Figures

Tables

REVISION HISTORY

REVISION	DESCRIPTION	DATE
1.0	Original Version	June 99
1.1	Figure 3 updated to show correct location of jumpers and switches Added section on Setting Audio Delay through serial port Added block diagrams Features current for software version 2.0	Aug 99
1.2	Minor editorial changes	Sept 99
1.3	Rear panel drawing corrected to show correct numbering of AES outputs	Mar 00
1.4	Updated block diagram to show correct Standard for AES audio	May 00
1.5	7720AD-OE-HD, 7720AD-A4-HD and 7720AD4-HD added	Jun 02
1.5.1	Updated block diagrams and specifications	Aug 03
1.5.2	Minor typos fixed	Mar 04

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1. OVERVIEW

The 7720AD-HD series Audio De-Embedders extract embedded audio as specified by SMPTE 299M from a 1.5 Gb/s serial HDTV video signal. The companion 7720AE-HD Audio Embedder facilitates audio multiplexing at the source. The 7720AD-HD is available in 4 different versions.

Model	Input	Audio Outputs		1.5 Gb/s HDSDI Re-clocked Outputs
		AES	Analog	
7720AD-HD	Electrical (BNC)	2 unbalanced	---	2
7720AD4-HD	Electrical (BNC)	4 unbalanced	---	---
7720AD-A4-HD	Electrical (BNC)	2 unbalanced	4	---
7720AD-OE-HD	Optical	2 unbalanced	---	2

The 7720AD-OE-HD version combines the Audio de-embedder with a Fiber to Electrical converter and provides an economical method of converting optical distribution to HDSDI video and AES audio.
SMPTE 299M allows for up to four groups (4 channels/group) to be embedded within a serial digital signal. The 7720AD-HD can de-embed one audio group onto two unbalanced AES outputs. The 7720AD4-HD can de-embed two audio groups onto four unbalanced AES outputs. The 7720AD-A4-HD can de-embed one audio group onto two unbalanced AES outputs and 4 balanced analog audio outputs.

Features:

- Front panel LEDs indicating module status, video presence, selected audio group data is present
- LED indication for the presence of each of the 4 audio groups within the input video
- Audio group selection via card edge DIP switches
- Audio channel swapping selection via card edge DIP switches (not on 7720AD-A4-HD)
- 7720AD-A4-HD has independent volume controls for each of the audio channel outputs
- 7720AD-OE-HD operates with multi-mode or single-mode fiber
- 7720AD-OE-HD has SC/PC, ST/PC or FC/PC connector options

