

SVX Trouble Shooting Guide

Application Summary

This is meant for a drive that has been running successfully on the application in the past.

Over Current (F1):

There are 2 kinds of over current trips and to find out which one you will need to check the sub codes in fault history. A sub code S1 is a hardware trip. A hardware trip means the output current has exceeded 2.5-4 times the CT rating of the drive. Normally the smaller the drive the closer this rating is to 4, the larger the closer to 2.5. This is an instantaneous trip. The other kind of trip is a software trip, sub code S3. A software trip will happen .6 seconds after the drive has gone into a current limit that has brought its output freq down to 0. What the drive does when it hits current limit to try to reduce the current the drive reduces its output freq. If it has brought the freq all the way to 0Hz and its still in current limit it will trip .6 seconds later on an output current trip.

We will address both of these faults the same way although normally a hardware trip indicates more of an insulation breakdown whereas software can indicate more of a locked rotor condition.

1. The first step is to remove the motor and start the drive. If the drive trips with nothing connected the drive has failed and will have to be repair or replaced.
2. If the drive doesn't trip go through "checking the drives output voltages" at the bottom of this document. If the drive fails this test, repair or replace.
3. Insulation test the motor and the output run. If this tests alright see if the motor can be uncoupled.
4. If the drive trips on an uncoupled motor connect a test motor to the drive and see if it can run this motor. For this purpose it is nice to have the test motor be the same size as the original motor although even a small motor will tell us certain things. If you can run the drive on a known good application this works the best. If the drive trips on the test motor or known good application repair or replace the drive.
5. If the drive can run the uncoupled motor try to spin what the motor was coupled to by hand to make sure it is not stuck. If you can spin the application re-couple the motor and try to start it again. The most likely place for the output to short is in the motor connection box, it is not a bad idea to have these connections reinsulated as a precaution. This problem can come and go and will normally get worse over time.

Over Voltage Fault (F2):

The over voltage fault is taken from the DC bus (trip level is 437V for 230V drives, 911V for 480V drives and 1200V for 575V drives). Being taken from the DC bus this trip isn't an extremely fast trip as the DC bus is filtered which will slow the rise and fall of the DC bus. An over voltage fault can come from either the input or the output of the drive so to troubleshoot this we need to figure out where it is coming from. The over voltage trip is turned on whether the drive is running or not.



Powering Business Worldwide

For an over voltage to come from the output you have to have either regenerative feedback or induced voltage. For there to be regenerative power the drive either has to be running or there is a PM motor (PM motors are not very common). If you have a PM motor and the DC bus is higher than it should be see if the motor is spinning or power the drive down and check to see if there is any voltage across the motor windings. With a PM motor there should be an isolation contactor on it to stop regen back into the drive. For all asynchronous motors there has to be a magnetic field applied to the motor for it to regenerate power back into the drive and it gets this field from the drive, this means that if the drive is not running there really can't be regenerative power. For a synchronous motor there also needs to be a voltage applied to the motor but this does not need to come from the drive so please make sure what type you have before troubleshooting.

For regenerative power to occur the drive has to be going slower than what the application is. This phenomenon normally occurs during ramp down of the unit. If you try to ramp down too fast you will regenerate power back into the drive. If the over voltage controller is on in the drive the drive will speed up to try to shed the excess voltage, for example on a 480V drive when the DC bus reaches about 750VDC the drive will speed up or it will reduce how fast it is decelerating to try to keep the DC bus below this level. If your deceleration time is too fast the drive will not react fast enough and you will trip out on an over voltage trip. A trip that comes from regenerative power will almost always have negative power and the drive will not be at reference. These are normally pretty good indicators that you have regeneration occurring.

The other place for a drive to get voltage from the output is induced voltage. This can occur at any time but is most likely to occur if the drive is powered up but not running. The source of this induced voltage is normally from another running drive whose output is run too close to the drive in question. I have actually seen this induce enough voltage to power up a drive with no input voltage applied. There are a couple ways to fix this the best way is to make sure that there is enough space between the outputs (12"). Running the outputs in shielded cable will allow you to run the outputs closer together or putting a sine filter on the output of the drive will eliminate the high freq component and allow the outputs to be run closer together.

The more likely place for an over voltage to come from is the input of the drive. There is not much the drive can do about high input line voltages. If the drive is running the over voltage controller will try to bleed this off but it is not likely it will succeed in doing this. There are a couple of events on the front of the drive that will cause the DC bus to go up. The first event is high input voltage. To get roughly what the DC bus should be for any given voltage multiply your measured input voltage by 1.414. As an example if you measured your input at 476VAC your DC bus should be about 673VDC. This will lower as you go up in power as you are drawing down the DC bus slightly and you are dropping voltage across the input reactor. With this formula to reach the trip limit on a 480V drive the input voltage would have to be about 644VAC.

