PowerXL Series Trouble Shooting Guide

Introduction

The PowerXL Series drive provides feedback during a fault condition. For each fault code, this document provides a brief description of what is occurring and the actions to take to resolve the issue. Please see below for each specific fault code and the recommended actions.

Contact the Technical Resource Center (Technical Resource Center at 1-877-ETN-CARE or 1-877-326-2273 option 2, option 6) for further information and assistance.

Fault Trouble Shooting

F1 Over Current Protection – There are 2 types of overcurrent conditions that occur when the output current exceeds safe running conditions.

1. Output current exceeds 2.2 times the constant torque current rating of the drive,
   a. When this occurs, the output PWM will shut down cycle by cycle. The output frequency will start to drop to lower the current draw of the motor. After 2 sec, if the motor current does not drop below the current limit level the drive PWM will shut down and display fault.
2. Output current exceeds 2.8 times the constant torque current rating of the drive
   a. When this occurs, the output PWM will be shut down and indicate over current fault instantaneously.

All conditions will be addressed in the same way:

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 repaired 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 certain things. Run the drive on a known good application. If the drive trips on the test motor or known good application, repair and 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 it 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 bad idea to have these connections reinsulated as a precaution. This problem can come and go but will normally get worse over time.

F2 Over Voltage Protection – The over voltage fault is taken from the DC bus (trip level is 460Vdc for 230VAC drives, 910Vdc for 480VAC, and 1100Vdc for 575VAC 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.

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For an over voltage to come from the output of the drive there is 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 a PM motor is being used 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 regenerative voltage from feeding 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 the motor is 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 the drive is set to ramp down too fast, the motor 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 the drives deceleration time is too fast, the drive will not react fast enough and the drive 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 regeneration is occurring.

The other place for a drive to get voltage from the output is induced voltage. This 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 too close to the drive in question. This has been seen to induce enough voltage to power up a drive with no input voltage applied. The best way to resolve this is to make sure that there is enough space between the outputs (12"). Running the outputs in shielded cable or putting a sine filter on the output of the drive (to eliminate the high frequency component) will 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 to succeed. 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 the measured input voltage by 1.414. As an example, if the measured input is 476VAC, the DC bus should be about 673VDC. This will lower as the power goes up as the drawing down of the DC bus slightly occurs and 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.

Drive Rating Voltage	ovTrip	ovResume
230V	460V	Vin*1.35+30v,(240*1.1>Vin>208*0.85)
480V	910V	Vin*1.35+30v,(500*1.1>Vin>380*0.85)
575V	1100V	Vin*1.35+30v,(600*1.1>Vin>525*0.85)

F3 Earth Fault Protection - The earth 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 15% of the motor nameplate current by default, but this value can be selected in the protections parameter group. 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. The ground connections should be checked 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, the problem is likely to be in the drive and 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 the zero sum current of the CT is above the trip level set in the drive keypad but the drive is not tripping, this would also likely be the drive. If the zero sum current is above the trip level and the drive is tripped the problem is outside of the drive, the motor and its cabling should be checked out.

F5 Charge Switch Protection - The charge switch fault is a hardware function. There is a soft-start circuit in the drive to make sure the hardware circuit is working correctly when power is on. If the soft-start circuit is not working based off the formula (V_{input} x 1.414 -100 >V_{dclink}), the charge switch fault will become active. When dealing with this fault, verify the input voltage levels line to line for each line (all should be equal). From there, check the DC bus voltage with a meter to verify voltage level, based off input voltage read it should be 1.414 times that value. If it is high, then there is an issue internally with the power or input rectifiers. Static checks for the input rectifiers to the DC bus should be performed.

F6 Emergency Stop Fault – The emergency fault is a fault that is fed into a digital input. First, go into the programming and see what inputs are set for an emergency fault. It functions on a closed contact. Once the assigned input is known, go into the monitoring menu and see which input is causing the fault. As an example, if DIN3 was programmed for emergency fault, go into monitor menu and look at DIN1-3 to see if 3 is on or off. For it to be faulted, the input should be on. The next step would be to check the voltage at this input to see if there is 24V. If there is, troubleshoot the circuit that is supposed to supply this input. If there is nothing wrong with the circuit, it may be an issue with a blown input and the control board will have to be replaced. To be sure, remove all external wiring and jumper 24V to the input to verify it functions properly.

F7 Saturation Fault - The saturation fault is the drive looking at the voltage across the IGBT, if it exceeds a threshold, the IC will trigger a fault. The fault is detected by the DSP IO pin. If the voltage is showing a low level of 0.3V, the drive will see the IGBT in saturation or a short. This problem is usually caused internally in the drive. Perform the static checks and DC balance checks listed below. This should indicate the issue being inside or outside the drive.

F9 Under Voltage Fault – The under voltage fault is taken from the DC bus. This fault will only occur if the drive is running and the DC bus gets to the one of 2 trip levels. One is based off the fault protection parameter (V_{uvtrip}) and the other is a hard fault (V_{uvstop}). This problem predominately is a loss of input power while the drive is running. The only thing in the drive that could cause this fault would be an invalid reading of the DC bus. This is diagnosed by taking a DC bus reading and comparing this to the monitored value of the drive. If these readings aren't close to each other, there may be a monitoring problem in the drive, which would require replacing the drive.

Drive Rating Voltage	Hard Trip Undervoltage Level	Resume Point Trip Level	User Select
230V	190V	210V	Vin*1.35-30v,(240*1.1>Vin>208*0.85)
480V	350V	390V	Vin*1.35-30v,(500*1.1>Vin>380*0.85)
575V	500V	550V	Vin*1.35-30v,(600*1.1>Vin>525*0.85)

F10 Input Phase Fault - The input phase fault is looking for voltage in the rectified 3 phase inputs. The drive monitors all 3 phase voltages and performs a calculation for differential voltage min and max values. If the differential max is greater than the differential min, the drive sees it as it losing one of the phases. This is a relatively 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 recommended to have this on. The input current can rise up 1.73 times on a single phase if a phase is missing, which forces the DC bus capacitors to filter out a ripple that goes down to 0VAC. For this fault, the first thing to check is to make sure that all 3 phases are present on the input of the drive. If they are not, troubleshoot upstream to see where one of the phases was lost. 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 all 3 phases are 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.

