

Real Freedom

4K Camera Back Transmitter

Product Manual

Revision A

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Manual part number: 13466-1-000




Revision A

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This manual contains important information regarding the installation and operation of the Real Freedom 4K Camera Back Transmitter. For safe and reliable operation, installers must ensure that they are familiar with, and fully understand, all instructions contained herein. Broadcast Sports International reserves the right to revise and improve its products as it sees fit. This publication describes the state of this product at the time of publication and may not always reflect the product in the future.

In this manual, the following symbols call your attention to important information:

	CAUTION Indicates that care is required when proceeding to avoid damage to the system.
	NOTE Used to draw your attention to additional important information.
	WARNING Indicates a potentially hazardous situation.

Warranty information

All products are warranted to be free from defects in materials or workmanship for a period of 24 months. If returned within the applicable warranty period, BSI will, at its sole discretion and at no cost to the customer, repair or replace the defective product with another unit of the same or equivalent model. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alterations or repairs.

Contact details and technical support

Real Freedom Team	For product information and help with missing or damaged items. Email: EngineeringDepartment@BSINTL.COM Tel: +1-410-564-2642
Telephone Support Line	Product technical support is provided via a telephone support line. Trained technicians are available to offer setup and configuration advice and to assist in troubleshooting technical issues. Tel: +1-410-564-2642
Return Merchandise Authorization (RMA) Procedure	Problems that cannot be resolved on the telephone may require the device to be returned to BSI for repair. In such cases, the telephone operator will assist the customer in obtaining an RMA. Please note that no returns can be accepted without a valid RMA.

About this manual

This manual contains safety information and information for installing, configuring, and operating a Real Freedom 4K Camera Back Transmitter.

It applies to the following products:

- Real Freedom 4K Camera Back Transmitter

Contents

1 Introduction.....	6
Location and functions of parts.....	6
RF module.....	6
Digital module	7
I/O module.....	8
2 Installation.....	9
Overview.....	9
Preparation	9
Environmental requirements	9
Power requirements.....	9
Unpack the camera back transmitter	9
Additional items required for installation	10
Cable requirements.....	10
Connections.....	10
Attach a camera back transmitter to a camera	10
Mounting	12
Connections checklist	13
3 Transmitter configuration.....	14
Overview.....	14
Before you start	14
Main configuration page	14
DVB mode	15
DVB-T	15
DVB-T2	15
Transmit power and frequency.....	16
Advanced transmit settings.....	17
Video source, format and encoder	17
Encoder, encoder CPB and license settings	18
Encoder CPB	18
Licenses.....	18
Camera control.....	19
Camera control settings	19
Settings.....	20
Network.....	20
Audio	20

4 Operation	22
Status LEDs	22
Routine checks	22
Verify the connection to the camera	22
Verify the transmitter is receiving data from the OCP/RCP	22
Monitor audio and signal levels	23
5 Troubleshooting	24
6 Maintenance	25
Routine maintenance procedures	25
Performance monitoring	25
Visual inspection	25
Cleaning	25
Storage	25
Update the transmitter's firmware	26
Change an RF module	26
A Technical data	27
Dimensions	27
Specifications	29
Audio compression	29
Audio inputs	29
Camera control	30
Compliance	30
Control	30
Environmental	30
Frequency band	30
Modulation	30
Physical	31
Power requirements	31
RF power	31
Tallies	31
Video compression	31
Video input	32
Video outputs / Save to file	32
Connector pinout assignments	32
Antenna port – RF output	32
Antenna port – UHF input	33
ASI / SDI video input	33
Audio 1	33
Audio 2	34

AUX.....	34
Camera control	35
Power	35
B Safety and regulatory compliance	36
Safety notice.....	36
Electromagnetic compatibility – Class A	36
Compliance statement (United States)	36
CE Declaration of Conformity (European Union).....	36
Disposal and recycling – European Union	36

The Real Freedom 4K Camera Back Transmitter is a compact wireless transmitter is equipped with a full range of customizable settings that can be easily adjusted through a user-friendly interface. It is designed with the most demanding applications and operating environments in mind, but its intuitive interface can be operated by a novice, making it an ideal solution for a variety of applications.

With the ability to receive and send UHD images over a low delay UHD wireless link, the Real Freedom 4K Camera Back Transmitter avoids the need to capture images at the 1080p/50/3G standard, and then up scale to UHD.

Providing 12G, dual 6G UHD as well as quad 3G inputs, the Real Freedom 4K Camera Back Transmitter consistently delivers low latency, high-quality images. Supporting both HEVC and H.264, the unit mounts easily on the back of most hand-held broadcast cameras. HEVC compression offers significant bitrate savings and supports the new 4K UHD formats.

The Real Freedom 4K Camera Back Transmitter's user swappable modules enable total flexibility across the full range of microwave frequency bands. The device's user selectable output power and DVB-T/DVB-T2 modulation scheme ensure robust and reliable signals regardless of the production environment.

The transmitter comes equipped with a built-in camera control module which makes the unit capable of wireless Camera Control Unit (CCU) functionality when paired with the Real Freedom Receiver's optional UHF data module. With the CCU functionality built into the transmitter, the unit is more streamlined and easier to deploy.

Location and functions of parts

This section provides an overview of the components and connectors on the Real Freedom 4K Camera Back Transmitter. You should familiarize yourself with this information before installing and operating the transmitter.

RF module

The top of the camera back transmitter's RF module provides connectors to attach a UHF input antenna and an RF output antenna. It is possible to swap this module to enable the camera back transmitter to operate in a different frequency band (1.4–1.6 GHz (TXM-1416-30), 2.0–2.7 GHz (TXM-2027-30), and 5.5–7.5 GHz (TXM-5575-30)).

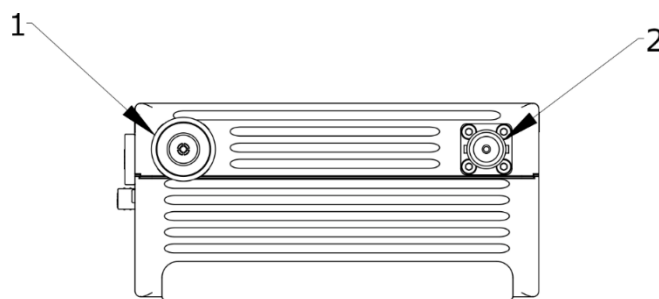


Figure 1: 4K camera back transmitter antenna connections

Key	Component	Description
1	BNC (F) connector	Use to connect a UHF antenna to receive camera control data from a data transmitter. Note this connector is 50 Ohm.

Key	Component	Description
2	N-connector	Use to connect an RF antenna to the camera back transmitter. Note this connector is 50 Ohm.

Digital module

The camera back transmitter's digital module provides a touch screen to configure the transmitter, LED status indicators, and a USB port.

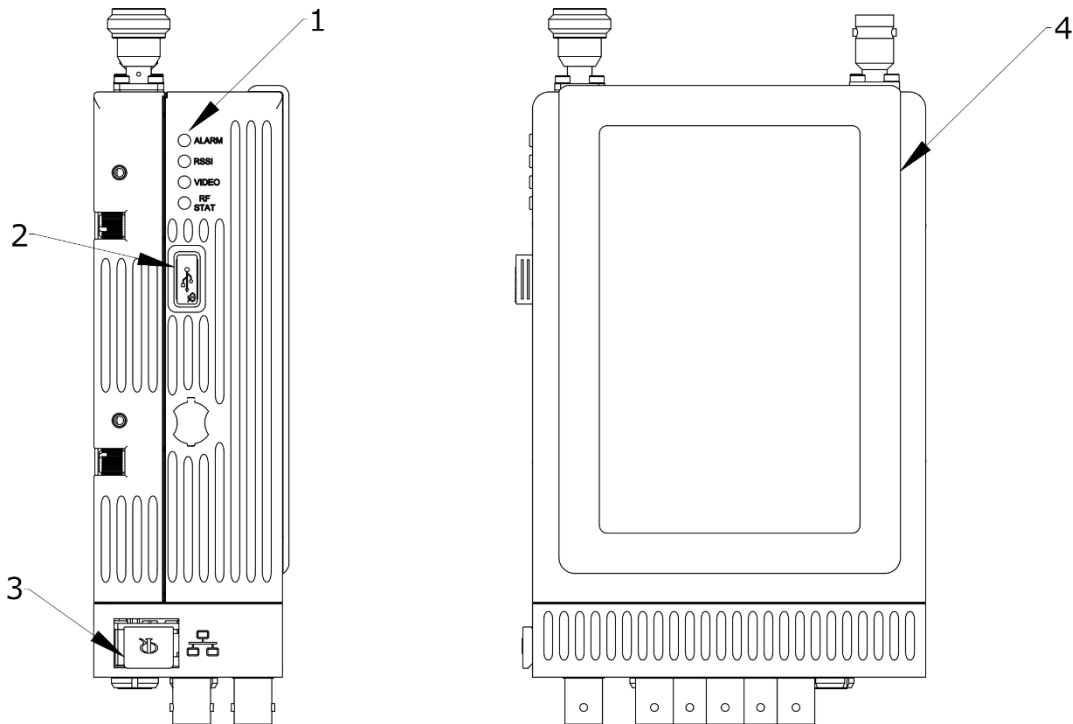


Figure 2: Connectors and components on the front and side of the 4K camera back transmitter

Key	Component	Description
1	LED indicators	ALARM: Indicates whether there is an error or problem with the camera back transmitter.
		RSSI: Indicates whether there is a good signal between the data transmitter and the camera back transmitter.
		VIDEO: Indicates whether there is active video input from the camera into the camera back transmitter.
		RF STAT: Indicates the status of the RF module.
2	USB	Use to provide firmware upgrade files.
3	RJ45	Use to stream or receive IP video through an Ethernet network connection. Note that this connector is on the side of the I/O module.
4	Touch-enabled color LCD	Use to configure the camera back transmitter and view status information. If the screen is dark and there is no display, touch all four quadrants of the screen within one second; trace a U or X pattern on the display to unlock the screen.

