



**DES VICOR POWER SUPPLY  
&  
INTERNAL CONTROLLER BOARD  
DIAGNOSTICS DOCUMENT  
FOR  
PRODUCTION CRATE VERSION 3.0  
NOT CONNECTED TO ICS**

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This document describes how to diagnose the cause of why the Vicor power supply will not turn on in the production crate, version 3.0 when there is no ICS connected. Diagnosis will include the Vicor power supply and the Internal Crate Controller board, without the Instrument Control System connected.

**STEP 1 – DHE SYSTEM INTERLOCKS:**

Any one of these interlocks will cause the power supply to turn off:

Hardware Based Interlocks

1. OK\_PWR\_UP Interlock.
2. Vicor power supply over-voltage Interlock.
3. Vicor Fan RPM Interlock.
4. Mechanical temperature switches Interlock.

Firmware Based Interlocks

1. No\_Faults Interlock

Each of these interlocks control a normally-closed, solid-state relay, which have to be energized for the power supply voltage to come up to nominal values. These relays are:

**TABLE #1: INTERLOCK RELAYS ON ICC BOARD**

SECTION	INTERLOCK	REFERENCE DES. ON ICC BOARD
I	OK_PWR_UP	U101
II	Vicor Fan RPM OK	U104
III	No Faults	U103
IV	Over-Voltage (Volts_Good)	U102
V	Mechanical Temperature Switch	P118

If the Vicor power supply voltages do NOT come up, each relay will need to be checked with a DMM to determine the failure.

**I. To check the OK PWR UP Interlock:**

The OK PWR UP signal and the SCLK signal are driven high by the emulator plug to allow the dhe crate & Vicor power supply to power up without any ICS connected. The OK PWR UP signal directly controls the OK\_PWR\_UP Relay. The SCLK signal needs to be driven high so the firmware on the ICC board Module won't hang and prevent proper monitoring for faults.

**I.I Check OK\_PWR\_UP Relay:**

- I.I.I. Make sure emulator plug is installed.
- I.I.II. Allow crate to power up & go into fault mode.



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- I.I.III Use a DMM to check the voltage on pin 1 of U101.
- I.I.IV. The relay is energized, and not the cause, when pin 1 measures between 1.00-1.50 volts RMS DC with respect to ICC RTN (TP501-TP504) on ICC Board). Typical Voltage on pin 1 is 1.16v.

### **I.II Check SCLK signal:**

- I.II.I. The crate should still be in fault mode.
- I.II.II. Use a DMM to check the voltage on pin 10 of U601.
- I.II.III. The voltage should be low (~0.989v) when sclk is not the cause. The voltage will be high (~2.91v) when there is a problem with the sclk signal.

## **II. To check the Vicor fan RPM OK Interlock:**

The Vicor fan RPM OK optical circuit directly controls the Vicor fan RPM OK Relay. This relay has to be energized to allow the crate and Vicor power supply to power up.