F11 Output Phase Fault – 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 looks at the 3 filtered output phase currents (U, V, W) and takes the maximum and minimum value of the 3 values. If the maximum current value is greater than 3 times the current minimum and the current minimum is greater than 0.03, the output phase fault will be triggered.

The first thing to do with this fault is to disconnect the output of the drive and start the drive. If the drive faults on output phase fault 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 max frequency and check the voltage on the output of the drive. Normally if the fault is coming from the drive, it is because it is not firing one of the phases. This can be seen by measuring the voltages on the output (they will not be equal). If they are equal, run the drive on a test motor. Check the 3 phase currents on the output and compare that to the monitored values of all 3 phases. If these are equal and everything looks good on a test motor, connect the original motor back up and try the same. If the drive trips right away, fault monitoring can be disabled by going into the Protections Parameter group and setting the Output Phase Fault Protection to "No Action", then using an oscilloscope read the phase currents. If the currents are uneven at this point, check the motor and its connections in the motor junction box.

F12 Brake Chopper Fault – The purpose of the brake chopper fault is to indicate when the brake chopper is enabled. There is a resistor connected to see if it is functioning properly. The drive sends 25% of its duty cycle output wave to the brake chopper. In addition, the drive captures the feedback signal which will indicate if the brake chopper is working properly. If the feedback is different than the signal sent out, the drive will indicate a brake chopper fault. From here, it is suggested to check the brake resistor to be sure it ohms out correctly. If it does, perform static checks on the brake as listed below.

F13 Drive Under Temperature – The trip level for the drive is at -10°C on both the IGBT's and power board. If the drive becomes too cold, there is the potential for condensation or frost to build up on the circuit boards and connectors. There is a greater potential for shorting out the fine pitch circuitry on the printed circuit boards so the drive will trip in its default settings. If the drive is getting cold, it is suggested to bring the temperature of the drive up.

If this is not possible, there is a cold weather feature that can be enabled to change the under temperature trip to -30°C. The drive will trickle voltage to the motor when the temperature is between -20°C to -30°C for current to flow and warm up the heat sink in the drive. When in this situation and the drive is given a run command, it will send out a user specified voltage level for a

specified time to heat up the drive. If not able to warm up, the drive will fault out. If temperature goes above -20°C, the drive will ramp up to normal running condition.

Mode	Conditions	Actions
Normal mode	$T_{drive} < -10℃$	1. Shut down inverter PWM within 100ms, 2. Send drive under temperature fault to MCU.
	$T_{drive} \geq -10℃$	Start normal
Cold Weather Mode	Under Temp Fault Override is Yes	Drives starts ignoring under temp condition until the drive is powered down.
	1. Under Temp Fault Override is No, 2. $T_{drive} \geq -20℃$	Start normal
	1. Under Temp Fault Override is No, 2. $T_{drive} < -30℃$	1. Shut down inverter PWM, 2. Fault drive under temperature and send to MCU.
	1. Under Temp Fault Override is No, 2. $-30℃ \leq T_{drive} < -20℃$	1. Warm-up at 0.5Hz, Cold Weather Voltage for the Cold Weather Time 2. Warn drive under temperature and send to MCU.
	1. Under Temp Fault Override is No, 2. In warm-up operation 3. $T_{drive} \geq -20℃$ for 2s continuously	1. Start normal 2. Clear under temp warning to MCU
	1. Under Temp Fault Override is No, 2. In warm-up operation 3. $T_{drive} < -20℃$ 4. Time out	1. Shut down inverter PWM within 100ms, 2. Fault drive under temperature and send to MCU. 3. Allow resetting fault and starting sequence again.

F14 Drive Over Temperature – The over temperature trip level is dependent on the frame size drive, all of which are based of the IGBT and power board temperature level. There are multiple temperatures that can be monitored through the PC tool or an external HMI though communications. The temperature display on the keypad is the larger value of the IGBT and power board sensors.

FR1: trip at 96°C, fold back at 90°C
FR2: trip at 91°C, fold back at 85°C
FR3: trip at 94°C, fold back at 85°C
FR4: trip at 89°C, fold back at 78°C
FR5: trip at 88°C, fold back at 80°C

When an over temperature fault occurs, the first thing to do is check and see if the cooling fans are working properly. Typically there will be a fan fault as well if the fan has failed. If the fans are not spinning, verify voltage is getting to the fans. With a multi-meter, measure the voltage across the fan connector. There should be 24Vdc on FR1-FR4 and 48Vdc on FR5-FR8 fans.

If the fans are working, check the air flow through the drive. If the air is restricted, it will be required to clean out the cooling tunnel. If there is air flow, check the temperature of the air to see if it is hot or cold. If cool air is flowing, it would indicate the temperature sensors have failed. This failure would require factory service to repair. Another thing to check would be the ambient air temperature that the drive is located in. The drive is meant to be in a location that does not exceed 50°C ambient and is no more than 1000M above sea level. If either of these conditions is exceeded, the drive requires de-rating which is found in the installation manual.

Another thing to note with this fault is the drive will try to prevent the fault condition by dropping the switching frequency once the fold back temperature is met (which varies based off frame size). The switching frequency will back itself down more the closer it gets to the fault temperature.

F15 Motor Stall Fault – There are 4 settings that are used in the motor stall protection trip. The settings are located in the protection group. There is parameters to enable the stall protection, set the stall current, set the stall time limit, and set the stall frequency. The first thing is to make sure that these settings are set correctly so a false trip isn't occurring. The stall current should be set to about an amp below the current limit setting. The time is how long it takes for the current to be above the stall current before the fault occurs. The frequency setting enables the drive to only look at this fault when the frequency is below this value. The fault func-tions if the current of the drive has to be above the stall current longer than the stall time while be-ing below the stall frequency.

This fault is indicative of a locked rotor. In the fault history, the drive would be in a current limit at about 4 Hz. Check the application and see if the motor can spin. Another thing to check is that there are no anti-backspin devices on the motor which if the drive is spinning the motor in reverse it would be going into the ratchet. Uncoupling the motor and running it with the drive is also a test that can eliminate the motor as the issue.

It is also possible that the application is hard to get started. In this case, it is suggested to do an ID run on the motor or ID run with auto torque boost. This will develop more torque when the ap-plication starts to get the motor to break free.

