

## Camball3 X & XM

### Mounting

The unit can be mounted either upright, as shown, or inverted. When mounting the unit inverted use the picture flip function to invert the picture from the camera.

**ALWAYS use a safety bond. There is an M6 safety bond bolt on the base.**

The maximum length for mounting bolts is 12mm. Exceeding this may damage the unit.



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## Instructions

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## Range of Movement & Resolution

### **Pan:**

Pan Home:	Normally, directly away from sockets.
Resolution:	16 bit – 2 channels
DMX resolution:	1 DMX bit = 0.011 deg.
DMX movement:	+/- 368 deg. From HOME. (736 deg. +/- 2deg.)
Free-D resolution:	16 bit – . 65,536 counts per 360deg. 1 bit = 0.0055 deg.
Free-D Movement:	360degrees – continuous rotation

### **Tilt:**

Tilt Home:	Directly upwards (away from socket base)
Resolution:	16 bit – 2 channels
DMX resolution:	1 DMX bit = 0.0055 deg.
DMX movement:	+/- 120 deg. From HOME (240 deg. +/- 2deg)
Free-D resolution:	16 bit – . 39,322 counts per 240deg. 1 bit = 0.0055 deg.
Free-D movement:	-30 - +210 deg.

### **Zoom 20x:**

Zoom Wide HFOV:	59.5 deg.
Zoom Tight HFOV:	3.3 deg.
DMX Resolution:	16 bit – 2 channels
DMX zoom angle:	1 DMX bit = 0.0857 deg. Tight = FFFF, Wide = 0000
Free-D Resolution:	16 bit
Free-D zoom angle:	1 bit = 0.0857 deg. Tight = FFFF, Wide = 0000

### **Focus:**

Focus Range:	10 mm. - Infinity
DMX Resolution:	8 bit – 1 channel
Free-D Resolution:	16 bit

### **Iris:**

Iris Range:	F1.6 – F28
Iris Resolution:	16 steps
DMX Resolution:	8 bit – 1 channel
DMX steps:	1 Iris step = 16 DMX bits
Free-D	Not applicable

## Motion Control

Full positional motion control can be achieved by using any number of motion control software applications. The unit continuously outputs **Free-D** metadata in either standard **angular** format or **RAW** numerical format. The RAW format has no scaling or conversion so is potentially more accurate.

The unit can be controlled with commands in **Dstar**, **Mstar**, **DMX** or **Free-D** protocols. Using **Mstar** protocols enables simultaneous motion control along with all other commands (eg. CCU commands) to be sent on the same data stream, either via RS422 or via an IP network.

### Dstar protocol

RS485, 9600 baud, 8 data bits, no parity, 1 stop bit.

### Mstar protocol

RS422, 38400 baud, 8 data bits, no parity, 1 stop bit.

### DMX protocol

RS422, 250,000 baud, 8 data bits, no parity, 2 stop bits.  
RS422 line is not terminated to 120 ohm.

### FreeD Protocol

RS422, 38400 baud, 8 data bits, odd parity, 1 stop bit

Full details of both D\* and M\* protocols are available on request.

## Notes

Pan and Tilt Home Positions can be defined by the user via the **Aux Protocol Setup** menu page.

A virtual model of the **Camball3 X** can be downloaded from Cast Software. This can be used directly with the **BlackTrax** software for motion tracking. [www.cast-soft.com](http://www.cast-soft.com)

There is a little backlash in the pan & tilt axes on the **Camball3 X**. This may be noticeable on very tight lens angles when moving to a position from different directions.

The **Camball3 XM** has shaft encoders with no backlash.

## Introduction

The '**DMX**' Control' (**CamBall3-X**) has been developed in response to requests from leading show facilities to integrate the **CamBall3** into the master show computer. It uses the higher resolution **Sony Exmor** sensor which matches extremely well with other larger cameras. It can still be controlled with any of our normal controllers but can also be controlled via **8 DMX channels**, giving 16bit precision in Pan, Tilt and Zoom plus Focus and Iris.

We then further developed the camera for use in **AR** and **VR** applications with shaft encoders and continuous metadata output in industry standard **Free-D** format.

