
HD IN-CAR TRANSMITTER

USER MANUAL



Approved (Engineering): _____

Approved (Manufacturing): _____

Approved (Maintenance): _____

Revision History

Revision	Date	Author	Comments
U	11/11/15	D. Starsoneck	First draft
1	6/8/16	D. Starsoneck	Preliminary release

WARNINGS



*No user serviceable parts inside. Warranty void if opened.
Refer servicing to qualified BSI personnel only*



Connect the product only to a power source with the specified voltage rating



Case temperature must not exceed 65 C. To prevent risk of overheating, use a heatsink and ventilate appropriately



Unless connected to a BSI data receiver or PC running the BSI control software, HD IN-CAR TX will start transmitting as soon as power is applied



To prevent damage it is recommended that only BSI supplied cables and accessories should be used with this product

NOTES

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

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1. OVERVIEW

1.1 TECHNOLOGY

The HD IN-CAR TX is an HD/SD video and audio microwave transmitter. It has been designed for simple, secure and reliable operation in the field. The latest technology is utilized to provide the perfect combination of high performance, ease of use, small size and low power operation.

1.1.1 Multi-Format Video and Audio Inputs

The transmitter accepts video in either NTSC, SD-SDI, HD-SDI, format through four front panel connectors. The Transmitter automatically detects the video format in use and decodes the video appropriately.

Four channels of balanced analog audio are accepted on the four Lemo connectors at microphone level. The connectors supply phantom power. Audio gain levels can be adjusted with remote control software.

1.1.2 Video and Audio Encoding

Video is compressed using an H.264 baseline profile encoder FPGA which accepts various standard video formats up to 1080p@30fps. Audio is compressed using a software MPEG encoder running on a floating point DSP.

Video and audio elementary streams are forwarded to the Transport Stream (TS) multiplexer which is implemented in a FPGA. Here the compressed audio and video are packetized and multiplexed with the camera control data into a standard MPEG-2 TS.

1.1.3 DVB-T Modulator

The OFDM modulator is implemented in FPGA and operates in standard 2K DVB-T mode. The modulator may be set up by the user to operate at various constellations (QPSK, 16-QAM, 64-QAM), Forward Error Correction rates ($\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$), and Guard Intervals ($\frac{1}{32}$, $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$). Additionally, the modulator can accept and output I/Q data for 2 videos simultaneously.

1.1.4 Direct RF Up-Conversion

I/Q data from the modulator is passed to an I/Q DAC whose analog output signals are then direct up-converted to RF at the transmit frequency via an I/Q modulator and VCO. In dual stream mode, the two videos are independently compressed and modulated onto 2 separate COFDM pedestals. The single RF up-converter provides the 2 outputs on

adjacent channels (i.e. one 16 MHz wide output). Non-adjacent channel operation is not possible.

1.1.5 Low Latency

A unique technique is used to provide ultra low latency of 2 video frames when operating with the BSI receiver. In compatibility mode the HD IN-CAR TX can be used with any HD H.264 receiver and can achieve a latency of 4 video frames.

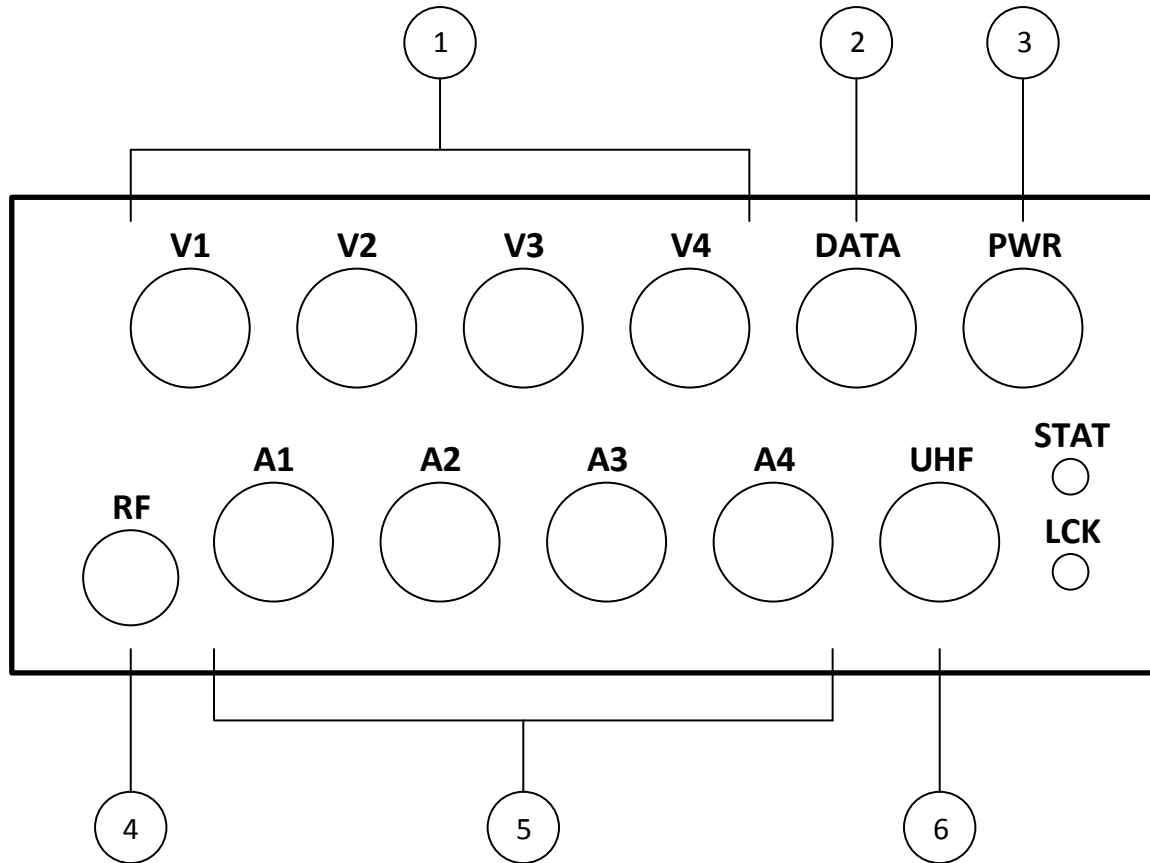
Full technical specifications are available in section 5.1.