F16 Motor Thermal Protection – Motor over temperature is a calculated trip in the drive. There are 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 frequency, motor ambient temperature factor, motor zero frequency current, motor heating time constant and duty cycle.

With the basic start-up, the 2 settings that are set during a start-up are the motor nameplate and motor nameplate frequency. The other settings in the drive are defaulted for normal NEMA1 drip proof motors. These parameters set up the heating curve of the drive. With these settings the drive will allow running at 100% current on the motor continuously at 100% speed. One thing to note is that the motor has a service factory of 1 when running with a VFD due to the high fre-quency heating of the VFD. Below is list of what each of the settings do to the curve:

- Motor nameplate current: this sets the continuous current rating of the motor.
- Motor nameplate frequency: on a motor that has a shaft driven fan this sets the frequency 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, this parameter would be used to correct for the temperature difference. 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 this would suggest setting to about 15%.
- Motor zero frequency 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. This value should not be changed unless this number is provided from the motor manufacturer.
- Motor duty cycle: This is the duty cycle of the motor. This should be on the nameplate of the motor.

Motor over temperature fault is normally an application fault, although it is good to check all of the above values to make sure they are correct. Check the parameters that are captured when the drive faulted out. The main thing to look for is the frequency of the drive and the output current. The default motor curves are calculating this for a shaft driven fan so full current can only be run at full speed. What to look for is too much current for the speed that the drive is running at. The trip level is at 105%. In most cases, the fault is due to simply drawing to much current for the speed that the drive is running at which is an application problem.

F17 Motor Under Load Fault – The motor under load fault is based off 4 parameters that are user settable. The parameters are located in the protections group. There is parameters to enable under load protection, set the under load F_{nom} torque, set the under load F0 torque, and the under load time limit. The first thing would be to verify that these parameters are set correctly for the application so there isn't a false trip occurring. The Torque at F_{nom} should be the torque at the field weaken-ing point. The torque at F0 should be the torque level when the motor is running at 5 Hz or basi-cally 0 speed. The time limit should be the amount of time it is allowed in this region below the torque levels before it faults. The function is designed in that if the torque drops below the squared torque curve based off the frequency level for the time limit the drive will fault.

In some cases, this fault can be due to improper setting for the application. If the application is set correctly the fault is indicating a belt has broken or the load has dropped off and the motor could be running away. First thing would be to go check the motor and load to be sure the application is still operational.

F18 IP Conflict Fault – The IP conflict fault is due to multiple devices on the Ethernet network having the same IP address. The current address on the drive is found in the Communication pa-rameter group, the active IP address is the current IP address of the drive. To resolve this, either change this IP address or find the other device with same IP and change that address.

F19 Power Board EEPROM fault – The power board EEPROM fault is an indication that the mi-croprocessor failed the startup checks, and bad data was received. In this case, the drive lost some of its programming. Power cycling the drive may resolve the data messages or try resetting the drive to default parameters. There also could be a voltage disturbance and may be a single occurrence. If the fault continues, a new control board is required.

F20 FRAM fault – The FRAM fault is an indication that the control board has bad data written to stored memory. This fault may be able to be reset by reloading firmware to the drive or perform-ing a factory reset to the parameters. If the fault continues, a new control board is required.

F21 Serial Flash Fault – The Serial flash is an indication that the control board has received bad data from the serial flash memory chip. This fault may be able to be reset by reloading firmware to the drive or performing a factory reset to the parameters. If the fault continues, a new control board is required.

F25 Watchdog Fault – The watch dog fault is a register overflow in the control board memory. Power cycle the drive. If this is the first time this has occurred, it could have been a voltage disturbance or the micro was overloaded. If the fault continues, replace control board.

F26 Start-up Prevent Fault – The startup prevent fault is due to a run command given to the drive with the damper startup function selected. If the time-out time on the damper timeout is met, the drive will go into the start-up prevented fault. To determine the issue with this fault, an input will come back to indicate the damper has closed. Go into to monitor menu to verify the input is on or off, then check wiring and the damper circuit to verify things are operat-ing properly.

F29 Thermistor Fault – The thermistor fault is due to the Thermistor input being enabled on the control board or the IO1 option card. This input is looking for a resistance value. If the resistance is greater than 4.7K ohm or it is seen as open or shorted out, the drive will go into this fault condition.

To handle this fault, go into the monitor menu and see what the drive sees as the monitored resistance value. From there it will point to an issue being with the thermistor being open, shorted or the value reading high. In a short or open condition, it would be suggested to take an ohm meter and measure the resistance to verify. If things measure okay, check connections and wiring. If the ohm meter readings are not acceptable, the thermistor has failed. If the value is reading high, check at the thermistor location if in-fact the measurement is an accurate reading and things are warm or it a false reading.

F32 Fan Cooling Fault – The fan cooling fault is enabled on the FR4 through FR6 drives. This fault is an indication that one of the 2 fans in these frame size drives has stopped which will greatly af-fect the ability for the drive to cool but the drive can still run with a single fan. The drive monitors the voltage on one of the pins of the fan circuit and when it goes low, it indicates a fan has stalled. To handle this fault, it is suggested to go to look at the main cooling fans at the top or the bottom of the drive. One of them is potentially not spinning. This could be due to voltage not getting to the fan or the bearing in the fan may have seized up. With a multi-meter, measure the voltage going to the fan. On FR4 there should be 24Vdc and on FR5 and FR6 there should be 48Vdc.

F36 Compatibility Fault – The compatibility fault is due to the power board not matching the control board. If the control processor is not able to read the correct control type code and EEPROM codes that are set in the factory, the drive will go into fault. This could be an issue with the software loading. Perform a factory reset and see if the fault will clear. If a factory reset does not work, reload software to the control board and see if fault clears. If fault does not clear, the control section will need to be replaced.

F37 Device Change Fault – The device change fault occurs when a different option card or control board is installed. This fault is looking at the serial numbers stored in the EEPROM on the circuit boards and if it has one registered. After adding a different circuit board, it would change. When this fault occurs, a power cycle should clear the fault.

F38 Device Added Fault – The device add fault occurs when a new option card is installed. This fault is looking at the option card slots and the serial number stored in the circuit board. When a new option card is added, the control board stores this value and sees it as a device that was added. The fault will occur on initial power up, display a warning for 10 sec then reset the fault.