When used as an 'Auto Tracking' camera it can follow the designated artist extremely smoothly, including zoom & focus. This has been made possible with our **PMS** (Predictive Move Smoothing) algorithm, which smooths the moves and also copes with missing data packets.

During a move, the **PMS** routine does not wait for a new position before initiating a move to that new position. Rather, it predicts the next position, based on the trajectory of the previous movement, and continues to move along that trajectory. When the position is confirmed, or changed, the camera makes the appropriate adjustment to the trajectory and then predicts the next position.

The **PMS** routine also predicts when to expect a position update, based on the previous frequency of data packets. If a new position does not arrive within the predicted window the **PMS** predicts further ahead to continue a smooth move even if the data packet is missing or corrupted.

The **PMS** routine achieves a far more natural movement of the camera as it tends to follow the artist's actual move in real time, not wait at the artist's previous position until moving to the next position, when it would always be behind the action.

## Free-D & M\* Operation

When in **Free-D** or **M\*** mode, the **Camball3 XM** outputs continuous metadata in **Free-D** (D1format). A **Free-D** cable is supplied with the camera. The metadata contains position data including Cam ID, Pan, Tilt, Zoom & Focus, plus genlock status. The same **Free-D** data format can be used as a control input protocol. For more information about **Free-D** protocols see separate documents.

## Genlock (optional extra)

When no genlock input is present the camera sends the metadata at either 50Hz or 60Hz, depending on the selected camera output standard.

## Control Priorities

No changes have been made to the normal joystick operation and the system is rigged in the normal way, with a joystick controller. **DMX, Free-D** or **Mstar** commands are automatically recognised and it moves as commanded. However, the operator can take control with the joystick panel at any time. When no further joystick moves are detected, the camera will return to computer control, but only when a new position is received.

On a position-based show this allows for the operator to correct for artists being out of position, or for live action following. Control will revert to computer control when there is no operator input **AND** a new target position is received.

This also allows for the iris to be operated by a vision engineer, rather than the computer controller. If the Iris computer channel remains constant the unit will not revert to Iris computer control and the vision engineer will continue to have control. The same applies to Focus and all the controlled axes.

## Joystick Control

When using the joystick to control the camera there are a number of settings that can be used.

**Pan & Tilt Directions** – These can be changed using the PT Reverse command in the main menu. Push the bottom right button to cycle between the 4 combinations of Pan/Tilt directions.



**Zoom & Focus Reverse** – These can also be changed from this menu.

**Pan & Tilt Speeds** – This menu also shows the pan & tilt speeds. These will also be shown for a short period on this screen whenever the speed knobs are turned.

**Speeds 1 & 2** – In either of these 2 speeds the pan & tilt speeds are proportional to the zoom angle. ie. If the zoom is wide the speed is higher. When you zoom in the pan & tilt speeds reduce to help with smooth camera control.

**Speeds 3 – 10** – These are fixed 'gears' and do not change with the zoom angle.

Fig.3 illustrates the opposite situation to Fig.2. Because each of these moves ends with position 1, each move will take the same amount of time – as defined by the profile associated with position 1. Therefore, the move from position 8 will be the fastest.

If the move is taking too long the operator simply needs to push the pre-set position button again and the camera will reposition as fast as possible.

The camera will make the profile move from **wherever it is** to the pre-set position selected, always in the same amount of **Time**. Therefore, the camera will move faster if the move is further.

To perform the same move repeatedly use 2 pre-set positions. 1 for the start position and 1 for the end position.

## LCD Display

The LCD display on the side can display a large amount of data which may be useful for setting up the unit and for de-bugging. The pages of the display can be scrolled using the '**Cam Display**' function on the main menu of the **Multi Function Controller**.