### **II.I Disable Vicor fan circuit:**

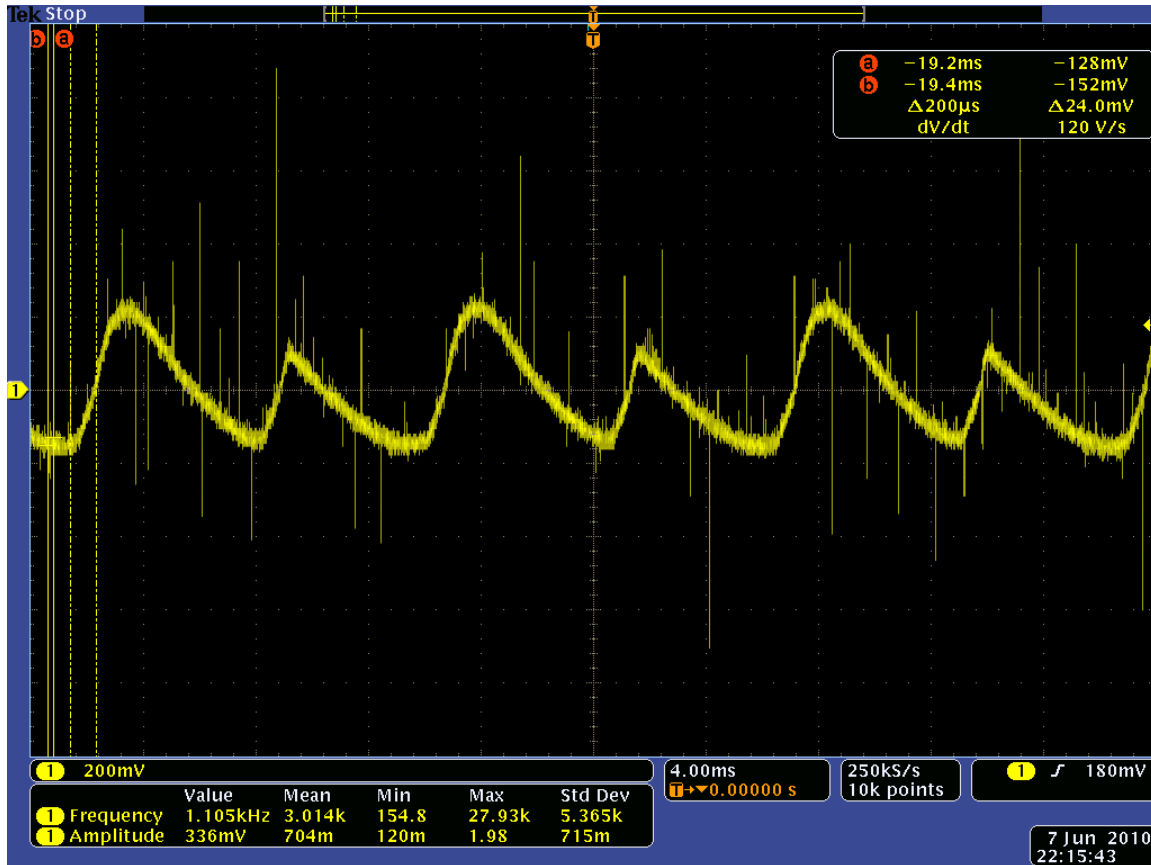
- II.I.I. Set SW901 to disable Vicor Fan signal.
- II.I.II. Power-cycle the crate.
- II.I.IV. The Vicor fan RPM OK circuit is the cause if the Vicor supply comes up.

If the Vicor fan RPM OK circuit is causing the the crate & Vicor power supply to not come up, then the optical circuit and it's connections can be checked and might need calibrated.

### **II.II Check External Optical Sensor Circuit & Connections:**

- II.II.I Use an oscilloscope to check pin 4 of P109 on ICC board for a signal.
- II.II.II Attach the probe return to ICC RTN (TP501-TP504) on ICC Board Module).
- II.II.III. Peak-Peak Voltage should be above 125mv for the circuit to work properly.
- II.II.IV. If signal is not above 125mv, first try to re-calibrate optical circuit by moving optical sensor inside A/C fan shield until peak-peak voltage is above 125mv and Vicor Fan RPM Relay stays energized.
- II.II.V. If no signal is present after moving optical sensor, then the external optical circuit is broken.
- II.II.VI. See Image #1 to see what the signal should look like.

**IMAGE #1: VICOR FAN RPM OPTICAL CIRCUIT SIGNAL**



### **III. To Check the No Faults Interlock:**

The ICC board Module's firmware monitors for fan RPM alerts, measured temperature faults, & measured humidity faults, The firmware will de-energize the No Faults Relay if any of these faults are seen.

#### **III.I Check the No Faults Relay:**

III.I.I. Use a DMM to check the voltage on pin 1 of U103.

III.I.II The relay is energized, and not the cause, when pin 1 measures between 1.00-1.50 volts RMS DC with respect to ICC RTN (TP501-TP504) on ICC Board). Typical Voltage on pin 1 is 1.16v.

III.I.III If no voltage is present then the firmware has determined one of the eight 60mm fans have failed.

If the No Faults relay is the cause, then either a fan or fan connection has failed, the temperature of the ICC board Module is above 50 degrees Celsius, or the relative humidity level of the air around the ICC board Module is above 80%.



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### **III.II Check temperature of ICC board Module.**

- III.II.I. The crate should be in fault mode.
- III.II.II. Use a thermocouple or other temperature measuring device to measure the temperature of the ICC board.
- III.II.III. The temperature should not be above 50 degrees Celsius.

