

EPSILON User Manual

Epsilon is a complete UHD integrated radio camera system. An all-in-one solution for your broadcast needs, Epsilon combines a cutting edge COFDM receiver, H.265 Decoder and Camera Control system all configured effortlessly through a modern touch screen interface.



Epsilon has a remote head unit containing down converters and a camera control data transmitter sending RF over fibre to the base unit over an industry standard SMPTE Hybrid fibre, unlike other solutions this allows for multiple head diversity.

TECHNICAL SPECIFICATIONS

EPSILON BASE

Outputs	4 x SD/HD/4K 12G BNC
4K Output	1 x 12G/2 x 12G (Dup)/2 x 6G/4 x 3G SDI 2SI or SQD
Audio	8 Channels Embedded Analogue 4 Balanced XLR3M
HEVC Compression	HEVC/H.265/MPEG-H Part 2 8-bit or 10-bit, 4:2:0 or 4:2:2
Legacy Compression	H.264 and MPEG2
PROFILES	
4K UHD	4:2:2/4:2:0, 8/10-bit
2160p	/ 23.98/ 24 / 25 / 29.97 / 30 / 50 / 59.94 / 60
HD	4:2:2/4:2:0, 8/10-bit 720p / 50 / 59.94 / 60
1080p	/ 23.98 / 24 / 25 / 29.97 / 30 / 50 / 59.94 / 60
1080i	/ 50 / 59.94 / 60
Genlock	BNC, TLS/B&B
HDR/WGC	Rec. ITU-R BT.2100-2 (PQ and HLG) Rec. ITU-R BT.2020

Latency	Encoder + Decoder 60ms (70ms in 4K mode) with ULL option	
DVB-T Bitrates	3.732Mbps to 63.336Mbps	
Power	IEC 100-240VAC, 50/60Hz Consumption TBC	
Ethernet	2x RJ45 Connectors (Front and Rear) 10/100/1000 Base-T	
Option Slots	2 Upgrade Slots for Option Modules	
SMPTE (RF over Fibre) Option module	Lemo 3K.93C FXW Connector 2x BNC IF inputs with LNB Power (switchable)	
IF/RF Option Module	1x XLR3F RS232/RS485 data connector (switchable)	
EPSILON HEAD RF		
Receiver		
Frequency	1.0 - 7.5GHz (RF Band specified upon ordering)	
Camera Control		
Frequency	403-473 MHz	Bandwidth 12.5kHz
Modulation	GMSK	
Power	Selectable between 0-1000mW	

What is Epsilon?

An Epsilon system consists of two distinct components; a head unit and a base unit. A base unit can be used with up to two head units. The Epsilon head interfaces with a SMPTE fibre card that physically slots into the back of the base unit.

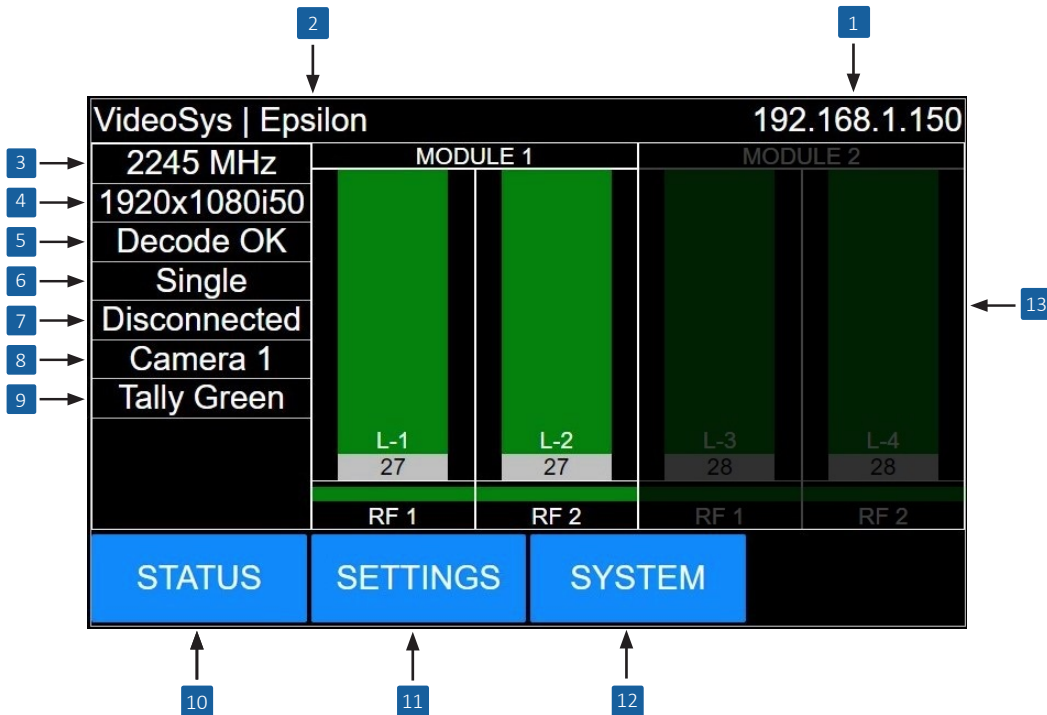
Where the receive heads don't need to be physically mounted remotely from the base station Epsilon can be configured with slot in direct IF modules, allowing the base to be used directly with downconverters and receive antennas.

