



# Bel7330

## Audio Delay Processor



# User's Guide

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## **BEL 7330 DELAY SYNCHRONISER**

The BEL 7330 is a DSP based stereo audio delay processor that offers manual and automatic resynchronization of audio and video signals, Fig 1. 0 Analogue and AES/EBU digital input /outputs are provided together with an unobtrusive delay adjusting system. The unit was designed to resynchronize audio to video following processes such as standards conversion, video F/X, video synchronization, satellite transmission etc.

### **FEATURES**

#### **DELAY CHARACTERISTICS**

The BEL 7330 can provide up to 5.2 Sec (130 frames) of stereo audio delay. This delay can be adjusted manually by using the front panel controls or remotely using an RS232 port. The delay may be adjusted in sample, millisecond, field or frame increments. The field and frame step values change to reflect the PAL or NTSC video mode selection. Bypass can be selected by means of a front panel control but it will also automatically engage in the event of a power failure.

#### **AUTOTRACKING**

The 7330 has an auto-track facility which will allow the audio delay imposed by the unit to be set and adjusted externally. The external delay sources can be video, TTL or Via RS232. Two BNC sockets are provided for video inputs, one a reference input (REF) and the other a variable input (PROG). The unit will calculate the delay between these two video signals and set the audio delay correspondingly. The maximum auto-tracking range in this mode is 40 milli seconds or one frame. The REF input BNC socket doubles as a TTL input. The pulse width of a TTL signal applied to this input can be used to control the audio delay. The auto-tracking range in this mode is 0 to 5.2 seconds. The 7330 can also be set to track a positive or negative going TTL pulse. The audio delay can be selected to be purely a function of the manual, external or the sum of both settings. Delay adjustment is carried out in an unobtrusive way and causes very little disturbance to the audio signals.

#### **SOFT TRACK**

Any delay adjustments are carried out using a soft track algorithm. This allows delay changes to be achieved with the minimum of disturbance to the audio signal.

#### **ANALOGUE I/O**

The BEL 7330 is equipped with a 24 bit, stereo analogue input-output system. The unit also provides simultaneously analogue and digital outputs. In

this way the BEL 7330 can be used as an A/D or D/A converter. Analogue and AES input/output to the unit are via XLR connectors. Located on the rear panel.

## **ANALOGUE GAIN ADJUSTMENT**

The analogue input and output gain of the BEL 7330 can be adjusted using the front panel controls over the range +10dB to -30dB.

## **DIGITAL GAIN ADJUSTMENT**

The internal digital gain of the unit may be adjusted over the range +20dB to -30 dB.

## **DIGITAL I/O**

The BEL 7330 provides a fully synchronized AES compatible digital audio interface. A sample rate converter is used facilitating the conversion of 32kHz, 44.1 kHz digital sources to 48kHz. A digital referencing system is employed which will synchronize the digital output to various type of input (AES, WORD, VIDEO and INTERNAL). The unit will automatically sense whether PAL or NTSC is used as a video reference. The AES reference input can be used with sampling rates other than 48kHz although the unit is optimized for 48kHz. A BNC connector is provided for video/ word clock reference input and an XLR connector for AES reference input. The digital output is always operating concurrently with the analogue output. The source, however, can be either analogue or digital. (+6dB analogue in provides -9dB AES output) When BYPASS is selected the digital input signal input will be connected directly to the digital output socket. This situation also occurs if the power fails allowing a degree of fault tolerance.

## **MEMORY**

Frequently used delay parameters are stored in one of eight memories and are retained when the unit is switched off. Four of these memories can be selected using the GPI inputs.

## **TIME CODE DELAY**

A linear time code input and output are provided; these will allow time code to be delayed to the same degree as the audio. This input may also be used to delay any single bit digital signal.

## **KEYBOARD LOCK**

Inadvertent operation of the keys can be avoided by invoking the lock function.

**LCD DISPLAY**

The unit carries a graphics LCD display. This display indicates current delay, input level and various operating parameters. It also provides graphical control over the operating parameters.

## OPERATION AND FRONT PANEL CONTROLS

6 keys are located on the front panel Fig 1.0, these are:

### **BYP**

This key will cause the unit to enter/leave the bypass mode. In the bypass mode the delay settings are overridden. The abbreviation *byp* is shown on the LCD display when the bypass mode is active. When power is removed from the unit the inputs are electrically connected to the outputs to provide a fail-safe condition.

