

# Instructions & Information



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## Introduction

The **Camball 5** is a fully integrated HD or 4k 50/60p camera with built-in fibre optic output and control. It is designed to accommodate the latest requirements for additional control protocols, **Virtual Reality (VR)**, **Augmented Reality (AR)** applications and for **Studio Automation** applications.

The control protocol options currently include, **DMX**, **Free-D**, **Mstar** and **Dstar**.

The **DMX** Control of the **Camball 5** has been developed in response to the requirement integrate cameras into master show computers.

**Free-D**, **Mstar**, are intended for use with **VR** and **AR** applications. **Free-D** metadata is streamed onto the network and is also available as serial from the Dsub connector.

**Dstar** is our standard 'live action' protocol which has been controlling remote cameras for over 20 years.

The camera is rugged and weatherproof and can be used externally without further protection.

There is option available.

It can be rigged normally or inverted and there are other options which can be specified including an **Rain Wiper**.



**iBase** showing ST fibre & IP Connections

## 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. Positional commands are automatically recognised and it moves as commanded. However the operator can take control with the joystick panel at any time.

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

This also allows for the iris to be operated by a vision engineer, rather than the positional controller. If the Iris position remains constant the unit will not revert to Iris (DMX, Free-D or Mstar) 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 **Setup** menu. This command will cycle between the 4 combinations of Pan/Tilt directions.

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

**Pan & Tilt Speeds** – When adjusting the Speed knobs the display will show the speed settings.



**Speed 1** – In speed 1 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 2 – 10** – These are fixed 'gears' and do not change with the zoom angle.

## DMX control

**DMX** Control of the Camball4 is input via the Dsub connector. A DMX input cable is supplied with the unit.

When used as an 'Auto Tracking' camera it can follow the designated artist extremely smoothly, including zoom & focus. This has been made possible with the **Predictive Move Smoothing (PMS)** 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 current 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 positional 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.

## DMX Settings

The camera uses 8 DMX channels for full DMX control;

- 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 horizontal.

HOME position is not required for **Camball4 VR** because absolute encoders are fitted to the shafts.

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.

## Free-D & Mstar control

When in **Free-D** or **Mstar** mode, the **CamBall 4Ki** outputs continuous metadata in **Free-D** (D1 format) or **Mstar** format. A **Free-D** cable can be supplied with the camera. The metadata contains 24bit position data for Cam ID, Pan, Tilt, Zoom & Focus, plus genlock status. (Internally the camera only uses 16bits). The same **Free-D** data format is used as a control input. Free-D output can be in **Angular** or **RAW** format. The RAW format is the absolute 16bit position. The angular output is calculated from this so is slightly less accurate. For more information about **Free-D** protocols see separate documents.

The type of Free-D metadata can be changed from the **Multi Function Controller**. This can be Angular or RAW.

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

## Connections

**Dstar** data from a BR Remote control desk is connected normally via the XLR4 input socket. There is an additional **9pin Dsub** on the base of the camera. This outputs Metadata and accepts other types of control data. This is **AUX** data and the **AUX Protocol** can be selected from the Setup menu.

**DMX, Mstar and Free-D** data is input on this Dsub connector.

Once you have selected the Protocol the menu will request further settings.

Selecting **DMX** will then prompt for the DMX Base Address.

Selecting **Free-D** will prompt for *Angular* or *RAW* data.

**Mstar** has no further options.



## 9 Pin Dsub

- Pin 1 - GND
- Pin 2 - RS422/485 Ch.A – Metadata **output**
- Pin 3 - RS422/485 Ch.B – DMX, Mstar or Free-D **input**
- Pin 4 - Do not connect
- Pin 5 - Do not connect
- Pin 6 - No connection
- Pin 7 - RS422/485 Ch.B – Metadata **output**
- Pin 8 - RS422/485 Ch.A – DMX, Mstar or Free-D **input**
- Pin 9 - Do not connect

These pins are the standard pins for RS422 connection and can be directly connected to other equipment with a suitable cable.