Epsilon's head units contain down converters, a camera control data transmitter and RF over fibre transmitters. The base unit contains the camera control RCP interface, video receiver, video decoder, radio IF splitter and up to two slot in RF over fibre modules or IF pass through modules.

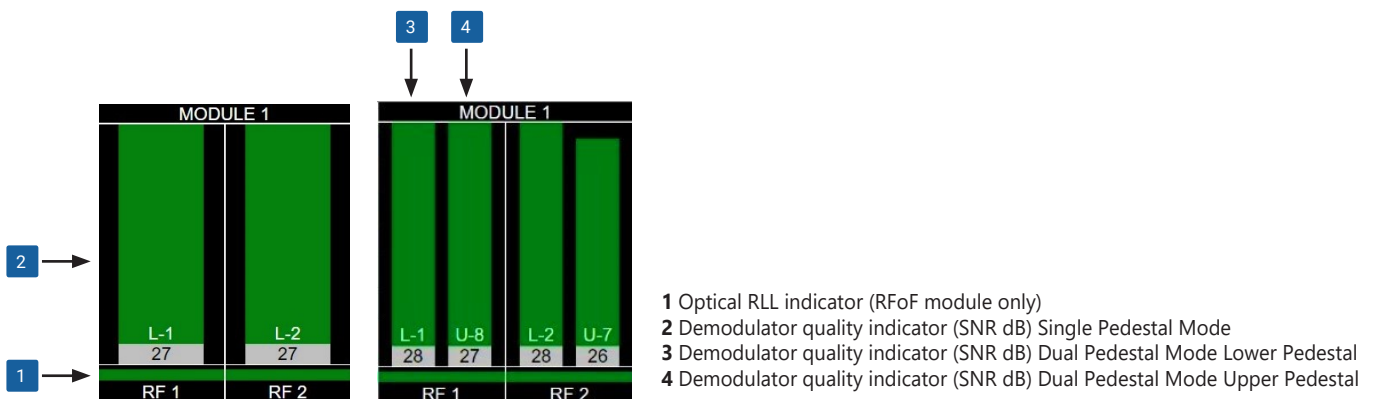
Epsilon is capable of full MRC diversity on all of its input channels, allowing for great coverage using multiple receive sites afforded by its pair of dual channel inputs; two channel diversity in dual pedestal mode or quad channel diversity in single pedestal mode. Epsilon's use of RFoF instead of video over fibre is what allows for MRC.

Epsilon base menus

Epsilon has a home screen that has been designed to provide all of the information that an operator might need to know at a glance. Key parameters, settings and operational levels are displayed.



- 1 Current IP Address
- 2 Unit Name
- 3 Demodulator Frequency
- 4 Current Video output standard
- 5 Video Decoder Status
- 6 DVB-T operational mode
- 7 Camera Control Connection status
- 8 System Camera Number
- 9 Current tally Status
- 10 Status Menu Button
- 11 Settings Menu Button
- 12 System Menu Button
- 13 Optional Module upgrade



- 1 Optical RLL indicator (RFoF module only)
- 2 Demodulator quality indicator (SNR dB) Single Pedestal Mode
- 3 Demodulator quality indicator (SNR dB) Dual Pedestal Mode Lower Pedestal
- 4 Demodulator quality indicator (SNR dB) Dual Pedestal Mode Upper Pedestal

Navigating Epsilon

STATUS

The Status Menu button will take you initially to the Receiver status page. Using the right (and left) arrow, will lead to subsequent status pages:

RECEIVER <-> DECODER <-> MODULE 1 <-> MODULE 2



The Home button will return you to the initial overview page.

SETTINGS

The Settings Menu Button will take you initially to the System Settings page. Using the right (and left) arrow will lead to subsequent Settings pages:

SYSTEM <-> RECEIVER <-> DECODER <-> CAMERA CONTROL <-> MODULE 1 <-> MODULE 2 <-> NETWORKING

Settings can be changed by pressing the relevant item

SYSTEM

The System Button will take you initially to a Maintenance overview page, informing you of firmware and software versions of the individual Epsilon components. Additional Engineering debug information is available should this be required.