Another thing on the input that can cause a rise in DC voltage is if there is a ringing circuit created. What happens here is that the drives RFI filters react with an external component to create a tuned circuit. This is something that is not easily detected with a normal DMM. The drive is affected more greatly by this if it is not active. The most likely place to look for this is in any passive filters on the front end, normally a 5th harmonic filter. If there is a filter on the front end deactivate this filter and see if the problem goes away.

Ground Fault (F3):

The ground fault is a software function that monitors the sum of all of the output currents. The drive is looking for this to be less than 50% of the motor nameplate current. The first step is to disconnect the motor and run the drive. If the drive faults more than likely the problem is in the drive but you should check the ground connections to make sure there is a solid ground as noise can cause this fault. If the drive does not trip it is best to try the drive on a test motor to see if it can run this. If the drive trips on a test motor again this problem is likely to be in the drive so the drive should be replaced. If the drive works on the test motor hook back up to the motor in question and monitor the output with a zero sum CT. If you do not see the zero sum current get above the trip level but the drive is tripping this would also likely be the drive. If you do see the zero sum current get above the trip level the problem is outside of the drive and the motor and its cabling will need to be checked out.

Saturation Fault (F7):

The F7 saturation fault is looking at the voltage from the collector to the emitter of the IGBT when the device is turned on. If the drive monitors greater than 7VDC when the device is on it sees this as too great of a voltage for the IGBT to be working properly. This fault is only active on the FR4-9 frame sizes.

There are a few things that can cause this trip.

- IGBT did not turn on due to defective firing circuit or IGBT
- Monitoring circuitry is not monitoring the voltage correctly giving false trips
- A short on the output of the drive can make the IGBT the highest impedance load
- Poor grounding can cause noise that will trip the drive

Most of the problems occur inside of the drive but not all of them. Do the static checks and DC balance checks listed below. This should tell you whether the problem is inside or outside of the drive.

System Fault (F8):

The system fault has many sub codes to it that will lead you in different directions. This fault covers a lot of things in the drive so it is important to look at the sub codes for the fault. The following is what the #s mean for the "module" and "sub module":

Module: 1=power, 2=power1, 3=power2 and 4=control

Sub-module: 1=unit, 2=board, 3=U, 4=V and 5=W.

On all F8 faults you should make sure the fault is repeatable before replacing any parts.

Sub codes for F8:

S1:

1. On all sizes check the IGBTs and the driver board.
2. On FR8 and below drives try a new control board
3. On FR9 and above check the fiber optic connections and order.
4. On FR9 and above if no work was previously done to the unit replace the ASIC board.

S2/S3: These have been disabled but if they do appear do the following.

1. Check the grounding. Bad grounding will cause noise the can cause these trips.
2. Reload the system software to see if it will get rid of the fault. If the fault happens again replace the control board.

S4: This has also been disabled if it appears do the following.

1. Check the grounding.
2. This is more likely to be caused by an ASIC so this is the first board to try if that does not work try the control board.

S5: This fault is an internal communication issue, this fault should only occur in the drives that use fiber optics but not star coupled drives.

1. Check all of the fiber optics for routing and correct order.
2. The boards most likely to cause this failure are the bus coupler (VB00228) and the ASIC board. The bus coupler is easier to replace although less likely to fail but it where I would start.

S6/S7: This is the charging relay feedback. It is only on FR9 and above drives and is likely to mean that the rectifier did not turn on. If there is an external precharge there may be a sequencing issue with this otherwise it is likely that the ASIC board is not working correctly. Pins 21&23 are the external contacts for the charging circuit, this is a dry normally open contact. If it doesn't work replace the ASIC card.

S8: This fault is the power OK signal coming back from the power boards. The best way to see this is with a PUT2 tester. With this you should be able to pin point the fault to the board that is causing it. This

fault is only on the large drives (FR9 and above). The fault is likely coming from a power board and hopefully between the “module” & “sub module” that was captured in fault history it will tell you which one. There is a chance this fault is coming from the ASIC card but it is a lot more likely to be in the power board. Again the best way is to use a PUT2 as with this you should be able to see what board is causing the problem.

Under Voltage (F9):

The under voltage fault is taken from the DC bus (trip level is 183V for 230V drives, 333V for 480V drives and 461V for 575V drives). This fault will only occur if the drive is running when the DC bus gets to the trip level. This problem predominately is a loss of input power which the drive is running. The only thing that I have seen in the drive to cause an under voltage is an incorrect reading of the DC bus. This is usually pretty easy to diagnose as you can take a DC bus reading and compare this to the monitored value of the drive. If these readings aren't really close to each other you may have a monitoring problem in the drive.