I/O module

The camera back transmitter's I/O module provides connectors for video, power, control, and audio.



NOTE: There are two versions of the I/O module. The older version supports just Quad 3G UHD; the latest version supports 12G, Dual 6G and Quad 3G. If you are using the older version, you will only be able to use the transmitter with certain types of cameras.

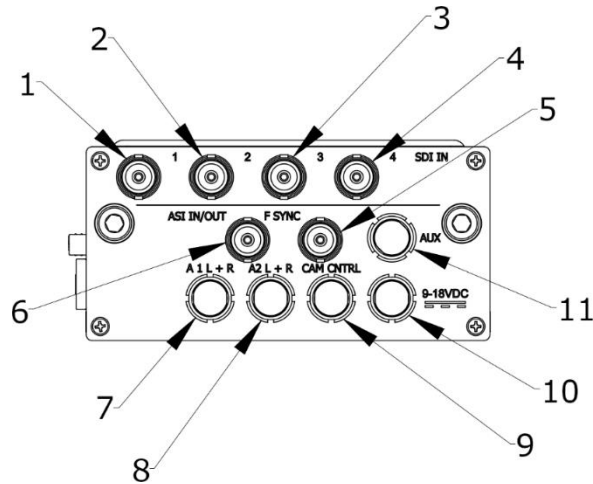


Figure 3: Connectors on the 4K camera back transmitter's I/O module

Key	Component	Description
1	SDI IN 1	Use to connect the camera back transmitter to the camera's SDI port if you are using SDI as the video source. If you are using the 12G I/O module, the SDI input connectors are as follows: 1: 12G, 2: 6G, 3: 3G, and 4: 3G. The 12G transmitter automatically detects the connected video format. If you are using the Quad 3G I/O module, all SDI inputs are 3G. Connector: BNC (F).
2	SDI IN 2	
3	SDI IN 3	
4	SDI IN 4	
5	F SYNC	Provides a connection to a client-supplied B&B or tri-level signal used to synchronize the video image. Connector: BNC (F).
6	ASI IN/OUT	Use to provide an ASI input or output to other Real Freedom or third-party equipment. Connector: BNC (F).
7	A1 L+R	Balanced analog audio inputs (Mic/Line level support with phantom power). Use to connect a microphone or audio signal from signal-processing equipment and mixing consoles. A1 is the primary analog audio into the camera back transmitter. A2 is the secondary/aux analog audio into the camera back transmitter. Connector: LEMO 6-pin
8	A2 L+R	
9	CAM CNTRL	Use to connect the camera back transmitter to the 'Remote' port on the camera to control camera settings. Connector: LEMO 5-pin 0B HGG.0B.305
10	9–18 VDC	Use to connect an external DC power supply to power the camera back transmitter. Connector: LEMO 0B 2-pin HGG.0B.302
11	AUX	Use for auxiliary data and tally light signals. Connector: LEMO 9-pin

This chapter contains the installation instructions for the Real Freedom 4K Camera Back Transmitter.

Before installing, you should familiarize yourself with the [Location and functions of parts](#), which provides information about the camera back transmitter's connectors.

Overview

The main installation steps for a camera back transmitter are as follows:

1. Attach the camera mount to the camera.
2. Attach the camera back transmitter to the camera mount.
3. Connect the camera back transmitter to the camera.

Preparation

Before connecting and configuring the camera back transmitter, you should familiarize yourself with the transmitter's environmental and power requirements.

Environmental requirements

The following table summarizes the environmental requirements for the operation and storage of a Real Freedom 4K Camera Back Transmitter.

Table 1: Environmental requirements

Specification	Details
Humidity	95% non-condensing
Temperature	-4°F to 131°F / -20°C to +55°C

Power requirements

The following table summarizes the power requirements for a Real Freedom 4K Camera Back Transmitter.

Table 2: Power requirements

Specification	Details
Connector	LEMO 0B 2-pin HGG.0B.302
Supply	9–18 V DC

Unpack the camera back transmitter

Unpack the Real Freedom 4K Camera Back Transmitter and refer to the packing list to ensure that all items are included. Report any missing items immediately to the Real Freedom Team.

Inspect the camera back transmitter for signs of damage. Report any damage to the Real Freedom Team.

Additional items required for installation

To install the Real Freedom 4K Camera Back Transmitter, you will require the following additional items:

- Camera

The Real Freedom 4K Camera Back Transmitter is compatible with most hand-held broadcast cameras.

- Camera mount.

BSI supply custom 'camera backs' that attach to different types of commercial cameras. These mounts have an integrated battery sled and power cables and allow the camera back transmitter to be connected to the camera.

- 9–18 V DC power supply.

Cable requirements

To install the Real Freedom 4K Camera Back Transmitter, you will require the following cables:

- Coaxial cables with BNC connectors.

It is recommended that you use good quality 75 Ohm cable.

- LEMO cable (LEMO 5-pin 0B HGG.0B.305).

Use the LEMO cable to connect the camera back transmitter to the 'Remote' port on the camera.

- Audio cables. LEMO (6-pin).

Connections

Refer to the [Location and functions of parts](#) which shows the locations of the connectors on the camera back transmitter.

If you are using the 12G I/O module, the SDI input connectors are: 1: 12G, 2: 6G, 3: 3G, and 4: 3G.

If you are using the Quad 3G I/O module, all SDI inputs are 3G.

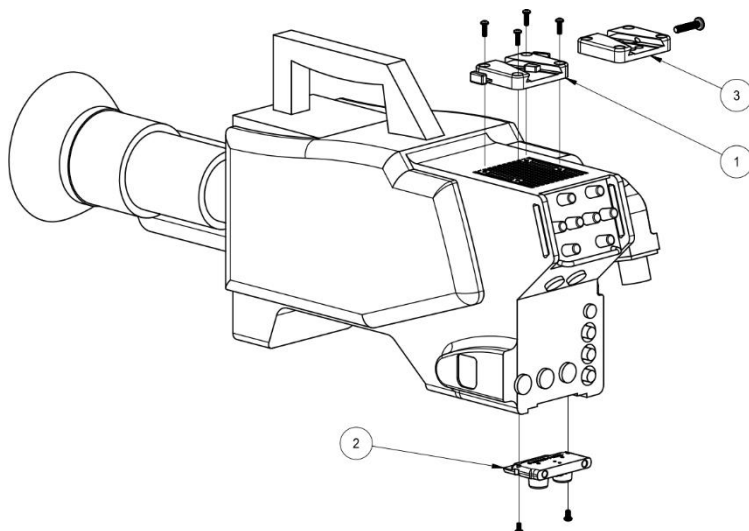
Attach a camera back transmitter to a camera

Use an appropriate BSI camera back to attach the 4K camera back transmitter to the camera.

The following procedure describes how to attach a 4K camera back transmitter to a Sony camera using a BSI camera back (20005-9-002).