Navigating Epsilon

STATUS PAGES:



Receiver:

- Guard Interval – Detected Guard interval
- Constellation – Detected DVB-T constellation
- FEC Rate – Detected DVB-T FEC
- BER Pre – Viterbi
- BER Post – Viterbi

VideoSys Receiver		192.168.1.150
Guard Interval	1/32	 
Constellation	16QAM	
FEC Rate	5/6	
BER Pre-Viterbi	1433	
BER Post-Viterbi	0	



Decoder:

- Link Rate
- Video Decode Status
- Chroma Format
- Genlock State > Reports state of external genlock signal

VideoSys Decoder		192.168.1.150
SDI Link Rate	1.485Gbps HD-SDI	 
Video Decode Status	Decode OK	
Chroma Format	4:2:0	
Genlock State	Reset	

Module 1(2) RFoF:

- Fibre Level 1 (dBm) – Received Light level from head unit (0 to 4.5dBm for best operation)
- Fibre Level 2 (dBm) – Received Light level from head unit (0 to 4.5dBm for best operation)
- Head Connection – Local Oscillator in head (0 if not fitted)
- Head Downconverter LO – Local Oscillator in head

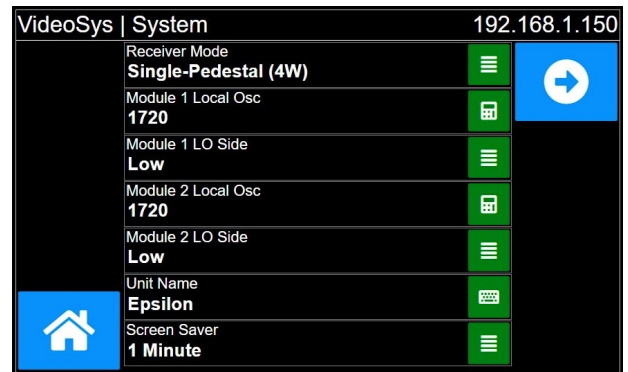
VideoSys Module 1		192.168.1.150
Fibre Level 1 (dBm)	4.3	 
Fibre Level 2 (dBm)	2.5	
Fibre 1 Fault	0	
Fibre 2 Fault	0	
Head Connection	1	
Head Downconvert LO	1720	

Navigating Epsilon

SETTING PAGES:

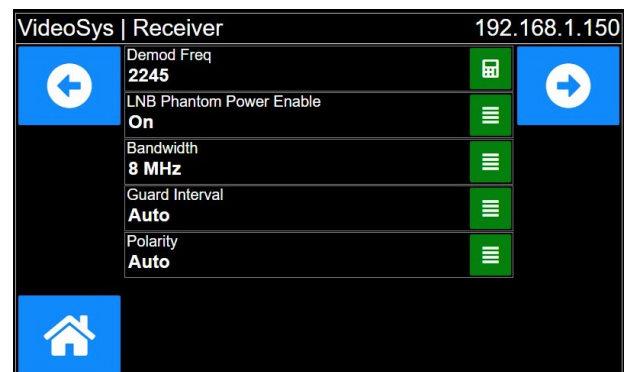
System:

- Receiver Mode – changes the receiver operation between Single and Dual Pedestal
- Module 1(2) Local Osc (v1.5 and below) – Set the LO in MHz of the attached downconverters for Module 1
- Module 1(2) LO Side (v1.5 and below) – Set the operation side of the LO
- Unit Name – A user defined name for the unit
- Screen Saver – Set timeout to 1,5 or 10 minutes



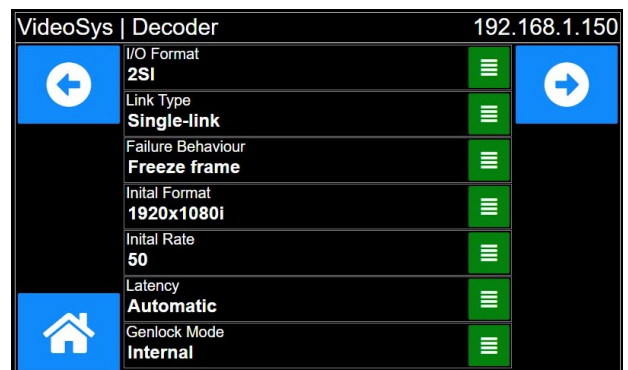
Receiver:

- Demod Frequency – Frequency in MHz the the demodulator is to tune
- LNB Phantom Power Enable – applies DC volts for powering Downconverters (I.F. modules only)
- Bandwidth – Channel Bandwidth of a single DVB-T pedestal (nominally 8MHz)
- Guard Interval – Set to Auto, or match to transmitter
- Polarity – Set to Auto, or match to transmitter



Decoder:

- Output Format – Select required 4K output format 2SI or SQD
- Link Type – H.265(4K/HD) Single: (1 x 12G/1 x 3G), Single (Duplicate): (2 x 12G/2 x 3G), Dual: (2 x 6G/1 x 3G), Quad: (4 x 3G/1 x 3G), Link
- Failure Behaviour – Option for Freeze or blue screen on signal loss
- Initial Format – Default Video Format i.e. 3840 x 2160p
- Initial Rate – Default Video Frame Rate i.e. 50
- Latency – Delay mode
- Genlock Mode – Enables external Genlock function

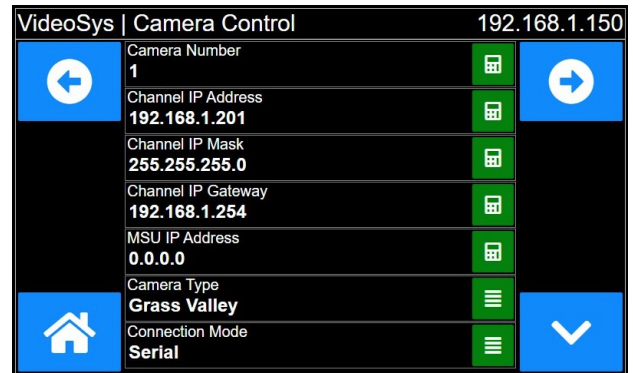


Navigating Epsilon

SETTING PAGES:

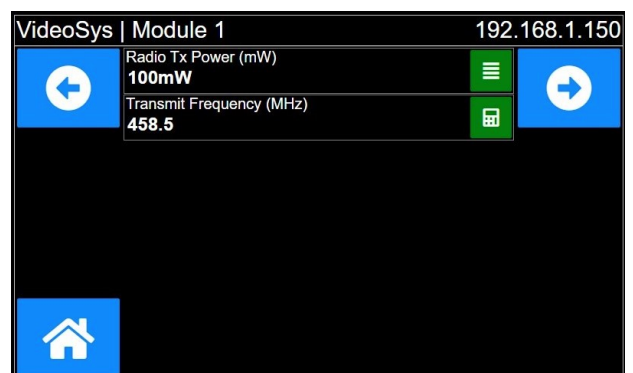
Camera Control:

- Camera Number – Camera Number required for RCP and Camera
- Channel IP Address – Unique IP address for RCP/OCP connections
- Channel IP Mask – Subnet mask for channel IP address
- Channel IP Gateway – Gateway address, can be 0.0.0.0
- MSU IP Address – Address of MSU used for Sony MCS connections
- Camera Type – Manufacturer of Camera – Licence dependant
- Connection Mode – RCP connection, Serial, direct IP or MCS
- BiDi Enable – Enables Bi-Directional control – full featured, maybe slower
- BiDi Panel Drop Time – Maintain connection to OCP for required number of seconds on signal loss
- Camera Model – Emulates specific camera models in unidirectional mode



Module 1(2):

- Radio Tx Power (mW) – Transmit power for Camera control data
Off/100/200/500/1000mW
- Transmit Frequency (MHz) – Frequency for camera control data unit connected module

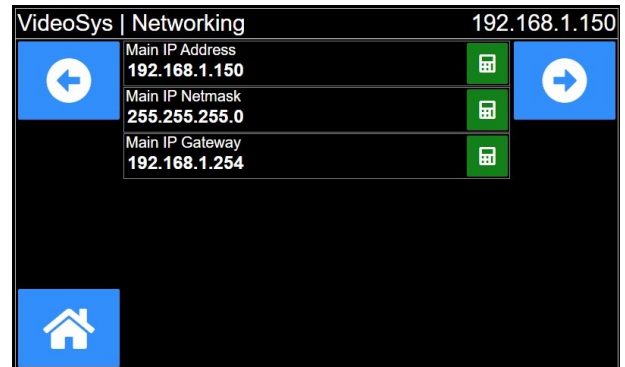


Navigating Epsilon

SETTING PAGES:

Networking:

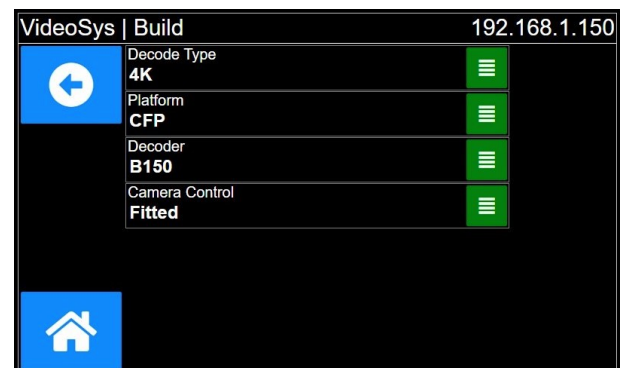
- Main IP Address – IP address for main system interface
- Main IP Netmask – Subnet Mask for main IP address
- Main IP Gateway – Gateway address, can be 0.0.0.0



Build:

Note: Unless your Epsilon has been fitted with uniquely requested components, or you have an additional H.264 license and are altering your encoder mode, H.265(HEVC) -> H.264 (AVC) or vice versa, these settings should be left as standard.