This display shows the status of many of the internal parameters, for instance;

Head Address Number  
DMX base address  
Input Voltage  
Internal Temperature  
Absolute positions (Pot)  
Encoder positions (Motor or Absolute)  
Demand RPM  
Demand Position  
D\* Data input  
Error Log

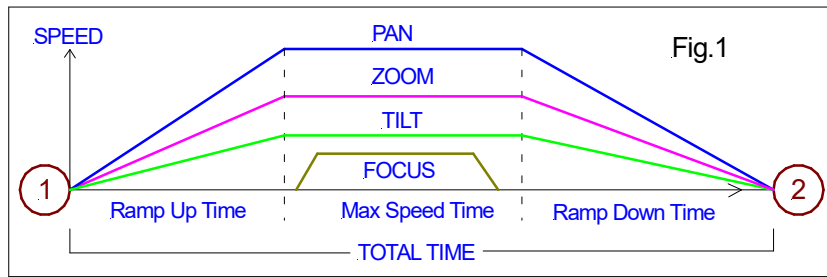


To cycle between information pages use the '**Cam Display**' function in the Main Menu.

## D\* Commands

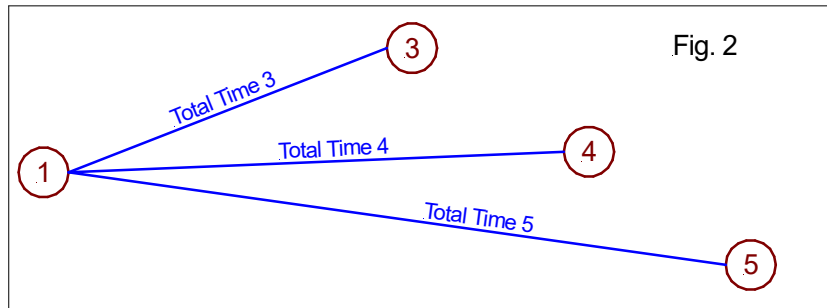
There are a number of D\* commands specific to setting up the camera for **DMX, Free-D** or **Mstar** positional operation. Base Address, Home Position etc. are addressed via the **Aux Protocol Setup** page in the **Multi Function Controller**.

The position of any axis can be requested from the camera. This is useful if you are not using a virtual model of the Camball3 X and need to generate your own reference positions.

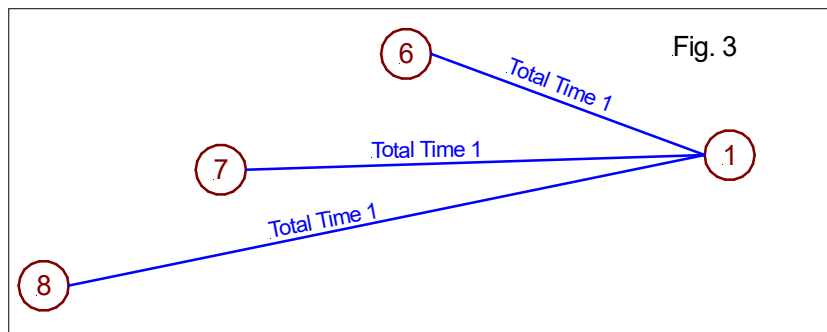


**Fig.1** shows a profile move for Pan, Tilt., Zoom and Focus. In the move illustrated, pan has further to move than tilt, therefore pan moves at a faster speed than tilt so that it stops at position 2 at the same instant as tilt.

Zoom also moves in the same time. Focus moves during the centre portion of the move so that objects of interest are not de-focused during the start or end of the move.



The Profile of each move is stored with each position. **Fig.2** illustrates that each move TO a pre-set position will take the time associated with that end position. Understanding this enables efficient use of the same start position.



### Connections

**D\*** data from any BR Remote control desk is connected normally via the XLR4 input socket. There is an additional **9pin Dsub** on the base of the camera for connecting **DMX** data.

