

USER GUIDE

EN8040 MPEG-4 HD DSNG and
EN8050 MPEG-4 HD DENG
Encoder

Software Version 2.2 and later

EN8040/BAS/IF,
EN8040/BAS/LBAND
and EN8050/BAS



EN8040/BAS DSNG, EN8050/BAS DENG Encoders

ENGLISH (UK)

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Customer Services

Europe, Middle East
and Africa:

Tel: +44 (0) 23 8048 4455
Fax: +44 (0) 23 8048 4467
support@tandbergtv.com

Americas:

Tel: +888 671 1268 (US and Canada)
Tel: +678 812 6255 (Outside of mainland US)
noc@tandbergtv.com

China:

Tel: +86 10 6856 0260 (Beijing)
Tel: +852 2530 3215 (Hong Kong)
fieldservice-asia@tandbergtv.com

Australia/NZ:

Tel: +612 8923 0450
fieldservice-australia@tandbergtv.com

Internet Address:

<http://www.tandbergtv.com>

Technical Training

International:

Tel: +44 (0) 23 8048 4229
Fax: +44 (0) 23 8048 4467
training@tandbergtv.com

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Registered Address:
Unit 2 Strategic Park, Comines Way,
Hedge End, Southampton,
Hampshire,
SO30 4DA
United Kingdom

Registered Company Number 03695535

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1 Who Should Use This User Guide?



This User Guide is written for operators/users of the EN8040 DSNG and EN8050 DENG Voyager Encoders to assist in installation and operation. It is not intended to be a detailed source of information. This can be found in the *Reference Guide* companion document, which is issued on CD.



WARNING

Do not remove the covers of this equipment. Hazardous voltages are present within this equipment and may be exposed if the covers are removed. Only TANDBERG Television trained and approved service engineers are permitted to service this equipment.



CAUTION

Unauthorised maintenance or the use of non-approved replacements may affect the equipment specification and invalidate any warranties.

1.1 What Equipment is Covered by This User Guide?

Table 1.1: Equipment Model Descriptions

| Model Number | Marketing Code | Description |
|--------------|------------------|---|
| EN8040 | EN8040/BAS/IF | Premium 2RU Encoder supporting H.264/AVC SD and optionally HD video and MPEG-2 SD video encoding for low bit-rate applications with DVB-S2 capable IF output satellite modulator. |
| EN8040 | EN8040/BAS/LBAND | Premium 2RU Encoder supporting H.264/AVC HD video and MPEG-2 SD video encoding for low bit-rate applications with -L-Band output satellite modulator. |
| EN8050 | EN8050/BAS | Premium 2RU Encoder supporting H.264/AVC HD video and MPEG-2 SD video encoding for low bit-rate applications with OFDM modulator for terrestrial link applications. |

1.2 Hardware and Software Options



See *Table 1.2* for a list of hardware options and *Table 1.3* for a list of software options available with the Encoder. Detailed information is in the *Reference Guide*.

Table 1.2: Hardware Options

| Marketing Code | Description |
|---------------------|--|
| EN8000/HDC/BISS | Allows BISS CA to be implemented |
| EN8000/HDC/AUD | Extra audio Encoding daughter Card |
| EN8000/HWO/IPTSDUAL | MPEG over IP (output) with 2 separate IP/Ethernet ports and can interface to GigE network. |

Table 1.3: Software Options

| Marketing Code | Description |
|-----------------------|--|
| EN8000/SWO/AC3 | Allows the audio input to be encoded using the Dolby AC-3 encoder. |
| EN8000/SWO/ACON | Auto-concatenation of the MPEG-2 SD input |
| EN8000/SWO/LSYM | Enables low symbol rate operation |
| EN8000/SWO/MPEG2 | Enables MPEG-2 SD encoding simultaneous to the MPEG-4 HD encoding. |
| EN8000/SWO/MPEG2/422 | Allows 4:2:2 Profile for MPEG-2 SD encoding |
| EN8000/SWO/AOMAAC | For use with the optional audio module. Allows the audio input to be encoded using MPEG-2 AAC LC profile, encapsulated with ADTS, MPEG-4 HE-AAC or MPEG-4 HE-AACv2 profile, encapsulated with LAOS/LATM. |
| EN8000/SWO/ICE3AAC | Allows the audio input to be encoded using any AAC profile on the ICE card when the encoder is operating in H.264 SD mode |
| EN8000/SWO/NR | Allows the pre-processor to enable a noise filter on the incoming video source. |
| EN8000/SWO/DBF | Enables the CLARUS input deblocking filter. |
| EN8000/SWO/RAS | Enables RAS scrambling on individual services |
| EN8000/SWO/PROFEC | Enables ProMPEG FEC when the optional Dual IPNIC card is fitted. |
| EN8000/SWO/SM38PSK | EN8040 only. Enables DVB-S QPSK and 8PSK. |
| EN8000/SWO/SM3A216QAM | EN8040 only. Enables DVB-S2 QPSK, 8PSK and 16QAM |
| EN8000/SWO/SM3S28PSK | EN8040 only. Enables DVB-S2 QPSK and 8PSK |
| EN8000/SWO/SM3A216QAM | EN8040 only. Enables DVB-S2 QPSK, 8PSK and 16QAM |

1.3 Summary of EN80xx Encoders for MPEG-4 Part 10

The EN80xx range of Encoders are professional-grade Encoders for highly efficient H.264/AVC video encoding. They deliver unsurpassed compression performance in real-time for broadcast applications.

The product is based on technology and knowledge gained over ten years and six generations of MPEG video and audio developments. The dedicated hardware and software implementation gives consistently the very best real-time quality at the very lowest possible bit-rates.

1.3.1 Video Encoder

The Encoder compresses a high definition video signal into an encoded bitstream for broadcast transmission in accordance with the ISO/IEC-14496-10 standard, also known as H.264/AVC.

Pre-processing features include noise-reduction filters and video resizing. More details are given in *Section 5*.

1.3.2 Audio Encoder

The Encoder can handle multiple audio services to accompany the video component, including:

- ▶ The ability to pass thru pre-compressed Dolby® Digital bitstreams with the option of glitch suppression.
- ▶ Compression of stereo and 5.1 audio services using algorithms such as MPEG-2 AAC-LC, MPEG-4 HE-AAC, Dolby® Digital or MPEG layer II. The operator can define the language descriptor associated with each service.

1.3.3 Encapsulation Methods

The video and audio bitstreams are multiplexed into a compliant MPEG-2 transport stream enabling the transmission over existing MPEG broadcast infrastructure. The EN8040 includes a satellite modulator and the EN8050 includes a COFDM modulator.

2 Installing the Equipment

2.1 Introduction



For best performance and reliability, follow the instructions for site requirements and installation in the *Reference Guide* and only use installation accessories recommended by the manufacturers.

2.2 Operating Voltage



CAUTION

This product should be operated only from the type of power source indicated on the marking label. If you are not sure of the type of power supply to your business, consult a qualified electrical engineer or your local power company.



NOTE

Refer to the *Reference Guide* for details of the colour codes used on the mains leads.



See *Table 2.2* for fuse information and also the *Reference Guide* for a full power supply specification.