- Decode Type – **4K**: H.265 (4K & HD) as standard, **HD**: H.264 (Optional Licence) (HD Only)
- Platforms – CFP as standard
- Decoder – B150 as standard
- Camera Control – Fitted as standard



Navigating Epsilon

SYSTEM PAGES:


System Homepage (Maintenance):

- Panel – Software version displayed, Upgrade Installation option via web page.

Access to advanced Receiver, Decoder, IDU (CC) and Fibre settings are all available through the blue chain links seen on the system maintenance web page.

(Recommended for advanced users only).

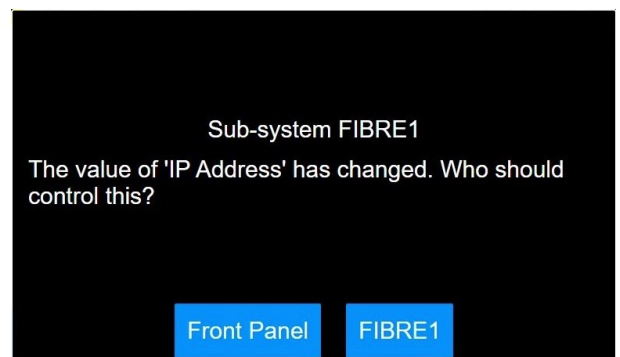
VideoSys Maintenance		192.168.1.150
Panel:	2.1.7.6 blue Install Upgrade	
Receiver:	Chain Link	Logging <input type="checkbox"/>
Decoder:	Chain Link	Logging <input checked="" type="checkbox"/>
Cam Control:	192.168.1.201 Chain Link	Logging <input type="checkbox"/>
Fibre 1:	Fitted Chain Link	Logging <input type="checkbox"/>
Fibre 2:	Fitted Chain Link	Logging <input type="checkbox"/>

 HOME
NETWORK
CONFIG
LOG FILE

Changing any of these advanced settings will result in a 'Sub-system' message appearing on the Epsilon front panel. (Shown right).

To allow these settings to be controlled by the web user, the Sub-system in question, ie. Receiver, Decoder, Cam Control, or Fibre 1(2), should be selected.

If 'Front Panel' is selected then any alterations made within a sub-system web-page will not update the configuration of the Epsilon.

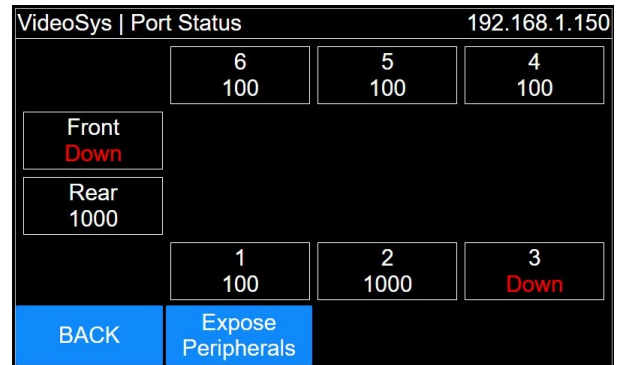


Navigating Epsilon

SYSTEM PAGES:

Network:

- RJ45 Port Status – Front: ETH1, Rear: ETH0, see pg.10
- Expose peripherals



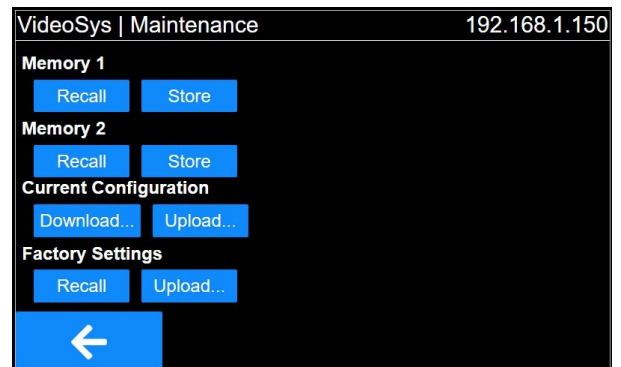
System Config:

The system configuration tab allows users to store and recall full Epsilon system configurations allowing for quick and easy setups.

Configurations for 'Memory 1' and 'Memory 2' can be stored via both the unit front panel and the web-page using the 'Store' button. These configurations will then be available to 'Recall' at any time until they are overwritten.

