



ULTI-AXIS

USER GUIDE VERSION 1.0d

Author: Andy Whitaker

Mark Roberts Motion Control Ltd.
Unit 4 Birches Industrial Estate,
Imberhome Lane,
East Grinstead,
West Sussex, RH19 1XZ,
England

www.mrmoco.com
support@mrmoco.com
Tel: +44-1342-334700
Fax: +44-1342-334701

Copyright 2006-2007 MRMC
Updated November 2007

SA-20 User Guide Version 1.0d

Contents

1 Introduction..... 3

2 Quick Reference Guide (Standalone).....4

 2.1 Power Supply Connections..... 4

 2.2 MSA-20 Connections.....4

 2.3 Ulti-Head Connections.....5

 2.4 Power Up (Using One Power Supply Unit)..... 6

 2.5 Power Up (Using Separate MSA-20 and Ulti-Head Power Supply Units).....6

 2.6 Loading the Ulti-Head..... 6

3 Quick Reference Guide (Flair)..... 7

 3.1 Power Supply Connections..... 7

 3.2 Rootbox Connections.....7

 3.3 MSA-20 Connections.....8

 3.4 Ulti-Head Connections.....9

 3.5 Power Up..... 10

 3.6 Using Flair.....10

4 Trouble Shooting..... 11

 4.1 Diagnostic LEDs on Ulti-Axis..... 11

 4.1.1 Power LEDs..... 11

 4.1.2 Enable LEDs..... 11

 4.1.3 Trip LEDs.....11

 4.1.4 Error LEDs.....11

 4.1.5 Other LEDs..... 11

 4.2 Diagnostic LEDs on Ulti-Driver.....12

 4.3 Bootloading from Flair..... 13

 4.3.1 Normal Operation.....13

 4.3.2 Problem Solving.....14

 4.4 Bootloading from the MSA-20..... 16

 4.4.1 Normal Operation.....16

 4.4.2 Problem Solving.....16

 4.5 Driving DC Motors..... 18

 4.5.1 Normal Operation.....18

 4.5.2 Problem Solving.....18

 4.6 Driving Stepper Motors..... 20

 4.6.1 Normal Operation.....20

 4.6.2 Problem Solving.....20

 4.7 General Purpose IO.....21

 4.7.1 Normal Operation.....21

 4.7.2 Problem Solving.....21

5 Appendix A, Temperature and Current Settings (Flair 4.3 and Earlier)..... 22

6 Appendix B, Ulti-Head Connector Pin-Outs.....23

 6.1 Motor (Pan/Aux2/Aux1/Tilt/Focus/Zoom).....23

 6.2 Power.....23

 6.3 Data.....23

 6.4 Camera Accessory.....23

 6.5 Serial.....23

7 Appendix C, I/O Specification..... 25

 7.1 GPI Specification.....25

 7.2 GPO Specification.....25

8 Appendix D, Motor Drive Specifications.....26

 8.1 DC Motors.....26

 8.2 Stepper Motors.....26

1 Introduction

The Ulti-Axis card is a 9 channel axis card. It has the following features:

1. 6 35VDC motor axes (10A)
2. 3 Stepper axes
3. 2 RS232 ports (Max 288Kbps)
4. 1 10 Mbps Datalink (2 on MK3 and later)
5. 2 opto general purpose inputs
6. 2 opto general purpose outputs

The Ulti-Axis card can be connected to either a Flair system or the MSA-20 for standalone operation.

Note: For the system to work with Flair the Serial cable must be disconnected from the Ulti-Head at the Ulti-Head elbow.

2 Quick Reference Guide (Standalone)

2.1 Power Supply Connections



Figure 1. Power supply unit with connections.

- 1). MSA-20 power
- 2). Mains power

2.2 MSA-20 Connections

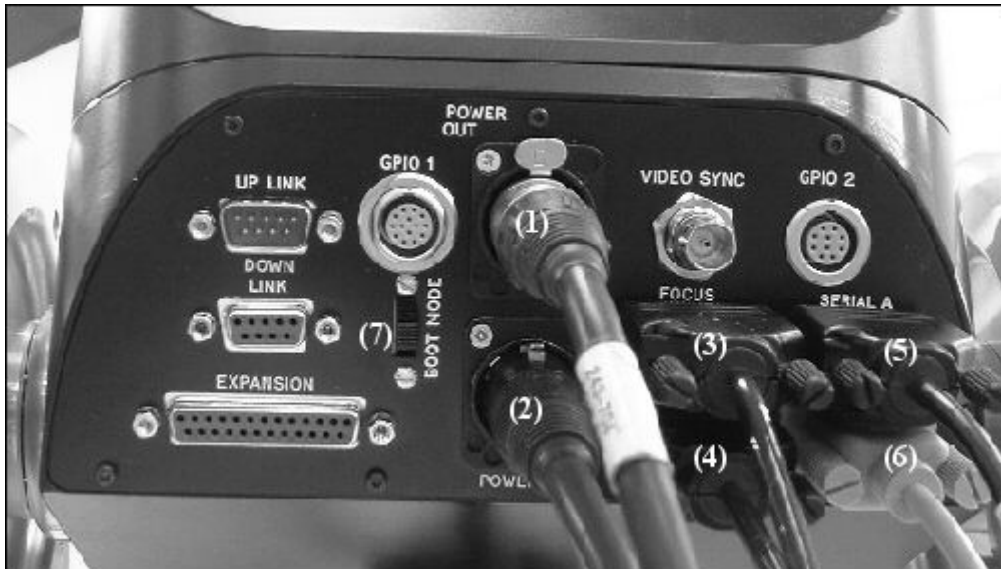


Figure 2. MSA-20 rear panel with (Standalone) connections.