### **SET**

Depressing this key will cause the unit to enter the Set-up mode in which various operating parameters of the unit can be adjusted. The operation of the Set-up menus are described below. This key can also be used to recover the factory parameters by depressing it while the BEL logo is shown during power-up.

### **PROG**

This key provides access to the 8 internal program memories. The BEL 7330 stores the current delay parameters in the currently displayed program number. When the prog key is depressed the unit will select the next highest program number. The old parameters are retained in the previous program number and the current settings invoked. Most of the operational parameters such as delay parameters, input source, gains etc. are retained. The unit is supplied with factory defaults set into the memories; these can be recovered by invoking the power-on reset. (Depress the SET key whilst the BEL logo is displayed on power-on).

### **LOCK**

When the unit is locked all the front panel keys, except lock, are inoperative. To release the keys press and hold the lock key for a period of about 4 seconds. A momentary operation of the lock key will again place the unit in the locked state. When in the locked state the word 'lock' is shown on the LCD display.

### **UP/DOWN**

Depressing these keys will, in the normal mode of operation, increase or decrease the delay setting. Holding one of these keys depressed will cause the delay setting to steadily increment or decrement. Once running, depressing and holding the other nudge key can increase the rate that the delay setting changes. These keys are also used to change various parameters in the set-up menus.

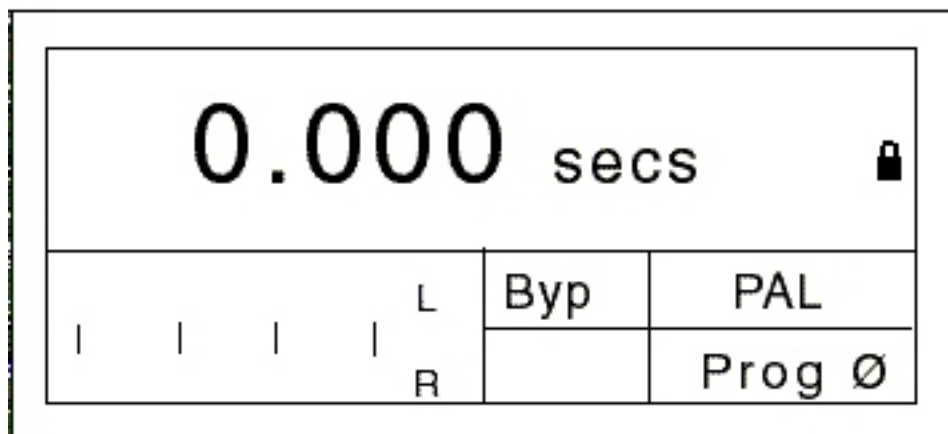
## LCD DISPLAY

The LCD display carries information about the operation of the BEL 7330. The upper part of the display shows the current audio delay. This value can be samples, milliseconds frames or fields as selected in the set-up menus. In the auto-track manual & external mode these delay values are both shown.

The lower left of the display carries an input level indicator. The calibration on this indicator is in 9dB steps. This calibration is “grayed out” when a valid audio input is not present.

When the AES reference is selected and a valid signal is applied to the AES reference input a lock symbol is shown on the right hand side of the display.

The lower right of the display shows the keyboard lock State, the video standard, bypass mode and the program number.



### SET-UP PAGES

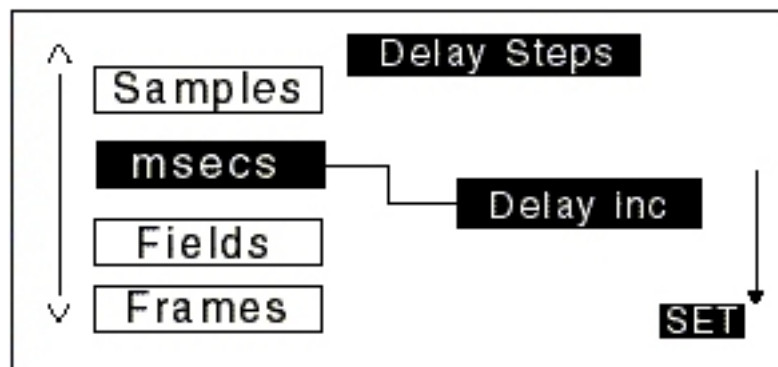
Many of the operating characteristics of the BEL 7330 can be adjusted from within the Set-up pages. Pressing the SET key enters set-up, the set key is subsequently used to sequence through the Set-up pages. Set-up can be quit at any time by pressing the BYP, Lock or the prog key. The nudge keys  $\wedge$   $\vee$  are used to select settings in each page.