A.C. models are fitted with a wide-ranging power supply. It is suitable for supply voltages of 100-120 Vac -10%/+6% or 220-240 Vac -10%/+6% at 50/60 Hz nominal.

2.3 Power Cable and Earthing

Check that the power cable is suitable for the country in which the Encoder is to be used.



WARNINGS

1. The Technical Earth is not a Protective earth for electric shock protection.
2. This unit must be correctly earthed through the moulded plug supplied. If the local mains supply does not have an earth conductor do not connect the unit. Contact Customer Services for advice.
3. Before connecting the unit to the supply, check the supply requirements in Annex B of the Reference Guide.

2.4 Power Supply Standby Switch

This switch puts the Encoder into standby mode. It powers down the supply rails of the display and internal circuits within the unit. The switch type avoids accidental powering-down of the Encoder. For normal use, using a screwdriver, ensure that the **I** is always at the top (see *Figure 2.1*).



NOTES

1. This switch is not fitted to later models.
2. This product should be operated only from the type of power source indicated on the marking label.
3. If you are not sure of the type of power supply to your business, consult a qualified electrical engineer or your local power company.



WARNING

This is **NOT** a mains switch and will not isolate the Encoder from the power supply. Disconnect the power cord to isolate the unit.

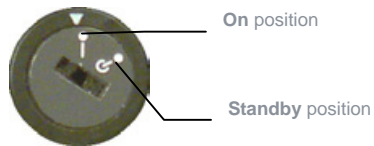


Figure 2.1: Standby Switch

2.5 Connecting Up the Basic Encoder



Always use the specified cables supplied for signal integrity and compliance with EMC requirements (see *the Reference Guide*).

The purpose of each active connectors illustrated in *Figure 2.2* for the EN8040/BAS/LBAND and in *Figure 2.3* for the EN8050/BAS is described in *Table 2.1*.

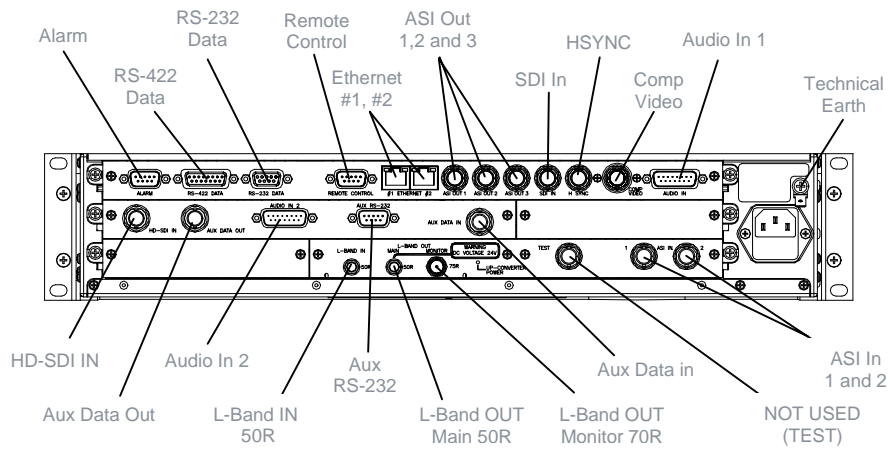


Figure 2.2: Rear Panel Connectors for EN8040/BAS/LBAND

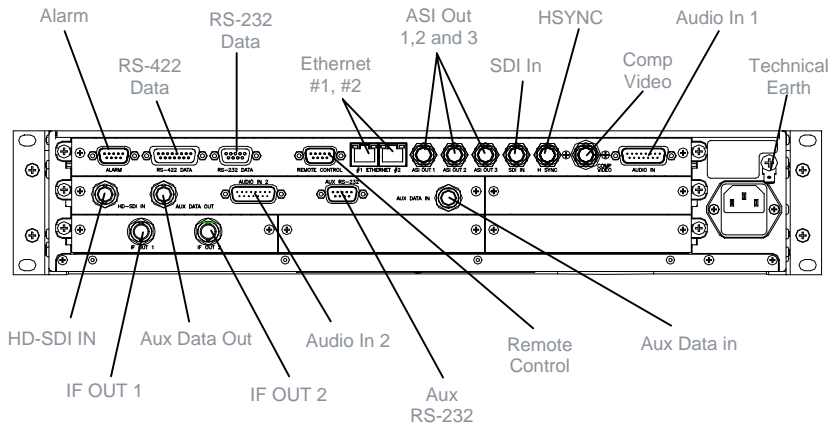



Figure 2.3: Rear Panel Connectors for EN8050/BAS


Table 2.1: Types of Connector

| Type of Connector | Description |
|------------------------------|--|
| Alarm | If required, connect an external status-monitoring device to the Alarm connector. A 9-way, D-type male connector provides an alarm relay interface. |
| Ethernet #1 and #2 | An 8-way, RJ-45 connector provides a 10BaseT Ethernet interface for control and monitoring. The Encoder has a single switched Ethernet channel. Ethernet#1 is selected as default at power up. If a carrier is not detected on Ethernet#1 then the input switches to Ethernet#2. |
| ASI OUT 1, 2 and 3 | A 75 Ω BNC connector provides the transport stream output from the Encoder, if this feature has been enabled. |
| HD-SDI | A 75 Ω BNC connector provides a serial digital video input to the unit. This input is terminated in 75 Ω . (Not used in SD operation) |
| SDI In | A 75 Ω BNC connector provides a serial digital video input to the unit. This input is terminated in 75 Ω . |
| HSYNC | A 75 Ω BNC connector allows the internal encoder clock to be locked to a reference. |
| Comp Video | A 75 Ω BNC connector provides a high quality analogue video input to the unit. |
| AUDIO IN | The 15-way, D-type male connector is used in different ways according to the audio input and the encoding configuration selected. A breakout cable is supplied as part of the basic unit with the necessary connections for digital and analogue audio. |
| AUDIO IN 2 | The 15-way, D-type male connector is used in different ways according to the audio input and the encoding configuration selected. A breakout cable is supplied as part of the basic unit with the necessary connections for digital audio. |
| Technical Earth | Connect the Encoder's Technical earth to a suitable point. |
| Ge1 and Ge2 (Option Card) | Two RJ-45 connectors provide 100/1000BaseT Ethernet outputs to give transport stream output over IP. |
| L-Band IN | 50 Ω SMA female connector provides an L-band input to allow another L-band signal to be summed with the modulator output. |
| L-Band OUT | 50 Ω SMA female connector provides the main L-band output. This can also provide +24 Vdc at up to 500 mA to power an up-converter. |
| L-Band Monitor | 75 Ω F-type female provides an L-band monitoring output which is -30 dB relative to the main output. |
| IF Output | Standard IF (70 MHz) output to drive the broadcast equipment |
| IF Monitor | IF (70 MHz) output which has been attenuated by 10dB relative to the Standard output so that it can be used as an input to a monitoring solution. |
| TEST (not used) | BNC connector has no use other than to identify the modulator as DVB-S2 capable. |

| Type of Connector | Description |
|-------------------|--|
| ASI IN 1 & 2 | Two BNC female connectors allowing the modulator section to be provided with an externally generated transport stream. Rate adaptation is supported. |

| | |
|---|---|
|  | <p>NOTE</p> <p>Refer to the <i>Reference Guide</i> for all power supply, fuse, safety, EMC information and operating conditions.</p> |
|---|---|