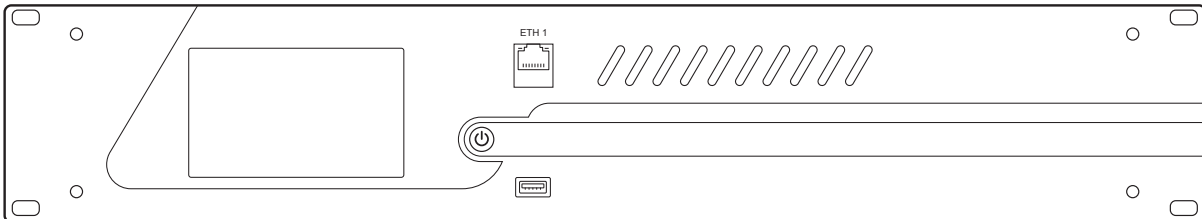
The 'Current Configuration' section is only assessable via the web-page. This section allows remote users to download a file containing the current configuration of their epsilon, and to upload any previously saved configurations that have been downloaded. This means a countless number of configurations can be externally stored for future use.

Downloaded configurations can also be used to create 'Factory Settings'. Factory settings act as a good base recovery option for if something goes wrong. This setting can only be uploaded via the web-page, therefore preventing any physical users from accidentally overriding it. The 'Recall' button is available via both the unit front panel and the web-page.