1.2 FEATURES

- Four Multi-Format Video Inputs
- Auto Detect of Video Format, Resolution and Frame Rate
- Four Balanced Analog Audio Inputs
- Up to 2 simultaneous video outputs
- Mic level Audio Input
- 200 mW RF Output Power
- End to End Latency < 4 Video Frames
- Remote Control from Windows PC

1.3 LOCATION AND FUNCTIONS OF PARTS

1.3.1 CONNECTORS



1 – Video Inputs (V1-V4)

7-pin Lemo connectors. The Transmitter auto detects the video format (NTSC, SDI, HD-SDI), resolution and frame rate. Data to/from the camera can also be found on this connector.

2 – Aux Data Interface (DATA)

6-pin Lemo connector. Provides communications for programming and remote control, as well as a monitor output.

3 – Power Connector (PWR)

2-pin Lemo connector to power the unit. Compatible with a 10-18 VDC supply.

4 – Antenna Connector (RF)

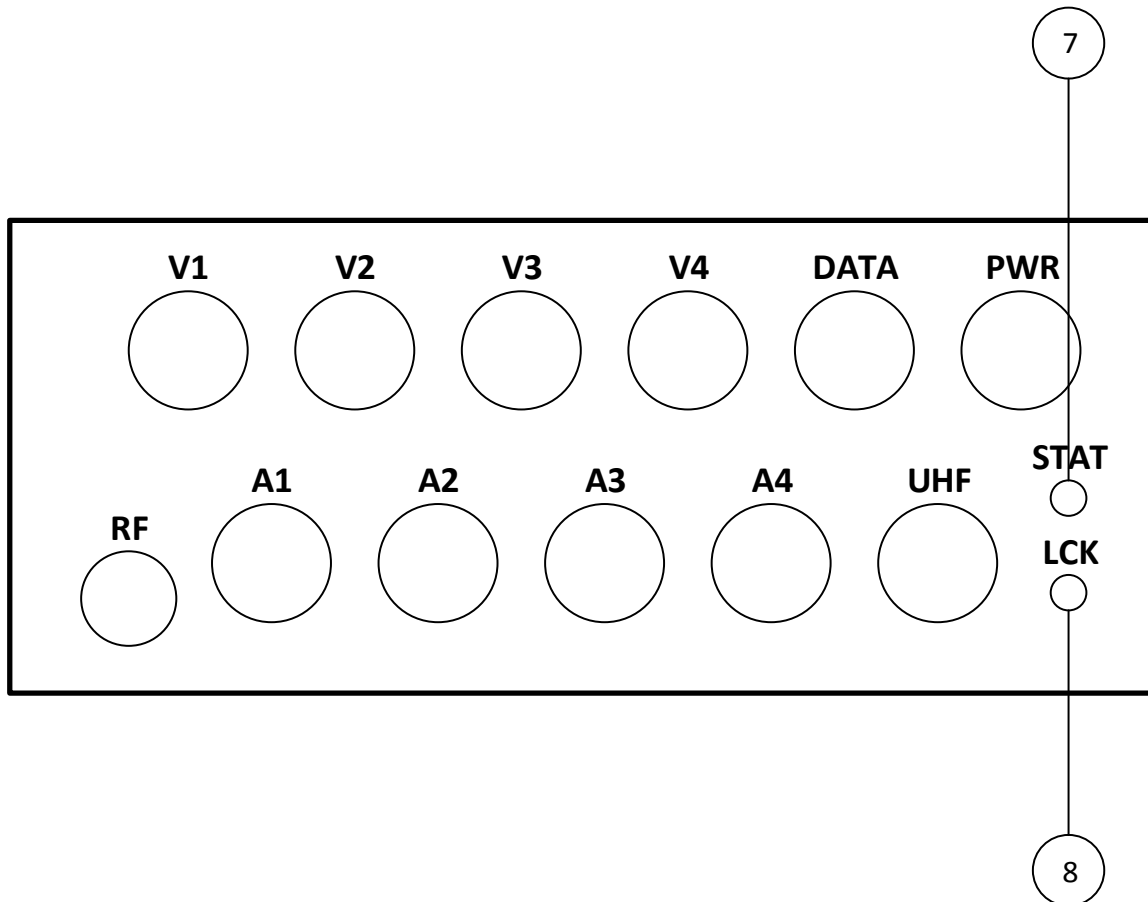
SMA connector. The RF output can be connected directly to an antenna.

5 – Audio Inputs (A1-A4)

3-pin Lemo connectors. Each connector accepts 1 channel of balanced analog audio at Microphone or Line level. Audio gain level is set from the remote control software.

6 – Control Connector (UHF)

5-pin Lemo connector. Provides power and an RS-485 link to the data receiver. Also allows transmitter control via PC using the Digital Camera Controller software.

1.3.2 INDICATORS**7 – Status Indicator**

A red LED indicator that is on (with infrequent flashes off) when in an active powered state, and is off (with infrequent flashes on) when in standby mode.