The pages are:

### DELAY STEPS

This page allows the delay increment values to be selected. The options are:

- |              |   |
|--------------|---|
| Samples      | The delay is incremented in single sample intervals $20\mu$   |
| Milliseconds | The delay is incremented in one-millisecond intervals.  |
| Fields       | The delay is incremented in one-field intervals. (The actual delay step will change depending on the video standard). |
| Frames       | The delay is incremented in one-frame intervals. (The actual delay step will change depending on the video standard). |

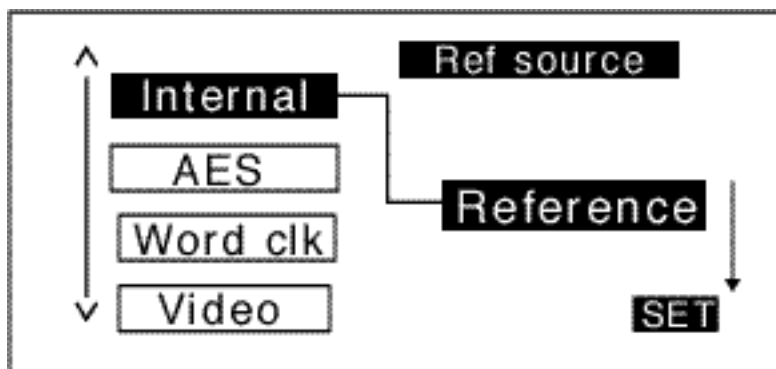


### REFERENCE SOURCE

This page allows the reference source for the AES output to be selected. The AES output is locked to this reference by employing a sample rate converter regardless of the AES audio input rate.

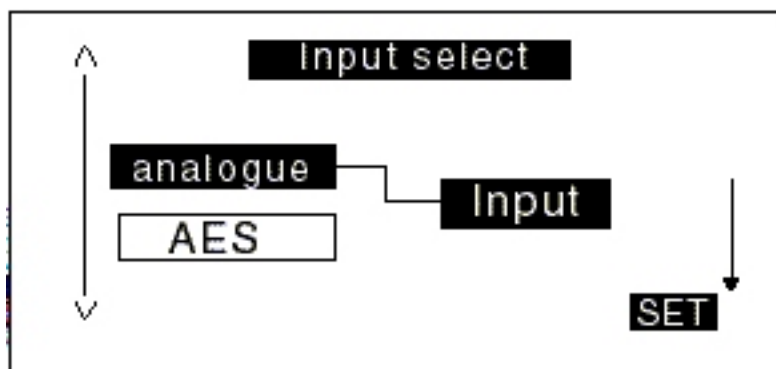
The source options are:

- Internal** The AES output is locked to an internal 48kHz clock, which is accurate to approximately 10ppm.
- AES** The AES output is locked to an external AES source applied to the reference XLR socket on the rear panel. The sampling rate of the external AES reference can be any value from 32kHz to 50 kHz although the BEL 7330 is optimized for 48kHz.
- Word Clock** The AES output is locked to an external 48kHz, TTL level clock signal applied to the external BNC socket.
- Video** The AES output is locked to an external video signal. The video standard applied to the external reference BNC socket is auto-detected by the unit.



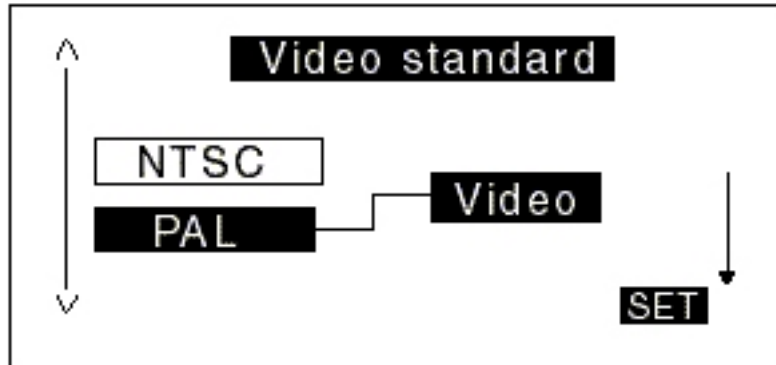
### INPUT SELECTION

This page will allow an analogue or AES audio source to be selected. Note that the BEL 7330 outputs both AES and analogue regardless of this selection.