Input Phase Fault (F10):

The input phase fault is looking for notches in the rectified 3 phase input. When a notch comes through it lowers this signal so if enough notches come through in a row it will lower this signal enough that it will fall below the trip point. This is a relative slow trip as the drive is capable of running with a missing input phase for a short period of time. This trip can be turned off but it is a good idea to have this on as the input current goes up 1.73 times on a single phase and the DC bus caps now have to filter out a ripple that goes all the way down to 0V. For this fault the first thing that you check is to make sure that all 3 phases are present on the input of the drive. If they are not you will need to troubleshoot upstream to see where you lost one of the phases. If all 3 phases are present reset the fault. If the fault resets it may have been a temporary loss of a phase on the input that the utilities have corrected. If the fault does not reset and you have all 3 phases present on the input of the drive there is something wrong with the monitoring circuit of the drive. Turn off this protection to see if the fault can be cleared. If there is something else monitoring the 3 phase that can shut the drive down the drive can be run this way. If there is no other monitoring circuitry for the 3 phase the drive should be repaired or replaced.

Output Phase Fault (F11):

The output phase fault is looking for the loss of current draw or a significant difference in current draw on the output of the drive. The drive will look for this fault when it gets above .5Hz and the output current exceeds 2.5% of the high overload (VT) rating of the drive. It will get this fault if a phase is less than 1/8 the sum of all the filtered output currents. If this condition lasts for more than 2 seconds you will get an output phase loss.

The first thing to do with this fault is disconnect the output of the drive and start the drive. If the drive faults on output phase loss there is something wrong with the current measurement on the output of the drive. If it does not fault ramp the drive up to 60 Hz and check the voltage on the output of the drive. Normally if the fault is coming from the drive it is because you are not firing one of the phases and you can see this by the voltage on the output. If you still do not see a problem run the drive on a test motor and check the 3 phase current on the output and compare that to the monitored value of all 3 phases. If this is all equal and everything looks good on a test motor hook the original motor back up and try this. If the drive trips right away you will need to use an oscilloscope on the output to be able to view the currents. If the currents are uneven at this point you will need to check the motor and its connections out.

Unit Under Temp (F13):

The trip level for this is -10C on both the IGBTs and the power board. See unit over temp for an explanation of where these temps come from. If the drive gets too cold we are concerned about there being condensation or frost on the boards. There is a great potential of shorting out the fine pitch circuitry on the printed circuit board so we trip the drive off. If it is getting this cold around the drive you will have to raise this temperature somehow. In some of the large frame drives we have seen this be a false trip from the gate drivers or ASICs boards. This should be pretty simple to figure out if this is a false trip on not given the environment that the drive is in.

Unit Over Temp (F14):

The trip level for this is 90C for the IGBTs and 85C for the power board. Depending on the drive size there may be up to 8 different temps that can be read from the HMI. FR8 and below drive only have one sensor for the IGBTs and one for the power board. The power board is not read out on the HMI. On larger drives you have a sensor for every IGBT although only the highest from each phase is displayed on the HMI. It will also display the power board's temperature. The temperature displayed in the monitor menu is the highest reading of the IGBTs. To see the individual reading you need to go to the multi-monitor which is normally located in the system menu.

When you have an over temp trip the first thing you need to figure out is whether you have a power module trip or a power board trip. In the fault history the fault will list a module and sub-module. The sub-module is the one that will say either module or board and this tells you where the fault is coming from. If it says module this is from the IGBTs and if it says board it is from the power board.

If the trip is from the module the first thing that you need to check is to see whether the cooling fans work. If the fans work the next thing to check is whether you have air flow through the drive. If you do not you may need to clean the cooling tunnel out on the drive. If you have air flow check the temp of the air flow to see if there is really hot air coming out of the drive or if it is cool air. If you have cool air flowing through the drive and it is still tripping out more than likely the temperature monitoring circuit is bad. This type of failure normally requires factory service to repair. Another thing to look for is the ambient temp that the drive is located in. The drive is meant to be in a location that does not exceed 40C and is no more than 1000 M above sea level. If either of these 2 conditions are exceeded the drive has to be de-rated.

If the trip is from the power board it can be caused by a couple of things. If the ambient temp around the boards is too high you can get this trip. More likely this trip will occur on FR10 and above drives. This trip is coming from the ASICs board and normally tells you the fan that cools the ASIC board is not working. Normally just replacing this fan will fix this problem.

Something to note with this trip is that the drive will try to prevent this trip by changing its switching frequency. The drive will start to do this 1C before the warning level and will reduce its switching freq faster the closer it gets to the trip level. The drive will lower its switching frequency down to 2kHz.