- 1). Ulti-Head Slip-Ring power – optional (The head can have a separate power supply)
- 2). MSA-20 power - required
- 3). Focus pot (Wheel 4) - optional
- 4). Zoom pot (Wheel 5) - optional
- 5). Ulti-Head Slip-Ring serial - required
- 6). PC serial (For use with PC Backup Facility) - optional
- 7). The boot mode switch must be in the centre position. – required

2.3 Ulti-Head Connections



Figure 3. Ulti-Head Slip-Ring side panel with (Standalone) connections.

- 1). Ulti-Head Slip-Ring serial
- 2). Ulti-Head Slip-Ring power



Figure 4. Ulti-Head Slip-Ring lower panel and Ulti-Head Elbow lower panel with (Standalone) connections.

- 1). Ulti-Head Slip-Ring to Ulti-Head Elbow Pan motor
- 2). Ulti-Head Slip-Ring to Ulti-Head Elbow serial
- 3). Ulti-Head Slip-Ring to Ulti-Head Elbow power

2.4 Power Up (Using One Power Supply Unit)

See sections 2.12.1 Power Supply Connections to 2.3 Ulti-Head Connections above on pages 4 to 5 for connection information.

Once everything is connected the mains power and 34VDC switches can be turned on. The power-up checklist is:

- 1). 1 Red LED on Power Supply Unit is on.
- 2). 1 Blue 'Power' LED, and 1 green 'Running' LED are on MSA-20 front panel are on.
- 3). 4 Blue 'Power' LEDs and 1 Yellow 'Inhibit' LED on the Ulti-Head upper panel are on.

2.5 Power Up (Using Separate MSA-20 and Ulti-Head Power Supply Units)

If the Ulti-Head and MSA-20 are running from separate power supplies the power up sequence is important. The power-up sequence is:

- 1). Turn on the MSA-20 power supply.
- 2). Turn on the Ulti-Head Power supply.

The power-up checklist is:

- 1). 1 Red LED on Power Supply Unit is on.
- 2). 1 Blue 'Power' LED, and 1 green 'Running' LED are on MSA-20 front panel are on.
- 3). 4 Blue power LEDs and 1 Yellow inhibit LED on the Ulti-Head upper panel are on.

2.6 Loading the Ulti-Head

Once the system has been powered up the Ulti-Head needs to be loaded by the MSA-20.

The MSA-20 screen should say “Press select to load Ulti-Head”. If this is not the case ensure the boot mode switch on the MSA-20 rear panel is set to the centre position and repeat the power-up procedure.

Press the select button. The MSA-20 screen should show “Loading Ulti-Head” and an increasing percentage as it loads the head. If the MSA-20 screen shows “Ulti-Head Load Fail” then there was a problem loading the head. Check the connections from the MSA-20 rear panel 'Serial A' connector to the Ulti-Head Elbow lower panel 'Serial' Connector. Rectify any connection fault and repeat the power-up and Ulti-Head Loading procedures.

3 Quick Reference Guide (Flair)

3.1 Power Supply Connections



Figure 5. Power Supply Unit with connections.