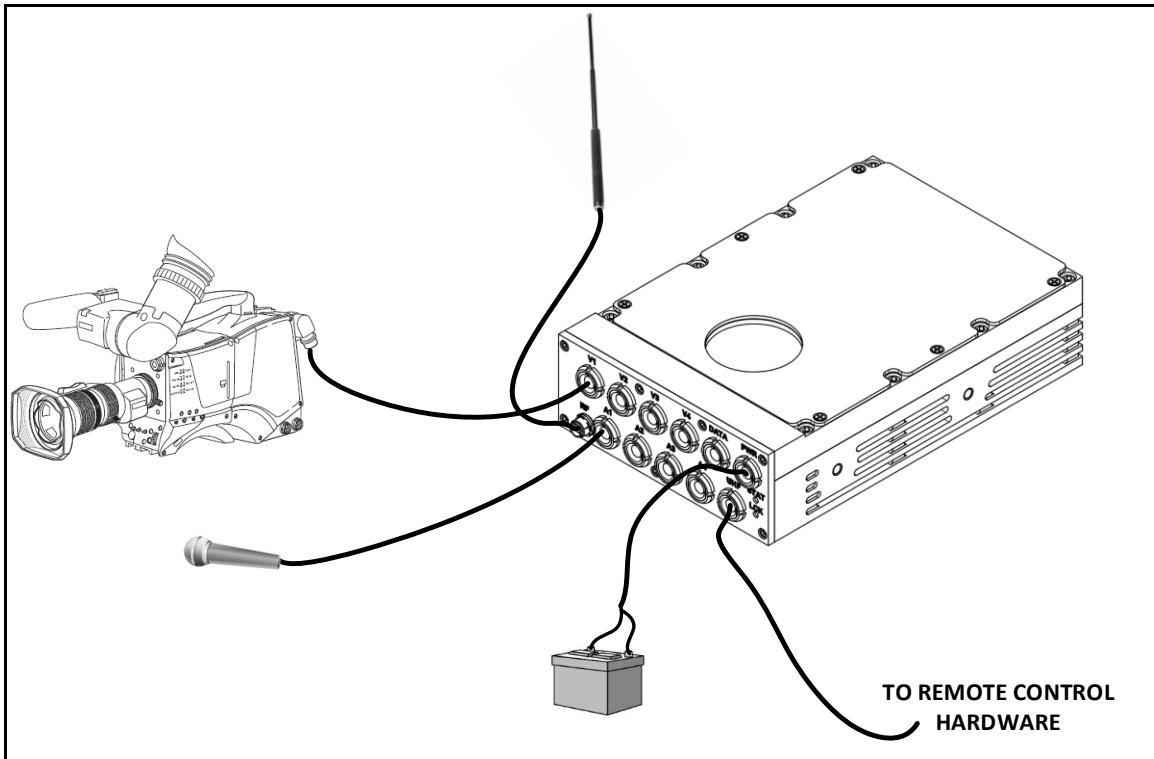
8 – Lock Indicator

A green LED indicator that is solid when the synthesizer is locked, and is off when the synthesizer is unlocked.

2. INSTALLATION

2.1 Typical System

A typical minimum operational system would include the HD IN-CAR TX, camera, microphone, battery and microwave antenna.



2.2 Connecting a Video Source

The HD IN-CAR TX accepts video in NTSC, SDI and HD-SDI formats. The video source can be any device which outputs video in one of these formats, for example a video camera or VTR. The video input on the HD IN-CAR TX also provides a bidirectional RS-485 connection for camera control, battery status, temperature readings, etc.

To connect the video source:

1. Determine if your video source provides video in one of the supported formats.
2. Connect a cable from your video source to a video connector (**V1 – V4**) on the HD IN-CAR TX.

3. The video format is automatically detected.

2.3 Connecting Audio

The HD IN-CAR TX accepts 4 channels of balanced analog audio at microphone (Mic) level.

To connect an audio source:

1. Connect an audio cable from your mic source to an audio input (**A1 – A4**). Make sure that associated video input is connected as well.
2. The audio gain level can be adjusted from the remote control software.

2.4 Connecting Power



CAUTION

Unless connected to a BSI data receiver or PC running the BSI control software, HD IN-CAR TX will start transmitting as soon as power is applied

To connect Power:

1. Ensure your power source outputs between +10 and +18 VDC.
2. Connect the power supply cable to the **PWR** connector on the HD IN-CAR TX.



CAUTION

*The power supply must not exceed +18 Vdc
The power leads must be correctly connected*

2.5 Connecting Control

To connect Remote Control:

1. Connect a DB9 serial cable to the serial port on your Remote Control PC. Connect the other end of the cable to the RS232 port on an RS232-RS485 converter.
 2. Plug the Lemo side of the remote control cable to the UHF port on the HD IN-CAR TX, and the DB9 side to the serial converter as shown in section 3.3.1.
-

2.6 Connecting an Antenna

The antenna should be connected to the HD IN-CAR TX with the shortest possible cable in order to minimize losses. If possible, connect the antenna directly to the HD IN-CAR TX.

To connect the antenna:

1. Connect the antenna to your RF cable
2. Connect the RF cable to the RF connector on the HD IN-CAR TX



CAUTION

Use an 8 in-lb torque wrench to tighten the SMA connector. Do not over-tighten.

3. OPERATING INSTRUCTIONS

3.1 *Turning on the Power*

The HD IN-CAR TX does not include a power switch. To turn on the unit simply connect power to the **POWER** connector.

3.1.1 With No Control/Programming Cable Connected

If the unit is powered while there is no connection to its UHF port, the HD IN-CAR TX goes into standby mode.

3.1.2 With Control/Programming Cable Connected

If power is applied when the UHF port is connected as in section 3.4.1, the HD IN-CAR TX automatically enters remote control mode. In this mode the unit does not start transmitting until commanded to do so. More information can be found in section 3.4.

3.2 *Checking Status*

3.2.1 Checking for Power Status

The Data LED is used to display the power status. The indicator state is decoded as follows:

LED STATE	MEANING
On, Flashing Off	Power
Off, Flashing On	Standby

3.2.2 Checking for BIT Status

The BIT Status indicator LED is used to indicate PLL lock valid and power supply voltage. The indicator state is decoded as follows:

LED STATE	MEANING
Flashing	BIT Fail
On	BIT Pass

3.2.3 Detailed Status Information

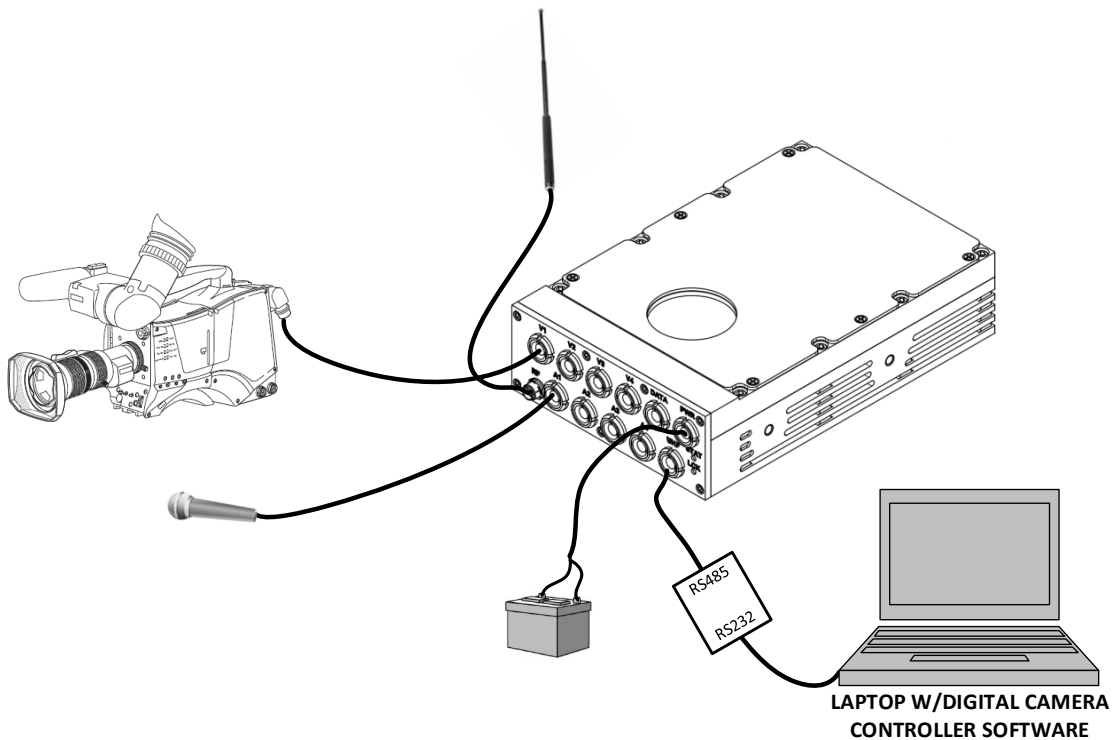
Detailed status information for the HD IN-CAR TX can be displayed in the Digital Camera Control GUI. Status information available includes: battery voltage, case temperature, video lock, audio level, synthesizer lock, RF output frequency, modulation scheme, video and audio encoder settings, audio gain, encryption active, DAC lock.

3.3 Using the GUI

3.3.1 Connecting

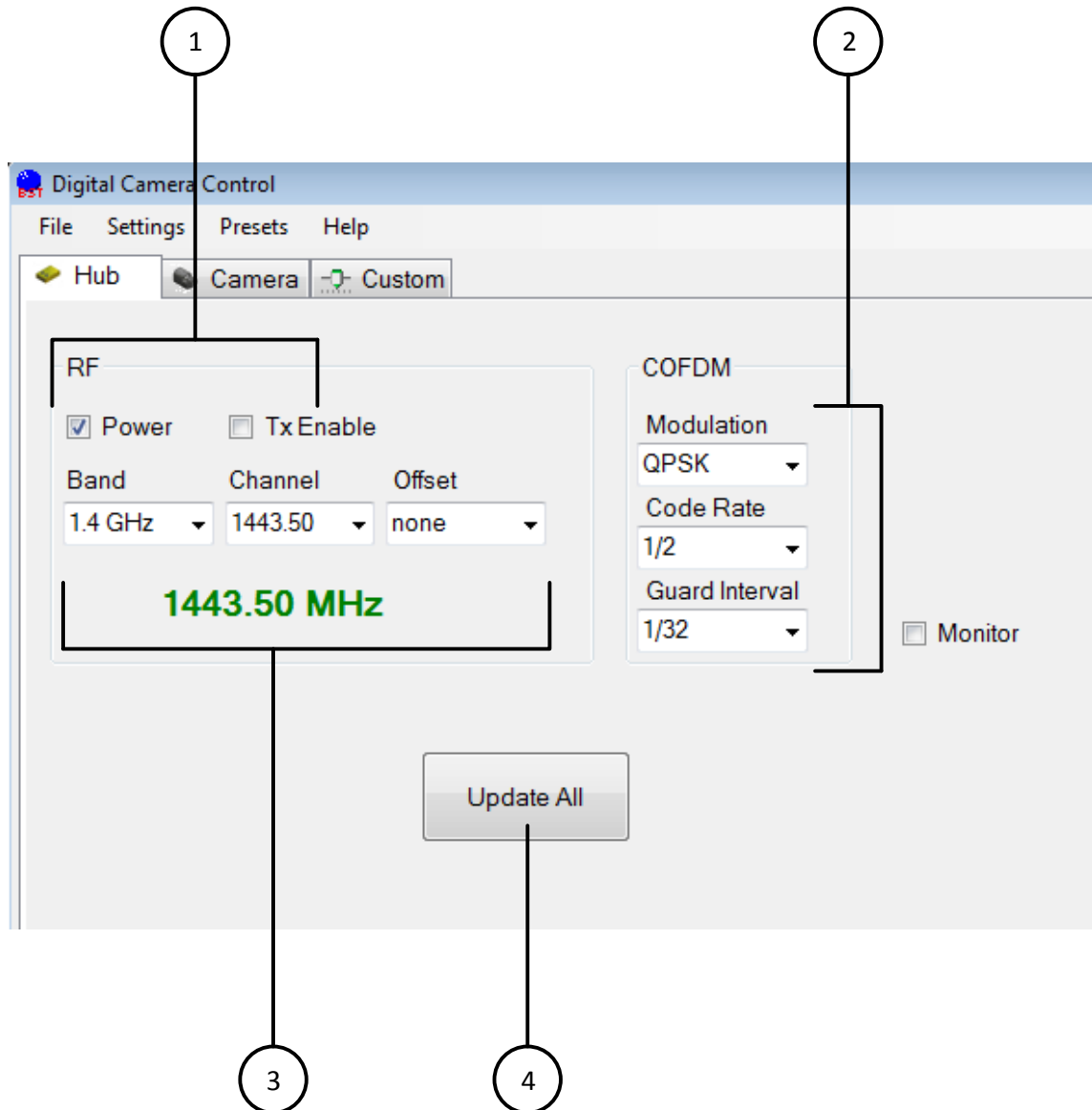
1. Connect the laptop or PC to the HD IN-CAR TX using the Control/Programming cable provided. See section 2.6 for details.
2. Connect an antenna, video and audio sources as required.