F39 Device Removed Fault – The device removed fault occurs when an option card is removed and not reinstalled. This fault is looking at the option card slots to see if a card was removed that was previously installed. Resetting or power cycling will reset this fault.

F40 Device Unknown Fault – The device unknown fault occurs when an unknown option card or power board is connected to the control section. The control board monitors the type code and if it does not recognize the code present in the option card or power board section, it will display a fault. On option cards, if the voltage doesn't match the configuration, it will also display a device unknown fault. To handle this fault power down the drive and check that the option card and ribbon cables are properly fastened, if the fault continues it would require replacing option board or the drive.

F41 IGBT Over Temperature Fault – The IGBT Over temperature fault is the drive performing an I2T trip. When the IGBT is running at a high switching frequency and there is a huge load on the drive, the IGBT junction temperature will rise quickly or cause the junction to brake. The drive calculates what it thinks the junction temperature is and adds it to the drive unit temperature. If the summed temperature is greater than 125°C for over 1 sec, the fault condition will occur. When this fault occurs, it typically indicates that the motor was drawing a high amount of current. It is suggested to verify if the current was high. From there, determine if it is the motor or application that is causing the large current draw.

F50 AIN<4mA Fault – The analog input less than 4mA fault indicates the analog input 1 or 2 is using a 4mA minimum level and the drive has seen this input drop below 4mA (typically it will go to 0mA, indicating it has lost its reference). To handle this issue, it is best to verify which analog input is using the current signal and then check the wiring on the drive and the other end to check for lost connections or miss wiring. Using a multi-meter, verify the current measured with a meter matches what is shown in the monitoring menu of the keypad. If the meter reads above 4mA but the drive is seeing 0 or a different value, it could be an issue with the dip switches for the analog inputs located on the left side of the control board below the STO terminal. If the dip switches are correct and the keypad is still not reading properly the analog input has failed which would require replacing the control board. If the measurement matches what the drive shows, there would seem to be an issue with the source.

F51 External Fault - 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. To troubleshoot this fault, go into the monitor menu and see which input is causing the fault. The digital inputs can be seen in the monitor menu. As an example if DIN3 was programmed for external fault open, 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. If there isn't, troubleshoot the circuit that supplies this input. If there is 24V present, it probably indicates there is a blown digital input and the option board will have to be replaced. To verify this input is bad, jumper it straight to 24V and see if the input turns on. If it were for a fault on closed, then it would work the opposite.

F52 Keypad Communication Fault – Keypad communication fault is a fault when the keypad losses communication with the control board when it is used as a reference/control location. If the keypad is removed from the drive control board when power is applied, the fault will occur. The fault will be active until the keypad is reinstalled or the drive is switched away from the keypad reference/control place. At that point, the reset command can be sent.

F54 Option Card Fault – The option card fault is an indication that either an option card or slot on the control board has failed. The drive monitors the software ID and if that value is not received or is corrupted, the drive will fault on option card fault. To determine the cause, power the drive down and verify the option card is seated properly. If so, try swapping it to the other slot and power up. If fault continues, it would point to the option card being the problem and replacement would be required. If the card works in one slot but not the other, try swapping again with power off and power back up see if fault continues with that slot. If so, replace the control board.

F55 RTC Fault – The RTC fault is the real time clock fault. This would occur if an error occurs in the real time clock chip or the time power was low going to the chip. This is a user settable fault. If the fault occurs, verify the settings in the protection group of the fault action. Changing the setting to no action should allow for bypassing the fault. There could be a potential issue with the control board that holds the real time clock chip which requires replacing the control board.

F56 PT100 Fault – The PT100 fault is a user selectable fault when the IO4 option card is installed. This allows for the ability to connect up 3 individual PT100 RTD's that can be used to measure temperatures in the motor or other devices. This measurement will come back as a temperature level from -30°C to 200°C. When the card is installed, there is a user selectable level for a warning and a fault condition. If the fault occurs, verify that the programming is set correctly and verify the reading in the monitor menu matches up with the application. If there are differences in the temperature readings then there could be an issue with wiring, thermal couple being short or open, or option cards not reading properly. Trace out the probes and verify they are wired and measuring properly. Try setting up for single PT100 if multiple are used and find the one with an issue.

F57 Motor ID Fault – The motor ID fault is an indication there was an issue when performing the motor identification command in the open loop control modes. The drive when told to do a motor ID run performs measurements. If the process doesn't finish or the values are out of range the motor ID fault will occur. Try resetting the fault, run through the initial motor parameters entered and run the motor normally to verify operation before re running the test.   If the fault continues to occur, there could be an issue with the motor or the drive. Disconnect motor and run drive with no motor and check the voltage levels. If possible, meg out motor and motor leads to be sure no issues are being caused by them.

F58 Current Measurement Fault – The current measurement fault is the power board monitoring the voltage bias on the current measurement circuit. If the biased voltage becomes greater than +/-7%, it will cause the drive to fault. ((Vbias/1.65)x100>+/-7%) To handle this fault, perform a factory reset to the drive and reprogram the motor information, and run the drive. If the fault returns, it would require re-placing control board. It might be an induced voltage issue where it is intermittently faulting, so verify all connections are properly tightened.

F59 Power Wiring Error Fault – The power wiring error fault is an indication that the drive was miss wired. The DC link voltage is normal but there is no input voltage when powering up. When this fault occurs, it usually indicates the input wires were wired to the output terminals U, V, and W. To resolve this issue, power the drive down and safely lock out system. After swapping the input and output wires, power up the drive and the fault should clear. If the input line wires (L1, L2, and L3) are properly wired, measure the input voltages and perform static checks of input rectifiers. If these are okay, there is an issue with the monitoring circuit and would require replacement.

F60 Control Board Over Temperature Fault – The control board over temperature fault occurs when the temperature of the control board is below -30°C or greater than 85°C. If this fault occurs, it should be handled similar to the over temperature fault on the drive. Verify the temperature of the control section by reading the Modbus register. Check all connections and verify the ambient air of the control section is in an adequate environment. If the fault continues and no issue is found, it would require replacing the control board.