- 3). MSA-20 power
- 4). Mains power

3.2 Rootbox Connections

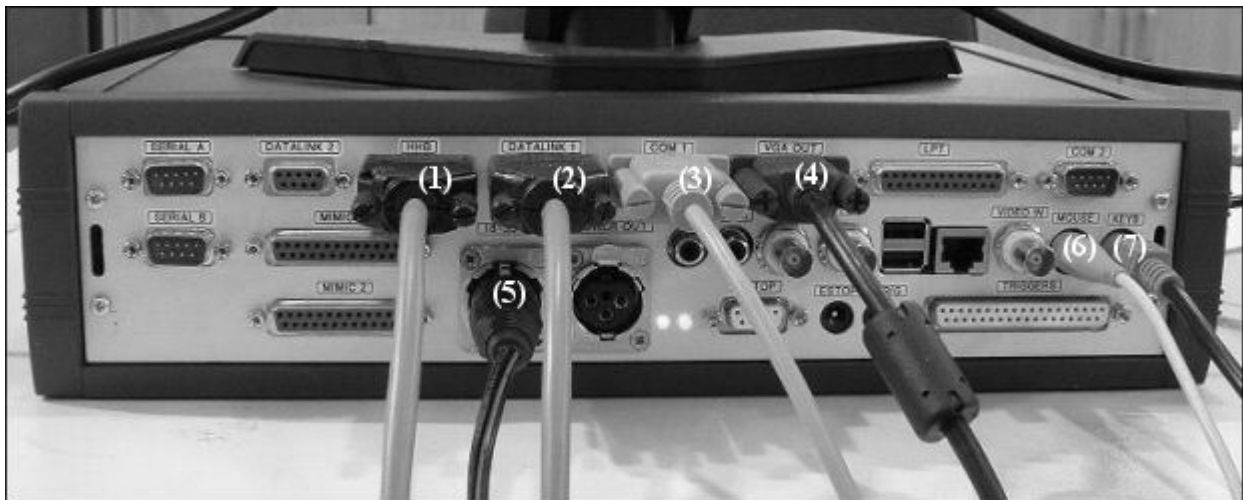


Figure 6. Rootbox rear panel with connections.

- 1). Hand Held Box datalink - optional
- 2). MSA-20 datalink - required
- 3). PC serial – optional (For use with PC Backup Facility when in standalone mode)
- 4). Monitor -required
- 5). Rootbox power - required (Connects to separate 24V rootbox power supply unit)
- 6). Mouse - required
- 7). Keyboard – required

3.3 MSA-20 Connections



Figure 7. MSA-20 rear panel with (Flair) connections.

- 1). MSA-20 datalink - required
- 2). Ulti-Head Slip-Ring datalink -required
- 3). Ulti-Head Slip-Ring power – optional (The Ulti-Head can have a separate power supply)
- 4). MSA-20 power - required
- 5). Focus pot (Wheel 4) - optional
- 6). Zoom pot (Wheel 5) - optional
- 7). The boot mode switch must be in the upper position - required

3.4 Ulti-Head Connections



Figure 8. Ulti-Head Slip-Ring side panel with (Flair) connections.

- 1). Ulti-Head Slip-Ring power
- 2). Ulti-Head Slip-Ring datalink

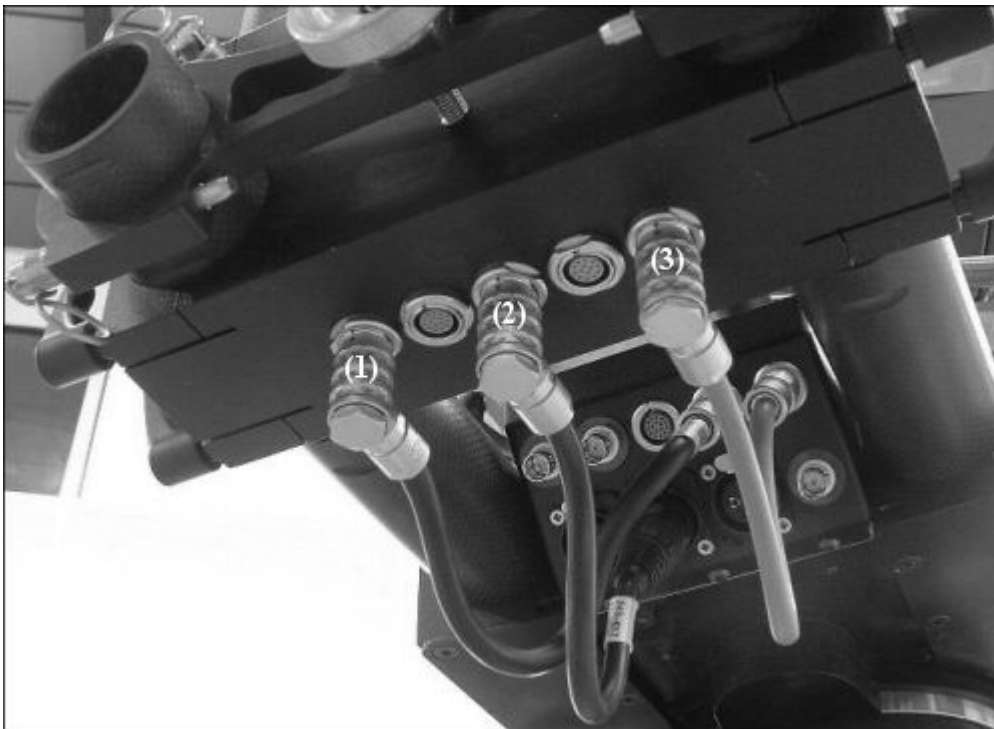


Figure 9. Ulti-Head Slip-Ring lower panel and Ulti-Head Elbow lower panel with (Flair) connections.

- 1). Ulti-Head Slip-Ring to Ulti-Head Elbow Pan motor
- 2). Ulti-Head Slip-Ring to Ulti-Head Elbow power
- 3). Ulti-Head Slip-Ring to Ulti-Head Elbow datalink

3.5 Power Up

See sections 2.12.1 Power Supply Connections to Ulti-Head Connections above on pages 7 to 9 for connection information.