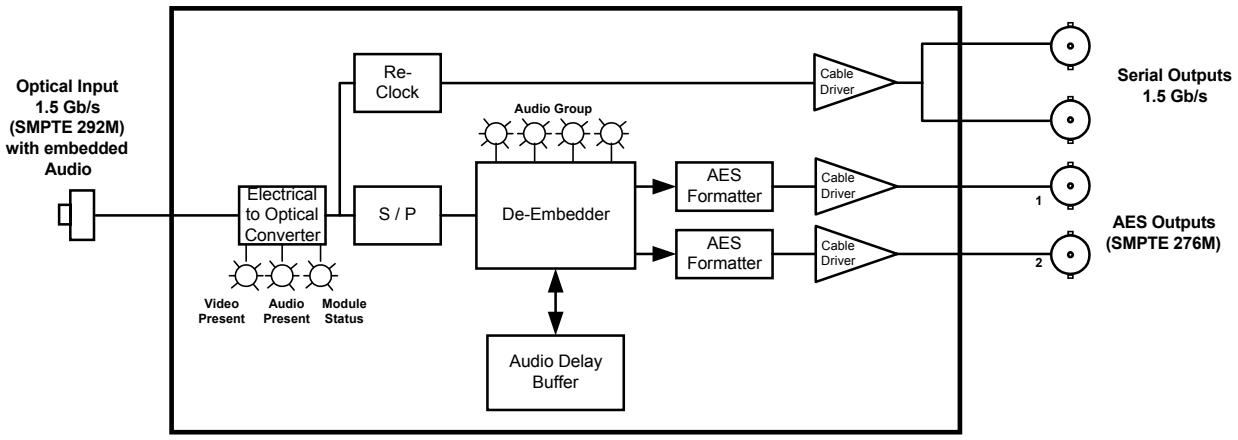

Figure 1: 7720AD-OE-HD Block Diagram

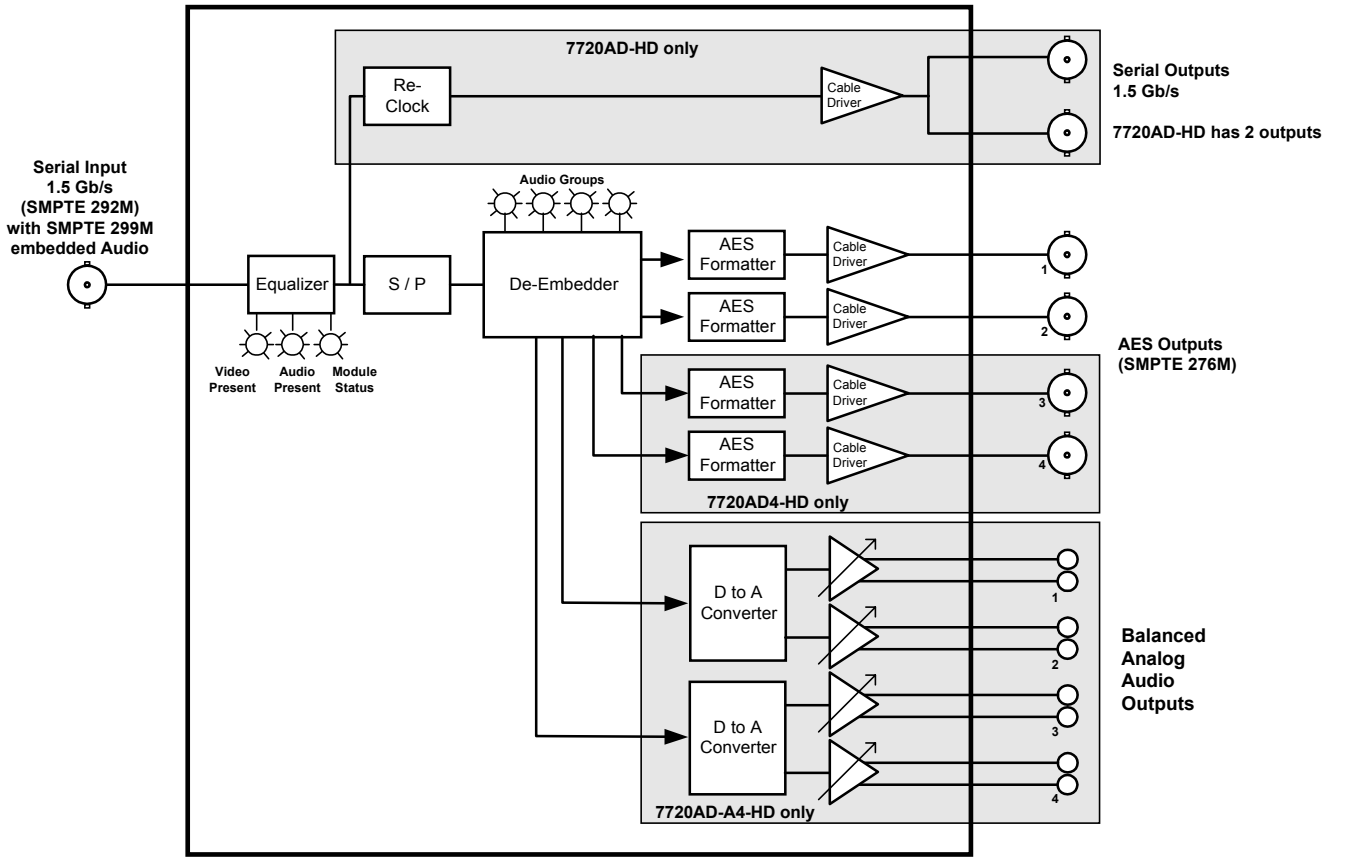

Figure 2: 7720AD-HD - Electrical Input Versions Block Diagram

2. INSTALLATION

The 7720AD-HD and 7720AD4-HD modules each come with a companion rear plate that has 5 BNC connectors. The 7720AD-OE-HD comes with a companion rear plate that has 4 BNC connectors and one SC/PC (shown), ST/PC or FC/PC optical connector. The 7720AD-A4-HD comes with a companion rear plate that has 3 BNC connectors and two 6 pin terminal strips. For information on mounting the rear plate and inserting the module into the frame see section 3 of the 7700FR chapter.

