

### Introduction

A red LED can indicate any of the following fault conditions:

- Over-voltage
- Under-voltage
- Invalid Hall State
- Drive Inhibited
- Over-temperature
- Short circuit
- Over-current
- Power-on Reset

Fault conditions are non-latching, meaning that when the fault condition is removed, the drive will enable (green LED).

**Note:** BX drives (e.g. BX25A20, BX30A8) have a switch setting for latching faults. The fault condition must be removed and power must be cycled or inhibit line toggled to clear a fault condition.

### Troubleshooting Instructions

1. Remove all connections from the drive. This includes the voltage supply, motor power cables, feedback and any controller I/O.
2. For a brushed drive, configure the amplifier for voltage mode. For a brushless drive, configure the amplifier for open loop mode. The switch settings for each mode can be found on the drive datasheet.
3. If using a brushless drive, set the 60 / 120 phasing switch to 60 degrees, which is the OFF position.
4. Apply power to the drive. If the drive has inverted inhibits, short the master inhibit pin to signal ground (for more information on inverted inhibits, see **Drive Inhibited** section). **The LED should be green.** The drive will fault if too much or too little voltage is applied to the drive. See **Over-voltage and Under-Voltage** section for details on this fault condition.

5. Remove power from the drive. If using a brushless motor, connect Hall sensor inputs and set the 60 / 120 phasing switch to the correct position according to the motor. Apply power to the drive and rotate the motor by hand. If the LED is red or changing between red and green, this could indicate an issue with the Hall sensor inputs. See **Invalid Hall State** section for details on this fault condition.

**Note:** Most motors have 120 degree Hall sensors.

6. Remove power from the drive and connect motor power cables. Set the Test/Offset switch to the OFF position and set POT4, the Test/Offset pot, 7 turns from the full clockwise direction.
7. Apply power. If the LED is red, it could be an indication of a short circuit fault. See **Short Circuit** section for details on this fault condition.
8. Remove power and connect the controller. Remove any command from the controller to avoid unexpected motion in the motor.
9. Apply power. If the LED is red, check if the controller is disabling the drive. See **Drive Inhibited** section for more information about the inhibit input.

### Fault Conditions Explained

#### Over-voltage and Under-voltage

An over-voltage fault occurs when the bus voltage exceeds the over-voltage limit of the drive. An under-voltage can occur if too little voltage is applied to the drive. The voltage rating can be found on the drive datasheet.

- For DC input drives, verify that the DC input voltage is within the spec of the drive.
- For AC input drives, verify that the AC input voltage is within the spec of the drive.

### Regeneration

If the drive faults during a deceleration or when lowering a vertical load, it could be due to regeneration energy raising the bus voltage beyond its over-voltage limit.

During these types of moves, the system's mechanical energy gets converted into electrical energy that flows back onto the DC bus. This charges the capacitors in the power supply and raises the DC bus voltage.

A shunt regulator may be necessary to dissipate the energy regenerated by the system.

- Some drives have built-in shunt regulators. Shunt regulator operation is described in the drive datasheet if available.
- For additional information on calculating regeneration energy and sizing a shunt regulator, see section **III.Regeneration** in the [Power Supply Selection](#) document or contact AMC tech support.

### Invalid Hall State

Brushless drives have 3 Hall sensor inputs that determine a Hall state. The drive will fault if an invalid Hall state is detected.

If the LED is red or changing between red and green as the motor rotates, it could be an indication of an invalid Hall state.

- Connect only the Hall sensors to the drive and apply power.
- Make sure the 60 or 120 phasing switch is in the correct position according to motor.
- Verify that all Hall sensor inputs are wired correctly to the drive.
- Measure the voltage levels for all Hall sensor inputs. The voltage levels should change between 0 and 5V as the motor rotates.
- If using a motor with both Hall sensors and an encoder, make sure the supply for the feedback has enough power. Drives with onboard Hall sensor power rated at 30mA

won't have enough current and a separate supply will be required.

- If using a separate supply for the Hall sensors, make sure the ground reference for the supply is tied to the signal ground of the drive.
- Rotate the motor and verify that ALL Hall sensor inputs are changing and follow the Hall sequence in the table below.

60 Degree			120 Degree		
Hall A	Hall B	Hall C	Hall A	Hall B	Hall C
1	0	0	1	0	0
1	1	0	1	1	0
1	1	1	0	1	0
0	1	1	0	1	1
0	0	1	0	0	1
0	0	0	1	0	1
1	0	1	1	1	1
0	1	0	0	0	0

Valid  
Green  
LED

Invalid  
Red LED

1 – Indicates high level hall sensor input (5V)  
0 – Indicates low level hall sensor input (0V)

### Drive Inhibited

For standard inhibits, the drive disables when the inhibit pin is grounded. For inverted inhibits, the drive enables when the inhibit pin grounded.

A drive with standard inhibits has a 0 ohm SMT resistor labeled "J1" installed on the PCB. Removing this jumper will invert the inhibits. Amplifiers can be ordered with the J1 jumper removed and have a "-INV" on the end of the part number, e.g., 12A8-INV. Some drives have a DIP switch to invert the inhibits. This option will be listed on the drive datasheet if available.

**Note:** Some drives have directional inhibits (+INHIBIT / -INHIBIT) which inhibit motion in their respective directions but do NOT cause a red LED.

- Measure the voltage of the inhibit pin. It should read 5V if left open and 0 if grounded.

- Verify if the drive is configured for standard or inverted inhibits.
- If your controller is disabling the drive, verify under what conditions this will occur, e.g., position following error, position limit reached, etc.

### Over-temperature

The drive will fault if the heat sink base plate temperature exceeds 65C.

- Safely measure the heat sink base plate temperature.
- If the temperature exceeds 65C, additional cooling may be necessary.

### Short Circuit

The drive will fault if a short circuit is detected on the output. ***This can occur if any of the motor phases are shorted to power ground, AC ground, or shorted together.*** Use a DMM to measure the resistance between two points of interest. A 0 ohm resistance indicates a short circuit.

- Measure the resistance between each motor phase.
- Measure the resistance between each motor phase and both the power ground and AC ground.
- Make sure the motor phases are not shorting to AC ground through the motor housing or shielding on the motor power cable.

### Over-current

An over-current fault will occur if commanding a current greater than the peak rating of the drive. In most cases though, the drive will limit the current to prevent an over-current fault.

PWM input and Sinusoidal input drives will alternate between an enabled and disabled state to limit current when outputting current greater than the continuous rating of the drive. The LED will alternate between red and green.

**Note:** BDC drives (e.g. BDC30A8) are PWM input drives that have the same current limiting behavior as analog input drives.

### Power-on Reset

All amplifiers will have a brief flicker of a red LED during power up. This is the power-on reset that is built into the amplifier that occurs on power up.