Once everything is connected the mains power and 34VDC switches on the PSU and can be turned on and the rootbox power supply can be plugged in. The power-up checklist is:

- 1). 1 Green 'Power' LED on the Rootbox power supply is on.
- 2). 1 Yellow '5V' LED and 1 Green '12V' LED on the Rootbox rear panel are on.
- 3). 1 Blue 'Power' LED and 1 Yellow 'Inhibit' LED on the Rootbox front panel are on.
- 4). 1 Red LED on Power Supply Unit is on.
- 5). 1 Blue 'Power' LED, and 1 Yellow 'Inhibit' LED on MSA-20 front panel are on.
- 6). 4 Blue 'Power' LEDs and 1 Yellow 'Inhibit' LED on the Ulti-Head upper panel are on.

3.6 Using Flair

- 1). Once the Rootbox has finished booting Windows Flair can be started, click on the 'Flair' desktop shortcut.
- 2). The Rootbox will issue a reset, this is indicated by the Yellow 'Reset' LED on all boards connected to the Rootbox and the Yellow 'Reset' LED on the Rootbox front panel illuminating.
- 3). The system will then be booted, all boards will show a flashed Green 'Running' LED when they are receiving boot data and will flash at a constant 25Hz when up and running.
- 4). Once all the boards have been booted Flair will start running, this is indicated by the Yellow 'Inhibit' LED on all boards and on the Rootbox front panel switching off.
- 5). Flair is now running. Please refer to the Flair manual for detailed information on how to use Flair.

4 Trouble Shooting

Set-up and operation of the Ulti-Axis card should follow the same simple steps every time. However, the diagnostic LEDs on the device can help identify problems that can occur.

4.1 Diagnostic LEDs on Ulti-Axis

The LEDs all have water clear lenses and so the colour is not apparent until illuminated.



Figure 10. Ulti-Axis LEDs.

4.1.1 Power LEDs

1. D2 – 5V regulator for the board electronics operational (on)
2. D6 – 5V regulator for external devices (e.g. Encoders, GPOs etc) operational (on)

4.1.2 Enable LEDs

1. D7 – DC motor channel 1 enabled (on)
2. D8 – DC motor channel 2 enabled (on)
3. D9 – DC motor channel 3 enabled (on)
4. D10 – DC motor channel 4 enabled (on)
5. D11 – DC motor channel 5 enabled (on)
6. D12 – DC motor channel 6 enabled (on)

Note: There are no enable LEDs for the 3 stepper channels.

4.1.3 Trip LEDs

1. D21 - Channel 1 Over current (continuous for 4 seconds) and over temperature (flashing for 4 seconds)
2. D22 - Channel 2 Over current (continuous for 4 seconds) and over temperature (flashing for 4 seconds)
3. D23 - Channel 3 Over current (continuous for 4 seconds) and over temperature (flashing for 4 seconds)
4. D24 - Channel 4 Over current (continuous for 4 seconds) and over temperature (flashing for 4 seconds)
5. D25 - Channel 5 Over current (continuous for 4 seconds) and over temperature (flashing for 4 seconds)
6. D26 - Channel 6 Over current (continuous for 4 seconds) and over temperature (flashing for 4 seconds)

4.1.4 Error LEDs

1. D17 – Up Link Fail (on)
2. D18 – Down Link Fail (on)
3. D14 – Board ID incorrect (continuous) and no watchdog (flashing 1Hz)

4.1.5 Other LEDs

1. D13 – Inhibit, all outputs disabled (on)
2. D15 – Reset, Up link reset signal detected, DSP reset (on)
3. D19 – Booting (erratic flashing) and running (flashing 25Hz)

Note: The illumination of the inhibit LED (yellow D13) also indicates that the board logic is operational.

4.2 Diagnostic LEDs on Ulti-Driver

1. D1 – 3.3V regulator on Ulti-Axis board operational (on)
2. D14 – 12V regulator for H-Bridge drivers and FETs operational (on)
3. D45 – 5V regulator for external devices is operational (on) (MK4 onwards only)

4.3 Bootloading from Flair

4.3.1 Normal Operation

The following steps explain what is happening and what LEDs are illuminated. Each step only indicates a change from the previous step.

1. Power the Ulti-Axis card (MAX 35V).

Ulti-Axis:

D2 – 5V (Blue), turns on.

D6 – 5V (Blue), turns on.

D13 – Inhibit (Yellow), turns on.

Ulti-Driver:

D1 – 3.3V (Blue), turns on.

D14 – 12V (Blue), turns on.

D45 – 5V (Blue), turns on (MK4 onwards only)

2. Start Flair.

Ulti-Axis:

D15 – Reset (Yellow), illuminates during reset period (1second approx).

3. Ulti-Axis Booting.

Ulti-Axis:

D19 – Booting (Green), only illuminates once the correct initial data stream structure is detected after which the LED is toggled for every 500 bytes received. This produces erratic flashing.

4. Ulti-Axis Running – No Tick Packets Received.

Ulti-Axis:

D19 – Running (Green), when the program is running D19 is toggled every watchdog pulse causing it to flash at 25Hz.

5. Ulti-Axis Running – Tick Packets Received.

Ulti-Axis:

D13 – Inhibit (Yellow), the Inhibit LED turns off when the encoders are being read faster than 500Hz (normal operation is 1600Hz).