2.6 Connecting the Encoder to the Power Supply

| | |
|---|---|
|  | <p>WARNINGS</p> <ol style="list-style-type: none"> 1. Do not overload wall outlets and extension cords as this can result in a risk of fire or electric shock. 2. As no mains switch is fitted to this unit, ensure the local power supply is switched OFF before connecting the supply cord. 3. The Encoder is not fitted with an on/off switch. Ensure that the socket-outlet is installed near the equipment so that it is easily accessible. Failure to isolate the equipment properly may cause a safety hazard. |
|---|---|

Connect the Encoder to the power supply as follows:

- ▶ **Power Supply**
Ensure the power supply is isolated and switched off.
- ▶ **Encoder**
Ensure the correct fuse type and rating has been fitted to both the equipment and the power cable.
- ▶ **Supply Cord**
Connect the lead to the Encoder input connector and then to the power supply. Switch on the power supply.

Table 2.2: Fuse Type and Rating

| Power Supply | Fuse Type and Rating |
|---------------------------|---|
| 100-120 Vac / 220-240 Vac | Bussmann S505/Littelfuse 215, 5 A 250 V T HBC |

3 Operating the Equipment From the Front Panel

3.1 Introduction

The front panel display and keypad may be used to configure, control and monitor the Encoder when an external control system is not used.

3.2 Establishing Local Control

At power-on the Encoder runs through a boot sequence where the operation of different modules within the Encoder are checked. The time taken for the unit to boot is between one and two minutes.

After this process, the Encoder displays the summary screen and the operator can access the menus from the front-panel or use a web browser once the remote control IP address has been set correctly.

3.3 Navigating the Menus

3.3.1 Navigation Keys and Buttons

The front panel of the Encoder can be operated according to *Figure 3.1*. The operation of the individual keys is described in *Figure 3.2*.

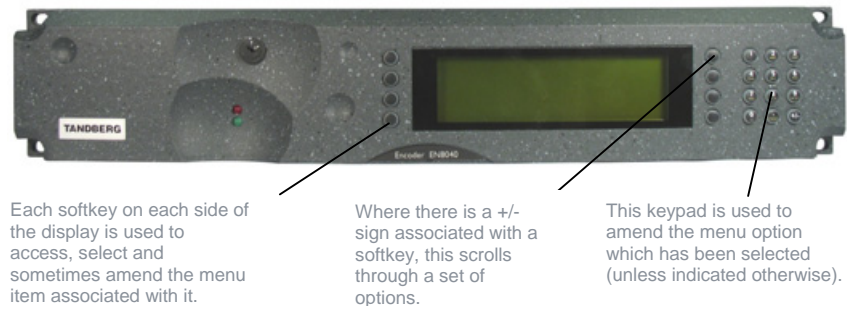


Figure 3.1: Keypad and Display Functions

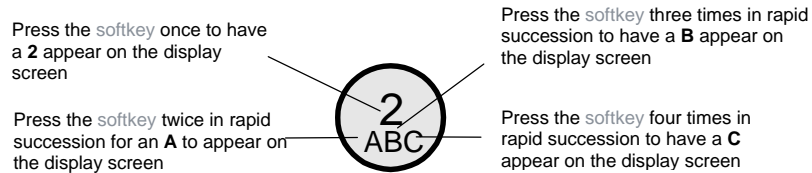


Figure 3.2: Accessing Inscriptions on the Keypad

3.3.2 Typical Display During Operation

The following display screens show the different functions associated with the options.

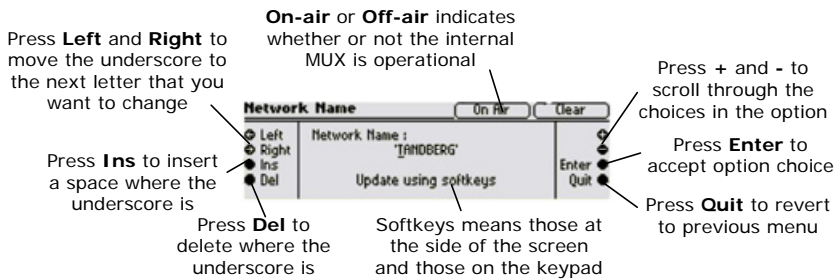
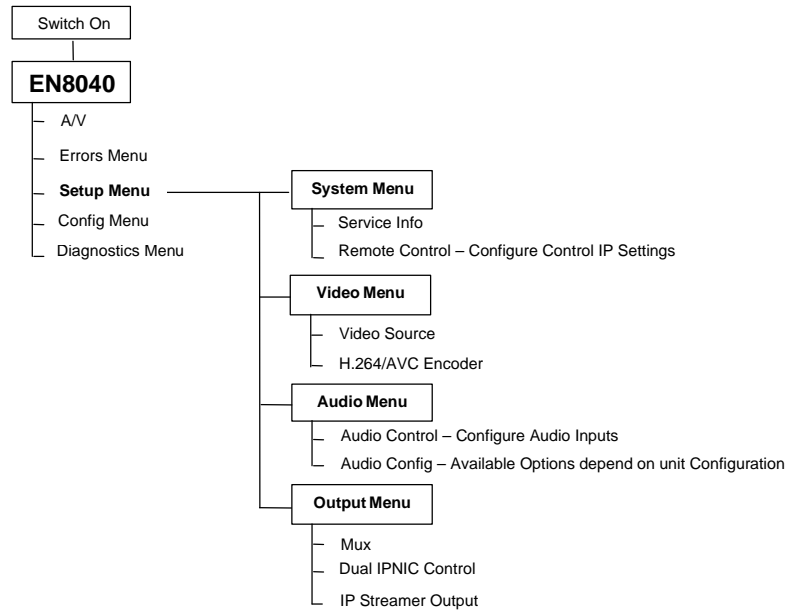


Figure 3.3: Functions Associated With Softkeys

The softkeys can be locked out to prevent inadvertent operation and the key icon will be displayed. Press the softkey adjacent to the key icon. This shows the **Keyboard Lock** screen. Press the **Yes** softkey to disable the softkeys. They are all disabled with the exception of **Unlock**. To enable and restore the softkey functions, press the **Unlock** softkey. This shows the **Keyboard Lock** screen. Press the **Yes** softkey.

| | |
|--|--|
| | <p>NOTE</p> <p>A black diagonal cross enclosed by a white circle (⊗) means that the Encoder is under remote control and the user does not have access to change that parameter.</p> |
|--|--|

4 Typical Operation and Setting of Parameters



NOTE

This is a partial menu structure, indicating those menus used in the following sections.

Figure 4.1: Menu Structure



Refer to the following steps for a typical set-up. See *Figure 4.1* for the menu structure and *Section 4.1* onwards on how to navigate the menus. For more detailed information or parameters not mentioned refer to the *Reference Guide*.