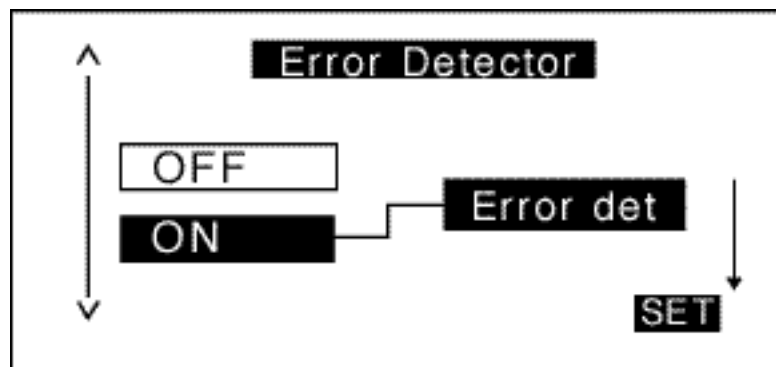
## VIDEO STANDARD

This page allows the video standard (NTSC, PAL) to be selected. This will change the delay increments for field and frame delay modes.



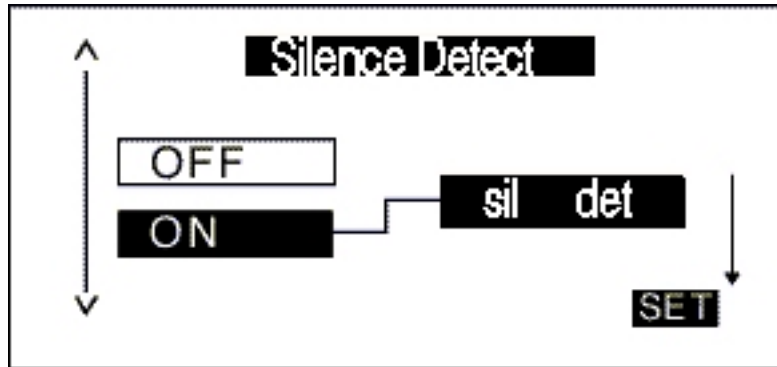
## AES ERROR DETECTION

The 7330 AES error detection can be enabled in this menu page. The 7330 can detect AES input errors and resynchronize the AES input and output system. This can avoid problems that arise with matrix switchers. The resynchronization can, however, produce audible effects and can also emphasize discontinuities in the AES input.



**Silence detector**

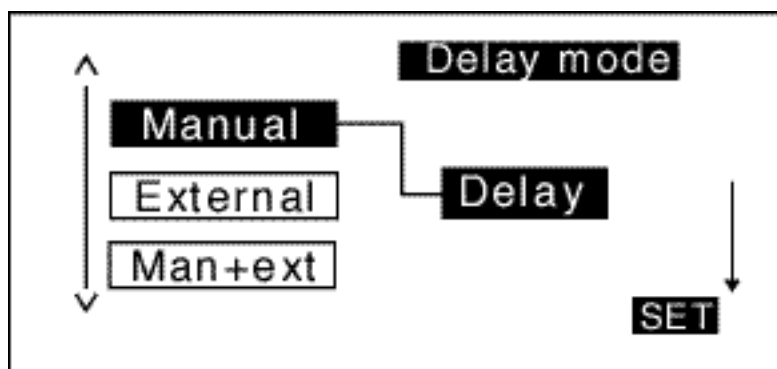
The delay adjustment can be made even less obtrusive by ensuring that the delay changes are only carried out when no audio is present. This can be enabled by selecting the silence detect to be ON.