F61 Internal Control Supply Fault – The internal control supply fault is an indication that the control board internal 24VDC supply is outside the range of 18-27VDC. When this fault occurs, measure the 24VDC output coming from the control board. If the voltage reads okay, perform a power cycle to see if fault clears. If fault is not able to clear, replace the control board.

F62 Too Many Speed Search Restarts Fault – The too many speed search restarts fault is an indication that the drive is not able to see the motor connected when performing a flying start. The drive performs 5 speed searches in the forward direction and 5 in the reverse direction. If it is not able to find the motor, the drive will fault out ending the start sequence. This could be an indication the motor is disconnected or there is a contactor that is not functioning between the drive and the motor. To verify, check connections at the drive. If there is a contactor between the drive and the motor, verify that is pulling in. If everything is connected properly, it could be an issue with the current sensing circuit that is used to find the direction of the motor.

F63 Current Unbalance Fault – The output current unbalanced fault is the drive monitoring the positive and negative current swings on a single phase of all 3 phase current. If the absolute value of them is greater than a 20% differ-ence, the drive will shut down on an output current unbalanced fault. When this fault occurs, it is typically an internal issue with the drive where one of the swings on the output is not firing in the IGBT or a stray voltage may be causing issues. To determine the phase, connect an oscilloscope up to the motor leads and look at the current wave form. This will show which phase would have an imbalance of the positive and negative phases. From there, disconnect the motor and run the drive with no motor connected to check voltages balances. If the voltages are unbalanced, it would mean an issue with the IGBT and static checks can be performed but the drive will most likely need to be replaced.

F64 Replace Battery Fault – The replace battery fault is an indication that the real time clock battery is depleted. The drive monitors the voltage on the battery and depending on the voltage level, it will indicate different status. If the fault occurs, measure the voltage across the battery to determine the status. In most cases, it will require replacing the battery.

Voltage	Warning/Fault	Battery State
<.5V	No Warning/ Fault	Not Installed
>.1V	No Warning/Fault	Installed
0.6V< >2V	Warning/Fault	Change Battery
2V< >3.8	No Warning /Fault	Installed
>3.8V	Warning	Over Voltage

F65 Replace Fan Fault – The replace fan fault is an indication that the fan life is less than 2 months. The drive monitors this based off the power on time of the drive. If the fan is set to not run all the time, the fan life can be extended. When this fault occurs, it is possible to reset the fault and the fan run time counter will reset (even if it's a new or old fan). This is just an indication that the fan may fail shortly and a replacement may soon be needed.

F66 Safety Torque off Fault – The safety torque off fault occurs when the safety circuit opens. By default, the yellow terminal block comes with a jumper installed from the factory. If the jumper or terminal block is removed, the drive will go into fault. If there is a safety circuit that is connected to the terminals, it should be a normally closed contact. If that circuit opens, it will cause the drive to shut down the output by bypassing the control board. In most cases, this fault occurs due to an E-stop being pressed or some safety circuit getting opened. Check the circuit and wiring. If everything is okay, remove the external circuit and replace with a jumper to see if resetting the fault will clear the fault. If it doesn't clear, replace control board.

F67 Current Limit Control Warning – The current limit control warning is an indication that the drive is in the current limit controller. The torque and load have reached the maximum that the drive is set to supply, in which it will limit the output frequency to try and allow the current to back down. When the drive goes into this mode, it uses a PI loop to control the output frequency to the motor. This current level can be set via the keypad on the drive in the motor control parameter group. Typically this value should be 1.15 times the full load amps of the motor. If it is set too low, it could be causing the drive to go into this state. If the value is set correctly, then the load should be checked to be sure it is working properly and that things were sized right.

F68 Over Voltage Control Warning – The over voltage control warning is an indication that the drive is in the over voltage limit but is not high enough for the fault condition. This is typically an indication that the deceleration is too fast. The drive will decelerate the motor but the inertia in the motor is too great to decelerate that quickly. This causes the motor to regenerate voltage back into the drive causing the DC bus to rise. When the drive goes into this state, it prevents the drive from decelerating at the rate specified until the voltage drops.

$$U_{ovc} = U_{in} * 1.414 + deltaVoltage$$

Drive Rating Voltage	deltaVoltage
230V	30V
480V	65V
575V	65V

F69 Thermistor SPI System Fault – The system fault is due to a communication error in the signal processing bus from the thermistor inputs, and an incorrect voltage is read. This is due to internal issues in the control board. Try performing a power cycle to see if fault clears. If fault does not clear, it is suggested to replace the control board.

F70 DSP Parameter System Fault – The system fault is due to a communication error between the main pro-cessing chip and the digital signal processing chip. This could be an issue with a voltage in bal-ance or an issue on the control board. Try cycling power to the drive to see if fault returns. If it does, it would require replacing control board.

F71 Intercom System Fault – The system fault is due to an issue in the parameters signals in the digital signal processing chip that was received from the main processor board. For example, this could be the basic motor parameters. If they would come back as 0 or any other data, it would be seen as inadequate and the fault would occur. When this fault occurs, verify parameter settings in the basic settings group. Once set correctly, perform a factory reset and reprogram the drive. If fault continues to return, replace control board.

F72 Power Board EEPROM Fault – The power board EEPROM fault is an indication that the power board EEPROM chip was not able to initialize on power up. To deal with this fault, try power cycling the drive. If the fault returns, replace the power board.

F73 FRAM Fault – The FRAM fault is an indication that there is an issue with the FRAM chip. The MCU is seeing 0 values come back when trying to read from it. To deal with this fault, per-form a factory default and power cycle the drive. If the fault does not clear, it would require re-placing the control board.

F74 FRAM Fault – The FRAM fault is an indication that the data sent from the FRAM chip to the main processor chips CRC error checking failed. When this fault occurs, try cycling power the drive to reset error messages. If the fault continues, reinstall firmware to the drive and see if it clears the error. If this does not clear the fault, replace the control board.

F75 Power Board EEPROM Fault – The Power board EEPROM fault is an indication that the data being transferred from the EEPROM to the main processor is reading 0, indicating there is an issue with the EEPROM chip. To hand this issue, try cycling power to see if voltage disturbance occurred. If that does not resolve the issue, replace the control board.