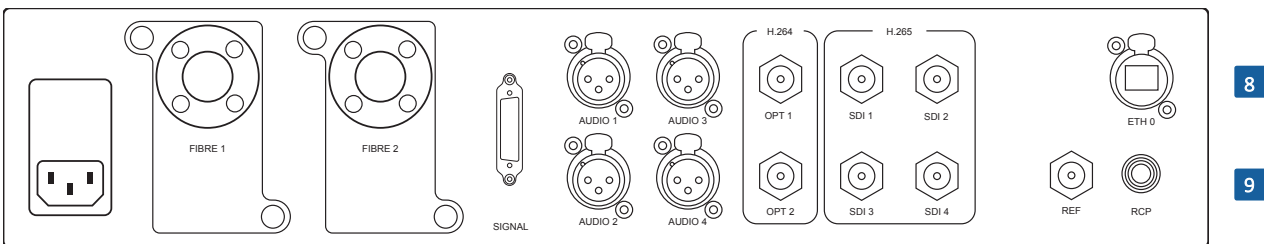


EPSILON front and rear panels

Videosys EPSILON CCU base unit front panel



Videosys EPSILON CCU base unit back panel



1

2

3

4

5

6

7

8

9

1 IEC -POWER IN x1

2 FXW.3K LEMO SMPTE -Fibre x2

3 15/25 WAY D-SUB -Signal x1

4 3 PIN Male XLR -AUDIO OUT x4

5 Optional H.264 SDI OUT x2

6 12G BNC - H.265 SDI OUT x4

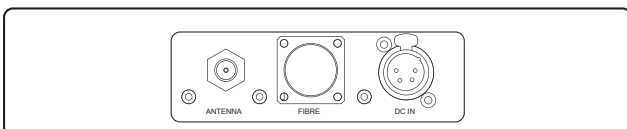
7 BNC - Reference x1

8 RJ45 -Ethernet

9 10 PIN Female HIROSE -RCP x1

Videosys EPSILON CCU head unit

Bottom



1

2

3

Top



4

1 TNC -Antenna

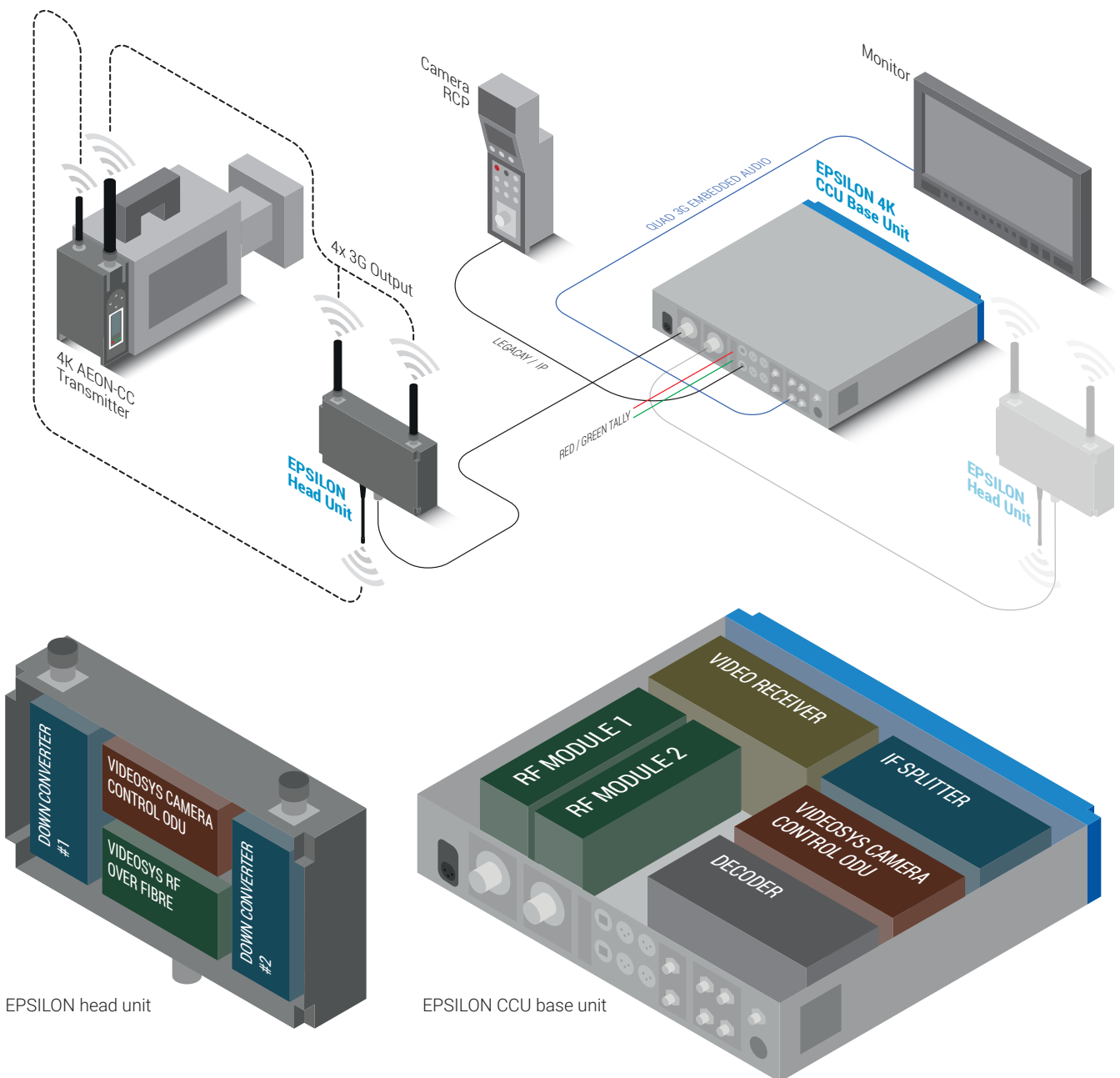
2 EDW.3K LEMO SMPTE -Fibre x1

3 4 PIN Male XLR -DC IN x1

4 N-TYPE -Antenna x2

EPSILON set up options

The Epsilon System has been designed from the ground up to provide a solution for users where fast and easy deployment is a requirement, while still retaining industry leading flexibility and performance. The operating diagram below shows a fully functional UHD system with Camera Control with an incredibly low component count; Epsilon requires just a RCP, Camera, Transmitter and Camera control receiver.



EPSILON head unit

EPSILON CCU base unit

Transmission guide

This part of the document is designed to help an operator successfully and quickly configure the Epsilon system. It contains background information on the technology behind the video link and how to best configure it for the environment, as well as settings an operator may have to configure in order to get the video and camera control paths operational. We would recommend that for configuring the video path it is best to start at the signal source, in this case the camera, and to work backwards to the monitor output on the Epsilon base unit. Similarly for the camera control it is advisable to start at the RCP and work back to the camera. For more detail on connectivity and user interfaces refer to the user manuals.

The Epsilon system is designed to leverage DVB-T to get the best picture and performance. DVB-T is an industry standard Digital Video Broadcasting standard that uses COFDM to transmit compressed video over the air. The Epsilon radio camera system and associated Aeon transmitters use an ultra low delay subset of DVB-T to provide a low latency broadcast solution. Most DVB-T transmitters allow settings to be changed to trade off data bandwidth for video link robustness.

DVB-T transmitters typically allow the following settings;

Constellation/Modulation setting

QPSK, 16 QAM, and 64 QAM

QPSK allows for two bits per symbol, 16 QAM allows for four bits per symbol, 64 QAM six bits per symbol. This means that 16 QAM allows twice the raw data rate of QPSK and 64 QAM three times QPSK.

Coding rate or FEC

Typically $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$ or $\frac{7}{8}$ This is the percentage of the data bandwidth that is used for transmission payload (video/audio) instead of error correction data - $\frac{7}{8}$ would mean that only 1/8th of the data bandwidth is correction data, giving the most bandwidth for video (better picture quality) but potentially at the expense of link robustness - RF breakup may occur in some situations.