#### XLR4

- Pin 1 - GND
- Pin 2 - RS485 Ch.A – **Dstar only**
- Pin 3 - RS485 Ch.B – **Dstar only**
- Pin 4 - +12v – 16v

#### D-Sub 9

- Pin 1 - GND
- Pin 2 - RS422/485 Ch.A – **Free-D Metadata output** (Camball3 XM only)
- Pin 3 - RS422/485 Ch.B – **DMX input (Free-D or M\* input for Camball3 XM)**
- Pin 4 - Do not connect
- Pin 5 - Do not connect
- Pin 6 - No connection
- Pin 7 - RS422/485 Ch.B – **Free-D Metadata output** (Camball3 XM only)
- Pin 8 - RS422/485 Ch.A – **DMX input (Free-D or M\* input for Camball3 XM)**
- Pin 9 - Do not connect

**BNC #1** - HDSDI output

**BNC#2** - Genlock input

A **DMX** input cable is supplied with the **Camball3 X**

A **Free-D** input/output cable is supplied with the **Camball3 XM**

If the **iBase** is fitted (see picture). There is the option of built-in IP connectivity and also control input over fibre input and uncompressed HDSDI output over fibre.

Depending on which of these features are fitted **RJ45** and/or **ST** fibre connections will be fitted to the unit. One fibre carries the HDSDI and the other fibre carries the control.



## LED indicators

There are a total of 5 LED indicators which all flash 3 times at power up.

1. **BLUE** - Standard D\* data LED
2. **BLUE** - **DMX** data indicator
3. **BLUE** - **Free-D or M\* data indicator (Camball3 XM only)**
4. **GREEN** - Position Mode indicator
5. **RED** - Position Status

### Indications:

1. **Data LED** 1 flash per second = Power but no data  
Continuous ON = Data OK but not being addressed by joystick  
Fast flashing (20per sec) = Data OK and being addressed  
Flashing = **DMX** data received
2. **DMX LED** Flashing = **Free-D or M\* data received**
3. **Free D LED** On = Head is being driven in position mode (not joystick)
4. **Position Mode** Solid ON = Soft limits reached  
Flashing = Position Error detected (difference between the absolute and encoder positions. Usually, because the head has been knocked.  
Re-set HOME position to correct this.
5. **Posn. Status**

## Protocol Settings

The unit always responds to **Dstar** protocol commands. This is the standard protocol as used by all **BR Remote** controllers. This can either be sent as RS485 into the XLR4 or via an IP network. Both **Dstar** and **Free-D** can be sent over fibre or IP simultaneously using our **Mstar** protocol.



Before using the unit you will need to set the protocol you are using. This is done via the **Aux Protocol Setup** page in the main MFC menu.

Pushing the button at the top right will take you through various other menus to set up the protocol, DMX Base Address etc.

## DMX Settings

The **DMX Base Address** is set via this menu. This command is sent via the normal D\* connection to the XLR4. The camera uses 8 DMX channels for full DMX control;



The DMX Base address can be cycled **Up** or **Down** to set the Base Address. When the desired Base Address is shown – push the 'Set' button.

- Ch1 (Base) - Pan position coarse (8bits)
- Ch2 - Pan position fine (8bits)
- Ch3 - Tilt position coarse (8bits)
- Ch4 - Tilt position fine (8bits)
- Ch5 - Zoom position coarse (8bits)
- Ch6 - Zoom position fine (8bits)
- Ch7 - Focus (8bits)
- Ch8 - Iris (8bits)

The factory HOME position is camera forwards and directly UP.

**HOME position is not required for Camball3 XM as absolute encoders are fitted to the shafts.**

The **HOME** position can also be reset from this menu. Move the camera to the desired Home position (Normally this is pointing directly away from the sockets and straight up), push **OK**.

## Pre-Set Positions & Profile Moves

Up to 64 pre-set positions can be stored and recalled in the head. (dependent on controller) Each position includes, Pan, Tilt, Zoom and Focus positions. Once stored, the positions are saved during power loss. Simply drive the head to the required position and **Store** this position as a Pre-Set.

A major feature of the **Caball3 X & XM** is that it always does a **Smooth Profile Move** to each pre-set position. The profile of this move can be specified by the operator using the **Multi Function Controller**. All axes, Pan, Tilt, Zoom & Focus, move in the same amount of **time** to the pre-set position.

Default Total Time = 4.5sec.  
Default Ramp Up = 1.5sec.  
Default Ramp Down = 1.5sec.

These settings are automatically stored but can be adjusted at any time from the **Multi Function Controller** Total Time, Ramp Up time, and Ramp Down time can be adjusted by the operator for each pre-set position independently.