Motor Stall (F15):

There are 4 different settings in the drive that determine this trip. The first thing is to make sure that these settings are correct and that you aren't getting a false trip because of it. The settings for this are in the protections group (1.7.13-1.7.16). 1.7.13 is to turn on the stall protection. 1.7.14 is the stall current. This should be set about an amp below the current limit. 1.7.15 is stall time. This setting is how long it takes for the current to be above the stall current before you will get a fault. 1.7.16 is stall freq. The drive will only look for this fault below this freq. The way this fault works is that the current of the drive has to be at or above the stall current longer than the stall time while being below the stall freq.

This fault is indicative of a locked rotor. What you would see in fault history is that the drive would be in a current limit at about 4 Hz. Check the application and see if you can spin it. You also want to make sure

that if you have anti-backspin that you aren't trying to run the motor backwards and you are just starting into the ratchet. It is also a good idea to uncouple the motor and start the drive on just the motor, this will eliminate the motor as a potential issue.

There is a possibility that the motor or application is also hard to get started. In this case it is best to do an ID run on the motor or ID run with auto torque boost. This will develop more torque when the application starts to get it going or break it free. This could be something that happens periodically and not consistently.

Motor Over Temp (F16):

Motor over temp is a calculated trip in the drive. There are a quite a few factors that the drive takes into consideration when it is calculating this trip. The settings in the drive that affect this trip are: motor nameplate current, motor nameplate freq, motor ambient temp factor, motor zero freq current, motor heating time constant and duty cycle.

In normal circumstances the 2 settings that are set during a start up are the motor nameplate current and motor nameplate freq. The other settings in the drive are defaulted for a normal NEMA1 drip proof motor. What these settings are doing is setting up the heating curve of the drive. With these settings you can only run 100% current on the motor continuously at 100% speed. One thing to note here is that the motor has a service factor of 1 when running with a VFD due to the high freq heating of the VFD. Below is a list of what each of the setting do to the curve:

- Motor nameplate current: this sets the continuous current rating of the motor.
- Motor nameplate freq: on a motor that has a shaft driven fan this sets the freq at which the motor can continuously run motor nameplate current.
- Motor ambient temp: when the drive first starts up it uses its temp as the temp of the motor. When this setting is 0 it means the motor is at the same temp as the drive. If the motor is in a significantly different ambient temp than the drive you would use this to correct for this temp. An example of this would be if the motor is on a roof out in the desert with an ambient outside of 110F whereas the drive is in an air conditioned room at 70F you would set this to about 15%.
- Motor zero freq current: This is the % of FLA that the motor can run at zero speed. If the motor is cooled by an external blower or water jacket this can be drastically changed and put close to 100%. The thing that normally limits this is the cooling on the motor.
- Motor heating time constant: This is basically how long it takes the motor to heat up to 63% of 100% temp. Normally the bigger the motor the longer this time is. Unless you have this # from the motor manufacturer you should not change this value.
- Motor duty cycle: This is the duty cycle of the motor. This should be on the nameplate of the motor.

Motor over temp fault is normally an application fault although you will need to check all of the above values to make sure they are correct. Check the parameters that were captured when the drive faulted out. The main things that we are looking for is the freq of the drive and the output current. As I mentioned above the typical default motor curves is calculating this for a shaft driven fan so full current can only be run at full speed. What we are looking for is running too much current for the speed that we are running at. The trip level for this is 105%. Most of the time this fault is caused simply by drawing too much current for the speed that you are running at which is an application problem. At this point you need to try to figure out why this is happening in the application. The normal questions to ask are: How long has the application been running? Has anything changed lately? When do the trips happen? What kind of current did the application used to run?

EEprom Checksum (F22/23):

This fault means that the microprocessor failed the start up check. This indicates that it lost some information which means you would probably have to reload the parameters to the drive. This could be

caused by a voltage disturbance and may be a single occurrence. If this fault repeats you will have to replace the control board.

Watchdog Fault (F25):

This is a fault of the microprocessor. First thing to do is try to reset the trip. If this is the first time it happened resetting it may work as it could have just been a voltage disturbance or the micro was overloaded for some reason. You should check the load on the microprocessor with the drive running and any communications working to see if it is possible the load is too high. We would consider anything in the 90 percentile to be of concern. If the micro is not being overloaded and if the trip has been repeated replace the control board.