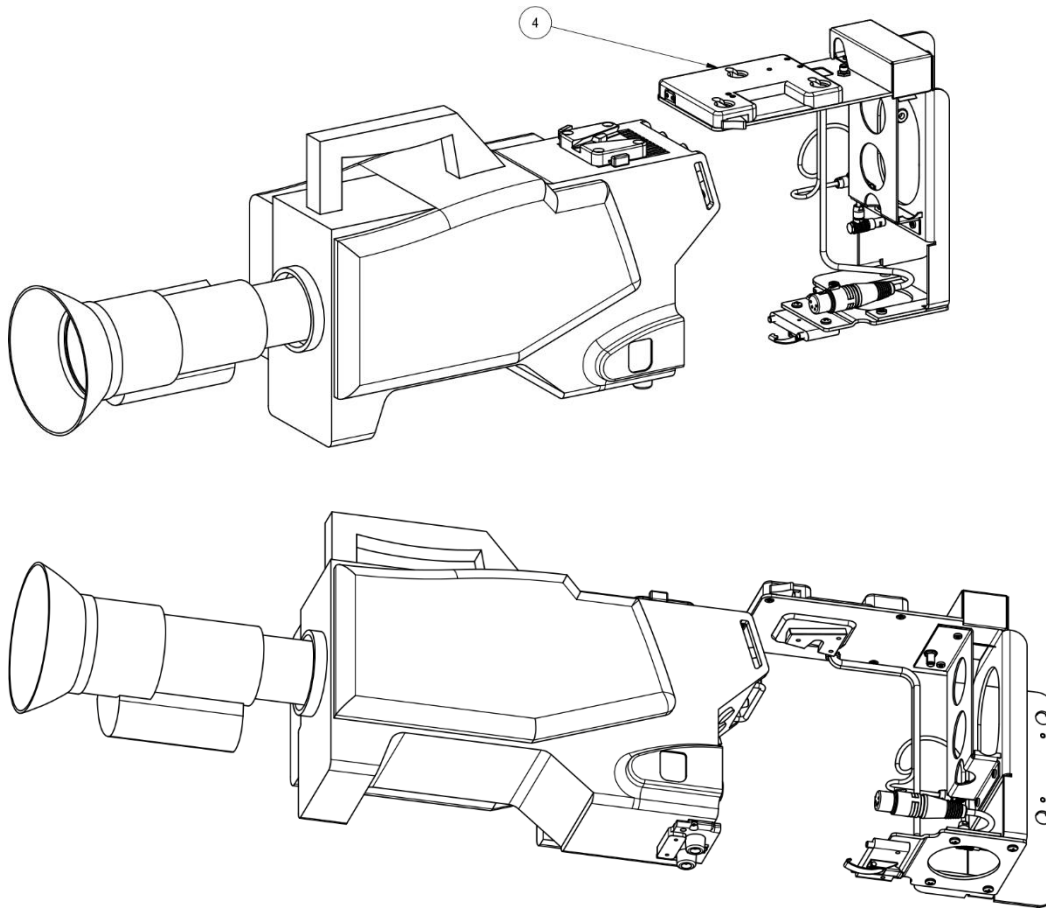
1. Attach the shoe assembly, V edge (1), to the camera using four M3 x 10 screws.

Alternatively, attach a BSI camera shoe (3) to the camera using four M3 x 10 screws.

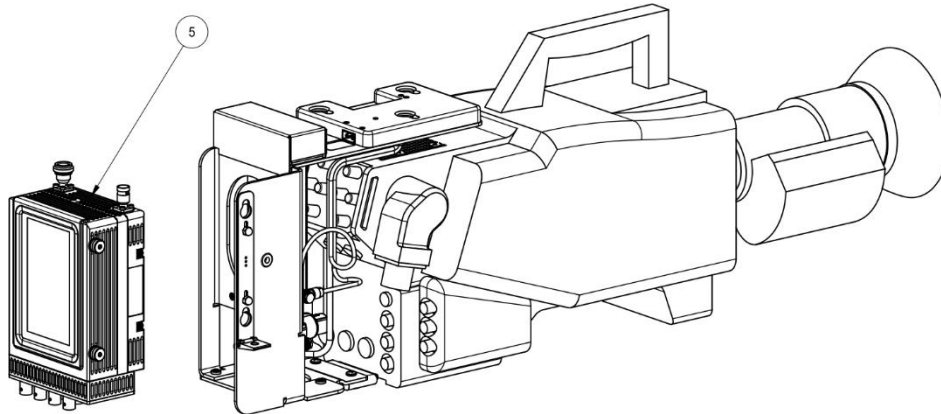


2. Attach the lower hook (2) to the camera using two M3 x 6 screws.

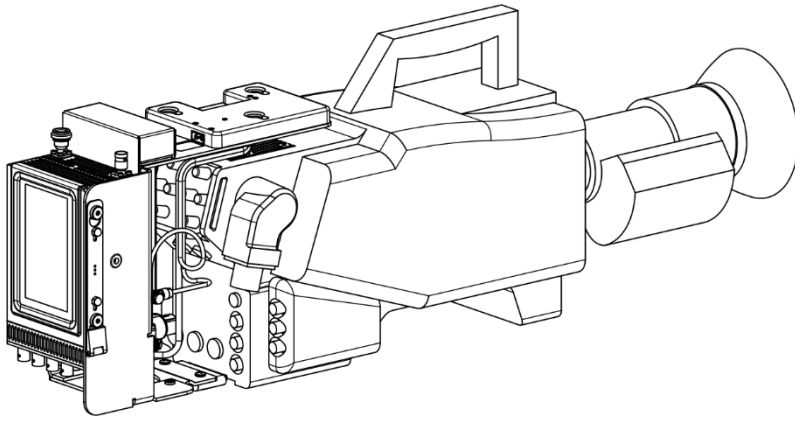
3. Attach the camera back (4) to the camera. To do this slide the V wedge on the camera back into the shoe assembly and the lower mounting block into the lower hook. If you are using a BSI camera shoe, secure the V wedge with an M5 x 25 screw.



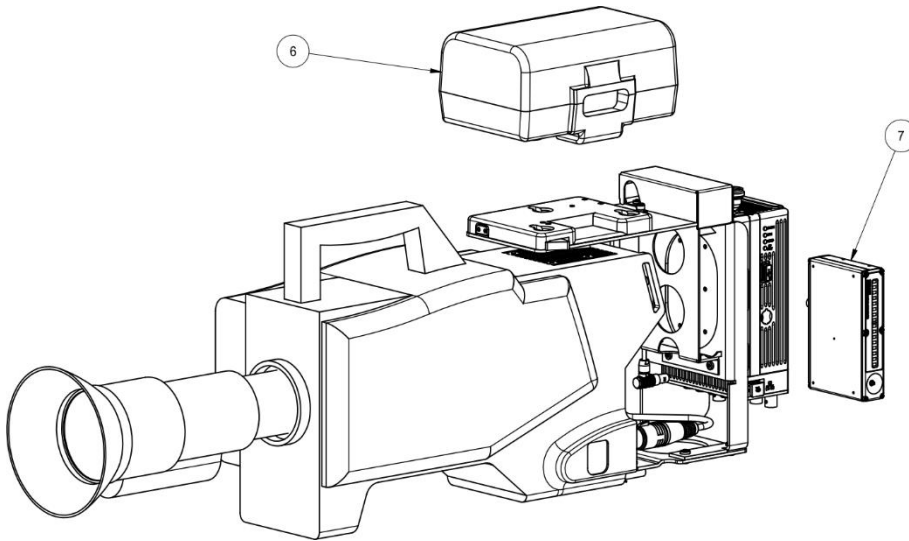
4. Attach mounting studs to the side of the 4K camera back transmitter (5) using M5 x 15 flat head socket cap screws.



5. Align the mounting studs with the holes in the mounting bracket and engage the 4K camera back transmitter (5). Push the transmitter latch up and close the safety latch.



6. Attach the battery (6) to the camera back.



7. Insert the return video receiver (7) into the slot in the camera back. The receiver clips into place.

8. Attach the power cables to the camera, 4K camera back transmitter and return video receiver.

Mounting

The Real Freedom 4K Camera Back Transmitter has threaded mounting holes on each side of the digital module that you can use to mount the unit.

The recommended mounting hardware (thumb screws) for the M3 and M5 locations on the transmitter are as follows:

Table 3: Mounting hardware specifications

Manufacturer part number	Supplier part number
RAF M3465-SS (M3 x 8 mm thumb screw)	Mouser 761-M3465-SS
RAF M3478-SS (M5 x 9 mm thumb screw)	Mouser 761-M3478-SS

Connections checklist

Use the following table to ensure that the connections to the camera back transmitter are correct.

Table 4: Connections checklist

Component	Connector/cable type	Notes
Camera back transmitter power	LEMO 2-pin to battery pack	
Camera back transmitter audio	LEMO 6-pin or AUX	
Camera back transmitter control	LEMO 5-pin to camera control tally and paint	
Camera back transmitter video	BNC to camera SDI	
Camera back transmitter antenna	Standard N-type connector	Either a BSI or third-party antenna

Transmitter configuration

Once powered, use the touch-enabled color LCD to configure the camera back transmitter and view status information.

Overview

To configure the camera back transmitter, you must do the following:

1. Set the transmit frequency and adjust the transmit power.
2. Set the camera control frequency.
3. Select the source.
4. Define the camera type and camera number.
5. Assign audio settings.