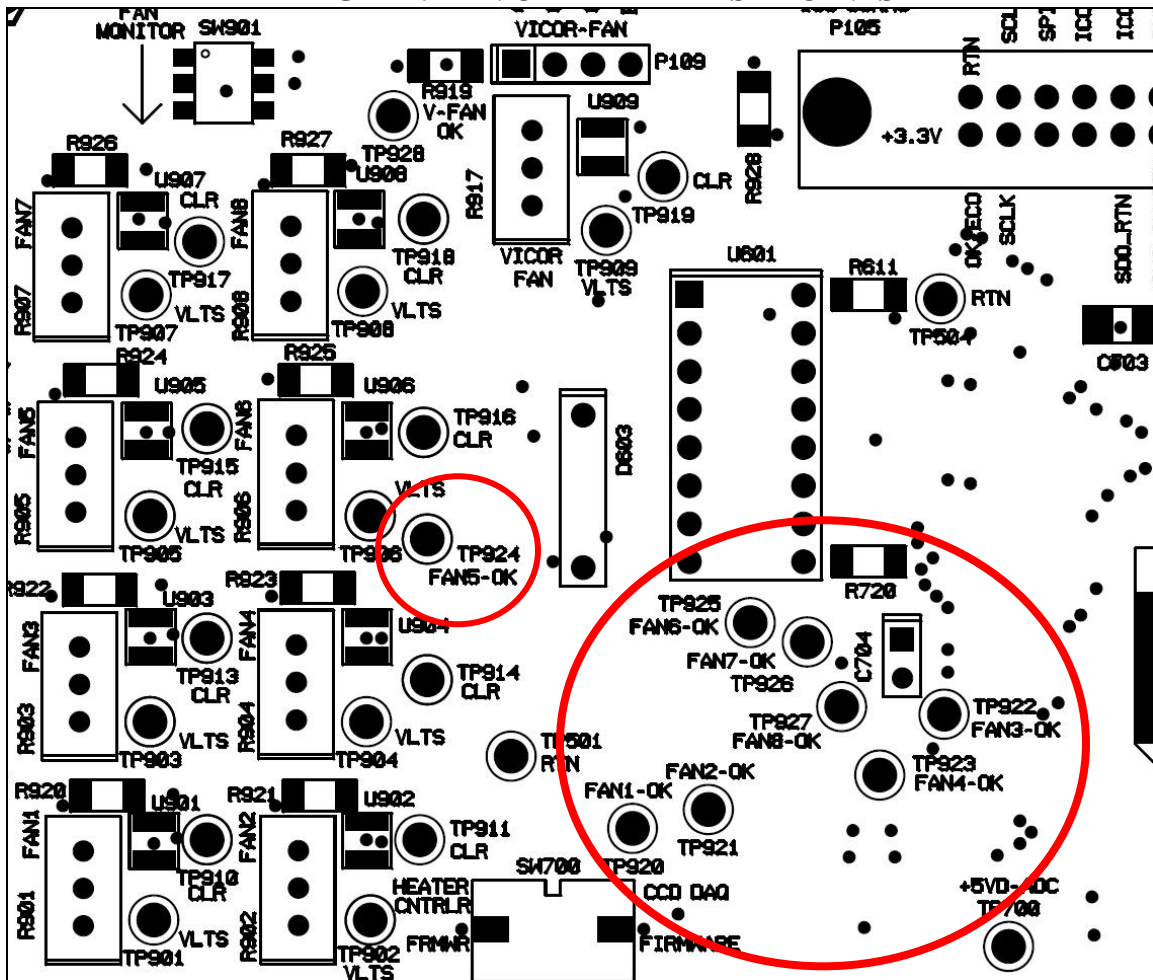
### **III.III Check relative humidity of ICC board Module.**

- III.III.I. The crate should be in fault mode.
- III.III.II. The air around the ICC board Module should have a relative humidity less than 80%.
- III.III.III. Check for any coolant leaking in the crate if the relative humidity is above 80%.

### **III.IV. Check fan alert circuit:**

- III.IV.I. The crate should be in fault mode.
- III.IV.II. Use a DMM to check the voltage of each fan ok alert test points.
- III.IV.III. See Image #2 below for each fan ok test point location.
- III.IV.IV. The voltage should be 3.308v, at each test point, to indicate the fan RPM is OK for each fan.
- III.IV. V. A low signal indicates a fan ok RPM fault.