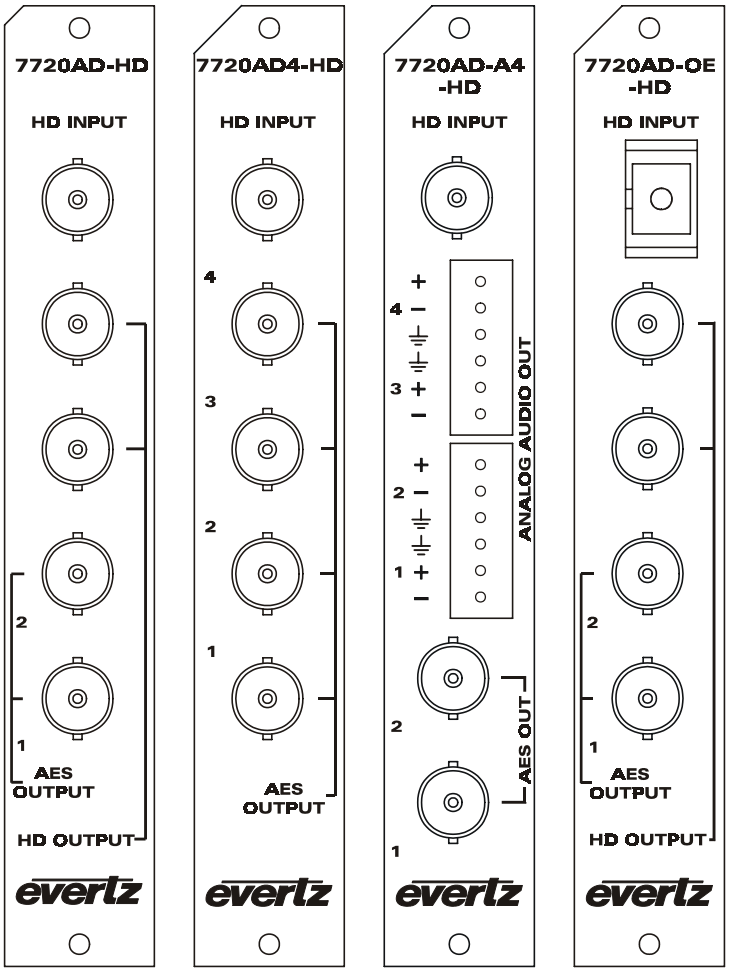

Figure 3: 7720AD-HD Series Rear Panels

2.1. HD VIDEO CONNECTIONS

HD INPUT On 7720AD-HD, 7720AD4-HD and 7720AD-A4-HD versions there is an input BNC connector for 10-bit serial digital video signals with embedded audio, compatible with the SMPTE 292M standard. The 7720AD-HD series modules automatically select the video standard. See Table 1 for a list of the video standards supported.

HD OUTPUT On the 7720AD-HD and 7720AD-OE-HD there are two These two BNC connectors are used to output reclocked serial component video, compatible with the SMPTE 292M standard. These outputs contain a reclocked copy of the input video.

2.2. FIBER OPTIC VIDEO CONNECTIONS

HD INPUT On the 7720AD-OE-HD version there is an input SC/PC (shown), ST/PC or FC/PC female connector for optical 10-bit serial digital video signals with embedded audio compatible with the SMPTE 292M standard.

2.3. AES AUDIO CONNECTIONS

On all versions there are BNC connectors containing unbalanced AES that has been de-embedded from the HD video.

AES OUTPUT 1 AES audio output from channels 1 and 2 of the audio group selected by DIP switches 1 and 2 for de-embedding.

AES OUTPUT 2 AES audio output from channels 3 and 4 of the audio group selected by DIP switches 1 and 2 for de-embedding.