A typical system is shown below:



3.3.2 Hub Tab

The Hub Tab of the Digital Camera Control software allows the user to select the transmit frequency and modulation parameters of the In-Car TX, as well as control power. It is detailed below:



1 – Power and Tx Enable

The Power button toggles power for the unit. Tx Enable toggles power to the final RF transmit stage. Both need to be checked for normal operation

2 – Modulation Parameters

Allows selection of COFDM modulation parameters. The user can select between QPSK, QAM-16, and QAM-64 constellations as well as a variety of forward error correction code rates and guard intervals. For typical operation select QAM-16 modulation, $\frac{3}{4}$ code rate, and 1/32 guard interval.

3 – Frequency Selection

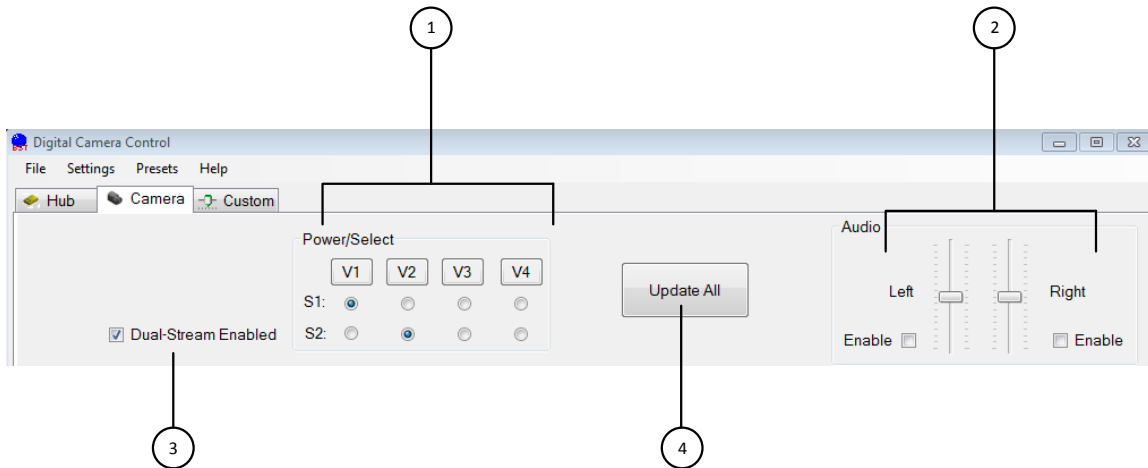
Typical transmit frequencies are selectable from these drop down menus. First select the band of operation, then the channel, and then the offset (if any). The selected frequency is displayed in large font below. To use a transmit frequency not available in these drop down menus, see section 3.3.4.

4 – Update All

Some drop down menu selections won't automatically be written to the In-Car TX. Click the Update All button to ensure that all commands are applied.

3.3.3 Camera Tab

The Camera Tab of the Digital Camera Control software allows the user to select the video and audio signals that are transmitted. It is also where dual-stream mode can be chosen. The tab is detailed below:



1 – Power/Select

The top buttons (V1 to V4) are used to supply power to connected cameras. Leave them unselected if the cameras have their own power supplies. The S1 radio buttons select which video signal is being transmitted. If the TX is in dual-stream mode, a second row of radio buttons labelled “S2” will be available.

2 – Audio

Only 2 of the 4 audio channels are controllable in the current version of this software. They can be enabled/disabled and their gains selected in this section.

3 – Dual-Stream Enabled

Click this button to enable dual-stream. In this mode the two selected videos are independently compressed and modulated onto two adjacent COFDM pedestals (i.e. 16 MHz wide output). The channel frequencies will be +/- 4.25 MHz above and below the transmit frequency selected on the Hub Tab (see section 3.4.2).

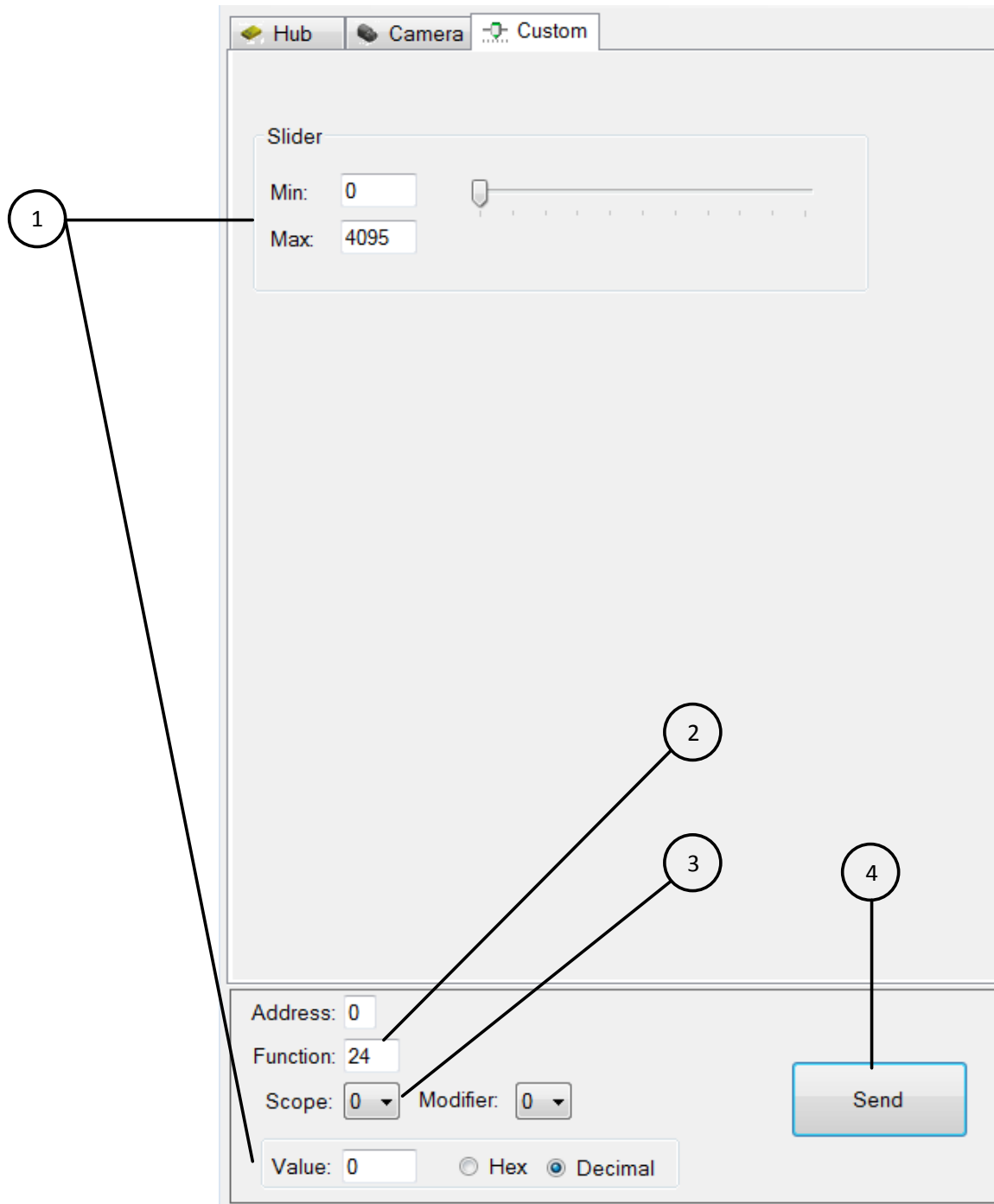
For example, if a transmit frequency of 1460.50 MHz is selected while in dual-stream mode, the lower channel will be 1456.25 MHz and the upper channel will be 1464.75 MHz.