Guard Interval

DVB-T Values are $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, Guard intervals are pauses in transmission that are necessary to prevent the system from accidentally interpreting signal reflections and echoes. With insufficient guard interval, reflections and echoes may reach the receiver in combination with valid transmitted data, this will reduce performance and potentially cause RF breakup, in environments where RF reflections are less likely (very open environments) a lower Guard interval can be used. Whereas in areas where reflections are more likely to occur, such as near large concrete structures, a larger guard interval might be needed.

Channel Bandwidth

Typically 6MHz, 7MHz or 8MHz this is the RF bandwidth occupied by the transmission, more bandwidth allows for higher data rates, but may require additional licensing in some areas.

The Epsilon and Aeon products can operate in a non-standard DVB-T mode called dual Pedestal. Dual Pedestal is where a pair of DVB-T channels spaced 1MHz apart are used in unison to deliver twice the data rate of a single channel. Videosys recommend dual pedestal operation and at least 20Mbps data rate for UHD operation.

For an ultra robust RF link but a poor picture quality we would recommend (Yellow)

For normal usage we would recommend (Green) and for controlled studio environments where the best image quality is required we would recommend (Blue)

Modulation	Coding rate	Guard Interval			
		1/4	1/8	1/16	1/32
QPSK	1/2	4.976	5.529	5.855	6.032
	2/3	6.635	7.373	7.806	8.043
	3/4	7.465	8.294	8.782	9.048
	5/6	8.294	9.216	9.758	10.053
	7/8	8.709	9.676	10.246	10.556
16-QAM	1/2	9.953	11.059	11.709	12.064
	2/3	13.271	14.745	15.612	16.806
	3/4	14.929	16.588	17.564	18.096
	5/6	16.588	18.431	19.516	20.107
	7/8	17.418	19.353	20.491	21.112
64-QAM	1/2	14.929	16.588	17.564	18.096
	2/3	19.906	22.118	23.419	24.128
	3/4	22.394	24.882	26.346	27.144
	5/6	24.882	27.647	29.273	30.16
	7/8	26.126	29.029	30.737	31.668

EPSILON

4K Base Station Camera Control System

VideoSys
Broadcast

DVB-T Background

Configure your transmitter to your desired DVB-T parameters. Set your transmission power to the appropriate value, lower power will limit the transmission range, but using higher powers close to the receiver may also swap it and cause issues. Make sure that you are using the equipment within the permitted frequency, bandwidth and power that you have from your local licensing authority. Your transmitter encoder settings also have to match those configured in the Epsilon Base units decoder, we recommend H.265, but the Epsilon is also capable of AVC and MPEG-2 for compatibility with other transmitters.

Receiver configuration

The Epsilon receiver will automatically determine the DVB-T parameters. The only settings that the user will need to enter are reception frequency, 'Dual Pedestal' or 'Single Pedestal' mode and bandwidth. Depending on firmware revision, the Epsilon will automatically detect the downconverters in the Head unit and configure the Local Oscillator settings accordingly. Unit setting can also be entered manually.

Camera Control Path Configuration.

This quick setup guide assumes that the Camera Control is being configured for unidirectional operation, this requires only the forward UHF link and is the more robust operating mode, the equipment can also operate in bi-directional mode where the entirety of the cameras features are represented on the manufacturers control panel. We would recommend initially setting the unit up in unidirectional camera control mode, making sure that Epsilon is receiving video and then switching the system to bidirectional mode, if required.

RCP to Epsilon

Check that the RCP is connected to either the 10 pin RCP serial connector or the Ethernet connector on the rear of the unit. Select the correct camera manufacturer and connection mode from the camera control settings menu. On the home screen the unit should say 'Camera Connected' and the RCP should light up with the selected camera number

Epsilon Base to Epsilon Head

Configure the Camera Control transmission frequency and power to the parameters that are going to be used, be aware that it will need to check with your local licensing authority as to the powers and frequencies that you are permitted to use. The Epsilon Base will transmit camera control data up the SMPTE Hybrid to the Epsilon Head, the data light on the head unit will flash as it transmits data.

Camera Control Receiver

Set your camera control receiver to the correct Camera Control transmission frequency, it should display "Data OK" and Flash an LED as valid data is received. Make sure that the camera control data receiver is connected to the camera via either the appropriate serial cable or Ethernet cable where appropriate. Select the correct camera manufacturer and connection settings from the settings menu on your camera control receiver. The camera control receiver should state that it has connected to the camera, at this point camera control should be working.

Guide to abbreviations

RFoF =	Radio Frequency over Fibre
RCP =	Remote Control Panel. Some manufacturers refer to as ROP (Remote Operator Panel) or OCP (Operator Control Panel).
COFDM =	Coded Orthogonal Frequency Division Multiplex
SMPTE Hybrid =	SMPTE311M Hybrid Fibre cable using Lemo 3K.93C connectors
UHD =	Ultra High Definition (3840 x 2160 pixels resolution)
MRC =	Maximal Ratio Combining

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