AES OUTPUT 3 (7720AD4-HD only) AES audio output from channels 1 and 2 of the audio group selected by DIP switches 5 and 6 for de-embedding.

AES OUTPUT 4 (7720AD4-HD only) AES audio output from channels 3 and 4 of the audio group selected by DIP switches 5 and 6 for de-embedding.

2.4. ANALOG AUDIO CONNECTIONS (7720AD-A4-HD)

The 7720AD-A4-HD has two 6 pin terminal blocks containing balanced analog audio that has been de-embedded from the HD video. The output audio cables can be secured into the removable portion of the terminal strips using a small screwdriver. The removable part of the terminal strip is then inserted into the rear panel.

ANALOG OUTPUT 1 to 4 Analog audio output from channels 1 to 4 of the audio group selected by DIP switches 1 and 2 for de-embedding.

2.5. CARE AND HANDLING OF OPTICAL FIBER (7720AD-OE-HD ONLY)

2.5.1. Safety

Never look directly into an optical fiber. Non-reversible damage to the eye can occur in a matter of milliseconds.

The laser modules used in the Evertz fiber optic modules are Class I, with a maximum output power of 2mW, and wavelengths of either 1310 nm or 1470 to 1610 nm.

2.5.2. Handling And Connecting Fibers

Never touch the end face of an optical fiber.

The transmission characteristics of the fiber are dependent on the shape of the optical core and therefore care must be taken to prevent fiber damage due to heavy objects or abrupt fiber bending. Evertz recommends that you maintain a minimum bending radius of 3 cm to avoid fiber-bending loss that will decrease the maximum attainable distance of the fiber cable. The Evertz fiber optic modules come with cable lockout devices, to prevent the user from damaging the fiber by installing a module into a slot in the

frame that does not have a suitable I/O module. For further information about care and handling of fiber optic cable see section 3 of the Fiber Optics System Design chapter of this manual.

3. SPECIFICATIONS

3.1. SERIAL VIDEO INPUT (7720AD-HD, 7720AD4-HD AND 7720AD-A4-HD)

Standard: 1.485 Gb/sec SMPTE 292M – standards supported are shown in Table 1.
Connector: BNC per IEC 60169-8 Amendment 2.
Equalization: Automatic to 100m @ 1.5Gb/s with Belden 1694 or equivalent cable

Common Name	Pixels / Active Lines	Frame Rate	Progressive /Interlace	SMPTE Standard
1080i/60	1920 x 1080	30	I	274M
1080i/59.94	1920 x 1080	29.97 (30/1.001)	I	274M
1080i/50	1920 x 1080	25	I	274M
1080p/30	1920 x 1080	30	P	274M
1080p/30sF	1920 x 1080	30	P (sF)	Proposed 274M
1080p/29.97	1920 x 1080	29.97 (30/1.001)	P	274M
1080p/29.97sF	1920 x 1080	29.97 (30/1.001)	P (sF)	Proposed 274M
1080p/25	1920 x 1080	25	P	274M
1080p/25sF	1920 x 1080	25	P (sF)	Proposed 274M
1080p/24	1920 x 1080	24	P	274M
1080p/24sF	1920 x 1080	24	P (sF)	Proposed 274M
1080p/23.98	1920 x 1080	23.98 (24/1.001)	P	274M
1080p/23.98sF	1920 x 1080	23.98 (24/1.001)	P (sF)	Proposed 274M
720p/60	1280 x 720	60	P	296M
720p/59.94	1280 x 720	59.94 (60/1.001)	P	296M
1035i/60	1920 x 1035	30	I	260M
1035i/59.94	1920 x 1035	29.97 (30/1.001)	I	260M

Table 1: Video Input Formats

3.2. OPTICAL INPUT (7720AD-OE-HD)

Standard: 1.485 Gb/sec SMPTE 292M – standards supported are shown in Table 1.
Connector: SC/PC, ST/PC or FC/PC female housing
Maximum Input Power: 0 dBm
Wavelength 1270 nm to 1610 nm
Optical Sensitivity: -17 dBm
Fiber Size: 62 μm core / 125 μm overall