6. Axis Enabled.

Ulti-Axis:

D7-D12 – Enable (Green), when an enable command is received the corresponding axis is enabled and its enable LED will illuminate.

7. Axis Disabled.

Ulti-Axis:

D7-D12 – Enable (Green), when a disable command is received the corresponding axis is disabled and its enable LED will turn off. If the limit for the axis is open the axis will be disabled after a short delay (e.g. No motor connected).

4.3.2 Problem Solving

Problem: The board bootloads but the error LED is illuminated and the board stays inhibited without running.

Cause: The head was loaded with the wrong software.

Solution: The Flair.ini file needs updating. Ensure that the Ulti-Axis card is being loaded with Ulti-Axis.btl, e.g.

```
*Acode3:      btl/Ulti_Axis.btl
```

Where 3 represents the position of the Ulti-Axis card in the comms (First board is 1).

Problem: The board bootloads but the error LED flashes (1Hz) and the board stays inhibited.

Cause: There is no watchdog signal:

- a). The data cable is damaged and/or
- b). The comms receiver IC (RX2) is damaged.

Solution: a). Replace the cable and/or
 b). Replace RX2, MAX3096CPE

Problem: Flair is started but no bootloading occurs and Flair appears to start successfully.

- Cause: 1. The boot file has the wrong structure (the file might be for a Transputer).
 2. The boot data has been corrupted and the wrong initial data structure is read in:
- a). The data cable is damaged.
 - b). The comms receiver IC (RX2) is damaged.
 - c). The transmitter IC (TX1) on the next board up is damaged.

Solution: 1. Update the Flair.ini file to the correct file name for the board and its location in the comms system.
 2. a). Replace the data cable.
 b). Replace RX2
 c). Replace TX1 on next board up.

Problem: Flair has started but bootloading fails and Flair is shutdown.

- Cause: The next board up cannot complete booting the Ulti-Axis board.
- a). The Ulti-Axis card is not powered (Check number of blue LEDs, 4 on MK3 and earlier, 5 on MK4 onwards).
 - b). The wrong bootload mode is selected (Standalone serial cable is connected)
 - c). The data cable is damaged.
 - d). The comms receiver IC (RX2) is damaged.
 - e). The comms transmitter IC (TX1) is damaged.
 - f). The comms ICs on the next board up are damaged.

Solution: a1). Power the Ulti-Axis card (Max 35V) and/or
 a2). Replace Fuse (F1).
 b). Disconnect the boot select signal (Disconnect the standalone serial cable).
 c). Replace the data cable.
 d). Replace RX2.
 e). Replace TX1.
 f). Replace the receiver and/or transmitter ICs on the next board up.

Problem: Flair has started, bootloading occurs, Flair starts successfully, but the Ulti-Axis card does not run correctly (LEDs flash other than described in section on page .

Cause: The boot data has become partially corrupted allowing bootloading to complete but with a faulty program.

- a). The comms receiver (RX2) is damaged.
- b). The comms transmitter on the next board up is damaged.
- c). The root unit has corrupted the data

Solution:

- a). Replace RX2.
- b). Replace the comms transmitter on the next board up.
- c). Update to the latest version of Flair.

4.4 Bootloading from the MSA-20

4.4.1 Normal Operation

The following steps explain what is happening and what LEDs are illuminated. Each step only indicates a change from the previous step.

1. Power the MSA-20 (MAX 35V)

MSA-20:

Power LED (Blue), turns on.
 Running LED (Green), turns on.
 Inhibit LED (Yellow), off.
 Reset LED (Yellow), off.

2. Power the Ulti-Axis card (MAX 35V).

Ulti-Axis:

D2 – 5V (Blue), turns on.
 D6 – 5V (Blue), turns on.
 D13 – Inhibit (Yellow), turns on.

Ulti-Driver:

D1 – 3.3V (Blue), turns on.
 D14 – 12V (Blue), turns on.
 D45 – 5V (Blue), turns on (MK4 onwards only)

3. Press Select on the MSA-20 to start loading.

MSA-20:

Screen displays the loading progress as a percentage.

Ulti-Axis:

No additional LEDs light when loading from the MSA-20.

4. Ulti-Axis Running and communicating with the MSA-20

MSA-20:

Running LED (Green), flashes at 25Hz.
 Screen displays initializing and then system ready.

Ulti-Axis:

D19 - Running (Green), flashes at 25Hz.
 D13 – Inhibit (Yellow), the Inhibit LED turns off when the encoders are being read faster than 500Hz (normal operation is 1600Hz).

7. Axes Enabled.

Ulti-Axis:

D7-D12 – Enable (Green), the MSA-20 will automatically enable any motors connected to the Ulti-Axis card.

8. Axes Disabled.

Ulti-Axis:

D7-D12 – Enable (Green), an axes will disable when the motor is disconnected or if the axis trips.

4.4.2 Problem Solving

Problem: The MSA-20/Ulti-Axis card will not power up.