Before you start

To configure the camera back transmitter, you will need the following information:

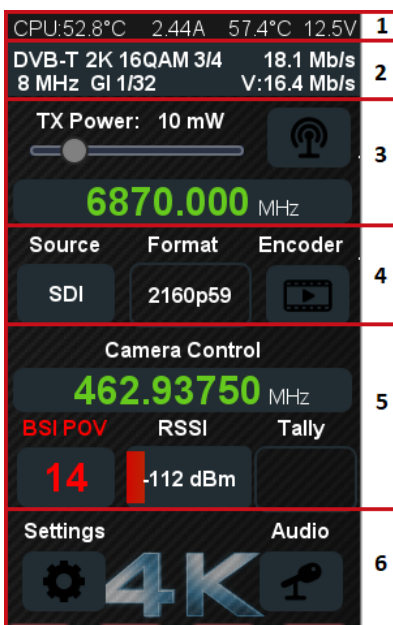
- Transmit and camera control frequencies.
- Camera type and camera number from the camera's control panel.



NOTE: If the screen is dark and there is no display, touch all four quadrants of the screen within one second; trace a U or X pattern on the display to unlock the screen.

Main configuration page

The information and settings on the main configuration page are as follows:



1. Displays diagnostic information.
2. Displays the settings for the selected transmission standard (DVB-T or DVB-T2). Tap the area above the text to change the standard and settings. In the example, V: 16.4 Mb/s is the video bit rate, and 18.1 is the overall bitrate including video and audio.
3. Displays the transmit power and frequency. Tap the transmit icon to define advanced transmit settings.
4. Displays the video source and format. Tap the encoder icon to define video encoder settings.
5. Displays the camera control frequency, the camera type and ID, RSSI (Received Signal Strength Indicator) or SNR (Signal to Noise Ratio) and tally indicator. Tap the camera number to define camera settings.
6. Displays settings, including network configuration, and audio settings. The four green/red bars at the bottom of the screen indicate the status of each of the four video inputs.

DVB mode

Tap the area above the DVB text to display the **DVB-T/DVB-T2** page. Use this page to choose the transmission standard that you want to use and to define the settings for the selected standard. When you have selected the appropriate settings, tap the **Back** icon to return to the main page.

DVB-T

Digital Video Broadcast - Terrestrial (DVB-T) is the most widely used digital television standard for terrestrial television transmissions. The following settings are available if you select DVB-T.

Table 5: DVB-T settings

Setting	Description
Bandwidth	Specifies the bandwidth of operation. For DVB-T, choose from 5 MHz, 6 MHz, 7 MHz, or 8 MHz.
Carriers	Choose the mode of operation, either 2K or 8K mode. Use 2K mode for single transmitter operation and for small single frequency networks with limited transmitter distances. Use 8K mode both for single transmitter operation and for small and large single frequency networks.
Constellation	DVB-T offers three different modulation schemes: QPSK, 16QAM, and 64QAM. Lower order modulation formats like QPSK (Quadrature Phase Shift Keying) do not transmit as much data compared to higher modulation formats such as 64QAM (Quadrature Amplitude Modulation), but they can be received when signal strengths are lower. Note that as the QAM order increases, there is a higher possibility of introducing data errors since these schemes are less resilient to noise and interference.
Code Rate	Match the code rate to the requirements of the broadcast network. The higher the level of error correction that is applied, the greater the level of supporting error correction data that needs to be transmitted, which reduces the data rate of the transmission. For example, if you select 2/3, for every 2 bits of data, you are sending out 3 bits, one of which is for error correction.
Guard Interval	Choose the appropriate guard interval so that distinct transmissions do not interfere with each other. In DVB-T, four guard intervals are available: 1/32 provides the lowest protection and the highest data rate, 1/4 results in the best protection but the lowest data rate.

DVB-T2

Digital Video Broadcasting — Second Generation Terrestrial (DVB-T2) is an extension of DVB-T which allows for significantly higher data rates. The following settings are available if you select DVB-T2.

Table 6: DVB-T2 settings


Setting	Description
Bandwidth	Specifies the bandwidth of operation. DVB-T2 provides additional bandwidths compared to DVB-T.
Carriers	Choose the mode of operation, 1K, 2K, 4K or 8K mode. Use 2K mode for single transmitter operation and for small single frequency networks with limited transmitter distances. Use 8K mode both for single transmitter operation and for small and large single frequency networks.

Setting	Description
Constellation	<p>DVB-T2 offers different modulation schemes: QPSK, 16QAM, 64QAM, Rotated QPSK, Rotated 16QAM and Rotated 64QAM.</p> <p>Lower order modulation formats like QPSK do not transmit data as fast as the higher modulation formats such as 64QAM, but they can be received when signal strengths are lower.</p> <p>Note that as the QAM order increases, there is a higher possibility of introducing data errors since these schemes are less resilient to noise and interference.</p> <p>Choose rotated modulation to lower the dynamical range of fluctuations in the signal and to improve the data rate.</p>
Code Rate	<p>Match the code rate to the requirements of the broadcast network. The higher the level of error correction that is applied, the greater the level of supporting error correction data that needs to be transmitted, which reduces the data rate of the transmission.</p> <p>For example, if you select 2/3, for every 2 bits of data, you are sending out 3 bits, one of which is for error correction.</p>
Guard Interval	<p>Choose the appropriate guard interval so that distinct transmissions do not interfere with each other.</p> <p>In DVB-T2, four guard intervals are available: 1/32 provides the lowest protection and the highest data rate, 1/4 results in the best protection but the lowest data rate.</p>
Pilot Pattern	<p>Pilots are needed to adapt transmissions to current channel conditions. DVB-T2 has eight different patterns. Choose the appropriate pattern depending on network type and reception conditions or select 'Auto'.</p> <p>If you choose a specific pattern, you can also set the frame duration and forward error correction (FEC) block size.</p>
Frame duration	<p>Frame duration ranges between 10 and 43ms and allows you to trade modulation delay, bit rate efficiency and interleaving performance.</p>
FEC Block Size	<p>This is a trade-off parameter, with shorter FEC blocks giving finer control over achievable bit rate but requiring more overhead and thus not as efficient as long frames.</p> <p>Choose between short FEC frame (16,200 bits) and long FEC frame (64,800 bits).</p>

Transmit power and frequency

You must define the transmit power and frequency. Note that the transmit frequency set here and the receive frequency set on the receiver must be the same.

Table 7: Transmit configuration

Setting	Description
TX Power	<p>Defines the transmit output power. Move the slider to set the required power.</p> <p>Transmit power directly impacts signal range. The more power, the longer the range. Increasing the power can also make the signal more stable, but keep in mind it can have a negative effect on battery life.</p> <p>If the power is too low, the camera range may be insufficient resulting in loss of RF signal and video image.</p>
	<p>Tap the transmit icon to display the Transmit page. Use this page to define advanced settings used to transmit the video signal.</p> <p>When you have selected the appropriate settings, tap the Back icon to return to the main page.</p>

Setting	Description
Transmit Frequency (MHz)	<p>Sets the transmit frequency assigned for your event.</p> <p>Tap the current value, change the numbers to the required frequency and tap Done.</p> <p>Note that you can keep the transmit and receive frequency at the same value by selecting the Update Receive Frequency option from the receiver's Remote Tx Ctrl menu. Then, if you change the transmit frequency, the receive frequency automatically changes to the same value.</p>

Advanced transmit settings

Tap the transmit icon to display the **Transmit** page. Use this page to define advanced settings used to transmit the video signal. When you have selected the appropriate settings, tap the **Back** icon to return to the main page.


Table 8: Advanced transmit settings

Setting	Description
Dual Pedestal	<p>Specifies whether you want to use a double-capacity wireless link.</p> <p>'Off' creates a single video link with double capacity.</p> <p>'On' creates two independent video streams.</p> <p>In 'BSI control' mode, the selected setting syncs from the receiver to the transmitter.</p>
Pre-Distortion	<p>Specifies whether to use pre-distortion to improve the linearity and efficiency of the transmitter's amplifier and reduce interference. The recommended setting is 'On'.</p> <p>Choose 'Power Save' to allow the device to 'sleep' between periods of transmission and reception, which lowers power consumption and can increase battery life.</p>
Pilot Offset	<p>This is an advanced setting used to offset the RF spectrum by one sub-carrier. Default setting is 'Off'.</p>
RF Calibration	<p>RF calibration is generally done to test or calibrate the source data. This is tested by BSI to avoid any errors in the field.</p>

Video source, format and encoder

You need to define the video input source and the settings that you want to use to prepare the video for output.

Table 9: Source, format and encoder configuration

Setting	Description
Source	<p>Specifies the video input source (ASI or SDI). This corresponds to the port used to connect the transmitter to the camera.</p> <p>Tap the current source, select the source that you require, and tap Done.</p>
Format	<p>Displays the video format and frame rate when the transmitter is powered and connected to the camera.</p>
	<p>Tap the encoder icon to display the Encoder page. Use this page to define the settings that you want to use to prepare the video for output.</p> <p>When you have selected the appropriate settings, tap the Back icon to return to the main page.</p>

Encoder, encoder CPB and license settings

Tap the encoder icon to display the **Encoder** page. Use this page to define the settings that you want to use to prepare the video for output. Separate settings are provided for HEVC and H.264. When you have selected the appropriate settings, tap the **Back** icon to return to the main page or tap the **Next** icon to change the encoder coded picture buffer (CPB) setting.