- ▶ Set the remote control options.
- ▶ **Optional:** control the Encoder using a web browser.
- ▶ Set the output connection options.
- ▶ Set the video input options.
- ▶ Set the audio input options (for both sets of channels if necessary).
- ▶ Set service information.

4.1 Set the Remote Control Options

Before the Encoder is to be controlled via its Ethernet interface, the IP address of the unit must be set in the **Remote Control Menu** from the front panel.

Navigate to the **Remote Control** Menu. Select the following option:

- ▶ **IP Address** – enter/modify the IP address through which the unit will be controlled.
- ▶ **Network mask** – enter/modify the network mask for the IP control network.
- ▶ **Default Gateway** – enter/modify the default gateway for the network so that the Encoder can be controlled from another network.

4.2 Control the Encoder Using a Web Browser

If the web browser is pointed to the IP address set in the previous Section, the Encoder will serve out web pages which gives the operator user-friendly access to all of the menu options.

As there are security issues with remote control of the Encoder, the following information is required before the Encoder allows any options to be modified:

- ▶ Username: engineer
- ▶ Password: defaults to “password” but it can be changed from within the **System** menu.

The parameters required to set-up the encoder are found under the Configure tabbed page.

4.3 Select Mux Options

All of the options associated with the output connections are set from the MUX configuration Menu.

Configure > MUX

The typical options that should be checked by the operator are:

- ▶ **Packet Length** – enter/modify the length in bytes of each transport stream packet.
- ▶ **Bit-rate** – enter/modify overall output rate of total MPEG transport stream including video, audio and NULL packets.
- ▶ **Clock** – select the clock source for the system clock (local oscillator, video or external HSYNC)

**NOTE**

This setting is important for Dolby E Passthrough and should be set to VIDEO for passing E streams .


- ▶ **PCR PID** – define the PID that the PCR shall appear in. If the PCR is required to be on the video PID then this must be the same as the video PID defined in the H.264 Encoder menu.

4.4 Set the Video Options

To configure the video input to the Encoder navigate to **Configure > Video Menu** and select the following options:



- ▶ **Video Source** – select the video input required. If the SDI input is to be used, the frame rate must also be set. However, in some circumstances this can be detected automatically (see the *Reference Guide* for details).
- ▶ **H.264/AVC** - The menu lists all of the H.264 encoding parameters that can be changed by the operator, including:
 - **Mode** – select the mode to determine the decoder buffer size. Use 'Mega Low Delay' Mode for latency critical applications. Video quality will be reduced to obtain lower latency.
 - **Bit-rate** – select the desired maximum bit-rate from the video encoder. This is constrained so that the maximum total bit-rate for the whole bitstream is not exceeded.
 - **Resolution** – select the resolution of the decoded video image. The use of this parameter is discussed in *Section 5.1*.
 - **GOP Length** – select the maximum number of frames between consecutive I-frames. This value can be varied between 1 and 250 frames. The video encoder may choose to use I-frames more frequently if the content requires it.
 - **GOP Structure** – configures the structure of the GOP. IBBBP is strongly advised.
 - **Adaptive GOP** – it is recommended to set this to ON.
 - **PID** – defines the program identification number for the H.264/AVC elementary stream in the transport stream.
 - **PCR on Video PID** – this on/off selection sets which PID the PCR will appear on. When set to on the Video PID defined in this menu is used. When set to off the PID defined in the MUX menu is used.
- ▶ **H.264/AVC (PIP) or MPEG-2 encoding options** will be listed if these features have been licenced. The required parameters can be configured here.
- ▶ **VBI** – provides the user the opportunity to control the data types extracted from each VBI line.

| | |
|---|--|
|  | <p>NOTE</p> <p>For more than 1 service to be enabled the number of services must be increased before the additional service can be configured. The number of services can be set in either the “output selection” or “multiple services” menus.</p> |
|---|--|

4.5 Set the Audio Options

Depending upon the options fitted the encoder can process audio as shown in Figure 4.2. Each audio codec has its own set of menus.

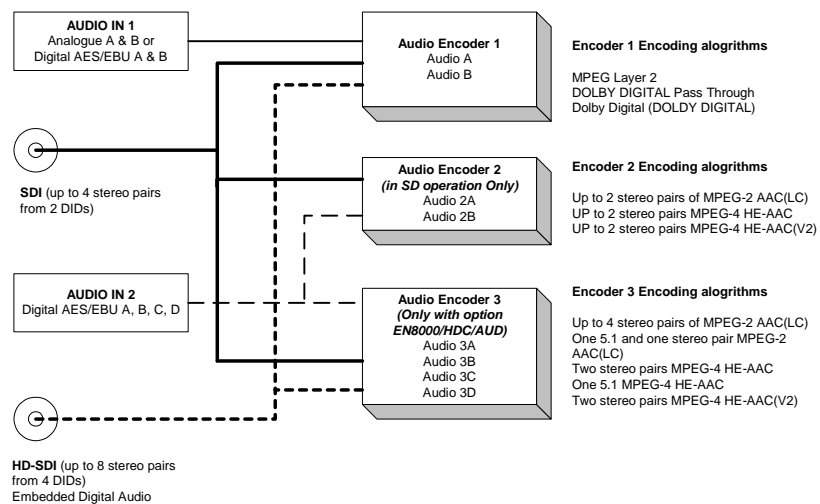


Figure 4.2: Audio Encoding Options

Navigate to **Configure > Audio Menu** and select the audio stream to be configured (Advanced Audio 3A to 3D (if option fitted), 2A and 2B if option licenced and the encoder is configured in SD mode, Audio A or Audio B.

- ▶ **Audio A or Audio B** - select the audio source for the stereo pair. This can be an analogue or a digital input (Audio In 1), or can be de-embedded from the SDI IN input when configured in SD operation or the HD-SDI input when in HD operation. If the audio source is embedded in one of the SDI sources then the audio DID must be set. Entering 1024 for the DID causes the default DID for the selected group to be used.

- ▶ **Audio 2A to 2B (option)**– This option will only appear if the licence is enabled and the unit is configured for SD operation. The audio source can be a digital AES/EBU input (Audio In 2), or can be de-embedded from the SDI IN input. If the audio source is embedded in the SDI then the audio DID must be set. Entering 1024 for the DID causes the default DID for the selected group to be used.
- ▶ **Advanced Audio 3A to 3D (option)** – This option will only appear if the optional daughter card is fitted and AAC licences are enabled. The audio source can be a digital AES/EBU input (Audio In 2) or can be de-embedded from the SDI IN input when configured in SD operation or the HD-SDI input when in HD operation. If the audio source is embedded in one of the SDI sources then the audio DID must be set. Entering 1024 for the DID causes the default DID for the selected group to be used.

Select the required audio encoding algorithm (“Coding Standard”) and the audio bit-rate (“Bit-rate”) for the output of the TS audio encoding for each of the required audio encoders.



NOTES

1. Each audio codec can be individually configured to take audio from any of the supported input sources.
2. More than one codecs can take their sources from the same input.
3. The individual channels within a codec will all use the same source (eg Audio 3A -> 3D all come from the same source).