3.3. RE-CLOCKED HD SERIAL VIDEO OUTPUTS (7720AD-HD AND 7720AD-OE-HD ONLY)

Number of Outputs: 2
Standard: same as input
Connectors: BNC per IEC 60169-8 Amendment 2.
Signal Level: 800mV nominal
DC Offset: 0V ±0.5V
Rise and Fall Time: 200ps nominal
Overshoot: <10% of amplitude
Wide Band Jitter: < 0.2 UI

3.4. AES AUDIO OUTPUTS

Number of Outputs: 2 on 7720AD-HD, 7720AD-A4-HD and 7720AD-OE-HD
4 on 7720AD4-HD
Standard: SMPTE 276M, single ended synchronous or asynchronous AES
Connectors: BNC per IEC 60169-8 Amendment 2.
Sampling Rate: 48 kHz
Impedance: 75 Ohms unbalanced
Delay: 9 samples to approx. 3 seconds (user adjustable)
Resolution: 24 bit

3.5. ANALOG AUDIO OUTPUT (7720AD-A4-HD ONLY)

Number of Outputs: 4
Type: Balanced analog audio
Connector: two 6 pin terminal strips
Output Impedance: 66Ω
Signal Level: 0dB FS =>8 to 24dBu into 10 kΩ loads (user settable)
0dB FS =>8 to 22dBu into 600 Ω loads (user settable)
Frequency Response: < ± 0.1dB (20Hz to 20kHz)
THD+N: > 90dB RMS @ 1kHz, with 24dBu output
Crosstalk isolation: > 90dB RMS (20Hz to 20kHz)

3.6. SYSTEM PERFORMANCE

Deembedding Latency:
HD SDI to AES: 1.35 mSec (7720AD-A4-HD)
600 μSec all other versions
HD SDI to Analog: 2.25 mSec

3.7. ELECTRICAL

Voltage: + 12VDC
Power: 8 Watts.
EMI/RFI: Complies with FCC regulations for class A devices.
Complies with EU EMC directive.

4. STATUS INDICATORS

4.1. MODULE STATUS LEDS

MODULE OK This Green LED will be On when the module is operating properly

LOCAL FAULT This Red LED makes it easy to identify one module in a frame that is missing an essential input or has another fault.

The LED will blink on and off if the microprocessor is not running.

The LED will be on solid when input video is lost, the selected audio group is missing or has DBN errors, or there is a fault in the module power supply.

VIDEO PRESENT: This Green LED will be On when there is a valid video signal present at the module input.

AUDIO PRESENT: This Green LED will be On if the audio group selected is present and free from DBN errors.

(7720AD4-HD) This LED will flash if only 1 group is present. (See section 5.3)

4.2. AUDIO GROUP STATUS LEDS

Four LEDs located on the lower half (opposite the DIP switch) indicates the presence of the four audio groups as shown below. Audio Group LED 1 is located near the center of the printed circuit board.

Audio Group LED	Color	Audio Group Status
1	Off	Group 1 embedded audio is not present on the video input.
	Green	Group 1 embedded audio is present on the video input.
2	Off	Group 2 embedded audio is not present on the video input.
	Green	Group 2 embedded audio is present on the video input.
3	Off	Group 3 embedded audio is not present on the video input.
	Green	Group 3 embedded audio is present on the video input.
4	Off	Group 4 embedded audio is not present on the video input.
	Green	Group 4 embedded audio is present on the video input.

Table 2: Audio Group Status LEDs

On the 7720AD-A4-HD the audio group LEDs are also used in conjunction with the pushbutton and toggle switch to allow the user to adjust the volume level of each of the 4 analog outputs. See section 5.3 for information on adjusting the analog volume levels.

5. CARD EDGE CONTROLS

At the bottom edge of the module there is an 8 position DIP switch, giving the user control over the de-embedder. The ON position is closest to the PCB. Sections 5.1 and 5.2 show the assigned DIP switch functions. On the 7720AD-A4-HD there is also a toggle switch and pushbutton which are used to set the volume level for the analog outputs.