Table 10: HEVC and H.264 encoder settings

Setting	Description
Video Format	Defines the resolution of the video file. Select the format that you want to use from those available (720p, 1080i, 1080p, 1080p (3G), and 2160p), and then tap Done . Note that 2160p is not available for H.264.
Chroma	Chroma subsampling is a method for compressing color data in a video signal or file. It reduces the amount of color information in the signal to allow more luminance data instead and allows you to maintain picture clarity while effectively reducing the file size by up to 50%. Select the ratio that you want to use, and tap Done . The camera back transmitter supports 4.2.2 and 4.2.0.
Bit Depth	Choose whether to use 8-bit or 10-bit color.
Video Delay Mode	Defines whether to use 'Normal', 'Low' or 'Ultra Low' video encoder latency. Select the delay mode that you want to use, and then tap Done . Note that you must ensure that you set the correct Video Latency setting on the receiver, which depends on the Video Delay Mode that you select here. If latency is set incorrectly on the receiver, the image may freeze or judder.
Quadlink Mode	Quadlink Mode bonds four 3G SDI signals together equaling 12G, which helps in streaming 4K. Two modes exist for splitting the pixels, where the signal is divided in four equal parts and transported on four different coaxial cables. 'UHD - 2SI': each quad is a copy of the same image at ¼ resolution. 'UHD – Square': each link contains one quarter (1920 x 1080) of the original image.

Encoder CPB

From the **Encoder** page, tap the **Next** icon to display the **Encoder CPB** page. When you have selected the appropriate setting, tap the **Back** icon until you return to the main page or tap the **Next** icon to view or upload a license on the **Licenses** page.

Table 11: Encoder CPB

Setting	Description
Encoder CPB	This is an advanced setting that allows you to change the encoder's coded picture buffer size. A large value at the encoder generally results in better video quality but requires more expensive decoder hardware. Either tap 'Default' or enter your own custom value.

Licenses

From the **Encoder CPB** page, tap the **Next** icon to display the **Licenses** page. Use this page to upload an encoder software license.

To upload a license file, follow these steps:

1. On the **Licenses** page, tap **License Upload**.
2. Insert a USB stick containing the license file into the transmitter's USB port.

3. Tap **Scan** to locate the license file.
4. Select **Update** to load the license file.
5. When you have uploaded the appropriate license file, tap the **Back** icon until you return to the main page.

Camera control

You need to set the camera control frequency, which is the frequency used by the data transmitter to send camera control data to the camera back transmitter. You also need to ensure that the camera type and ID are set correctly.

Table 12: Camera control configuration

Setting	Description
Camera Control	Sets the required camera control frequency. Tap the current value, change the numbers to the required frequency, and tap Done .
Camera Type/ID	Tap the camera number icon to display the Camera Control page. Use this page to define the camera ID and type. When you have selected the appropriate settings, tap the Back icon to return to the main page.
RSSI/SNR	RSSI shows the received signal strength. When measured in negative numbers, a number that is closer to zero usually means a better signal. SNR shows the signal to noise ratio, which is the difference between the data transmitter's signal strength and the background noise. A low SNR decreases throughput and data rate.
Tally	A tally is a signal sent from the production workflow to the camera indicating that the camera is 'live'. This normally displays as a red or green light on the camera to show the presenter that the camera is live and in the camera viewfinder to alert the camera operator. When the tally signal is activated, 'Tally' shows red or green indicator.

Camera control settings

Tap the camera number icon to display the **Camera Control** page. Use this page to enter details of the of the camera that you are using. It is important to enter all the settings correctly so that the camera transmitter can communicate with the camera.

When you have selected the appropriate settings, tap the **Back** icon to return to the main page.

Table 13: Camera control settings

Setting	Description
Camera ID	Specifies the camera ID number. Tap the current ID, set the required camera number, and then tap Done . Note that the camera ID is shown on the camera's Operator Control Panel/Remote Control Panel.
Camera Type	Defines the camera type. Tap the current type, choose the camera type that you want, and then tap Done .
Call: Sony	Camera Type set to 'Sony'. Sony Call is required on Sony camcorder-style cameras to allow tally to operate.
GV Series	Camera Type set to 'Grass Valley'. Tap to define the camera series, either 'LDK' or 'LDX'.

Setting	Description
Ikegami Mode	Camera Type set to 'Ikegami'. Tap to select the value mode, 'Absolute' or 'Relative'. Refer to the camera's operator control panel manual for an explanation of these settings.

Settings

Tap the settings icon to display the **Settings** page. This page has the following options:

Table 14: Settings options

Option	Description
Serial Port	Use the serial port settings 'Host Console', 'Console', and 'Command' to directly interface with the host Zynq processor and encoder.
Network	Use this option to define the network configuration for the camera back transmitter.
Firmware Update	Use this option to upgrade the camera back transmitter's firmware.
About	Use this option to view software and firmware version information.
Screen Timeout	Select this check box to enable a screen timeout.
Backlight	Use the slider to adjust the brightness of the LCD screen.

Network

From the main screen, tap **Settings** and select **Network**. The **Network** page displays the current network configuration, including whether the IP address is static or allocated by DHCP.

Tap 'Next' to display the **Network Config** page and configure as follows.

Table 15: Network configuration

Setting	Description
Use DHCP	Specifies whether to dynamically assign an IP address and other network configuration parameters to the transmitter. Clear this check box to disable DHCP and set a static IP address.
IP	Enter the required IP address to identify the camera back transmitter on the network. This IP address must match the subnet of the Operator Control Panel/ Remote Control Panel (OCP/RCP).
Netmask	Enter the required subnet/network mask. This must be the same as the RCP's subnet mask.
Apply changes	Tap to apply any changes. Note that you must reboot the transmitter to activate the new configuration. To do this, remove the power cable, wait a few seconds, and then reconnect the power cable.

Audio

From the main screen, tap **Audio** and configure as follows.

Table 16: Audio configuration

Setting	Description
Channel 1-2 Source	Source Sets the source of audio on channel 1-2. Use 'Test Tone' to test and align the audio gain and losses.

Setting	Description
	<p>Stream Defines the format used to stream the recorded audio through a network connection. Select the required format or leave this set to 'Off'.</p>
Channel 3-4	<p>Source Sets the source of audio on channel 3-4. Use 'Test Tone' to test and align the audio gain and losses.</p>
	<p>Stream Defines the format used to stream the recorded audio through a network connection. Select the required format or leave this set to 'Off'.</p>
Phantom Power	<p>Phantom is used to enable phantom power by channel if required by the microphone. Note that when you use a stereo microphone that requires phantom power, you must switch on BOTH channels for phantom power (Phantom Ch 1 and Phantom Ch 2).</p>

Once connected and correctly configured, no further changes are generally required to the camera back transmitter during routine operation.

Status LEDs

Use the LED indicators on the camera back transmitter to help you to determine whether the transmitter is operating correctly.

Table 17: Camera back transmitter LED status indications

LED	LED state	Meaning
ALARM	Green	The camera back transmitter is operating normally.
	Red	There is an error or problem with the camera back transmitter.
RSSI	Green	There is a good signal between the data transmitter and the camera back transmitter.
	Red	The camera control frequency is set incorrectly at the data transmitter, or the camera back transmitter is too far away from the data transmitter to pick up the control data.
VIDEO	Green	All expected video inputs are locked and present.
	Red	There is no connection or active video input from the camera.
RF STAT	Green	The RF module is operating normally.
	Red	There is a problem with the RF module.

Routine checks

You should verify the connection to the camera and verify that the transmitter is receiving data from the OCP/RCP and regularly monitor audio and signal levels.



NOTE: You should also ensure that the transmit frequency matches the receive frequency set on the receiver and that the camera number matches the camera that you are using.

Verify the connection to the camera

The camera type label above the camera number on the main configuration page will be solid green if the transmitter is communicating with camera. Red indicates no communication.

Verify the transmitter is receiving data from the OCP/RCP

If the transmitter is receiving data from the OCP/RCP, the camera ID number on the main configuration page will either be green or change between green and red.

Monitor audio and signal levels

It is recommended that you monitor audio and signal levels while using the camera back transmitter.

- Signal levels are shown on the main configuration page, either as RSSI or SNR.
- To view audio levels, tap **Audio** on the main configuration page, and then tap **Next**.

Troubleshooting

This chapter provides troubleshooting information for Real Freedom 4K Camera Back Transmitter.

Use this information to help you to solve some of the problems that you may encounter when using a camera back transmitter in a Real Freedom system.