4.6 Set Dual IPNIC Parameters (If fitted)

Navigate to **Configure > Dual IPNIC Control** to set the network configuration of the IP outputs along with port speed. The output can be configured for single or multi TS output.

- ▶ **Single TS** – All services are output in a single stream. Navigate to **Configure > IP Streamer Output** to set the IP output on/off. The bit-rate, protocol, destination IP address and port are all configured in this menu. The stream can be output on one or both IP outputs.
- ▶ **Multi TS** – Each service is output in an individual TS. To enable each stream be configured, the number of services must be increased before the additional configuration menu becomes available. The number of services can be set in either the “**output selection**” or “**multiple services**” menus. This will then provide a configuration menu for each stream (now called TS*). Each stream can be configured to be output on one or both IP outputs.

4.7 Set Service Information

Navigate to **Configure > System Menu > Service Info** to modify this information. This sets the name on the front panel. The bitstream carries some self-descriptive information that can be displayed on many of the decoders.

4.8 Configuring Option Cards



For information regarding configuring any additional option cards that may be fitted to the Encoder please refer to the *Reference Guide*.

4.8.1 Satellite Modulator (EN8040) Output

A major advantage of having the satellite modulator integrated into the Encoder is that the Encoder bit-rate can be automatically linked to the satellite modulator modulation type, symbol rate and FEC rate. Changing any one of these parameters causes the others to be automatically updated.

The **Output** Menu allows the output of the Encoder to be selected. If the modulator output is to be used then the Output Format should be set to Sat. Modulator. The **Satellite Modulator** Menu is then available to allow all the modulator parameters to be configured. The displayed parameters depend on whether the Encoder Model supports IF or L-band outputs.

4.8.2 Initial State of the Modulator

Following power up the Modulator is configured into a safe state such that:

- ▶ The Modulator output is off.
- ▶ Modulation is switched on.
- ▶ The output power is set to the 'Low' setting.

The exception to this is if 'Power Dip Recovery' (in the **Setup/General** Menu) has been enabled, and the power interruption was less than eight seconds. In this case the unit will power up in the same state as when the power failed.

4.8.3 The Ops Menu

The most frequently performed operation on a DSNG Encoder is configuring the Modulator, switching the output on and off, and controlling the output power.

The **Ops** Menu is intended to allow the user to quickly configure the Modulator. The following parameters can be controlled via the **Ops** Menu:

- ▶ **Output** – On/off
- ▶ **Modulation** – On/off
- ▶ **Output Power** – Preset Low / Preset High
- ▶ **FEC Rate**
- ▶ **Bit-rate**
- ▶ **Symbol Rate**
- ▶ **Frequency**

4.8.4 OFDM Modulator (EN8050) Output

The **Output** Menu allows the output of the Encoder to be selected. If the modulator output is to be used then the Output Format should be set to OFDM Modulator.

The **OFDM Modulator** Menu is then available to allow all the modulator parameters to be configured.

4.8.5 Initial State of the Modulator

Following power up the Modulator is configured into a safe state such that:

- ▶ The Modulator output is off.
- ▶ Modulation is switched on.
- ▶ The output power is set to the 'Low' setting.

The exception to this is if 'Power Dip Recovery' (in the **Setup/General** Menu) has been enabled, and the power interruption was less than eight seconds. In this case the unit will power up in the same state as when the power failed.

4.8.6 The Band Plan

Access the Band Plan option from the **Delivery Descriptor** Menu.

Once a country has been selected then the required channel should be selected in the Channel option. Each channel number corresponds to a particular frequency.

Full control of all OFDM modulator parameters is provided via the **OFDM Modulator** Menu.

5 Typical Configurations

5.1 DSNG System Operation Using EN8040

5.1.1 Satellite Modulator (EN8040) output

The **output** menu allows the output of the encoder to be selected. If the modulator output is to be used, then the **Output Format** should be set to **Sat. Modulator**.

The **satellite modulator** menu is then available to allow all the modulation parameters to be configured. The displayed parameters depend upon whether the modulator card supports an IF or an L-band output, and the feature licences that have been purchased.

All satellite modulators shipped with the EN8040 are capable of supporting DVB-S higher-order modulation as well as DVB-S2. However, many of these features are licence key controlled. A Licence key capable of un-locking these features can be obtained by contacting TANDBERG customer services, providing customers with the ability to upgrade equipment instantly whenever required.

Although the input to the modulator is normally passed through internally, it is also possible to feed the modulator from an external ASI source. This feature is often used with the TANDBERG IP Datacaster, which can insert and remove IP data bi-directionally from inbound and outbound ASI streams. The modulator supports rate adaptation.

5.1.2 Satellite Modulator Control

A major advantage of having the satellite modulator integrated with the encoder is that the encoder bit-rate can be automatically linked to the satellite modulator modulation type, symbol rate and FEC rate. Changing any of these satellite modulation parameters can cause the encoder bit-rate to be adjusted automatically.

5.1.3 Initial state of the modulator

Following power up, the modulator is configured into a safe state such that:

- ▶ Modulator output is switched off
- ▶ Modulation is switched on
- ▶ Output is set to the “low” power setting

The **Lineup** menu allows the modulation state and output power to be readily adjusted in 0.5 dB steps. Additionally, it also allows the RF power to easily toggled between a high, low or user-defined value. These presets are set in the **Output** menu.

The **OPS** menu works in conjunction with the **Lineup** menu and enables key parameters to be adjusted without having to enter the full set-up menus. These parameters include

- ▶ Output: on/off
- ▶ Modulation: on / off
- ▶ Output power: Preset low / Preset high
- ▶ FEC rate
- ▶ Bit-rate
- ▶ Symbol rate
- ▶ Frequency

5.2 DENG System Operation Using EN8050

The DVB-T standard was designed to be flexible. It offers users the possibility of adjusting three key parameters to alter the balance between the amount of useful data that you can transmit, and the robustness and range of the link. This assumes that the actual channel bandwidth will be fixed, which is usually the case. The channel bandwidth is normally set according to geography and the country of operation. It is typically 8 MHz in Europe, and the following tables are based upon a channel bandwidth of 8 MHz.

The three key parameters that can be adjusted are:

5.2.1 Modulation Scheme

The Modulation Scheme defines how the data will be transmitted and how much data will be transmitted per symbol.

QPSK provides the most robust performance, since it sends only 2 bits of data per symbol using phase modulation. This makes it simple and very robust, providing the least data carrying capacity but the most robust performance. The philosophy behind this is simple. If you only use a change of phase as the means of signalling what the data is to the receiver, and restrict the number of possible phase states so that it is difficult for the receiver to make a mistake, even if the signal arrives weak and distorted, then you get a high degree of robustness in exchange for a lower data rate. This is QPSK.

16QAM adds complexity and carries more data per symbol. However, the additional complexity makes it less robust than QPSK. For this reason, an extra 4 dB of carrier to noise performance is required for it to work properly when compared to QPSK. The additional complexity arises because the number of possible states is increased from 4 (with QPSK) to 16 (with 16QAM), allowing it to transmit three bits per symbol. In addition, amplitude as well as phase is used to convey the data. This makes it far easier for a receiver to make a mistake, especially in the presence of noise. This is why the carrier to noise requirement, as well as other critical parameters such as linearity and phase distortion, are increased.