**AUTOTRACK DELAY MODE**

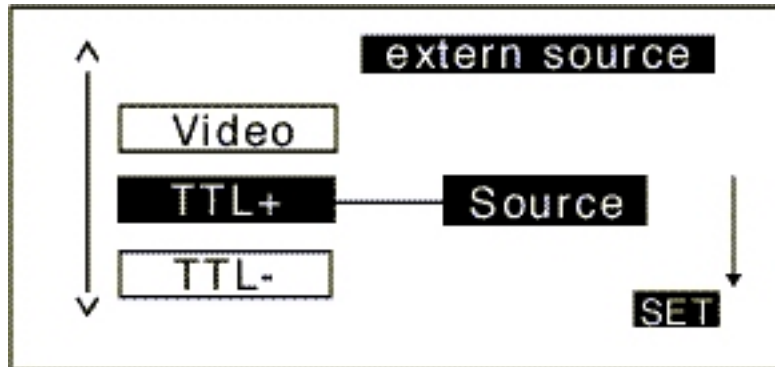
This menu page permits the selection of manual, external or manual + external delay setting modes. In the manual mode the delay is solely a function of the displayed manually adjustable delay. In external mode the delay is dictated by the external delay source. This source is selected in the next menu page. In manual + external mode the delay corresponds to the sum of the manually set delay and that of the external source. Delay adjustment in the auto-track modes is accomplished with minimal disturbance to the audio signals.

NOTE: In auto-track mode the display is in seconds only.



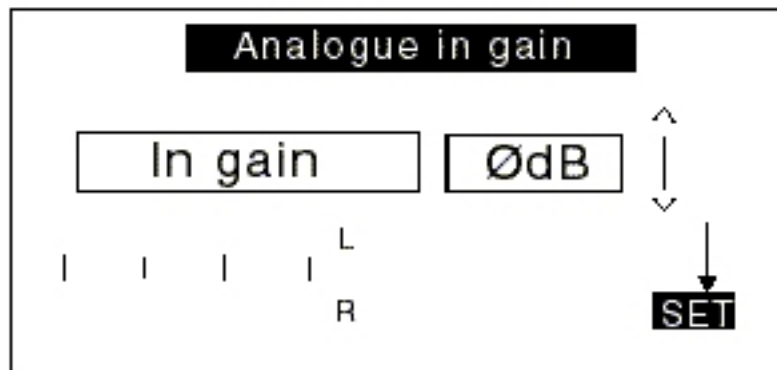
### AUTOTRACK DELAY SOURCE

The external source to set the delay can be selected in this menu page. Two sources are possible, video or TTL.



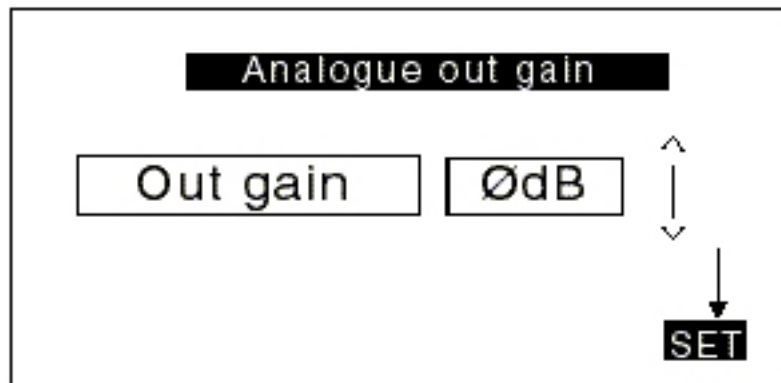
### ANALOGUE INPUT GAIN

This page allows access to a variable gain block placed in the analogue input path. The gain can be adjusted over the range -30dB to +10dB. While in this page the input level indicators are active.



### ANALOGUE OUTPUT GAIN

This page allows access to a variable gain block placed in the analogue output path. The gain can be adjusted over the range -30dB to +10dB.



### DIGITAL GAIN

This page allows a variation of the digital gain applied to the audio signal. The gain can be adjusted over the range -40dB to +20dB. While in this page the input level indicators are active.