Table 18: Troubleshooting camera back transmitter issues

Symptom	Possible cause	Actions
Dark screen/display.	The display has 'timed out'.	<ul style="list-style-type: none"> • Touch all four quadrants of the screen within one second; trace a U or X pattern on the display to wake. You can disable the screen timeout from the Settings page. • The screen backlight is set too low. Adjust the screen backlight from the Settings page.
No audio signal.	Incorrect audio settings.	<ul style="list-style-type: none"> • Check the transmitter's audio settings.
	Loose or incorrect connections at the receiver.	<ul style="list-style-type: none"> • Check all physical connections on the back of the receiver. Analog audio is available at the 3-pin XLRs on the back of the receiver and embedded audio is always available on the SDI 1 and 2 outputs.
Connection error.	Transmit and receive frequency set incorrectly.	<ul style="list-style-type: none"> • Verify that the frequency settings on the receiver and transmitter match. • Enable automatic frequency updates in the receiver's configuration so that the transmit and receive frequency is always the same.
Poor audio signal.	Audio settings are not correct.	<ul style="list-style-type: none"> • Monitor incoming audio channels and determine if gain should be applied or reduced.
No remote control from receiver.	No active connection to the receiver.	<ul style="list-style-type: none"> • Remote control is only possible when data is active, and the receiver is properly coded and connected to the client RCP.

This chapter describes the maintenance, cleaning, and storage procedures for Real Freedom 4K Camera Back Transmitter.

Routine maintenance procedures

You should perform the following maintenance procedures on a regular basis.



WARNING: The Real Freedom 4K Camera Back Transmitter does not contain user serviceable parts. Warranty is void if the device is opened. Refer servicing to qualified BSI personnel only.

Performance monitoring

It is recommended that you periodically monitor the overall performance of the camera back transmitter and system. If you experience failure or deterioration in the performance of the system, check cables and adapters, input, and output connectors for damage.

Visual inspection

Depending on operating environments and use, periodically inspect the Real Freedom 4K Camera Back Transmitter for signs of damage, dirt, or corrosion. Check that all markings and warning labels are in good condition.

Cleaning

If necessary, use low-pressure compressed air cleaning to remove small particles and debris from the surface of a camera back transmitter.

Clean connector surfaces with a cotton swab moistened with a small quantity of alcohol. Use a lint-free cloth to wipe connector surfaces after cleaning.



CAUTION: Do not use abrasive cleaners.

Storage

Store a camera back transmitter either attached to the camera or in a safe location.

For long term storage:

1. Disconnect all cables from the Real Freedom 4K Camera Back Transmitter.
2. Detach the Real Freedom 4K Camera Back Transmitter from the camera.
3. Remove the antennas.
4. Cover the connectors with suitable dust covers.
5. Place the Real Freedom 4K Camera Back Transmitter in protective packaging and store in a cool, dry environment.

Update the transmitter's firmware

From time to time, new firmware will become available for the camera back transmitter. Be aware that updating the firmware is a sensitive process that may take some time. Make sure the transmitter is undisturbed during the upgrade and do not switch off the transmitter during the update process.



NOTE: Download new firmware files from <https://www.bsintl.com/real-freedom>

To update the firmware, follow these steps:

1. From the main menu, tap **Settings**, and then select **Firmware Update**.
9. Insert a USB stick containing the new firmware into the transmitter's USB port.
10. Tap **Scan** to locate the new firmware.
11. To begin the update, select **Update**.
12. To complete the firmware update process, power cycle the transmitter when the message on the screen instructs you to do so.

Change an RF module

You can change the Real Freedom 4K Camera Back Transmitter's RF module to operate in a different frequency band.

To change an RF module, follow these steps:

1. Disconnect all cables from the camera back transmitter and detach the transmitter from the camera.
2. Disconnect the UHF and RF antennas from the transmitter.
3. Unscrew the five screws securing the RF module to the digital module assembly.
4. Gently pull the RF module to release it from the digital module assembly.
5. Place the RF module in a safe place.
6. Position the new RF module and push down gently to engage the connector.
7. Tighten the five screws to secure the RF module to the digital module assembly.
8. Connect the UHF and RF antennas to the camera back transmitter.
9. Reconnect the cables and attach the camera back transmitter to the camera.

Technical drawings, specifications, and connector pinouts for the Real Freedom 4K Camera Back Transmitter.

Dimensions

The following drawings show the dimensions of the Real Freedom 4K Camera Back Transmitter.

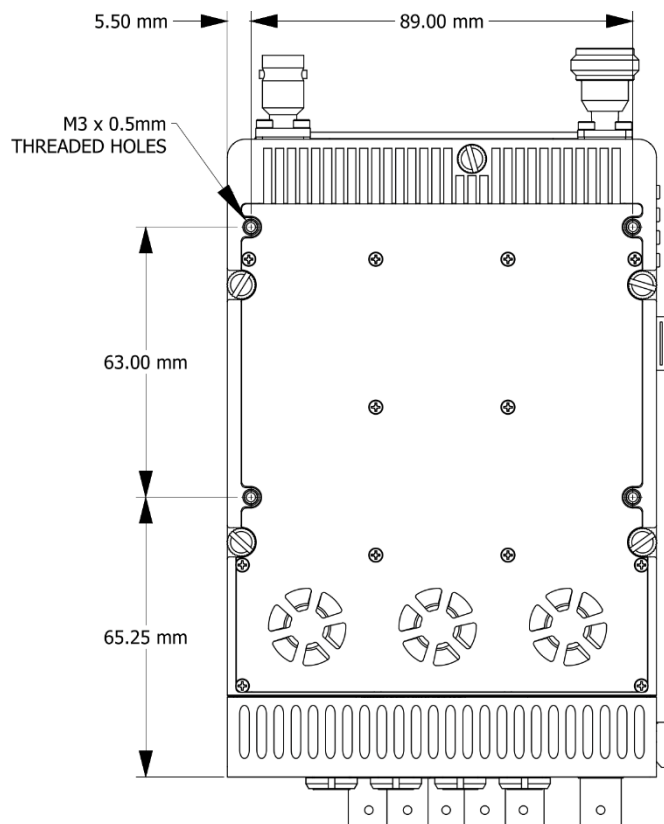


Figure 4: 4K camera back transmitter (back)

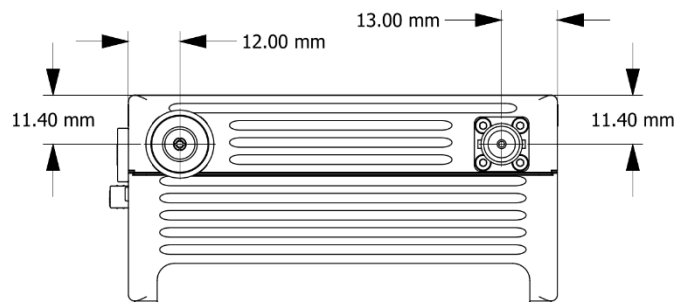


Figure 5: 4K camera back transmitter (top)