64QAM adds even more complexity and therefore carries more data, but is the least robust. It is therefore only reliable when you have a good radio link.

In addition to requiring a higher carrier to noise ratio, 16QAM and 64QAM require tighter specifications from the radio equipment in order to be transmitted without unacceptable distortion. For example, the power amplifier must be significantly more linear for 64QAM than QPSK. Also, the phase noise performance of the up-converters and down-converters need to be far better for 64QAM than for QPSK. 16QAM falls between these and most good wireless camera systems have a specification good enough to support at least QPSK and 16QAM.

For most wireless camera applications, either QPSK or 16QAM tends to be most used. 64QAM has proved popular for fixed links where a consistently good quality link can be achieved. It is also often used in aircraft-to-ground repeaters, where an aircraft is used to receive several low bit-rate transmissions from wireless cameras on the ground (using QPSK for instance) and then consolidate them into a high bit-rate 64QAM link from the aircraft to the studio using a device such as the TANDBERG MX5210.

If you do use a less rugged modulation scheme (16QAM or even 64QAM), then you can remove some of the disadvantages by using a higher degree of forward error correction to protect against errors. However, in doing this you are giving back some of the useful bit-rate that you have gained by switching to the less robust modulation scheme. The modulation schemes are shown graphically in Figure 5.1.

Modulation Schemes

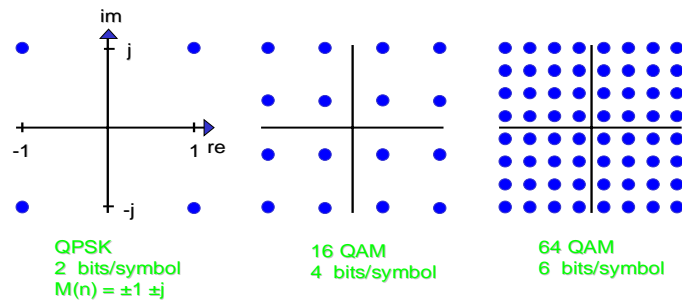


Figure 5.1: Modulation Schemes

5.2.2 Guard Interval

The guard interval is designed to allow the system to be tailored to tolerate the multi-path echoes that the receiver will see. Very simply, in a terrestrial environment, the signal from the transmitter is likely to be reflected from various objects (usually hills or buildings) until the signal arrives back at the receiver. Problems can occur when there is more than one possible path back to the receiver (which is almost always the case in real environments). If the signal can get back to the receiver via two or more completely different routes, then it is almost certain that the distance travelled to get to the receiver will be different for each route. This means that the signals will arrive at different times, with the one travelling the furthest being most delayed. This can cause a number of problems. Firstly, it can cause cancellation at specific frequency points, causing the destruction of some of the carriers and the “punctured” shape of the received spectrum when viewed on a spectrum analyser. TANDBERG uses a very special technique in its receivers, known as “Mean Ratio Combining” to solve this problem. However, as well as affecting the signal in the frequency domain, it can also affect it in the time domain. The delayed signal can therefore also cause the receiver to see the current symbol being transmitted by the transmitter and the previous symbol (delayed because it has travelled further) at the same time. This can cause confusion at the receiver with a consequential increase in bit error rate. The Guard interval solves this problem by allowing time for reflected signals to arrive before the receiver takes a sample. This makes sure that all of the received signals are in symbol-phase with each other when the receiver samples them.

The more time the system is configured to wait for the reflections to come through (higher guard interval), the less data can be transmitted in a given time. The guard interval must therefore be set according to the conditions and is a compromise between the multipath performance and the bit-rate that can be achieved.

The guard interval settings relate to the fraction of the symbol period time that will be allowed for reflections to arrive. The possible settings are 1/4 (most robust), 1/8, 1/16, 1/32 (least robust but highest useful bit-rate).

Large terrestrial transmitters may need to use long guard intervals because the high power makes it possible to receive reflected signals which have travelled over a very long distance. Guard intervals of 1/8 or 1/16 are commonplace in mountainous areas. However, the much lower power of a wireless camera ensures that the distances involved are much less. Consequently, it is nearly always possible to use a guard interval of 1/32 successfully in wireless camera applications. Certain manufacturers have even fixed the guard interval at 1/32 and do not allow you to change it. TANDBERG has provided full control over this however, which is especially useful if the wireless camera is used with a higher power amplifier to achieve an extended range and therefore encounter potentially longer echoes from reflected signals.

5.2.3 Forward Error Correction (FEC)

Forward error correction is used to detect and correct errors at the receiver end, regardless of the actual cause of the errors. FEC is necessary to provide general resilience to interference, although it can also be incorrectly used to mask errors resulting from the incorrect choice of either modulation scheme or guard interval, or other problems with the radio equipment in general.

FEC is displayed as a fraction. An FEC of 1/2 indicates that for every data bit, an error correction bit is provided. This makes the data to error correction ratio 1:1, providing the highest degree of protection available but at the cost of significantly reducing the amount of useful data that is transmitted.

An FEC of 5/6 means that every five bits is protected by one bit of error correction. The data rate is increased, but the ability to detect and correct errors is decreased.

Although the error correction circuits will always apply the maximum amount of forward error correction internally (1/2), the user has the option to remove error correction bits prior to transmission to increase the data capacity of the link. This process is called "puncturing" and literally throws away some of the error correction data. The consequence of this is that the number of errors that the system can detect and correct in a given time is reduced.

For wireless camera applications, the forward error correction is almost always set to a very high level, principally to provide protection against unexpected signal fades and interference. This makes the use of 1/2 or 2/3 FEC common.

The chart in *Figure 5.2* illustrates the useful bit-rate that will be obtained for a system operating in 2K mode and with a bandwidth of 8 MHz.

| Code rate | 1/4 Gard | | | 1/8 Gard | | | 1/16 Gard | | | 1/32 Gard | | |
|-----------|----------|--------|--------|----------|--------|--------|-----------|--------|--------|-----------|--------|--------|
| | QSK | 16-QAM | 64-QAM | QSK | 16-QAM | 64-QAM | QSK | 16-QAM | 64-QAM | QSK | 16-QAM | 64-QAM |
| 1/2 | 498 | 995 | 1493 | 553 | 1106 | 1659 | 585 | 1171 | 1756 | 608 | 1206 | 1810 |
| 2/3 | 664 | 1327 | 1991 | 737 | 1475 | 2212 | 781 | 1561 | 2342 | 804 | 1609 | 2413 |
| 3/4 | 746 | 1493 | 2239 | 829 | 1659 | 2488 | 878 | 1756 | 2635 | 905 | 1810 | 2714 |
| 5/6 | 829 | 1659 | 2488 | 922 | 1843 | 2765 | 976 | 1952 | 2927 | 1005 | 2011 | 3016 |
| 7/8 | 871 | 1742 | 2613 | 968 | 1935 | 2903 | 1025 | 2049 | 3074 | 1056 | 2111 | 3167 |

Figure 5.2: Bit-rate Chart

6 Frequently Asked Questions

6.1 How to Define the Bit-rate?

There are several bit-rates involved with the operation of the Encoder:

- ▶ Transport System (TS) bit-rate: this is defined in the `Output/Mux` Menu and defines output rate of the TS packets
- ▶ The bit-rates for the output of each underlying module including video and audio.