Cause: 1. The power supply Voltage is less than 5V.
2. The internal fuse has blown.

Solution: 1. Use a power supply that can supply a minimum of 8V.
2. Replace the internal fuse (2A).

Problem: The MSA-20 Fails to load the Ulti-Axis card

Cause: 1. The MSA-20 was powered up after the Ulti-Axis card.
2. The Ulti-Axis card is not powered.
3. The standalone serial cable is not fully connected.
4. The internal fuse has blown.

Solution: 1. Switch off both the MSA-20 and Ulti-Axis card, turn on the MSA-20, then the Ulti-Axis card.
2. See solution to problem The MSA-20/Ulti-Axis card will not power up.
3. Check the cable is connected to “Serial A” on the MSA-20 and “Serial” on the Ulti-Head.
4. Replace the internal fuse (2A).

Problem: The Ulti-Axis card is running but the DC motors do not hold position

Cause: 1. The power supply Voltage is less than 15V.
2. The PID tunings are incorrect.
3. The maximum position error is to low.
4. The maximum current is too low.

Solution: 1. Use a power supply the can supply a minimum of 20V.
2. Adjust the PID tuning to suit the motor.
3. Increase the maximum position error (typically 250).
4. Increase the maximum current.

4.5 Driving DC Motors

4.5.1 Normal Operation.

1. The power LEDs are on, bootloading is complete, the Ulti-Axis card is running (green LED D19 flashing at 25HZ) and is un-inhibited (yellow LED D13 is off), and all axes are disabled (green LEDs D7-D12 are off).
2. Each axis can be enabled by Flair or automatically by the MSA-20, illuminating the corresponding enable LED for the axis (D7-D12).
3. Axes that have no motor connected will disable as the limit switch connections will be open. The corresponding enable LED will turn off.
4. Axes that have a motor connected should be able to be driven in both directions once enabled.
5. If Flair or the MSA-20 is attempting to drive an axes too fast such that it loses position the axis will be disabled.
6. If the FETs controlling an axis are being over worked (too much current or too high temperature) the axis will trip. The axis will be disabled and the trip LED (red, D21-D26) will illuminate (over current -continuous for 4 seconds , over temperature flashing for 4 seconds).
7. If the user disables an axis in Flair the corresponding enable LED will turn off.

4.5.2 Problem Solving

Problem: The axis runs away when enabled but stops at an end position set by Flair.

Cause: 1. Flair is attempting to drive the axis from a Mimic input that is physically disconnected .

- Solution 1.
- a). Disable the Mimic control of the axis or
 - b). Connect a Mimic input to the Mimic source being used to drive the axis.

Problem: The axis is disabled after a short delay even though it is connected to the correct Lemo connector.

Cause: The Ulti-Axis card is detecting an open limit switch.

- a). The motor cable is damaged.
- b). The opto isolator for that axis is damaged.

- Solution:
- a). Replace the motor cable.
 - b). Replace the opto for that axis.

Problem: The axis remains stationary when attempting to be driven by Flair.

- Cause:
1. There is a conflict with another axis in the Flair axis setups.
 2. The PID tuning is incorrect (zero values).
 3. The motor cable is damaged.
 4. The axes are inhibited (yellow LED D13 is flashing/on)
 - a). The up link comms are failing too often (red LED D17 flashing/on)
 - b). The encoders are being read too slowly (less than 500Hz).
 5. Both sides of the H-Bridge are not driving the motor.
 - a). At least one FET (T1-T24) on each side of the H-Bridge is damaged and/or
 - b). Both H-Bridge driver ICs (MD1-MD12) are damaged (unlikely) and/or
 - c). The logic connections to the H-Bridge drivers are damaged (unlikely).

- Solution:
1. Change the board and/or port selections in the Flair axis setups to remove any duplicated axes.
 2. Ensure that the correct PID tunings are selected in Flair axis setups.
 3. Replace the motor cable.
 4.
 - a1). Replace the data cable.
 - a2). Replace the comms receiver IC (RX2).

- a3). Replace the comms transmitter IC (TX1).
- a4). Replace the transmitter and/or receiver ICs on the next board up.
- b). Update the DSP program to read the encoders faster than 500Hz.
- 5. The H-Bridge circuitry may need replacing or connections to it fixed.

Problem: The axis runs away and stops at different positions.

Cause: One side of the H-Bridge for that channel is damaged.

- a). 1 or both of the FETs (T1-T24) on that side of the H-Bridge are damaged and/or
- b). The H-Bridge driver IC (MD1-MD12) for that side is damaged.

Solution: a). Replace the FET(s) and/or
 b). Replace the H-Bridge Driver IC and FET gate passives for that half of the H-Bridge.

Note 1: This is unlikely since the current sensing and temperature sensing should protect the H-Bridge.

Note 2: Its is likely that when a FET is damaged that the H-Bridge driver IC is damaged also. The best solution is to replace all FETs, H-Bridge drivers, and FET gate passives at the same time.

Problem: The axis moves erratically, especially when driving heavy loads, and trips.

Cause: The encoder receivers are worn out.

Solution: Replace the receivers for that axis.