DIP Switch	Function
1	AES 1 and AES 2 Group Selection
2	
3	AES 1 Channel Swap
4	AES 2 Channel Swap
5	Not used
6	
7	
8	

Table 3: DIP Switch Functions (7720AD-HD and 7720AD-OE-HD)

DIP Switch	Function
1	AES 1 and AES 2 Group Selection
2	
3	Not used
4	Not used
5	AES 3 and AES 4 Group Selection
6	
7	Z bit Free Run
8	AES Group Lock Mode Selection

Table 4: DIP Switch Functions (7720AD4-HD)

DIP Switch	Function
1	AES 1 and AES 2 Group Selection
2	
3	Not used
4	Not used
5	Not used
6	Not used
7	Z bit Free Run
8	Analog Audio Volume Adjust Enable

Table 5: DIP Switch Functions (7720AD-A4-HD)

5.1. SELECTING THE AUDIO GROUP THAT WILL BE DE-EMBEDDED

The SMPTE 299M standard permits up to 4 groups of 4 audio channels to be embedded into the 1.5 Gb/s video bitstream.

The models 7720AD-HD, 7720AD-A4-HD and 7720AD-OE-HD de-embed one group of audio (selected by switches 1 and 2) onto AES outputs 1 and 2. On the 7720AD-HD and 7720AD-OE-HD models switches 3 and 4 select if the channels will be output as they were embedded or if they will be swapped.

The model 7720AD4-HD will de-embed two groups of audio, the first group (selected by switches 1 and 2) on AES outputs 1 and 2, and the second group (selected by switches 5 and 6) on AES outputs 3 and 4. Switch settings are shown in Table 6.

DIP 1	DIP 2	Audio Group Output on AES 1 and AES 2 and 7720AD-A4-HD Analog Outputs
Off	Off	1
Off	On	2
On	Off	3
On	On	4

DIP 5	DIP 6	Audio Group Output on AES 3 and AES 4 (7720AD4-HD only)
Off	Off	1
Off	On	2
On	Off	3
On	On	4

Table 6: Audio Group Switch Settings

5.2. SELECTING THE AUDIO CHANNEL SWAP FUNCTIONS (7720AD-HD AND 7720AD-OE-HD ONLY)

Switches 3 and 4 select if the channels will be output on AES 1 and 2 as they were embedded or if they will be swapped

DIP 3	Channel Swap for AES 1
Off	Channels 1 & 2 normal
On	Channels 1 & 2 swapped

DIP 4	Channel Swap for AES 2
Off	Channels 3 & 4 normal
On	Channels 3 & 4 swapped

Table 7: Channel Swap Switch Settings

5.3. SELECTING THE Z BIT ALIGNMENT MODE (7720AD4-HD and 7720AD-A4-HD Only)

In some cases, where the Z bit on the incoming audio has not been encoded correctly, it may be desirable to regenerate the Z bit on the outputs. Switch 7 selects if the Z bit on the AES outputs will be free-running or locked to the incoming embedded audio.

DIP 7	Z Bit Free Run Selection
Off	Z Bit from Embedded Audio
On	Regenerate Z bit

Table 8: Z Bit Alignment Switch Settings

5.4. SELECTING AES LOCKED GROUP MODE (7720AD4-HD only)

For audio that is synchronous to video there is exactly 8008 audio samples (48kHz sampling rate) in 5 frames of NTSC, 525 line video. Most audio embedders will spread these samples as evenly as possible throughout the 5 frames of video. Because the 8008 samples do not divide evenly into 5 frames of video, there is a sequence that only repeats every 5 frames. In order to transport 8 channels of audio (4 AES pairs) through an embedded link with exactly the same delay on each channel, both the embedder and the de-embedder must lock both groups of audio to this 5 frame sequence. Failing to do so will cause a phase difference between the audio from the two groups.

Switch 8 selects if the 7720AD4-HD will de-embed the two groups independently or locked together.

DIP 8	Locked Group Selection
Off	Independent groups
On	Locked groups

Table 9: Locked Group Switch Settings

In *independent group* mode, the two selected groups will be de-multiplexed independently to each other as if two separate de-multiplexers were used. The output FIFO management will have different reset timing between the two groups creating different output phase relationships on the associated AES channels. Both groups do not necessarily need to be present.

In *locked group* mode, the resetting of the output FIFOs are locked together thus maintaining the phase relationship between all 4 AES channel pairs. Because the two groups are tightly tied together, both audio groups must be present to get any AES audio output.