Both a **DMX** input cable and a **Free-D** input/output cable are supplied with the **Camball4**

## XLR4

- Pin 1 - GND Blue
- Pin 2 - RS485 Data A Green
- Pin 3 - RS485 Data B Yellow
- Pin 4 - +10 – 16v (nominally 12v) Red



## LED indicators

There are a total of 5 LED indicators which all flash 3 times at power up. Only LED1 is seen through the cover. The others are on the PCB inside for diagnostic purposes.

1. **BLUE** - Standard D\* data LED
2. **BLUE** - **DMX** data indicator
3. **BLUE** - **Free-D or M\*** data indicator (Camball4 XM only)
4. **GREEN** - Position Mode indicator
5. **RED** - Position Status

### Indications:

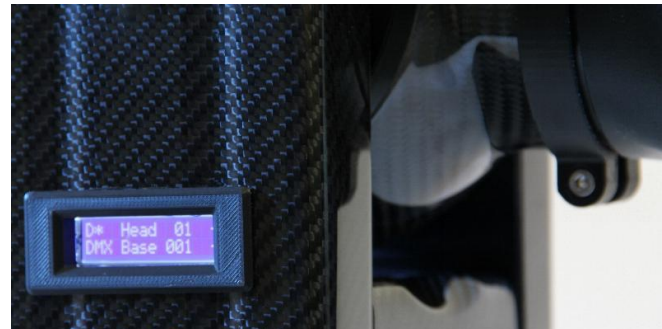
1. **Data LED** 1 flash per second = Power but no data  
Continuous ON = Data OK but not being addressed by joystick  
Fast flashing (20per sec) = Data OK and being addressed
2. **DMX LED** Flashing = **DMX** data received
3. **Free D LED** Flashing = **Free-D or M\*** data received
4. **Position Mode** On = Head is being driven in position mode (not joystick)
5. **Posn. Status** 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.

## 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 in the **Setup** Menu of the 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 **Setup** Menu. There are also buttons on the PCB inside the cover.

## 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 **Camball 5** 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. By default, 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.

The Zoom start and stop times can be separated from the Pan/Tilt start stop times.

The **Zoom Start** can be started before or after the main Pan/Tilt move.

The **Zoom End** can be stopped before or after the main Pan/Tilt move.

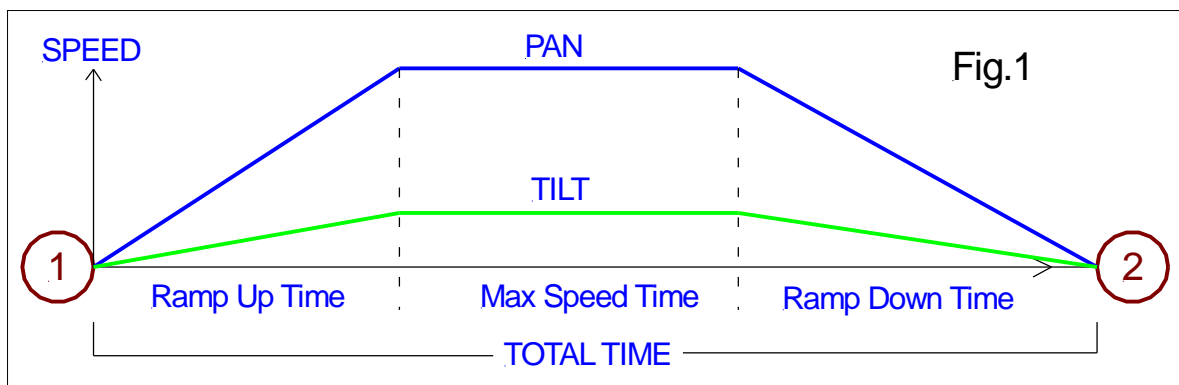
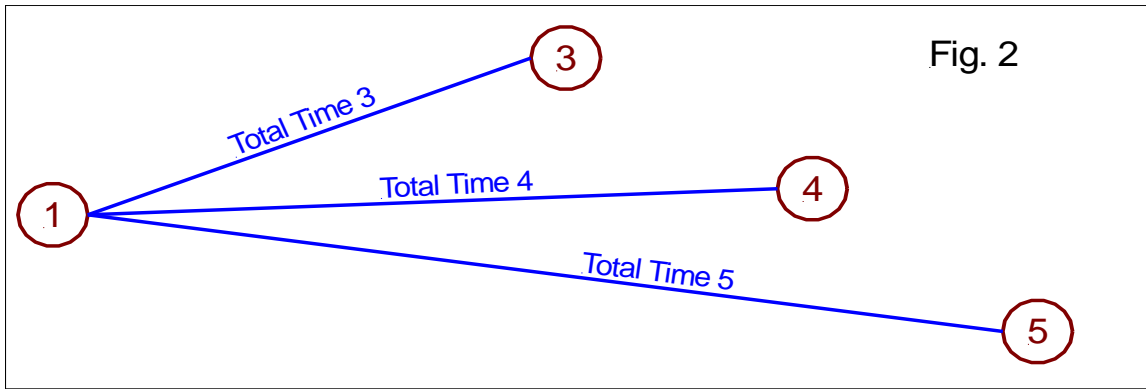