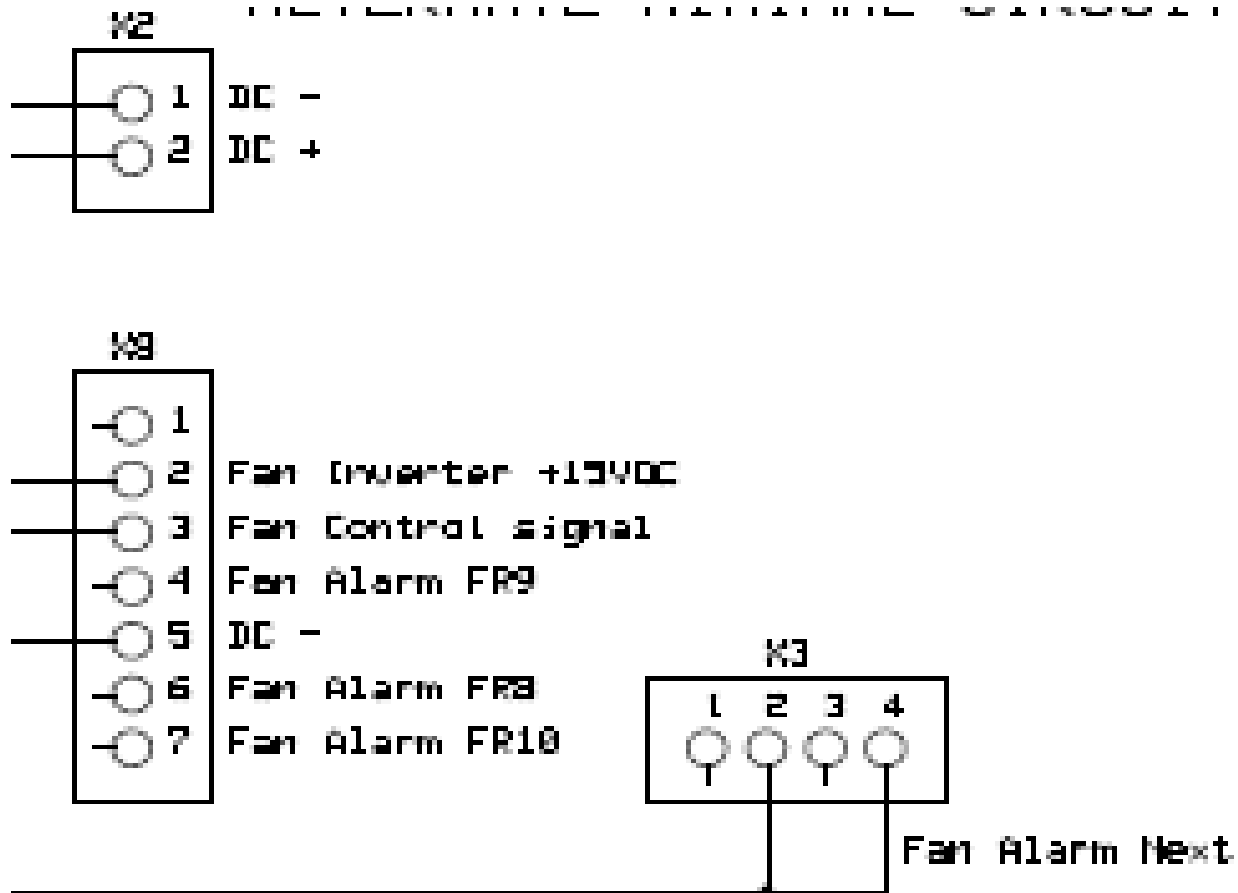
IGBT Over Temp (F31):

This is a hardware I2T function. This fault is only active on FR9 and above drives. This is a 4 stage circuit with each stage representing a higher current and quicker trip. When this fault is by itself it normally indicates a locked rotor. What you will find in fault history is a very low freq probably about 4 Hz with the current being at the current limit set in the drive. What this indicated is that the application went into a current limit when it started which means you either have a locked rotor or a hard starting application. If you have a locked rotor you should check this by spinning the motor manually. You may also want to confirm that you are not trying to start the motor backwards and you are hitting the anti-backspin. If you can spin the motor and there is nothing stopping the application from starting it is possible that the application takes a lot of starting torque. It may be a good idea to try the auto torque boost to get the starting torque needed.

If there are other faults that occurred at the same time as this fault you should look at these faults first.

Fan Fault (F32):

The F32 fault will only occur in drives with AC fans in them. AC driven fans are on the FR8 chassis and higher drives. These all have fan inverters that run the fan. These drives are also the only ones that will come up with a F32 fan fault. This fault comes from the fan inverter. Below is the pin outs for the controls of the fan driver board.



X2 pins 1 & 2 are DC bus. This comes from the DC bus of the drive through a pair of fast acting 6A fuses.

X3 pins 2 & 4 are for the alarm coming from the next board in the series. The last board in the series will have a jumper between these two pins. Most FR8 & 9 drives have a brd that does not have this connector.

X8 pin 2 is +15VDC control voltage. The VB00299 board creates its own 15V, all others are fed from the power board. Pin 3 is the control signal, this will be -DC bus. When there is a 15VDC potential between pins 2 & 3 the fan driver turns on(-DC bus is applied to pin 3 to turn on and removed to turn off). Pins 4, 6 & 7 are the different alarm signal. 15VDC referenced to -DC bus is OK, 0V is alarmed.