F76 Power Board EEPROM Fault – The Power board EEPROM fault is an indication that the data being sent from the EEPROM to the main processor meets the CRC check error. This would be an issue with the messages being sent. Perform a power cycle to see if the data is reset. If the issue continues, replace the control board.

F77 Serial Flash Fault – The serial flash fault is an indication that data is showing 0 when being read/write from the serial flash chip on the signal processing chip. To deal with this fault, try cycling power to the drive. If the fault continues, replace the control board.

F80 Feildbus Fault – The Fieldbus fault is an indication that there is an issue with the BACnet IP network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handle this fault, verify cabling from master to the drive and verify` parameters in the master and drive are matching up correctly for message addressing. If communication is established the fault should not occur, and should be able to be reset.

F82 Bypass Overload Fault – The bypass overload fault is used when there is a bypass motor protector used on the drive. The overload protector should be fed into the drive to indicate it has tripped and to have the drive indicate a fault. To handle this fault, go in to the input signals and determine which input is set up for bypass overload. If that input is correct, go to the overload block and verify that is has been set up correctly for the application. Also, verify the wiring from the overload to the drive and the motor connections on the overload block to make sure nothing is loose or miss wired. If the fault will not reset, it could be an issue with the overload block. Remove the wiring and verify the fault resets. If it does, put a jumper to test again. If the fault doesn't reset then there could be an issue with the control board input, and the control board will need to be replaced. If the Control board is okay the overload may have went bad, the overload will need to be replaced.

F83 RTU Fieldbus Fault – The Fieldbus fault is an indication that there is an issue with the Modbus RTU network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handle this fault, verifies cabling from master to the drive and verify parameters in the master and drive are matching up correctly for message addressing.communicatfion is established the fault should not occur, and should be able to be reset.

F84 TCP Fieldbus Fault – The Fieldbus fault is an indication that there is an issue with the Modbus TCP network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handle this fault, verify cabling from master to the drive and veri-fy parameters in the master and drive are matching up correctly for message addressing. If communication is established the fault should not occur, and should be able to be reset.

F85 MSTP Fieldbus Fault – The Fieldbus fault is an indication that there is an issue with the BACnet MS/TP network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handle this fault, verify cabling from master to the drive and veri-fy parameters in the master and drive are matching up correctly for message addressing. If communication is established the fault should not occur, and should be able to be reset.

F86 IP Fieldbus Fault – The Fieldbus fault is an indication that there is an issue with the EIP fieldbus network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handel this fault, cabling from master to the drive and verify parameters in the master and drive are matching up correctly for message addressing. If communication is established the fault should not occur, and should be able to be reset.

F87 Fieldbus Fault – The Fieldbus fault is an indication that there is an issue with the Profibus, CANopen, or DeviceNET card in the A option card slot network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handle this fault, verify cabling from master to the drive and verify parameters in the master and drive are matching up correctly for message addressing. If communication is established the fault should not occur, and should be able to be reset.

F88 Fieldbus Fault – The Fieldbus fault is an indication that there is an issue with the Profibus, CANopen, or DeviceNET card in the B option card slot network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handle this fault, verify cabling from master to the drive and verify parameters in the master and drive are matching up correctly for message addressing. If communication is established the fault should not occur, and should be able to be reset.

F89 Under Voltage Fault – The under voltage fault is similar to the fault listed above but this is the hard fault level. This is typically an indication that the input voltage feed dropped while the motor was running. Use the same techniques as mentioned for the F9 Under Voltage Fault.

F90 Drive Under Temp Fault – The drive under temperature fault is the indication that occurs when the drive cold weather parameters are enabled and the drive is in the warm up state. This alarm will indicate the drive output is trying to warm itself up by allowing voltage to flow and current draw to have the IGBT's heat up the heat sink.

F91 Option Card Fault – This fault is an idication that the 24V input on the DeviceNET card has been lost. To handle this fault check the connection on the 24V wires on the DeviceNET card as well as back to the power supply supplying power to the network.

F92 External Fault 2 - 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. To troubleshoot this fault, go into the monitor menu and see which input is causing the fault. The digital inputs can be seen in the monitor menu. As an example if DIN3 was programmed for external fault 2 open, 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. If there isn't, troubleshoot the circuit that supplies this input. If there is 24V present, it probably indicates there is a blown digital input and the option board will have to be replaced. To verify this input is bad, jumper it straight to 24V and see if the input turns on. If it were for a fault on closed, then it would work the opposite.

F93 External Fault 3 - 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. To troubleshoot this fault, go into the monitor menu and see which input is causing the fault. The digital inputs can be seen in the monitor menu. As an example if DIN3 was programmed for external fault 3 open, 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. If there isn't, troubleshoot the circuit that supplies this input. If there is 24V present, it probably indicates there is a blown digital input and the option board will have to be replaced. To verify this input is bad, jumper it straight to 24V and see if the input turns on. If it were for a fault on closed, then it would work the opposite.

F94 Pump Loss - The pump loss is used when in the Multi-pump control, when a pump is disabled via Run Enable signal or changed out of the Multi-pump mode it will cause the drive to indicate the pump is no longer in the mode for being active in the pump control. Look for this fault to be from an enable signal or the drive has change into single drive mode and is not communicating over the network.

F95 Need Alternation Warning - The need alternation warning is present when in the multi-pump or redundant drive control. This message occurs when run time is enabled for transistioning control and that time has expired. The drive is waiting for a condition where it can perform a transistion.

F97 Prime Loss - The prime loss fault is used with the multi-pump control where the drive is setup to initially prime the system before running in normal operaiton. This is a configurable fault that if the system pressure feedback does not meet the required level after a set time the drive will indicate there is an issue. To address this fault, it would require checking your system for leaks that could of occured or the feedback sensor is not providing the proper signal.

F98 PID1 Feedback AI Loss - The PID1 feedback AI loss fault is used with the multi-pump control where the drive is setup to monitor the feedback signal, if this signal is lost then the drive would indicate there is an issue. This is a configurable fault that if the system pressure feedback is lost the drive would give fault and stop, or warning and run at some set speed. To address this fault, it would require similar steps as the loss of 4mA signal listed above.