IMAGE #2: FAN OK ALERT TEST POINTS

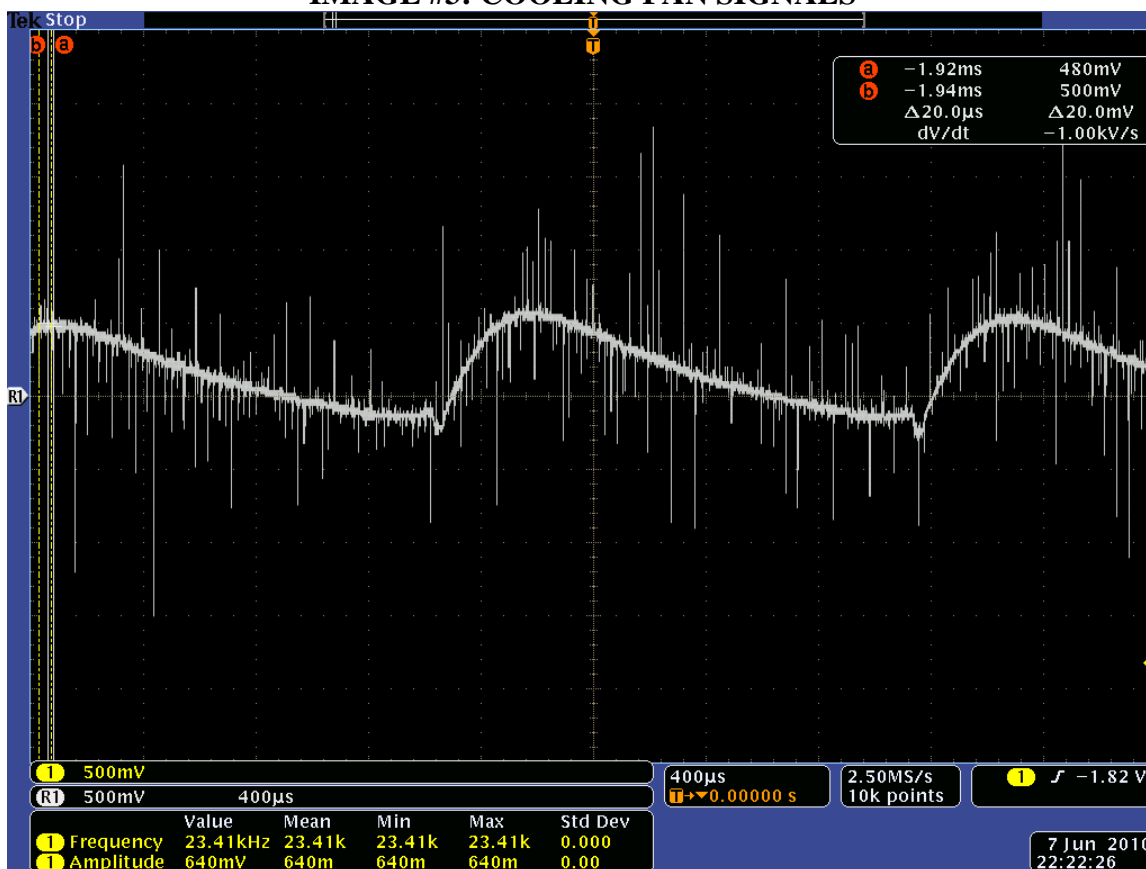


If the fan alert circuit is the cause, then one or some of the fans or fan connections are bad. Check the bad fan/s & fan connection/s.

### III.V Check each 60mm fan:

- III.V.I. Use an oscilloscope to check the pin on P110 or P111 associated with the bad fan.
- III.V.II. Check pin 3(fan #1), pin 5(fan #2), pin 7(fan #3), and pin 9(fan #4) on P110 for a signal.
- III.V.III. Check pin 3(fan #5), pin 5(fan #6), pin 7(fan #7), and pin 9(fan #8) on P111 for a signal.
- III.V.IV. If no signal is present, but fan is running, check connections from fan.
- III.V.V. If fan is not running, replace fan & retest.

**IMAGE #3: COOLING FAN SIGNALS**



#### **IV. To Check the Over-Voltage (Volts Good) Interlock:**

The voltages from the Vicor power supply are monitored for an overvoltage and an undervoltage condition. Any voltage level above 10% of nominal voltage will cause an overvoltage fault. Any voltage level below 10% of nominal voltage will cause an undervoltage fault. Any fault will de-energize the OverVoltage (Volts\_Good) Interlock Relay.