The recommended method to set the bit-rate:

- ▶ Set the Transport Stream bit-rate: this is set first as it is normally defined by an external parameter such as bandwidth of the DSL network or the bandwidth of the satellite transponder.
- ▶ Set the audio bit-rate: choose the value that corresponds to the minimum acceptable broadcast quality. For MPEG-1 Layer II, this is typically 192 kbit/s for a stereo pair. For MPEG-2 AAC, this is typically 96 kbit/s.
- ▶ Set the video bit-rate to be the maximum allowed. The Menu system restricts the video bit-rate so that the total bit-rate of all of the modules does not exceed the Transport Stream bit-rate.

The encoder implements a compression mode called "Capped VBR" where VBR denotes Variable Bit-rate. This means that the rate control for the video will ensure that the short-term (measured over the period of the video decoder buffer) video bit-rate will not exceed the value defined by the operator. The video encoder does not add any padding to the video stream and so it will not deliver constant bit-rate (CBR).

6.2 Video Quality Versus Bit-rate Versus Channel Switching

The implementation of H.264/AVC algorithm used for the EN80xx range of encoders has been optimised to produce broadcast quality video at very low bit-rates. However there are bit-rates below which the algorithm cannot maintain broadcast quality. It should be remembered that the cut-off bit-rates involved depend on the content being encoded. For example, sports content requires more bits to encode than the image of a newsreader to achieve the same visual quality.

However, in broadcast systems, the time taken to switch between two television channels needs to be kept below a maximum value. The two requirements, quality and switch time, work against each other in that setting parameters to improve video quality will generally increase channel-switching time. The values of the following parameters can be modified to achieve different compromises between video quality, bit-rate and channel switching:

- ▶ **Resolution Reduction:** The horizontal resolution of the image can be reduced from the full resolution of the input to lessen the information in the image and hence the number of bits required to encode it. This has no effect on channel switch time.
- ▶ **Mode:** This defines the size of the decoding buffer used by the encoder to allow short-term variations in bit-rate to give better quality at constant bit-rate. Choosing a long delay will increase the ability of the video encoder to handle difficult material. However, as the buffer exists partially in the receive device, when a channel is switched, the incoming stream associated with the new channel must be buffered for this time before the decoding process can start. So choosing a long delay will increase channel switch time.
- ▶ **GOP Length:** As the I-frames require many more bits than other frame types, reducing the number of I-frames per unit time reduces the total number of bits. Hence, a longer GOP (group-of-pictures) length can allow a lower bit-rate. However, the decoding process can only start with an I-frame, as the appearance of all other types of frames is dependent on the previous I-frame. Thus, increasing the GOP length will increase the average time for the I-frame to arrive and so the average channel switch time.

**NOTE**

Use of a full Microsoft TV (IPTV) system may allow larger buffer and longer GOP lengths with adversely affecting the channel switch time.

6.3 Why Does the Transport Stream Analyser Show Fluctuating Bit-rate for the Video PID?

If the `Compression` mode is set to `Capped VBR`, the video encoder does not implement constant bit-rate encoding but capped variable bit-rate as described in *Section 5.1*. The bit-rate does not exceed a maximum bit-rate defined in the `H.264/AVC Video Encoder Menu`. However if the encoding quality is sufficiently high, then the encoder does not attempt to maintain the maximum bit-rate. This can be useful in the scenario where there are other services that require to use the IP bandwidth.

6.4 How Can the End-to-End Latency of the System be Reduced?

It is important to note that decreasing the end-to-end latency will have a detrimental effect on the encoding efficiency and hence, the video quality will be decreased for the same bit-rate. The end-to-end latency consists of:

- ▶ **Latency Associated with the Video Pre-processing within the Encoder -**
The Encoder was designed to minimise this so no major reduction can be made by changing the parameters for the pre-processing module.

- ▶ **Latency Associated with the Actual Video Encoding** - This is dominated by the option chosen in the `Mode` menu item. Choosing “Mega Low Delay” will give the lowest latency.
- ▶ **Latency associated with the transmission medium and decoder** - This cannot be varied by any of the other parameters associated with the Encoder.

6.5 How Do I Transmit Transport Stream over an IP Network?

The product has an optionally fitted card that can output the internal Transport Stream (TS) over an IP/Ethernet network. This option can be purchased as part of the unit with the marketing code EN8000/HWO/IPTS.

The card implements RFC 2250, which specifies the carriage of MPEG-2 TS over IP using unicasting or multicasting. DVB-IPI has enhanced the reliability of the UDP transmission by defining a forward error correction (FEC) scheme to handle the loss of IP packets without loss of the underlying TS. More detail on the operation of this card is given in the *Reference Guide*.



Alternatively an external IP streamer or ASI adapter can be used. A range of suitable products is available from TANDBERG Television.

6.6 Why Are There no IDR Pictures in the Video Stream?

An IDR (instantaneous decoding refresh) picture is a type of I picture which states that no picture after the IDR may reference a picture prior to the IDR. An IDR can always be used for random access into a stream, however it is possible and desirable to have random access points which are not IDRs. The reason for this is that if every random access point is an IDR, it would restrict the way in which B frames could be used. Consider a random access I picture which has an associated B frame that follows it, in encode order, but precedes it in display order. This I picture cannot be an IDR as the B picture following it references pictures prior to it. However this I picture is still a valid random access point as no picture following it in display order ever references a picture preceding it.

All I pictures from TANDBERG TV encoders can be used for random access, this is signaled by the Random Access Indicator flag in the Adaptation Field of the video transport stream packet. When this flag is set, there will be a PES header starting at that packet and the decoder can start to decode the video stream. The presentation time stamps of the following frames need to be monitored to ensure that the following B frames are not displayed.

If this is still not sufficient for the decoder, there is a menu switch in the video encoder menu which forces the video encoder to switch off B frames at the end of each GOP so that the I frame can be identified as an IDR. This is at the expense of video encoding quality.

6.7 What Parameter Values Should be Used to Optimise Video Quality?

The parameters discussed in *Chapter 4* are the most important parameters for the operation of the encoder and these parameters should be set initially. However there are other parameters that can be used to further optimise the video quality.

Video quality can be optimised for two mutually exclusive scenarios:

- ▶ Viewing by human subjects called subjective quality testing: where it is important that the coding artefacts are not annoying.
- ▶ Analysis by computer called objective quality testing: where the coded video must be as close as possible to the original video source.

The recommended parameter values are shown in *Table 6.1*.