To handle this issue, it is best to verify which analog input is using the current signal and then check the wiring on the drive and the other end to check for lost connections or miss wiring. Using a multi-meter, verify the current measured with a meter matches what is shown in the monitoring menu of the keypad. If the meter reads above 4mA but the drive is seeing 0 or a different value, it could be an issue with the dip switches for the analog inputs located on the left side of the control board below the STO terminal. If the dip switches are correct and the keypad is still not reading properly the analog input has failed which would require replacing the control board. If the measurement matches what the drive shows, there would seem to be an issue with the source.

F99 PID2 Feedback AI Loss - The PID2 feedback AI loss fault is used with the multi-pump control where the drive is setup to monitor the feedback signal, if this signal is lost then the drive would indicate there is an issue. This is a configurable fault that if the system pressure feedback is lost the drive would give fault and stop, or warning and run at some set speed. To address this fault, it would require similar steps as the loss of 4mA signal listed above.

To handle this issue, it is best to verify which analog input is using the current signal and then check the wiring on the drive and the other end to check for lost connections or miss wiring. Using a multi-meter, verify the current measured with a meter matches what is shown in the monitoring menu of the keypad. If the meter reads above 4mA but the drive is seeing 0 or a different value, it could be an issue with the dip switches for the analog inputs located on the left side of the control board below the STO terminal. If the dip switches are correct and the keypad is still not reading properly the analog input has failed which would require replacing the control board. If the measurement matches what the drive shows, there would seem to be an issue with the source.

F100 Fieldbus SMDT - The Fieldbus fault is an indication that there is an issue with the SmartWire DT fieldbus network messages. There was a loss in communication between the drive and the master after a specified timeout time. To handel this fault, cabling from master to the drive and verify parameters in the master and drive are matching up correctly for message addressing. If com-munication is established the fault should not occur, and should be able to be reset.

F101 SMDT Card Fault - The SmartWire Card fault is an indication that there is an issue with the option card. To handle this issue, it is best to verify the connection between the card and the A/B terminals on the drive as well as the connection of the Smartwire cable.

F102 External Fault from SMDT - The External fault form Smartwire DT fieldbus is due to a bit in the Smartwire Control word bit 15 that is enabled to tell the drive to fault. Check the control system to verify where this bit is getting enabled from and trace that back to the source.

F103 Drive Overtemp Warning- This warning is an indication that the drive is 10 deg away from the trip point of 90deg C. To handle this fault would be similar to looking at the Drive overtemp fault listed above.

When an over temperature fault occurs, the first thing to do is check and see if the cooling fans are working properly. Typically there will be a fan fault as well if the fan has failed. If the fans are not spinning, verify voltage is getting to the fans. With a multi-meter, measure the voltage across the fan connector. There should be 24Vdc on FR1-FR4 and 48Vdc on FR5-FR8 fans.
If the fans are working, check the air flow through the drive. If the air is restricted, it will be re-quired to clean out the cooling tunnel. If there is air flow, check the temperature of the air to see if it is hot or cold. If cool air is flowing, it would indicate the temperature sensors have failed. This failure would require factory service to repair. Another thing to check would be the ambient air temperature that the drive is located in. The drive is meant to be in a location that does not ex-ceed 50°C ambient and is no more than 1000M above sea level. If either of these conditions is exceeded, the drive requires de-rating which is found in the installation manual.

Another thing to note with this fault is the drive will try to prevent the fault condition by dropping the switching frequency once the fold back temperature is met (which varies based off frame size). The switching frequency will back itself down more the closer it gets to the fault tempera-ture.

F104 Compatability Fault- This warning is an indication that the drives DSP processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F105 Compatability Fault- This warning is an indication that the drives Keypad processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F106 Compatability Fault- This warning is an indication that the drives IO1 option card processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F107 Compatability Fault- This warning is an indication that the drives IO2 option card processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F108 Compatability Fault- This warning is an indication that the drives IO3 option card processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F109 Compatability Fault- This warning is an indication that the drives IO4 option card processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F110 Compatability Fault- This warning is an indication that the drives IO5 option card processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

F111 Compatability Fault- This warning is an indication that the drives PROFIbus option card processor and MCB processor firmware is not compatible. This fault condition will require firmware update to get processors up to the compatible versions, this firmware is on the website as a single bundle of all firmware.

List of Fault Code Per PowerXL Product

Fault Code	Description	DG1	DH1	Fault Code	Description	DG1	DH1
					PowerXL Series Drives		
1	Over Current	X	X	67	current limit control	X	X
2	Over Voltage	X	X	68	over voltage control	X	X
3	Earth Fault	X	X	69	Thermistor spi fault	X	X
5	Charging Switch	X	X	70	DSP parameter fault	X	X
6	Emergency Stop	X		71	intercom fault	X	X
7	Saturation Trip	X	X	72	eeprom initial fault	X	X
9	UnderVoltage	X	X	73	internal FRAM fault	X	X
10	Input Phase Spv	X	X	74	fram data error	X	X
11	Output Phase Spv	X	X	75	internal eeprom fault	X	X
12	BrakeChopperSpv	X	X	76	eeprom data error	X	X
13	Drive UnderTemp	X	X	77	internal serial flash fault	X	X
14	Drive OverTemp	X	X	80	FieldBus Bacnet IP Fault		X
15	Motor Stalled	X	X	81	FieldBus SA Bus Fault		
16	Motor OverTemp	X	X	82	BypassOverLoad	X	X
17	Motor UnderLoad	X	X	83	FieldBus RTU Fault	X	X
18	IP conflict	X	X	84	FieldBus TCP Fault	X	X
19	Power board EEPROM Fault	X	X	85	FieldBus MSTP Fault	X	X
20	FRAM Fault	X	X	86	FieldBus EIP Fault	X	X
21	Serial Flash Fault	X	X	87	FieldBus SlotA Fault	X	X
25	MCU WatchDog Fault	X	X	88	FieldBus SlotB Fault	X	X
26	Start-up Prevent	X	X	89	Under Voltage Stop	X	X
29	Thermistor Fault	X	X	90	Cold Weather Drive Under Temp	X	X
32	Fan Cooling	X	X	91	Device Net External Power Fail Fault	X	X
36	Compatibility Fault	X	X	92	External Fault 2	X	X
37	Device Change	X	X	93	External Fault 3	X	X
38	Device Added	X	X	94	Pump Lost	X	
39	Device Removed	X	X	95	Need Alternation	X	
40	Device Unknown	X	X	97	Prime Loss	X	
41	IGBT Temperature	X	X	98	PID1 Feedback AI Loss	X	
50	AIN<4mA(4to20mA)	X	X	99	PID2 Feedback AI Loss	X	
51	External Fault	X	X	100	FieldBus SMDT Fault	X	X
52	Keypad Communication Fault	X	X	101	SMDT card fault	X	X
54	OPT Card Fault	X	X	102	External Fault from SWD	X	X
55	Real time clock fault	X	X	103	Drive OverTemp Warning	X	X
56	PT100 Fault	X	X	104	Compatibility Fault - DSP	X	X
57	Motor ID fault	X	X	105	Compatibility Fault - Keypad	X	X
58	Current Measure Fault	X	X	106	Compatibility Fault - IO1	X	X
59	Possible power wiring error detected	X	X	107	Compatibility Fault - IO2	X	X
60	Control Board OverTemp	X	X	108	Compatibility Fault - IO3	X	X
61	Internal-ctrl Supply	X	X	109	Compatibility Fault - IO4	X	X
62	Too Many Speed Search Restarts	X	X	110	Compatibility Fault - IO5	X	X
63	Current Unbalance	X	X	111	Compatibility Fault - PROFIbus	X	X
64	Replace Battery	X	X	112	Compatibility Fault - DevieNET	X	X
65	Replace Fan	X	X	113	Compatibility Fault - CANopen	X	X
66	Safety Torque Off	X	X	114	Compatibility Fault - SWD	X	