There are really 2 types of failures that you get with this type of system. The first is that the fan is not spinning but the drive is able to run. This will normally end with the drive tripping in a F14 drive over temp trip. The second fault is a F32 fan fault. The difference between them is that in the first case the fan driver board thinks everything is OK, in the second case the fan driver board is faulted out. Below are the steps to follow when troubleshooting this.

- Fan control and LED status:

The first thing to do when troubleshooting a fan problem is to turn the fan control to continuous. To do this, go into programming mode and then go to the system menu. In the system menu go to hardware and then fan control. Turn the fan control to continuous. If the fan still is not spinning look at the LEDs on the fan driver board. There are 2 LEDs on this board, a green one and a red one. One of these LEDs should always be on, if neither is on you should get a F32 fault and probably the fuses for this would be blown. If the board thinks it is running, you should get just a flashing green LED. If there is no control

signal applied to the board you should get a solid on green and red LED. If the board is faulted you should see something other than the above statuses.

Checking the fuses (this step is skipped if there are LEDs lit on the fan driver):

If when the drive is powered up there are no LEDs lit on the fan driver board the most likely cause is that the fuses are blown. The fuses for this are 6A fast acting fuse and like fuses should be used when replacing these. Remove power from the drive and locate the fuses. If you follow the wires back from X2 on the fan driver this should lead you to the fuses. Remove fuses and ohm check. If you have a blown fuse before you replace it, do a diode check on the X2 connector. Forward bias you should get .8-1.6V depending on the board and reverse bias you should get an overload. If you see a short on this the fan driver will have to be replaced, this is likely as something took out the fuse and it is likely to be the fan driver.

- Checking the output of the fan driver board:

Insure that power is removed from the drive and then disconnect the blue and black wires going out of the fan driver board. These are the only 2 spade connections made to this board. Connect a DMM to the spade connections on the board, you will be reading 230VAC at 50 Hz when the board is running. Power up drive and insure that the green LED is flashing, you should have roughly 230VAC on the DMM. If you don't have 230VAC here replace the board. If you have 230VAC here power down and reconnect the wires that were originally connected to these terminals.

- Checking the output of the fan isolation transformer:

The easiest place to check the fan isolation transformer is at the fan plug. On FR9 and above units this is at the bottom of the drive where the fans are and is a 4 pin quick disconnect. On FR8 drives this is located where the output leads enter the drive at the bottom of the unit, these are spade connectors. Disconnect the fan. Power up the drive and insure there is a flashing green LED on the fan driver board. With a DMM between the blue and black connection you should read 230VAC and between the blue and brown connection you should read the same. If you do not read 230VAC between blue and black replace the isolation transformer if you read it between blue and black and not blue and brown replace the starting cap.

- Checking the fan and starting capacitor:

Remove power from the drive and check the fan windings and starting capacitance per the table below. Normally if you are going to see something wrong with the windings they will be open. If the capacitor is less than 50% of its value it probably is not going to get the fan spinning at full speed. The fan may run with the cap at a low value but it will probably not get up to speed as it depends on this cap to give the motor a rotating magnetic field.

Fan part number	PP01123 (FR8)	PP01080 (FR9 and above)
Fan wires	Resistance in ohms	Resistance in ohms
Black – brown	110	60
Brown – blue	50	35
Blue - black	60	25
Fan starting capacitor	5uF	7uF

Try to spin the fan by hand to see if there is something mechanical stopping it from working. On the PP01080 fan we have never seen a failure of the actual fan itself but on the PP01023 it is not unknown to have bearings go bad. If the fan does not spin freely remove whatever is obstructing movement or replace the fan. If the fan spins freely hook the fan back up and power up the drive. The fan should start as soon as the green LED starts flashing on the driver board. If the fan doesn't start replace the fan.

By following the above steps this should lead you to successfully troubleshooting the problem but there are a few problems these will not find but all of the basic signals are explained. There can still be prob-

lems in the ASICs and control board for FR10 and above and problems in the power board and control board for the FR8 & 9. You should be able to tell this by the signals into and out of the fan driver board.