Table 6.1: Recommended Values for the Different Video Parameters

| Parameter | PSNR optimum | Visual optimum |
|----------------------|--------------|-----------------------------|
| Noise reduction | OFF | 1-3 (Subjective) |
| GOP Length | 1s | 1s |
| GOP Structure | IBBBP | IBBBP |
| Adaptive GOP | ON | ON |
| Scene Cut Detection | ON | ON |
| Closed GOP | OFF | OFF |
| MCTF (SD only) | OFF | OFF |
| De-blocking Alpha | 0 | 0 |
| De-blocking Beta | 0 | 0 |
| Hierarchical B | ON | ON |
| Bandwidth | sharp | Medium to soft (Subjective) |
| De-speckle filter | OFF | 2 |
| Half Line Processing | OFF | ON |

6.8 Why are the Audio and Video Presentation Timestamps so Different?

In some configurations, the presentation timestamps associated with audio and video frames that are located at a similar time in the Transport Stream can differ by several seconds. This causes problems for the decoder if either the video or audio time stamp is used as a clock reference.

This difference in time stamp is valid as the decoder is required to have a much larger video buffer than audio buffer. For most audio standards such as MPEG-2 AAC, the buffer is less than 1-second while the H.264/AVC video buffer for SD applications is 10 Mbit/s. To obtain the optimal video quality overall, the encoder varies the number of bits allocated to each frame dependent on a large number of parameters. This means that for a 2.0 Mbit/s video rate, the presentation time stamp of the video frame can vary from the system clock to 5 seconds ahead of the system clock. The difference associated with audio will always be less than 1-second so there could be up to 4 seconds difference between the audio and video timestamps. An example is shown in *Figure 6.1*.

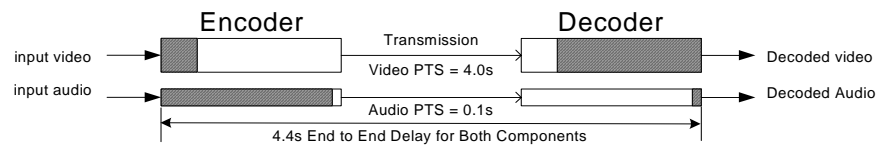


Figure 6.1: Time stamp Structure for Video and Audio

The decoder could use the audio time stamps as the timebase to determine how much video to buffer before decoding the frames. However the audio will still vary by some 100 milliseconds causing lipsync issues. The correct timebase to use in the decoder for referencing the presentation and decoding time stamps is the system clock as indicated by the PCR (program counter reference) values in the Transport Stream. The PCR values represent a very accurate clock reference from a stable temperature-controlled oscillator within the encoder and hence, will be more accurate than any clock system in a consumer decoder.

6.9 Why are there Referenced B Pictures?

With MPEG-4 H.264/AVC, B pictures contain extra tools, which allow them to be coded more efficiently. The detail is that the prediction modes available to generate data within a B picture from multiple reference frames, represent a superset of the modes available to generate a P picture from one reference frame. One such mode is "Direct Mode" where the motion vector is estimated from the equivalent motion vectors of the reference frame and minimal additional information is required.

Hence the number of bits required to encode B pictures is significantly less than P pictures. This has led to the development of referenced B pictures, which are pictures that are generated as B pictures so use fewer bits than an equivalent P picture but can be used as references for other B pictures. Thus, fewer bits are required to encode the same sequence to the same quality level. The technique is called hierarchical B pictures as a hierarchy of B pictures is created. The application of this technique has several implications:

- ▶ The encoding quality for the same bit-rate improves dramatically for still and low motion sequences. The encoder monitors amount of motion and seamlessly adapts the number of B pictures accordingly to obtain optimal efficiency.
- ▶ Due to the increased number of B frames, the time distance between P pictures is larger with an accompanying increase in the coding delay.
- ▶ As such, the difference between the DTS and PTS of the P frames will be larger than with the previous GOP structure.

7 Equipment Packaging

7.1 Packaging Statement

The outer carton and any cardboard inserts are made from 82% recycled material and are fully recyclable.

The Stratocell ® or Ethafoam 220 ® polyethylene foam inserts can be easily recycled with other low density polyethylene (LDPE) materials

7.2 Packaging Markings

The symbols printed on the outer carton are described below:



Handle with care



This way up



Fragile



Protect from moisture



See *Reference Guide* for compliance with directives details.



See *Reference Guide* for compliance details



Defines country of origin.



The packaging is reusable per GB 18455-2001



This symbol guarantees that packaging with this symbol is recyclable and will be accepted by cardboard recyclers



Recyclable per GB 18455-2001

8 Materials Declarations

8.1 Overview

TANDBERG Television products are designed and manufactured in keeping with good environmental practise. Our component and materials selection policy prohibits the use of a range of potentially hazardous materials. In addition, we comply with relevant environmental legislation.

8.2 For the European Union

For product sold into the EU after 1st July 2006, we comply with the EU RoHS Directive. We also comply with the WEEE Directive.

8.3 For China

For product sold into China after 1st March 2007, we comply with the "Administrative Measure on the Control of Pollution by Electronic Information Products". In the first stage of this legislation, content of six hazardous materials has to be declared together with a statement of the "Environmentally Friendly Use Period (EFUP)": the time the product can be used in normal service life without leaking the hazardous materials. TANDBERG Television expects the normal use environment to be in an equipment room at controlled temperatures (around 22°C) with moderate humidity (around 60%) and clean air, near sea level, not subject to vibration or shock.

Where TANDBERG Television product contains potentially hazardous materials, this is indicated on the product by the appropriate symbol containing the EFUP. For TANDBERG Television products, the hazardous material content is limited to lead (Pb) in some solders. This is extremely stable in normal use and the EFUP is taken as 50 years, by comparison with the EFUP given for Digital Exchange/Switching Platform in equipment in Appendix A of "General Rule of Environment-Friendly Use Period of Electronic Information Products". This is indicated by the product marking:



It is assumed that while the product is in normal use, any batteries associated with real-time clocks or battery-backed RAM will be replaced at the regular intervals.

The EFUP relates only to the environmental impact of the product in normal use, it does not imply that the product will continue to be supported for 50 years.

9 Disposal of this Equipment

9.1 General

Dispose of this equipment safely at the end of its life. Local codes and/or environmental restrictions may affect its disposal. Regulations, policies and/or environmental restrictions differ throughout the world. Contact your local jurisdiction or local authority for specific advice on disposal.

9.2 For the European Union



"This product is subject to the EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) and should not be disposed of as unsorted municipal waste."

10 Recycling

TANDBERG Television provides assistance to customers and recyclers through our web site <http://www.tandbergtv.com/ProductRecycling.in>. Please contact TANDBERG Television's customer services for assistance with recycling if this site does not show the information you require.

Where it is not possible to return the product to TANDBERG Television or its agents for recycling, the following general information may be of assistance:

- ▶ Before attempting disassembly, ensure the product is completely disconnected from power and signal connections.
- ▶ All major parts are marked or labelled to show their material content.
- ▶ Depending on the date of manufacture, this product may contain lead in solder.
- ▶ Some circuit boards may contain battery-backed memory devices.

11 Lithium Batteries

This equipment uses a single Lithium battery to allow an internal real-time clock to continue operating during periods when the unit is powered down. This cell is not a USA Environmental Protection Agency listed hazardous waste. It is fully encapsulated and should not be tampered with.