Fig.1 shows a profile move for Pan & Tilt. Zoom and Focus are not shown but are included in the move. In the move illustrated, pan has further to move than tilt therefore pan moves at a faster speed than tilt so that it stops at position 2 at the same instant as tilt.

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.

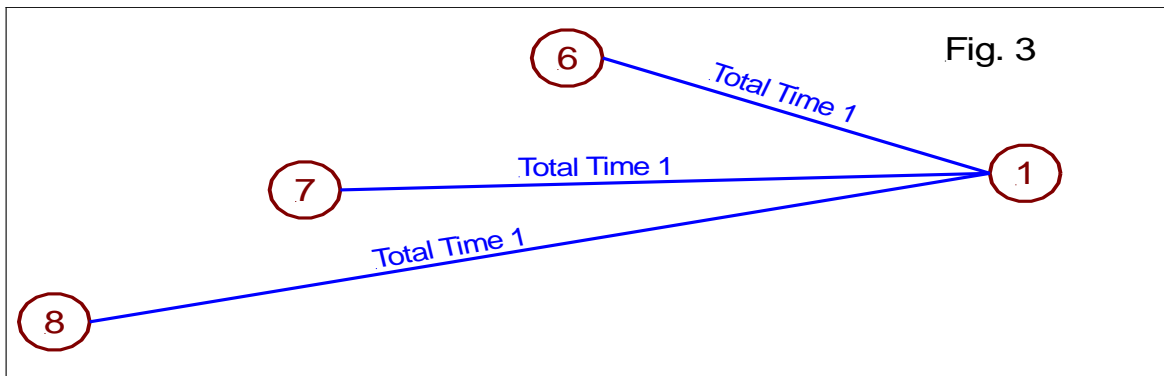


Fig.3 illustrates the opposite situation to Fig.2. Because each of these moves ends with position 1, each move will take the same amount of time – as defined by the profile associated with position 1. Therefore, the move from position 8 will be the fastest.

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.

### D\* Commands for the Camball4

The position of any axis can be requested from the camera. This is useful if you are not using a virtual model of the **Camball 5** and need to generate your own reference positions.

If you need to write your own control commands please ask **BR Remote** for the full Dstar & Mstar Protocol documents and the full command list.

## Notes

Pan and Tilt Home Positions can be defined by the user.

A virtual model of the **Camball** 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. This may be noticeable on very tight lens angles when moving to a position from different directions. The VR versions use the shaft encoders so this effect is not apparent.

A quick re-boot often does not re-boot correctly. Always power down for at least 10seconds to allow the electronics to discharge before powering up again.

## Range of Movement & Resolution

### Pan:

Pan Movement in DMX:	+/- 368 deg. From HOME. (736 deg. +/- 2deg.)
Pan Home:	Normally, directly away from sockets.
DMX resolution:	16 bit – 2 channels
DMX angular movement:	1 DMX bit = 0.0112 deg.
Pan Movement in Free-D	360degrees – continuous rotation
Free-D resolution:	16 bit – . 65,536 counts per 360deg. 1 bit = 0.0055 deg. .