	FR8/230V	FR8/480V	FR8/690V	FR9/230V	FR9/480V	FR9/690V
Fan driver	VB00599	VB00799	VB00699	VB00899	VB00399	VB00299
Iso xmfr	PP08026	PP08026	PP08026	PP09056	PP09055	PP09055
Fan	PP01123	PP01123	PP01123	PP01080	PP01080	PP01080
Starting cap	PP00061	PP00061	PP00061	S00465	S00465	S00465
Fan fuses	PP20202	PP20202	PP20202	PP20202	PP20202	PP20202

	FR10/12	FR11	FR13/14
Fan driver	VB00299	VB00299	VB00299
Iso xmfr	FR10844 (Left) FR10845(Right)	FR10845	
Fan driver assembly includes both parts above	FR10846 (Left) FR10847(Right)	FR10847	FI13301
Fan	PP01080	PP01080	PP01080
Starting cap	S00528	S00530	S00520
Fan fuses	PP20202	PP20202	PP20202

Application Fault (F35):

This fault occurs if the application has gotten overloaded for some reason. The first thing to do is reset the fault and see if it will reoccur. If the fault does reoccur you should reload the system and application software. If this does not fix the problem please contact Eaton for further instructions.

Device Unknown Fault (F40):

A device unknown fault predominately happens when replacing boards in a drive. What this fault is looking for is valid data in the EEPROM on the circuit boards. This fault usually comes from the power board but the fault history should tell you what module and sub-module that is not valid. If this fault comes up without any work being done to the unit it means that some data has been lost by the board in question. You may be able to reprogram the board and get it to work but the board should probably be replaced at the earliest convenience as it is likely to happen again. If this happens after a board has been replaced it is likely that the correct data has not been loaded to the board. On drives that have multiple ASIC boards all the extra data needs to match from one unit to another. Of some note is that a star coupler board has to have a serial number programmed in it to make it work.

IGBT Over temp (F41):

This fault is the software I2T trip. It works a little different than the hardware trip and is active on all drives. For this trip the drive calculates a simulated temperature for the IGBT and adds it to the measured temperature for the IGBT. If this temp exceeds 125C the drive will trip on a F41 fault. You troubleshoot this fault about the same way you troubleshoot the F31 fault.

Ext Fault (F51):

The external fault is something that is fed into a digital input. The first thing to do is go into programming and figure out what input is set for an external fault. There can be multiple external faults and there can also be normally open and normally closed external faults. You will need to know all of this to troubleshoot this fault. Once you figure which input or inputs are programmed for external fault go into the monitor menu and see which input is causing the fault. You can see the digital inputs in the monitor menu so

as an example if DIN3 was programmed for external fault open you would go to the monitor screen and look at DIN1-3 and see if 3 is on or off. For it to be faulted this should be off. The next step would be to check the voltage at this input to see if there is 24V there or not. If there isn't troubleshoot the circuit that is supposed to supply this input. If there is 24V present you probably have a blown digital input and the option board will have to be replaced. Just to make sure this input is bad it would be advisable to jumper it straight to 24V and see if the input turns on.

Slot Communication Fault (F54):

A slot communication fault occurs when the main control board cannot communicate with one of the boards that are plugged into it. In the fault history under the sub-module it should tell you what slot it is not seeing. The easiest way to troubleshoot this problem is to take the board out of this slot and install a different board. If you do not have another board to try this most boards can be put into more than one slot. Switch the board in question to another slot, if the problem moves with the board you have a bad board that will need to be changed. If the problem stays with the slot the control board is bad. To temporarily get up and running if you have an open slot that the board can be put into move the board. Sometimes this fault can't be cleared whether there is a board in the slot or not, in this case the only real option is to replace the control board.

Bypass Overload Fault (F82):

This fault is only on drives with HVX software loaded to them. This is normally defaulted to DIN6 into the drive. This is a feedback coming from the reversing starter that is used as the isolation contactor for the bypass. If this trips out while you are running in bypass you will need to check that the starter is set for the proper FLA current of the motor. Seeing as this setting only really needs to protect when the drive is in bypass you can use the SF rating of the motor for this. It is a good idea to set this slightly above the SF rating so you do not get nuisance trips. The other thing to check at this point is to make sure when the bypass is running that you are drawing current on all of the phases and what that current is compared to the rating of the motor. If you are drawing too much current it is likely that the application is not sized to run across the line and you will have to troubleshoot the application. It would be a good idea to uncouple the application and run the motor to see what the magnetizing current is of the motor, if this is too high check the motor out.

If you get this fault while running the drive the first thing to look at is what the drive thinks it is outputting for current. If this is not close to what the starter is set for it is likely that the starter is not tripping on current especially if we are getting this trip while the drive is trying to ramp up when it starts. At this point I would suspect that the starter has its phase loss circuitry still enabled. If this is enabled the starter expects the freq running through it to be at or near 60Hz and the drive is not running at this freq so the starter is not seeing the output waveform when it expects to see it so it thinks there is a phase loss. If this is happening go through the procedure to turn off the phase loss detection in the starter.

Static Checks:

The first thing that should be done is static checks on the drive. This has to be done with power removed from the drive and the motor isolated from the drive. Checks can be done with any meter that has a diode scale on it but different meters may read this differently, we recommend a Fluke 87V. Forward bias is with your + lead to -DC or your - lead to +DC.

