or keyboard controllers, etc.).

Board Malfunction or Manufacturing Defect

No treatise on sporadic CPU resets would be complete without mentioning potential board malfunctions or manufacturing defects. Obviously broken solder joints or compromised chipsets can cause intermittent operation. Sometimes this can result in sporadic CPU resets, but usually it manifests in a dead board or a malfunctioning subsystem (e.g., no video, no Ethernet, etc.).

Unexpected Activity on IRQ or DMA Signals

System hangs and restarts have been known to occur if Interrupt Request (IRQ) or Direct Memory Access (DMA) signals are activated on the ISA or PCI bus without the appropriate handlers being set up in software. It is always a good practice to disable (mask) unused interrupt levels and keep all DMA hardware in a disabled state until needed.

Bus Trouble

If data, address, and/or control signals on the PC/104 (ISA) or PC/104-Plus (PCI) buses are physically corrupted (circuit opens, shorts, etc.) or electrically corrupted (timing problems, bus contention, improper decoder design), it is possible for software and hardware to react in unpredictable ways.

Bad CPU Chip

Not above suspicion. But all VersaLogic boards are subject to rigorous testing and environmental stress screening (ESS), so most CPU chip failures can be traced to ESD damage or other physical damage (excessive heat, fell out of socket, etc.).

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