### Tilt:

Tilt Movement DMX & FreeD:	+/- 120 deg. From HOME (240 deg. +/- 2deg)
Tilt Home:	Directly upwards (away from socket base)
DMX Resolution:	16 bit – 2 channels
DMX angular movement:	1 DMX bit = 0.0037 deg.
Free-D resolution:	16 bit – . 65,536 counts per 360deg. 1 bit = 0.0055 deg.

### Zoom 18x:

Zoom Wide HFOV:	approx. 60 deg.
Zoom Tight HFOV:	approx 3.3 deg.
DMX Resolution:	16 bit – 2 channels
DMX zoom angle:	1 DMX bit = 0.0857 deg. Tight = 0xFFFF, Wide = 0x0000
Free-D Resolution:	16 bit
Free-D zoom angle:	1 bit = 0.0857 deg. Tight = 0xFFFF, Wide = 0x0000

### Focus:

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

### Iris:

Iris Range:	F1.6 – F28
Iris Resolution:	255 steps
DMX Resolution:	8 bit – 1 channel
DMX steps:	1 Iris step = 1 DMX bit

## CCU Commands

The camera is supplied set to factory default settings. Some commands are set to AUTO but can be changed to manual if required. The camera will always power up with all the settings set as it was powered down. The settings can be restored to factory settings if needed.

To adjust the White and Black balance manually you need to be in 'Manual' which is automatically set when you select a 'Scene File'. There are 4 manual Scene Files; A, B, C or D. which are accessible from the Remote Camera Panel. When working in a Scene File all changes are automatically saved in that Scene File.

<u>White Balance:</u>	Auto Tracing, 5600K (outdoor), 3400K (indoor), Manual, Push.
<u>Red Gain: (Manual white)</u>	Adjusts the RED balance in the light areas of the picture.
<u>Blue Gain: (Manual white)</u>	Adjusts the BLUE balance in the light areas of the picture.
<u>Gain:</u>	Adjusts the total GAIN in the whole picture.
<u>Colour Matrix:</u>	3 parameters can be adjusted for each of the 6 colours; Magenta, Red, Yellow, Green, Cyan, Blue.
<u>Red Ped: (Manual white)</u>	Adjusts the RED balance in the dark areas of the picture.
<u>Blue Ped: (Manual white)</u>	Adjusts the BLUE balance in the dark areas of the picture.
<u>Green Ped: (Manual white)</u>	Adjusts the GREEN balance in the dark areas of the picture.
<u>Master Pedestal:</u>	Adjusts the overall level of the dark areas of the picture.
<u>Detail:</u>	Adjusts the amount of high frequency detail in the picture.
<u>Knee:</u>	Sets the knee point at which the highlights are compressed. Range: OFF, 100%, 95%, 90%, 85%, 80%, 75% Knee is disabled when set to HDR mode.
<u>Gamma:</u>	Adjusts the Gamma curve to match human eye perception. Range: BT709 +/- 1 or 2 and HLG75
<u>Chroma:</u>	Adds or subtracts the amount of colour in the picture.
<u>Shading:</u>	Increases the brightness outside the centre area of the picture to compensate for lens shading.
<u>Noise Reduction:</u>	Reduces noise when adding gain.
<u>D-Range:</u>	Dynamic Range has 3 settings. Low, Normal and High. <b>Low is better for outdoor bright scenes.</b> High sets the camera to HLG HDR mode. Only use this if you are shooting in HDR or in low light situations. The Knee is disabled in HDR mode.

- Colour Space: BT.709 or BT.2020
- Iris Reaction: This sets the speed at which the iris reacts to control changes. Too slow and it may appear sluggish. Too fast and it may be too 'steppy'.
- IR Mode: Switches the camera to 'Near InfraRed' and monochrome.
- Output Standard: Sets the output standard of the camera. Make sure your monitor can display the standard you are setting or no picture will appear. Both **UHD** and **HD** standards are available.
- Note:** Ensure you have control of the camera by operating the zoom before attempting an output standard change.



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