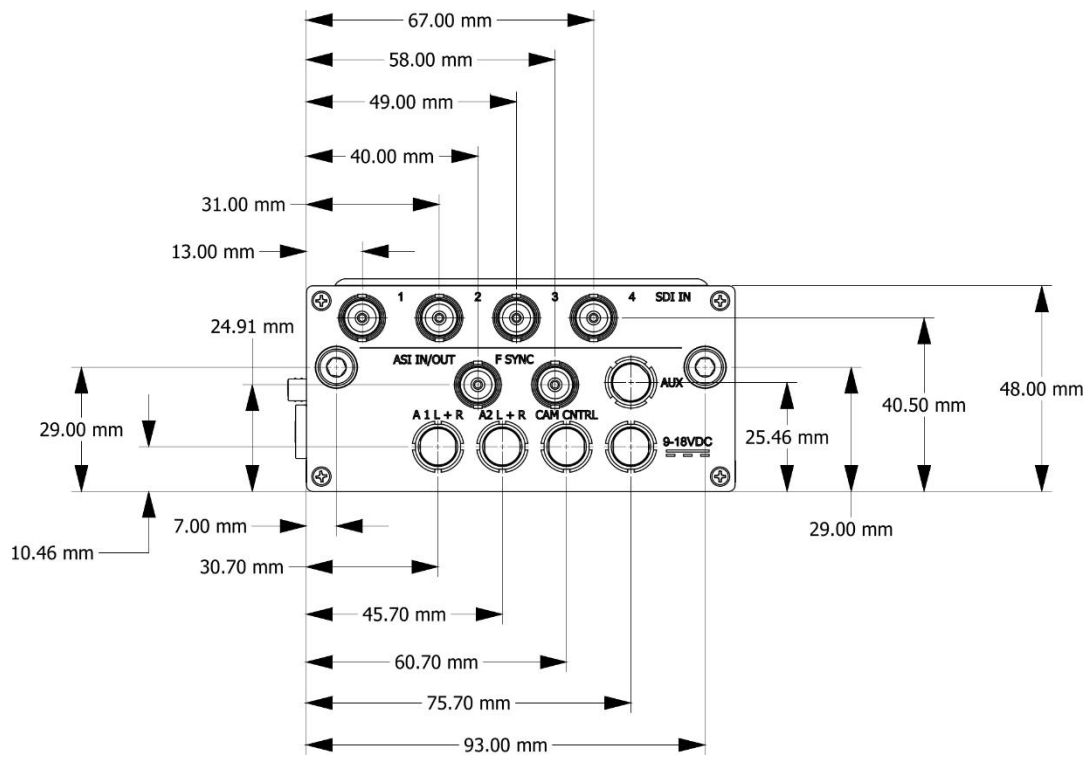


Figure 6: 4K camera back transmitter I/O module connections

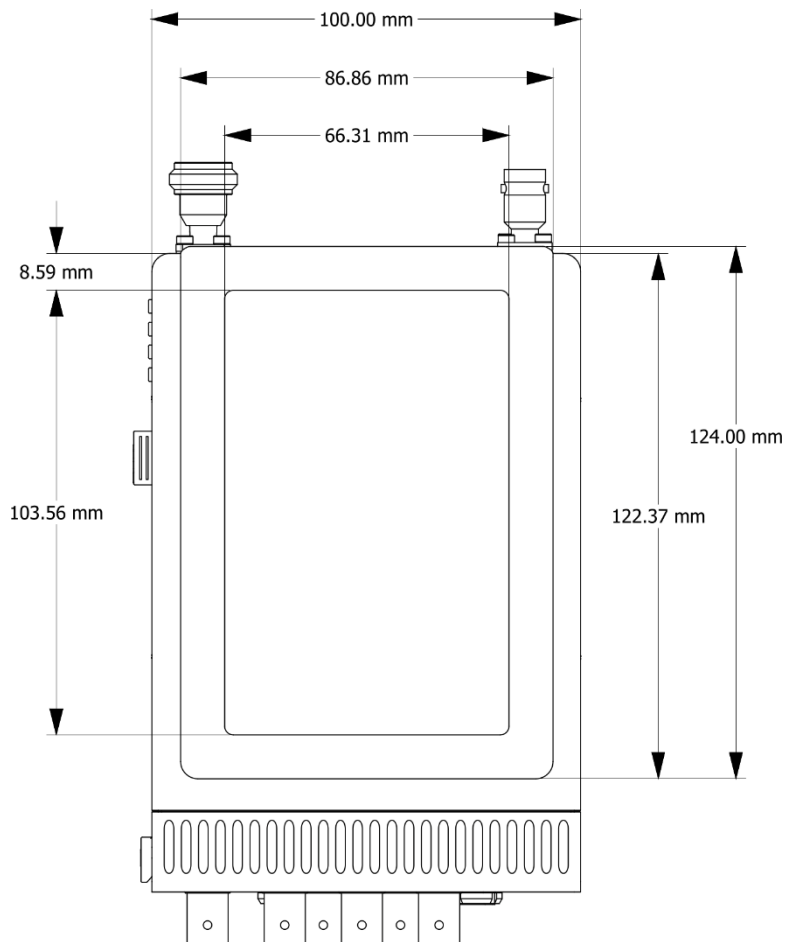


Figure 7: 4K camera transmitter (front)

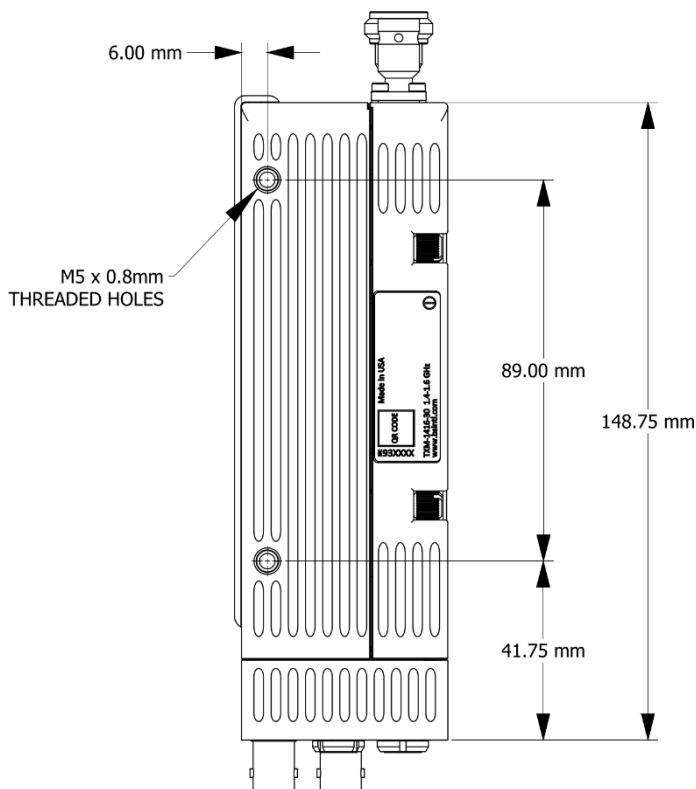


Figure 8: 4K camera back transmitter (right side)

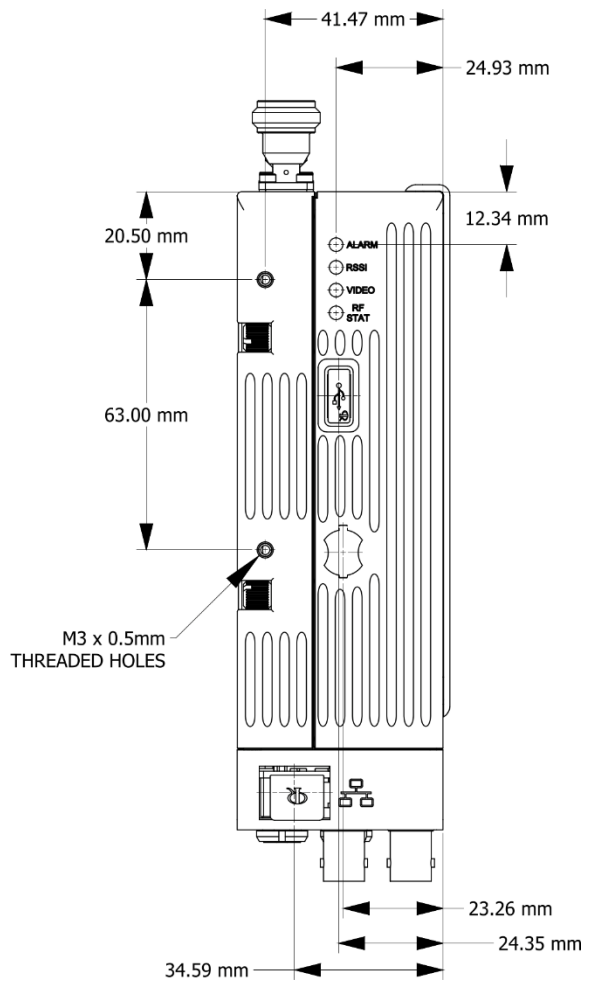


Figure 9: 4K camera back transmitter (left side)

Specifications

The following tables contain the specifications for the Real Freedom 4K Camera Back Transmitter.

Audio compression

Table 19: Audio compression specifications

Parameter	Specification
Standard	LPCM, MPEG-1, Layer I & II
Optional	Dolby AC3

Audio inputs

Table 20: Audio input specifications

Parameter	Specification
Digital inputs	8 channel embedded SDI
Analog inputs	4 (with Phantom Power) Balanced Analog (Mic / Line)
Connector	2 x XLR-3 (M), BNC (F) or optional LEMO

Camera control

Table 21: Camera control specifications

Parameter	Specification
Type	Built in UHF data receiver
Frequency band	410–490 MHz
Bandwidth	12.5 kHz
Step size	6.25 & 10kHz
Input/output	Remote point & tally of connected camera
Connectors	LEMO 5-pin 0B HGG.0B.305
Camera support	BSI POV, Sony, Ikegami, Grass Valley/Thomson

Compliance

Table 22: Compliance information

Parameter	Specification
Radio (RF/UHF)	EN302064, EN300113
EMC	EN301489

Control

Table 23: Control specifications

Parameter	Specification
Local control	Touch-enabled color LCD
Remote control	Via UHF data receiver, built-in HTTP web server
Connectors	RJ45, USB type A

Environmental

Table 24: Operating and storage specifications

Parameter	Specification
Temperature	-4°F to 131°F / -20°C to +55°C
Humidity	95% non-condensing

Frequency band

Table 25: Frequency band specifications

Parameter	Specification
Band options*	1400 MHz to 1600 MHz, 2000 MHz to 2700 MHz, 3200 MHz to 3900 MHz, 5500 MHz to 7500 MHz, UWB: 450MHz to 8000 MHz *User swappable options, additional bands available upon request
Tuning step	250 kHz