4 – Update All

Some selections won't automatically be written to the In-Car TX. Click the Update All button to ensure that all commands are applied.

3.3.4 Custom Tab

The Camera Tab of the Digital Camera Control software allows the user to select from all supported transmit frequencies rather than just those available on the Hub Tab. You will also notice that the bottom portion of this window is visible from all tabs if “Debug” is selected from the “Settings” menu. The process for programming a frequency is detailed below:



1 – Value

This field allows user selection of the transmit frequency in 250 kHz steps.

First, make sure that the “Decimal” radio button is selected in the bottom portion of the window and that SCOPE selects the desired frequency range (see “3 – Scope” below for more details). Change VALUE by either moving the slider or directly entering a number between 0 and 4095 in the field at the bottom of the window.

To calculate the transmit frequency:

For SCOPE = 0:

$$\text{Transmit Frequency (MHz)} = 1000 + (\text{VALUE} * 0.25)$$

For SCOPE = 1:

$$\text{Transmit Frequency (MHz)} = 2000 + (\text{VALUE} * 0.25)$$

2 – Function

Ensure that “24” is entered for frequency selection. Other values control other functions of the transmitter.

3 – Scope

SCOPE determines the frequency band of operation. “0” should be selected for frequencies between 1000 MHz and 2000 MHz. “1” should be chosen for frequencies between 2000 MHz and 3000 MHz.

4 – Send

Click “Send” to write values from the Custom Tab to the TX.

3.4A Note about Low Latency Mode

Low latency mode provides a very small end-to-end delay for the transmission of video and audio. In order to achieve such a low delay, the encoding technology is modified from the published standard. The practical implication of this is that low latency mode will only work correctly if the HD IN-CAR TX is paired with a BSI receiver. For compatibility with receivers from other manufacturers please disable low latency mode.

MODE	GOP	QUALITY	LATENCY	COMPATIBILITY
Low Latency	N/A	Best	2 frames	BSI Decoders Only
Normal	1	Good	4 frames	Other HD H.264 Decoder
Normal	> 1	Very Good	> 5 frames	Other HD H.264 Decoder

4. TROUBLESHOOTING GUIDE

4.1 TROUBLESHOOTING COMMON PROBLEMS

4.1.1 No Video Lock (Deserializer is unlocked and fails BIT)

When the Connection Status Indicator shows “No Video” and the Deserializer BIT fails, it means the HD IN-CAR TX cannot lock to the incoming video.

Symptoms

1. Deserializer BIT Status shows “FAIL”
2. Connection Status Indicator bar shows “No Video”
3. No video is present at the receiver

Possible Causes

1. The video source is not connected to the HD IN-CAR TX **VIDEO** connector
2. The video is in an unsupported format
3. The video source is not turned on
4. Bad video input at HD IN-CAR TX

Troubleshooting Steps

1. Check the video source
 - a. Connect the video source to an appropriate video waveform monitor
 - b. Confirm that you can see video on the waveform monitor
 - c. Confirm that the video is in a supported format
2. Check the video cable
 - a. Replace the video cable with a new one and reconnect the video source to the HD IN-CAR TX
 - b. Turn on the video source and HD IN-CAR TX and check the Status on the GUI
3. Test the HD IN-CAR TX video input
 - a. Connect a video signal generator to the HD IN-CAR TX **VIDEO** connector
 - b. Turn on the HD IN-CAR TX and video signal generator
 - c. Set the video signal generator for NTSC composite output and select visible test pattern (for example 75% bars)
 - d. Check the Status on the GUI
 - e. Repeat the test for SDI and HD-SDI signals

4.1.2 No RF at Receiver

Receive problems may be caused by issues at the Transmitter or Receiver in addition to external causes such as interference and path loss. This section does not cover receiver issues. Please see the Operators Manual that came with your receiver.

Symptoms

1. No RF signal at receiver

Possible Causes

1. Transmitter is not turned on
2. No antenna connected to Transmitter
3. Bad antenna cable
4. Bad antenna
5. External interference
6. Path loss

Troubleshooting Steps

1. Check power supply is connected to the HD IN-CAR TX and turned on
2. Check the antenna is properly connected to the **RF** connector
3. Check the antenna and cable are functional
 - a. Replace the antenna and RF cable with new ones
 - b. Check for RF at the receiver
4. Check for external interference
 - a. Turn off the HD IN-CAR TX so it stops transmitting
 - b. Use a spectrum analyzer to check that the desired channel is clear from interfering signals. Remember that the HD IN-CAR TX requires up to 8 MHz of clear spectrum
 - c. Reprogram the HD IN-CAR TX and your receiver for an alternate, clear channel
 - d. Power up the HD IN-CAR TX and check for RF at the receiver.
5. Check for signal path loss (signal level too low)
 - a. Move the HD IN-CAR TX and receiver closer together (within the same room) and retest.
 - b. If low signal level is suspected, use a directional antenna or use an external PA to extend the transmission range.