Problem: Axes trip randomly when being driven.

Cause: 1). The current limit for the axis is too low.
 2). The temperature limit for the axis is too low.
 3). The comms are failing too often.

Solution: 1). Increase the current limit for the axis.
 2). Increase the temperature limit for the axis.
 3. a). Replace the data cable.
 b). Replace the comms receiver IC (RX1).
 c). Replace the comms transmitter IC (TX1).

4.6 Driving Stepper Motors

4.6.1 Normal Operation

1. The power LEDs are on, bootloading is complete, the Ulti-Axis card is running (green LED D19 flashing at 25HZ) and is un-inhibited (yellow LED D13 is off), and all axes are disabled (green LEDs D7-D12 are off).
2. The stepper axes can be enabled in Flair (no LED indicates the state of the stepper outputs) and the state of the axis is updated on screen.
3. Moving the axes in either direction in Flair causes an update of the position of the axis in Flair regardless of whether or not a motor is connected.
4. If a motor is connected it should move in both directions at the speeds selected, up to the limit of 500KHz.
5. The stepper axes can be disabled in Flair and the state of the axis is updated on screen.

4.6.2 Problem Solving

Problem: The axis is enabled and the position in Flair changes but the motor does not turn.

- Cause:
1. The motor is set to the wrong port in Flair axis setups.
 2. The motor is connected to the wrong pins on the Camera Accessory Lemo.
 3. The motor cable is damaged
 4. The axes are inhibited (yellow LED D13 is flashing/on)
 - a). The up link comms are failing too often (red LED D17 flashing/on)
 - b). The encoders are being read too slowly (less than 500Hz).
 5. The Hex Buffer IC (HEX1) is damaged.

- Solution:
1. Change the axis setups to the correct port.
 2. Connect the motor to the correct Pins on the Camera Accessory Lemo.
 3. Replace the motor cable.
 4.
 - a1). Replace the data cable.
 - a2). Replace the comms receiver IC (RX2).
 - a3). Replace the comms transmitter IC (TX1).
 - a4). Replace the transmitter and/or receiver ICs on the next board up.
 - b). Update the DSP program to read the encoders faster than 500Hz.
 5. Replace HEX1.

Problem: The axis is enabled but the motor only turns in one direction.

- Cause:
- The motor is not receiving the direction signal.
- a). The direction signal is connected to the wrong pin on the Camera Accessory Lemo.
 - b). The cable is damaged.
 - c). The Hex Buffer IC (HEX1) is damaged.

- Solution:
- a). Change the direction signal to the correct pin on the Camera Accessory Lemo.
 - b). Replace the cable.
 - c). Replace HEX1.

4.7 General Purpose IO

One opto (OPT3) is used for both general purpose inputs and outputs, 2 in and 2 out. The outputs are open-collector and the inputs are open-source.

4.7.1 Normal Operation

1. The power LEDs are on, bootloading is complete, the Ulti-Axis card is running (green LED D19 flashing at 25HZ) and is un-inhibited (yellow LED D13 is off), and all axes are disabled (green LEDs D7-D12 are off).
2. The outputs are normally open, allowing the signal to be pulled high by an external pull-up resistor. The inputs are pulled high unless pulled low externally.
3. Toggling the outputs in Flair should toggle the output transistor of the GPOs (General Purpose Outputs). Toggling the GPIs (General Purpose Inputs) should toggle the state of the signal seen by the DSP.

4.7.2 Problem Solving:

Problem: Toggling the GPO in Flair has no effect on the GPO.

Cause:

1. The GPO is set to the wrong board and port in the Flair axis setups.
2. The GPO is not being pulled high via a pull-up resistor.
3. The opto (OPT3) is damaged (Max current exceeded, 50mA).

Solution:

1. Update the Flair axis setups to the correct board and port number for the position of the board in the comms system. The Ulti-Axis card behaves as 3 boards, the GPOs are on board 1 of the 3 boards, ports 1 and 2.
2. Use a pull-up resistor that will limit the current to less than 50mA (e.g. 220R at 5V).
3. Replace OPT3.

Problem: The GPI signal stays high.

Cause:

1. The GPI input is not being pulled low enough to turn on the opto.
2. Insufficient current is being drawn to turn on the opto.
3. The opto (OPT3) is damaged (Max current or Voltage exceeded, 50mA, 5V)

Solution:

1. Reduce the input low Voltage.
2. Reduce the input resistance, 0R is OK.
3. Replace OPT3.

Problem: Pulses less than 10uS are not detected by the Synchronization Logic.

Cause: The input qualification of the FPGA GPI sync logic is preventing the detection of the pulse.

Solution: Increase the pulse width to greater than 10uS.

5 Appendix A, Temperature and Current Settings (Flair 4.3 and Earlier)

The MK3 and earlier boards use a current sense resistor to determine the current draw from the motor, whereas the MK4 and onwards use a hall-effect sensor. Therefore the current sensing on the MK3 and earlier boards is less accurate and less linear than the MK4 and onwards.