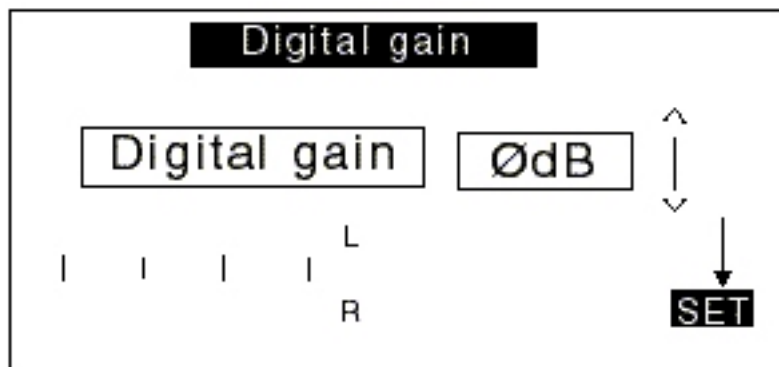




Fig 1.0 Bel 7330 Front panel

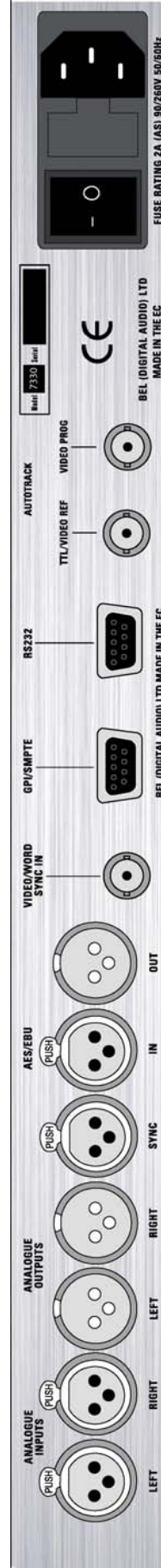


Fig 1.1 Bel 7330 Rear panel

## CONNECTIONS

The rear panel of the BEL7330 (Fig 1.1) carries the following connectors:

Mains power	IEC 3 Pin (90 to 260 VAC 100mA) 2 amp anti surge fuse
Autoracking	PROGBNC (HIZ)
Autotracking	REF/TTL BNC (HIZ)
RS232 serial port	9 Pin D female
SMPTE LTC and GPI I/O	9 Pin D female
AES/EBU Digital output	XLR 3 Pin male
AES/EBU Digital input	XLR 3 Pin female
AES/EBU Digital reference	XLR 3 Pin female
Video/Word Reference	BNC (optional internal 75ohm termination)
Left and right Analogue outputs	3 Pin XLR male Pin 2 Hot
	(To unbalance connect pin 3 to pin 1 on cable connector)
Left and right Analogue inputs	3 Pin XLR female Pin 2 Hot
	(To unbalance connect pin 3 to pin 1 on cable connector)

### RS232 Pin connections

Pin 2	RS232 out from unit
Pin 3	RS232 in to unit
Pin 9	Ground

### GPI and LTC Pin connections

Pin 1	GPI 1 in
Pin 2	GPI 2 in
Pin 3	GPI 3 in
Pin 4	GPI 4 in
Pin 5	Ground
Pin 7	LTC in
Pin 9	LTC out

## SERIAL PROTOCOLS FOR THE BEL 7330

### OVERVIEW

Commands to be communicated to the remote unit (7330) are arranged in frames. These frames will then be sent to the remote unit that will always reply with either ACK for acceptance or NAK for rejection. Any requested reply then follows in the same frame format.

### FRAME FORMAT

The frame starts with a start character 0xAA, which is alternating ones and zeros. This is followed by the destination address, the source address, the command code, the data count, the data, a checksum and an end flag 0xFE.

Start Flag	0XAA
Destination Address	
Source Address	
Command	
Data Count	
Data	
Checksum	
End Flag	0XFE

**START FLAG:** The start flag 0XAA may be sent at any time. If sent during a frame this will cause the frame to restart.

**DESTINATION ADDRESS:** This should be set to 1 for a 7330. This will be returned by the remote unit as the source address.

**SOURCE ADDRESS:** This should be set to 1 for 7330. This will be returned by the remote unit as the destination address.

**COMMAND:** This character is the command for the remote unit and must fall in the range 0X80 to 0XEF. More details of the relevant codes are shown below.

**DATA COUNT:** This is the total number of data bytes following, up to a maximum of 127.

**DATA:** The data required for the command is carried here. Each character can have a value of 0X00 to 0X7F i.e. 7 bits.