4.1.3 No Video at Receiver

Video reception problems may be caused by issues at the Transmitter or Receiver. This section does not cover receiver issues. Please see the operator's manual that came with your receiver.

Symptoms

1. Good RF signal at receiver, but no video is present
-

Possible Causes

1. Video source is not turned on
2. Video source is not connected to HD IN-CAR TX
3. Video format is unsupported
4. Bad video cable
5. Bad video input at HD IN-CAR TX

Troubleshooting Steps

1. Check the video source
 - a. Connect the video source to an appropriate video waveform monitor
 - b. Confirm that you can see video on the waveform monitor
 - c. Confirm that the video format is supported by the HD IN-CAR TX
2. Check the video cable
 - a. Replace the video cable with a new one and reconnect the video source to the HD IN-CAR TX
 - b. Turn on the video source and HD IN-CAR TX and check the Status on the GUI
3. Test the HD IN-CAR TX video input
 - a. Connect a video signal generator to the HD IN-CAR TX **VIDEO** connector
 - b. Turn on the HD IN-CAR TX and video signal generator
 - c. Set the video signal generator for NTSC composite output and select a visible test pattern (for example 75% bars)
 - d. Check the Status on the GUI
 - e. Check that video is present at the receiver
 - f. Repeat the test for SDI and HD-SDI signals

4.1.4 No Audio at Receiver

Received audio problems may be caused by issues at the Transmitter or Receiver. This section does not cover receiver issues. Please see the operator's manual that came with your receiver.

Symptoms

1. Good RF signal and video at receiver, but no audio is present

Possible Causes

1. Audio source is not connected
 2. Audio source level is incompatible with Transmitter
 3. Audio gain is set too low
 4. Incompatible audio compression is selected
 5. Bad audio cable
 6. Bad audio input at HD IN-CAR TX
-

Troubleshooting Steps

1. Check the audio source
 - a. Connect the audio source to an audio test set
 - b. Confirm that you have audio at the test set
 - c. Confirm that the audio level is either Mic or Line level
2. Check the audio compression type
 - a. Connect a PC running the Digital Camera Control software to the HD IN-CAR TX using the supplied Control cable.
 - b. Power up the HD IN-CAR TX and PC. On the PC run the Digital Camera Control software.
 - c. On the PC select “Remote Control” mode
 - d. Select the “Audio” tab to display the audio settings
 - e. Check that the selected audio compression type selected is compatible with your receiver.
 - f. Reprogram presets as necessary.
3. Check the audio gain
 - a. Connect a PC running the Digital Camera Control software to the HD IN-CAR TX using the supplied Control cable.
 - b. Power up the HD IN-CAR TX and PC. On the PC run the Digital Camera Control software.
 - c. On the PC select “Remote Control” mode
 - d. Select the “Audio” tab to display the audio settings
 - e. Increase audio gain settings as needed for your microphone.
 - f. Reprogram presets as necessary.
4. Check the audio cable
 - a. Replace the Audio Cable with a new one and re-test
5. Test the HD IN-CAR TX audio input
 - a. Connect an audio signal generator to the HD IN-CAR TX **AUDIO** connector using the Audio Cable
 - b. Turn on the HD IN-CAR TX and audio signal generator
 - c. Set the audio signal generator for a 1KHz tone at 0dBm
 - d. Check that audio is present at the receiver

4.1.5 Digital Camera Control Software Cannot Connect

Symptoms

1. The Digital Camera Control software cannot connect to the HD IN-CAR TX
2. Control is intermittent or does not work as expected

Possible Causes

1. The HD IN-CAR TX does not have power
2. Remote Control cable is disconnected from the HD IN-CAR TX or PC
3. The Remote Control cable is damaged
4. The PC is running an incompatible Operating System

Troubleshooting Steps

1. Check that the HD IN-CAR TX power supply is connected and turned on
2. Check that the Remote Control cable is correctly connected to the HD IN-CAR TX **UHF** connector and PC serial port
3. Check the Remote Control cable
 - a. Ensure a RS485 converter is being used.
4. Check PC operating system is Microsoft Windows XP

4.1.6 Remote Control Function Does Not Work

Symptoms

1. Digital Camera Control software connects to the HD IN-CAR TX, but the unit cannot be remotely controlled
2. Control is intermittent or does not work as expected
3. The Presets do not operate as expected after programming

Possible Causes

1. The HD IN-CAR TX is in standby mode
2. The PC is running an incompatible Operating System

Troubleshooting Steps

1. Check Digital Camera Control software is not in standby mode
 - a. Open the software
 - b. Check that the “Power” and “TxEnable” buttons are checked
2. Check PC operating system is Microsoft Windows XP