In addition, the MK2 and earlier boards have different current sense amplification. This was changed on the MK3 boards to allow measurements of higher currents, up to 8A.

Board Version	Current Range	Temperature Range
MK1 and MK2	0.75A to 5A	0°C to 90°C
MK3	1A to 8A	0°C to 120°C
MK4 onwards	0.1A to 13A	0°C to 120°C

Table 1. Ulti-Axis version information.

The motor drive electronics on the Ulti-Axis card can operate up to a maximum 120°C. Therefore, setting the temperature limit in Flair to 240 (no units) will adequately protect the electronics from over temperature.

Current (A)	Flair Value
1	30
1.25	45
1.5	60
2	90
2.5	120
3	150
4	220
5	280
6	360
7	440
8	480

Table 2. Flair current settings 4.3 and earlier

In Flair 4.3 and earlier, the Ulti-Axis card converts the values from Flair into a suitable current limit value based on the board version.

In Flair 4.4 and later, Flair will convert the current (A) entered into a suitable value for the Ulti-Axis card current sensing based on the board version.

6 Appendix B, Ulti-Head Connector Pin-Outs

6.1 Motor (Pan/Aux2/Aux1/Tilt/Focus/Zoom)

- 1 - DATUM
- 2 - A+
- 3 - B+
- 4 - Z+
- 5 - N/C
- 6 - MOTOR_B
- 7 - MOTOR_A
- 8 - LIMIT
- 9 - +5V
- 10 - GND

6.2 Power

- 1 - GND
- 2 - GND
- 3 - +35V
- 4 - +35V

6.3 Data

- 1 - Watchdog-
- 2 - Link1Out-
- 3 - Link1Out+
- 4 - Link1In-
- 5 - Link1In+
- 6 - Watchdog+

6.4 Camera Accessory

- 1 - Step1
- 2 - Gp2In
- 3 - Step2
- 4 - SerialTxB
- 5 - Step3
- 6 - SerialRxB
- 7 - Dir3
- 8 - GND
- 9 - +5V
- 10 - Gp1In
- 11 - Dir1
- 12 - Dir2
- 13 - Gp2Out
- 14 - Gp1Out

6.5 Serial

- 1 - SerialTxA
- 2 - SerialRxA
- 3 - +5V
- 4 - FGPIO
- 5 - DSP_TRSTN
- 6 - TCK
- 7 - TMS
- 8 - DSP_TDI
- 9 - DSP_TDO
- 10 - DSP_EMU0

- 11 - DSP_EMU1
- 12 - FPGA_TDI
- 13 - FPGA_TDO
- 14 - BOOT_SEL
- 15 - +3.3V
- 16 - GND

7 Appendix C, I/O Specification

All the general purpose outputs on the MSA-20 and Ulti-Head are optically isolated open-collector logic. All the general purpose inputs on the MSA-20 and Ulti-Head are open-cathode logic.

7.1 GPI Specification

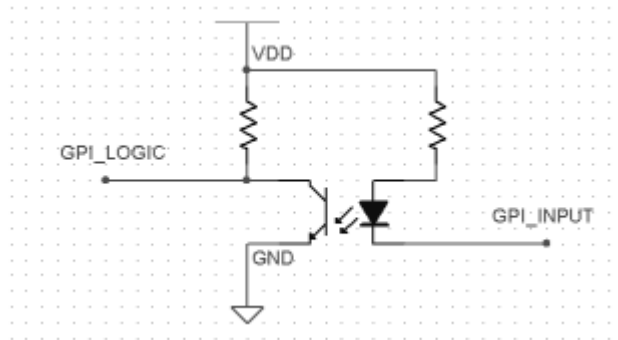


Figure 11. General Purpose Input.

Absolute Maximum Ratings:

V_{in} Max: 6V

V_{in} Min: -1V

I Max: 50mA

7.2 GPO Specification

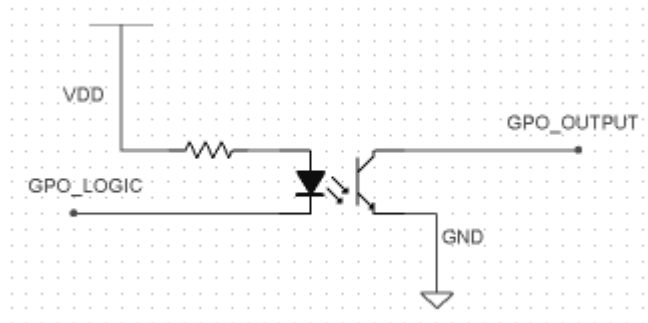


Figure 12. General Purpose Output.

Absolute Maximum Ratings:

V_{out} Max: 80V

V_{out} Min: -5V

I Max: 50mA

8 Appendix D, Motor Drive Specifications

8.1 DC Motors

Max Voltage:	35V
Max continuous current:	10A
Max peak current:	20A
Min inductance (Bi-Polar PWM):	1mH
Min inductance (Uni-Polar PWM):	500uH

8.2 Stepper Motors

Stepper Voltage:	5V
Pulse width:	1uS
Max step frequency:	500MHz