Modulation

Table 26: Modulation specifications

Parameter	Specification
Scheme	DVB-T, DVB-T2
Carriers	1K, 2K, 4K, 8K

Parameter	Specification
Modes	QPSK, 16-QAM, 64-QAM, Rotated QPSK, Rotated 16-QAM, Rotated 64-QAM
Bandwidth	Single pedestal: 5, 6, 7, 8 MHz Dual pedestal: 1.7, 5, 6, 7, 8, 10 MHz
Interleaving	DVB-T2 Standard – Part Compliant
FEC	1/2, 2/3, 3/4, 4/5, 5/6
Guard interval	1/32, 1/16, 1/8, 1/4

Physical

Table 27: Size and weight specifications

Parameter	Specification
Size (W x H x D)	3.93 x 5.82 x 1.9 in / 100 x 148 x 48.38 mm
Weight	2.75 lb. / 1.251 kg
Ingress	Fully sealed

Power requirements

Table 28: Power specifications

Parameter	Specification
Supply	9–18 V DC, 20 W
Connector	LEMO 0B 2-pin HGG.0B.302

RF power

Table 29: RF power specifications

Parameter	Specification
Output power	10–250 mW* (selectable) *100 mW ETSI, 250 mW FCC *Options
Connector	N (F)
HPA power	Built-in Bias-T/Phantom Power to power external booster amps
Additional features	RF Predistortion (band specific)*, Dynamic RF Level Control*

Tallies

Table 30: Tally specifications

Parameter	Specification
Type	Serial I/O & Steadicam Tally
Connector	LEMO 0B 6-pin HGG.0B.306

Video compression

Table 31: Video compression specifications

Parameter	Specification
Standard	HEVC, H.264
Profile	High 4:2:2 Profile (Hi422P*)
Resolution	720p, 1080i, 1080p, 1080p(3G), 2160p
Frame rates	23.976 / 24 / 25 / 29.97 / 30 / 50 / 59.94 / 60 Hz

Parameter	Specification
Chroma	4:2:0 / 4:2:2
Sample depth	8-bit, 10-bit
Connectors	BNC (F)

Video input

Table 32: Video input specifications

Parameter	Specification
Format (auto select)	SD-SDI (SMPTE-259M), HD-SDI (SMPTE-292), 3G-SDI (SMPTE-424M), ASI

Video outputs / Save to file

Table 33: Video output specifications

Parameter	Specification
Format	ASI/ASI over IP (option)
Connectors	BNC (F), RJ45, USB (save to file)

Connector pinout assignments

Pinouts for the connectors on the Real Freedom 4K Camera Back Transmitter.

Antenna port – RF output

Use to connect an RF antenna to the camera back transmitter.

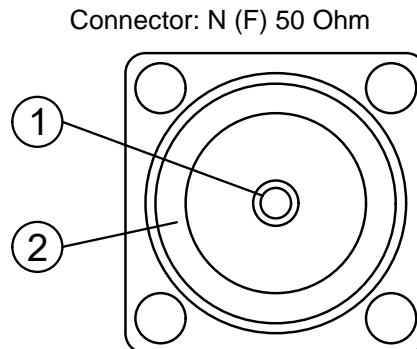


Figure 10: Front face of the N (F) RF output connector

Pin	Purpose
1	RF output
2	Ground/Shield

Antenna port – UHF input

Use to connect a UHF antenna to receive camera control data from a data transmitter.

Connector: BNC (F) 50 Ohm

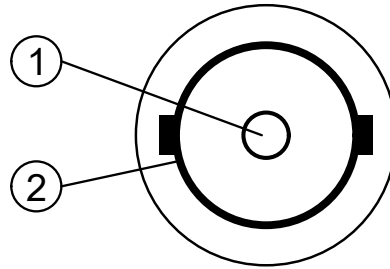


Figure 11: Front face of the BNC (F) UHF input connector

Pin	Purpose
1	UHF input
2	Ground/Shield

ASI / SDI video input

Use to connect the camera back transmitter to the camera's ASI or SDI port.

Connector: BNC (F) 75 Ohm

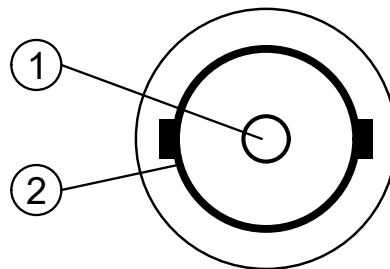


Figure 12: Front face of the BNC (F) video input connector

Pin	Purpose
1	Video input
2	Ground/Shield

Audio 1

Use for primary analog audio.

Connector: LEMO 6-pin

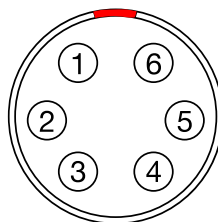


Figure 13: Front face of the LEMO audio connector

Pin	Purpose
1	Ground

Pin	Purpose
2	AUDIO1_P
3	AUDIO1_N
4	Ground
5	AUDIO2_P
6	AUDIO2_N

Audio 2

Use for secondary/aux analog audio.

Connector: LEMO 6-pin

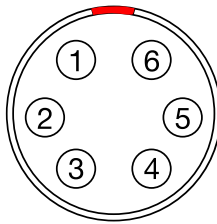


Figure 14: Front face of the LEMO audio connector

Pin	Purpose
1	Ground
2	AUDIO3_P
3	AUDIO3_N
4	Ground
5	AUDIO4_P
6	AUDIO4_N

AUX

Use for two additional channels of audio, a serial connection, or tally connections.

Connector: LEMO 9-pin

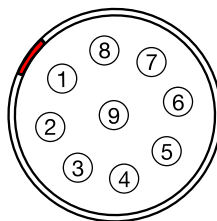


Figure 15: Front face of the LEMO AUX connector

Pin	Purpose
1	Ground
2	V_Out
3	Ground
4	TALLY1
5	AUX_TX P/TX D
6	AUX_TX_N

Pin	Purpose
7	AUX_RX_P/RX_D
8	AUX_RX_N
9	TALLY2

Camera control

Use to connect the camera back transmitter to the 'Remote' port on the camera to control camera settings.

Connector: LEMO 5-pin 0B HGG.0B.305

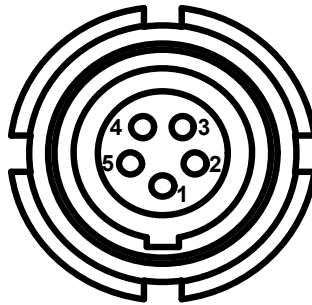


Figure 16: Front face of the LEMO 5-pin camera control connector

Pin	Purpose
1	Ground
2	Rx_N (RS-422)
3	Rx_P (RS-422) or Rx (RS-232)
4	Tx_N (RS-422)
5	Tx_P (RS-422) or Tx (RS-232)

Power

Use to connect an external DC power supply to power the camera back transmitter.

Connector: LEMO 0B 2-pin HGG.0B.302

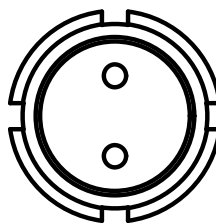


Figure 17: Front face of the LEMO 2-pin power connector

Pin	Purpose
1	Ground
2	Power

Safety and regulatory compliance

Important safety and electromagnetic compatibility information.

Safety notice

It is extremely important to read and understand all safety information and instructions before using a Real Freedom 4K Camera Back Transmitter. Specific warnings and cautions are found throughout this product manual, and you should follow this guidance during the routine use of a Real Freedom 4K Camera Back Transmitter.

Electromagnetic compatibility – Class A

Information about Real Freedom 4K Camera Back Transmitter's electromagnetic compatibility.

Compliance statement (United States)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions, however, set forth in Section 15.5 of the FCC Rules: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by Broadcast Sports International could void the user's authority to operate the equipment.

CE Declaration of Conformity (European Union)

This product meets the requirements of the following directives and carries the CE marking accordingly: 2014/35/EU Low Voltage Directive, 2014/30/EU EMC Directive.

Note that the product may operate on non-harmonized frequency bands and the actual operating frequency may differ between EU Member States.

Disposal and recycling – European Union

This product is required to comply with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC and 2012/19/EU) and is marked with the following symbol:



This symbol indicates that this product is not to be disposed of with household waste, according to the WEEE Directive and your national law. This product should be handed over to a designated collection point or to an authorized collection site for recycling waste Electrical and Electronic Equipment (EEE).

Improper handling of this type of waste could have a possible negative impact on the environment and human health due to potentially hazardous substances that are generally associated with EEE and products of this type. At the same time, your cooperation in the correct disposal of this product will contribute to the effective usage of natural resources. For more information about recycling this product, please contact BSI.