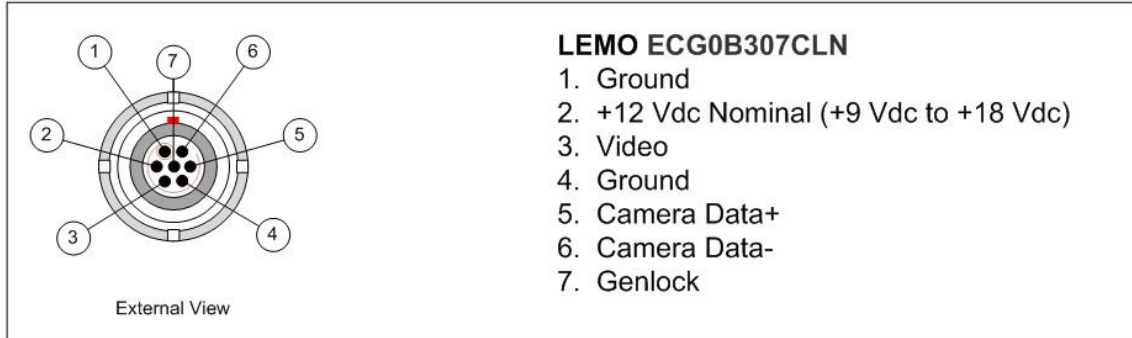
5. TECHNICAL DATA

5.1 TECHNICAL SPECIFICATIONS

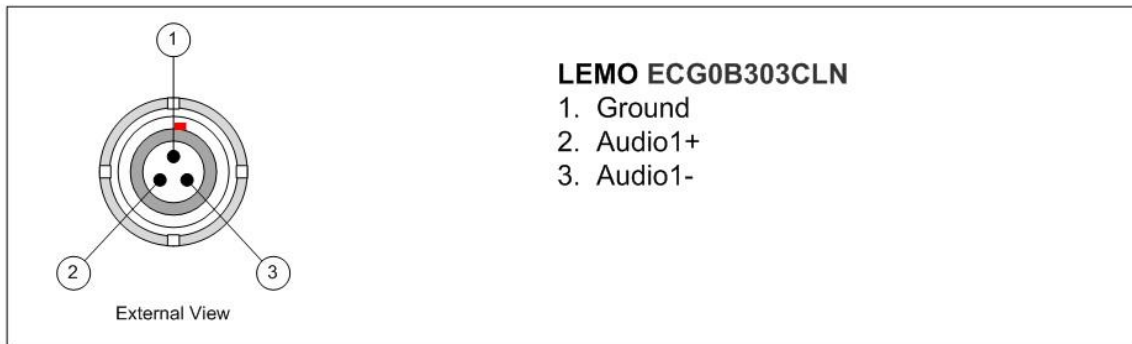
Video Inputs		Video Compression	
Format:	SD-SDI (SMPTE-259M) HD-SDI (SMPTE-292M) SD Analog Composite (NTSC) (auto select)	Standard:	H.264
Connector:	Lemo ECG0B307XXN	Profile:	BP@L4
		Resolution:	525i @ 29.97 Hz 480p @ 60 Hz 720p @ 60/59.94 Hz 1080i @ 30 / 29.97 Hz 1080p @ 30 / 29.97 Hz
		Latency	< 4 frames end to end
Audio Inputs		Audio Compression	
Inputs:	4	Standard	LPCM
Format:	Balanced Analog Mic level		MPEG-2, Layer I & II (optional)
Connector:	Lemo ECG0B303CLN		Dolby AC3 (optional)
RF Output			
Output Power:	200 mW		
Connector:	SMA		
Frequency Band		Remote Control / Programming	
Range:	1435MHz to 2600MHz	Format:	RS-485
Tuning Step	250 KHz	Connector:	Lemo ECG0B305CLN
Modulation		Power Requirements	
Scheme:	DVB-T	Supply:	9-18VDC, 10W
Carriers:	2K	Connector:	Lemo ECG0B302CLN
Modes:	QPSK, 16-QAM, 64-QAM		
Bandwidth:	6, 7, 8 MHz	Physical	
FEC:	$\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$	Size:	38 x 101 x 152 mm
Guard Interval:	1/32, 1/16, 1/8, 1/4	Weight:	214 g
		Environmental	
		Temperature:	-10 to +65 C
		Humidity:	< 95%

5.2 CONNECTOR PIN-OUTS

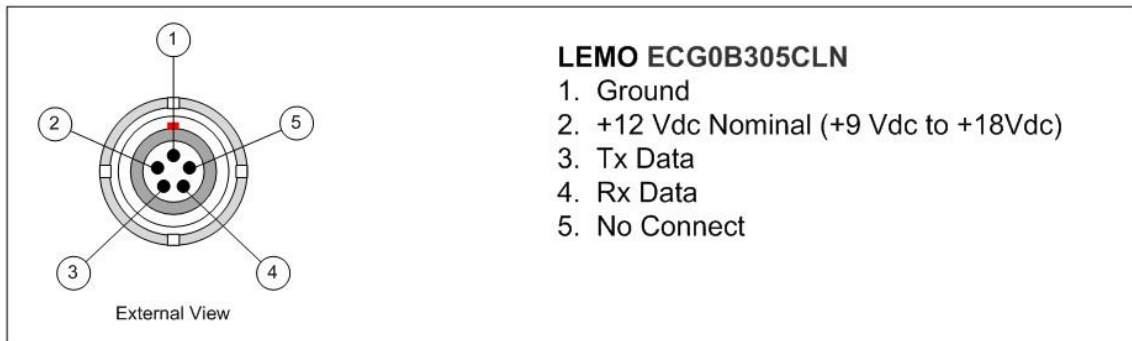
5.2.1 Video Inputs



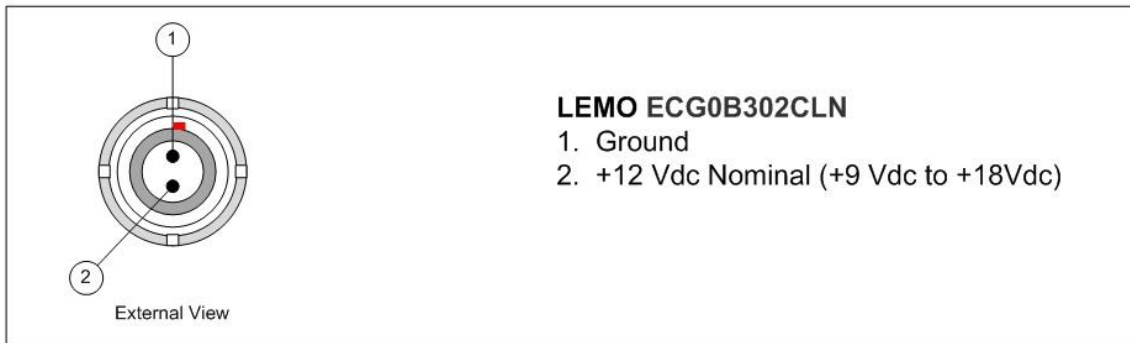
5.2.2 Audio Inputs



5.2.3 Control



5.2.4 Power



5.2.5 RF Output