DC Balance Checks - Power the unit up and insure that the drive is not started. With a meter on DC measure from –DC bus to U, V & W, should read somewhere between 2-50VDC. The key to look for is one that reads either 0VDC or a very high voltage. All 3 of the phases should read relatively even but it shouldn't be rejected unless it is outside of the range stated above. If one is found outside of the range listed above, power down the drive and contact Eaton with these readings.

If the readings pass, start the drive and do the DC checks again. With the drive running there should be 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 the measurements will likely give 0VDC or full DC bus. If either of these is seen, power down the drive and contact Eaton. If the readings are OK, ramp the drive up to full speed and check AC phase to phase on the output. There should be voltage that is normally higher than the actual rating of the drive but this will depend on the meter used. All 3 phases should be even. Then measure from each phase to ground but this may vary depending on what the 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 the problem if there is a problem 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, connect a small test motor to the drive and run it. If the drive can smoothly spin a small motor, it indicates 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.

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.

Rectifier Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC-"; Red lead "L1, L2, L3"	infinite	Red Lead "DC-"; Black lead "L1, L2, L3"	0.48V +/-10%
Black Lead "DC+"; Red lead "L1, L2, L3"	0.7V +/-10%	Red Lead "DC+"; Black lead "L1, L2, L3"	infinite
IGBT Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC-"; Red lead "U, V, W"	infinite	Red Lead "DC+"; Black lead "U, V, W"	infinite
Red Lead "DC-"; Black lead "U, V, W"	0.38V +/-10%	Black Lead "DC+"; Red lead "U, V, W"	0.38V +/-10%
Brake Static Checks			
Measurement Point	Value	Measurement Point	Value
Red Lead "DC-"; Black lead "R-"	infinite	Black Lead "DC+"; Red lead "R-"	0.48V +/-10%

FR1-2

Rectifier Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC-"; Red lead "L1, L2, L3"	infinite	Red Lead "DC-"; Black lead "L1, L2, L3"	0.48V +/-10%
Black Lead "DC+"; Red lead "L1, L2, L3"	0.6V +/-10%	Red Lead "DC+"; Black lead "L1, L2, L3"	infinite
IGBT Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC-"; Red lead "U, V, W"	infinite	Red Lead "DC+"; Black lead "U, V, W"	infinite
Red Lead "DC-"; Black lead "U, V, W"	0.38V +/-10%	Black Lead "DC+"; Red lead "U, V, W"	0.38V +/-10%
Brake Static Checks			
Measurement Point	Value	Measurement Point	Value
Red Lead "DC-"; Black lead "R-"	infinite	Black Lead "DC+"; Red lead "R-"	0.48V +/-10%

FR3

Rectifier Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC -"; Red lead "L1, L2, L3"	infinite	Red Lead "DC-"; Black lead "L1, L2, L3"	0.45V +/-10%
Black Lead "DC+"; Red lead "L1, L2, L3"	1.2V +/-10%	Red Lead "DC+"; Black lead "L1, L2, L3"	infinite
IGBT Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC-"; Red lead "U, V, W"	infinite	Red Lead "DC+"; Black lead "U, V, W"	infinite
Red Lead "DC-"; Black lead "U, V, W"	0.38V +/-10%	Black Lead "DC+"; Red lead "U, V, W"	0.38V +/-10%
Brake Static Checks			
Measurement Point	Value	Measurement Point	Value
Red Lead "DC-"; Black lead "R-"	infinite	Black Lead "DC+"; Red lead "R-"	0.48V +/-10%

FR4

Rectifier Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "Rec-"; Red lead "L1, L2, L3"	infinite	Red Lead "Rec-"; Black lead "L1, L2, L3"	0.43V +/-10%
Black Lead "Rec+"; Red lead "L1, L2, L3"; remove CN606 connector	infinite	Red Lead "Rec+"; Black lead "L1, L2, L3"	infinite
IGBT Static Checks			
Measurement Point	Value	Measurement Point	Value
Black Lead "DC-"; Red lead "U, V, W"	infinite	Red Lead "DC+"; Black lead "U, V, W"	infinite
Red Lead "DC-"; Black lead "U, V, W"	0.38V +/-10%	Black Lead "DC+"; Red lead "U, V, W"	0.38V +/-10%
Brake Static Checks			
Measurement Point	Value	Measurement Point	Value
Red Lead "DC-"; Black lead "R-"	infinite	Black Lead "DC+"; Red lead "R-"	0.48V +/-10%

FR5

If a short or open is found where there 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.

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 frequency on its output. It controls everything else by adjusting these 2 things. Checking the output voltage on the drive will indicate 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 drive 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 there are problems here, it normally will be 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 a problem is seen, it will normally show 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 is used 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 the readings are not within tolerance, 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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