**CHECKSUM:** This is the modulo sum of characters in the frame between the destination address and the last data character inclusively. It is calculated thus:

```
DO
{
checksum = (character+checksum) AND 0x7F
}
FOR ALL CHARACTERS IN FRAME
```

**END FLAG:** A character 0XFE ends the frame

**COMMANDS:** Commands to the remote unit

<u>Code(Hex)</u>	<u>Function</u>	<u>Reply</u>
80	General prompt for a reply	C0 - ACK (OK) C1 - NAK (send again)
81	Use first data char as a second command	ACK
82	Request unit identifier	ACK then C2
83	Send delay. Data count = 4, then 4 7 bit data bytes, most sig first	ACK
84	Send General data See below	ACK
85	Send Program number, Data count =1 then program number 0-7	ACK
86	Request General data	ACK then C6
87	Request Program number	ACK then C7
88	Request delay	ACK then C8
8A	Send Gains. Data count 2 then ingain 0-20, outgain 0-20	ACK
8B	Request Gains	ACK then CB
8C	Parameter reset	ACK

**REPLIES:** Replies, when requested (e.g. 82), will consist of frames that contain the original command value plus 0X40. So a request for an ident, 0x82, will elicit a reply of ACK then a frame containing 0xC2 and the ident string.

**GENERAL DATA FORMAT:** The send and request general data (84, 86) commands communicate most switch settings to PC and 7330. The format for these is:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
<b>Byte0</b>		Pal/NTSC					Lock	Bypass
<b>Byte1</b>		An/Dig Source	Ref.	Ref.			Inc. mode S/ms/fd/fm.	Inc. mode S/ms/fd/fm

**RS232 format:** 8 data bits, no parity, one stop bit, 9600 Baud.

A simple Windows software package is available from BEL, BEL distributors or on the BEL web site: [www.beldigital.com](http://www.beldigital.com)

## **EMC COMPLIANCE**

The BEL 7330 was designed and tested to comply with the EMC directive numbers EN55103, EN55022 when used as directed.



It is recommended that, where possible, all cables be good quality screened twisted pairs with the screening braid connected to pin one on the XLR connectors. Optimum performance is obtained using double screened cable with separate ground returns. It is also recommended that 360 degree connection be made to the screening braid on the BNC connectors. This unit must be used with an earthed mains lead to comply with the CE low voltage directive.

**BEL 7330 SPECIFICATION****DELAY**

Audio Delay	0 - 5.2 Seconds Stereo
LTC Delay	0 - 5.2 Seconds
Delay increments (NTSC, PAL)	Samples, milliseconds, Fields, Frames,
Auto Track	Video: 0 - 1 Frame, TTL: 0 - 5.2 secs

**ANALOGUE I/O**

Frequency response	20Hz - 20kHz $\pm$ 1dB
Input dynamic range	116 dB
Signal to noise ratio A/D	112 dBr. (+15dB ref. Audio Precision unweighted 22Hz-22kHz)
Signal to noise ratio D/A	107 dBr. (+15dB ref. Audio Precision unweighted 22Hz-22kHz)
Total through noise (A/D - D/A)	103 dBr. (+15dB ref. Audio Precision unweighted 22Hz-22kHz)
A/D, D/A Conversion accuracy	24 bits 128 times over sampled
Sampling rate	48kHz
Input	Electronically balanced 22k $\Omega$
Output	Electronically balanced 50 $\Omega$
Max input level	+15dB (Gain adjust @ 0dB) Can be adjusted to +22dB
Max output level	+15dB (Gain adjust @ 0dB) Can be adjusted to +22dB
Input and Output gain Adjustment	+10dB to -30dB. (Internal digital gain adjustment +20dB to - 30dB)

**DIGITAL I/O**

Input	24 bit AES 32 - 48kHz (Nominally 48kHz)
Output	24 bit AES
Reference sources	1. Internal clock @ 48kHz 2. External AES (48kHz) 3. External word clock (48 kHz) 4. External video 1v p-p (Auto detected NTSC/PAL)

**MISCELLANEOUS I/O**

GPI input	4 GPI inputs that select program memories
RS232	9.6 kbaud, 8 bit, 1stop bit
Windows (Software available)	