Measure point:	Value:	Measure point:	Value:
Rectifier forward: L1/L2/L3 to B+	1,2 V	Rectifier reverse: B+ to L1/L2/L3	Infinite
Rectifier forward: B- to L1/L2/L3	0,45 V	Rectifier reverse: L1/L2/L3 to B-	Infinite
Brake diode forward: R- to B+	0,35V	Brake diode reverse: B+ to R-	Infinite
Brake chopper: R- to B-	Infinite	Brake chopper: B- to R-	0,35V
IGBT diode forward: B- to U/V/W	0,35 V	IGBT diode reverse: U/V/W to B-	Infinite
IGBT diode forward: U/V/W to B+	0,35 V	IGBT diode reverse: B+ to U/V/W	Infinite

FR7/8 & FR10 and above

Measure point:	Value:	Measure point:	Value:
Rectifier forward: L1/L2/L3 to B+	0,45 V	Rectifier reverse: B+ to L1/L2/L3	Infinite
Rectifier forward: B- to L1/L2/L3	0,45 V	Rectifier reverse: L1/L2/L3 to B-	Infinite
Brake diode forward: R- to B+	0.4 V	Brake diode reverse: B+ to R-	Infinite
IGBT diode forward: B- to U/V/W	0,4 V	IGBT diode reverse: U/V/W to B-	Infinite
IGBT diode forward: U/V/W to B+	0,4 V	IGBT diode reverse: B+ to U/V/W	Infinite

FR4-6 & FR9

If you find a short or open where you should have a diode reading there is more than likely something wrong with at least one of the PN junctions, please contact Eaton with this information and further instructions. If everything looks good proceed to the next step.

DC Balance Checks:

Power the unit up and insure that the drive is not started. With your meter on DC measure from –DC bus to U, V & W. You should read somewhere between 2-50VDC. The real key that we are looking for is one that reads either 0VDC or a very high voltage. All 3 of the phases should read relatively even but I wouldn't reject it unless it is outside of the range stated above. If you do find something outside of the range, stop and contact Eaton with these readings.

If the readings pass start the drive and do the DC checks again. With the drive running you should now get an even split from + & - DC to U, V & W (**this has to be done with the drive in ramp to start and not flying start**). If an IGBT is not firing you will likely either get 0VDC or full DC bus, if you get either of these stop and contact Eaton. If the readings are OK ramp the drive up to full speed and check AC phase to phase on the output. You should see voltage that is normally higher than the actual rating of the drive but this will depend on the meter you are using. All 3 phases should be even. You can also measure from each phase to ground but this may vary depending on what your input power is referenced to. Most people have a wye input so the output will kind of look like a wye and it is easier to see what phase

is giving you a problem if you are seeing a problem but only use this as a reference. If there are problems noted here please contact Eaton with the results.

If all checks are good up to this point it is not a bad idea to connect a small test motor to the drive and run it. If the drive can smoothly spin a small motor it tells us there isn't a problem with the firing of the IGBTs in the drive. If the drive passes all of the tests up to this point it either means it takes current for the drive to fail or the motor is failing. If there is another motor close by that the drive can be run on it would be a good idea to try and run it on a known good motor. If it fails on this it is most likely the drive, if it works it is most likely the motor or grounding.

Checking the output of the drive with its output disconnected (drive has to be set for ramp to start and not flying start):

What a drive actually controls is the voltage and freq on its output. It basically controls everything else by adjusting these 2 things. Checking the output voltage on the drive will tell you within a certain amount of reason that the drive is outputting what it should. To check this, do the following steps:

1. Make sure everything is disconnected from the drives output. This includes reactors, DV/DTs, etc.
2. With the drive powered up check for DCV from –DC bus to U, V & W. This voltage should be even and will probably be in the range of about 5VDC to 50VDC. If you have a problem here you will normally see either 0VDC or full DC bus. If either of these is seen the drive will have to be repaired or replaced.
3. Start the drive at 0 Hz or close to 0 Hz. Check from both the + & - DC bus to U, V & W. The reading should all be at about 50% of the full DC bus. Again if you have a problem you will normally see either 0VDC or full DC bus. If either of these is seen the drive will have to be repaired or replaced.
4. Ramp the drive up to full speed and check U, V & W from phase to phase for ACV. The reading here may vary with the meter that you use so this measurement is more for reference, it will normally read high because of the PWM output. The readings should be even (the readings should be within a couple % of each other), if they are not repair or replace the drive.
5. Ramp the drive back down and turn off.

Additional Help

In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-386-2273 option 2, option 6.

All other supporting documentation is located on the Eaton web site at www.eaton.com/Drives



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