##### **IV.I Check the OverVoltage (Volts\_Good) Relay:**

- IV.I.I. The crate should be in fault mode.
- IV.I.II. Use a DMM to check the voltage on pin 1 of U102.
- IV.I.III. The relay is energized, and not the cause, when pin 1 measures between 1.00-1.50 volts RMS DC with respect to ICC RTN (TP501-TP504) on ICC Board). Typical Voltage on pin 1 is 1.11v.



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If the OverVoltage Relay is de-energized, then at least one of the Vicor voltages is causing the fault. Use the overvoltage disable switch, SW401, to determine which voltage/s are bad.

The DAQ crate will use all 8 voltages: +5vd, +3.3vd, +/-15va, +/-5va, -28va, & +48va and thus no voltages on SW401 should be disabled under normal conditions.

The heater crate will use only 5 voltages, instead of 8: +/-15va, -28va/-15va, +48va/+15va, and +5va/Shutdown Signal. Under normal conditions, on the heater crate +5vd, +3.3vd, & -5va on SW401 should always be disabled to allow the crate & Vicor power supply to come up.

**IV.II Method #1- Use SW401 to determine bad voltage/s:**

- IV.II.I. Disable all voltages on SW401.
- IV.II.II. Enable one voltage at a time on SW401.
- IV.II.III. Power-cycle the crate.
- IV.II.IV. Use the switch to determine which voltage/s are bad.

**OR**

**IV.III Method #2- Use DMM & probe to determine bad voltage/s:**

**IV.III.I. Force the Vicor power supply to turn on DC voltages:**

- IV.III.I.I. Unplug Cable H, Blue, Vicor Enable/Disable cable from ICC board.
- IV.III.I.II. Unplug Cable J, Brown, Power-Good cable from the ICC board.
- IV.III.I.III. Power-Cycle the crate.

**IV.III.II. Check each over-voltage signal:**

- IV.III.II.I. Use a DMM to check each pin on U409. See table below.
- IV.III.II.II. The voltage will be high (+5.01v) if the over-voltage circuit for that voltage is tripped.

**TABLE #2: OVER-VOLTAGE ALERT TEST POINTS**

Slot # on Vicor Supply:	#2	#1	#8	#7	#6	#5	#4	#3
	+3.3VD	+5VD	+5VA/ +15v	-5VA	+15VA	-15VA	-28VA/ -15v	+48VA/ +15v
<b>TO CHECK:</b>	<b>U401/ U205</b>	<b>U402/ U201</b>	<b>U403/ U202</b>	<b>U404/ U206</b>	<b>U405/ U203</b>	<b>U406/ U207</b>	<b>U407/ U204</b>	<b>U408/ U208</b>
<b>USE U409</b>	<b>PIN 4</b>	<b>PIN 3</b>	<b>PIN 9</b>	<b>PIN 12</b>	<b>PIN 2</b>	<b>PIN 5</b>	<b>PIN 11</b>	<b>PIN 10</b>





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## **V. To Check Temperature Switches Interlocks:**

There are 2 temperature switches that can cause the dhe crate & Vicor power supply to not come up. The ICC dhe air temperature switch is a mechanical, normally-open thermal switch used to monitor the inside air temperature. The dhe air temperature switch is mounted inside the ICC board Module shield & will close if the air temperature inside the top of the crate goes above 30 degrees Celsius. The other switch is mounted inside the filter box and to be a redundant system for the Vicor fan RPM alert circuitry. The filter box thermal switch monitors the inside temperature of the filter box. Both switches are directly connected to the Vicor general shutdown signal which forces the Vicor power supply voltages off.

### **V.I Check ICC crate air temperature thermal switch:**

- V.I.I. Unplug thermal switch from P118 on ICC board Module.
- V.I.II. Use a DMM to measure the resistance between both pins of the temperature switch.
- V.I.III. A short indicates the switch has been tripped and is causing the dhe & Vicor power supply voltages to be off.
- V.I.IV. Either the dhe air temperature is above 30 degrees Celsius or the switch is bad & needs to be replaced.

### **V.II. Check Other Switch (Vicor Filter Box Temperature):**

- V.II.I. Make sure no overvoltage fault is causing the dhe crate & Vicor power supply voltages to be off.
- V.II.II. Disable all voltages using SW401, as was done in overvoltage fault check earlier in this document.
- V.II.III. Unplug Cable I (I-DAQ on DAQ crate, I-HTR on heater crate) from ICC board Module.
- V.II.IV. Power-cycle dhe crate.
- V.II.V. If crate powers up then Vicor filter box temperature is either too high or switch is bad & needs to be replaced.