To maintain a guaranteed audio phase relationship through a complete SDI link, the audio embedder MUST also provide the same locked FIFO management functionality.

5.5. ADJUSTING THE VOLUME LEVEL ON THE ANALOG OUTPUTS (7720AD-A4-HD ONLY)

The toggle switch and pushbutton on the card edge of the 7720AD-A4-HD are used to adjust the volume control of the analog outputs individually.

When DIP switch 8 is Off, volume level adjustments are disabled to prevent accidental changes. When DIP switch 8 is On the user can adjust the volume of each of the analog audio outputs.

The three position, return to center toggle switch is used in conjunction with a momentary pushbutton to adjust the level of the outputs. The Audio Group LEDs, located on the lower end of the module (opposite the DIP switch) are used to indicate when the module is in volume level adjust mode and which output is being adjusted. When one of the LED's is flashing this indicates that you are adjusting the level of the respective channel as shown in Table 10.

Audio Group LED	Color	Audio Group Status
1	Flashing	Analog Output 1 level can be adjusted with toggle switch.
2	Flashing	Analog Output 2 level can be adjusted with toggle switch.
3	Flashing	Analog Output 3 level can be adjusted with toggle switch.
4	Flashing	Analog Output 4 level can be adjusted with toggle switch.

Table 10: Analog Audio Level Adjustment LEDs

To enter the volume control mode, press the pushbutton. The Output 1 Volume level adjust LED will start flashing, indicating that the toggle switch can be used to adjust the volume level of analog output 1. Pressing the toggle switch up will increase the volume level and pressing the toggle switch down will decrease the volume level.

Continue adjusting the volume level of the other outputs by pressing the pushbutton to select the desired output and then using the toggle switch to adjust the level. Press the pushbutton the fourth time will exit volume adjust mode. None of the LEDs will be flashing. You can lock the volume levels by turning off DIP switch 8. If you stop pressing either the pushbutton or toggle switch for more than 30 seconds, the module will exit the volume adjust mode.

6. JUMPERS

The 7720AD-OE-HD and 7720AD-HD versions are built using the 7700PB base board (see Figure 4 and Figure 5). The 7720AD4-HD and 7720AD-A4-HD are built using the 7700PB3 base board (See Figure 6).

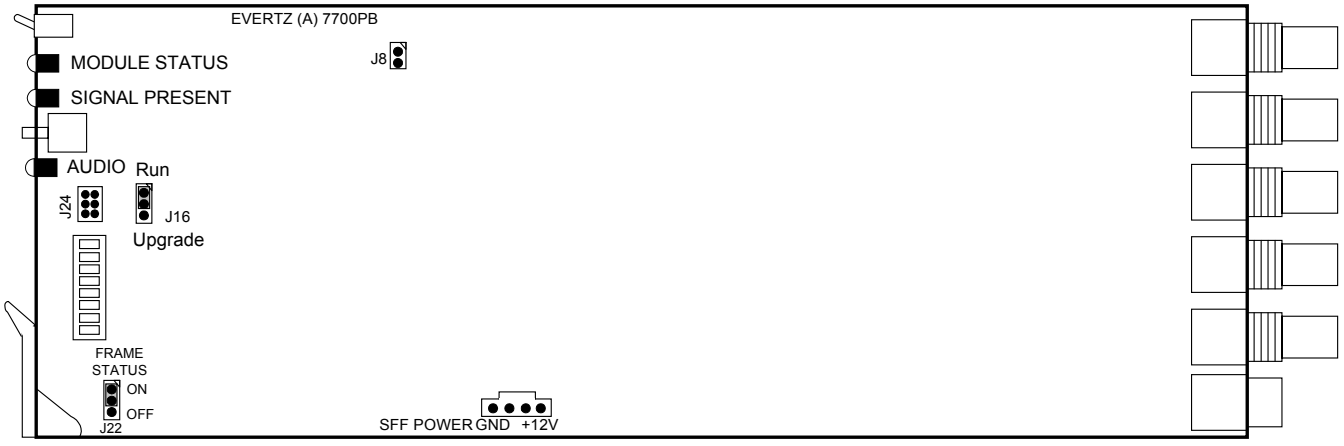

Figure 4: Location Of Jumpers On 7720AD-HD

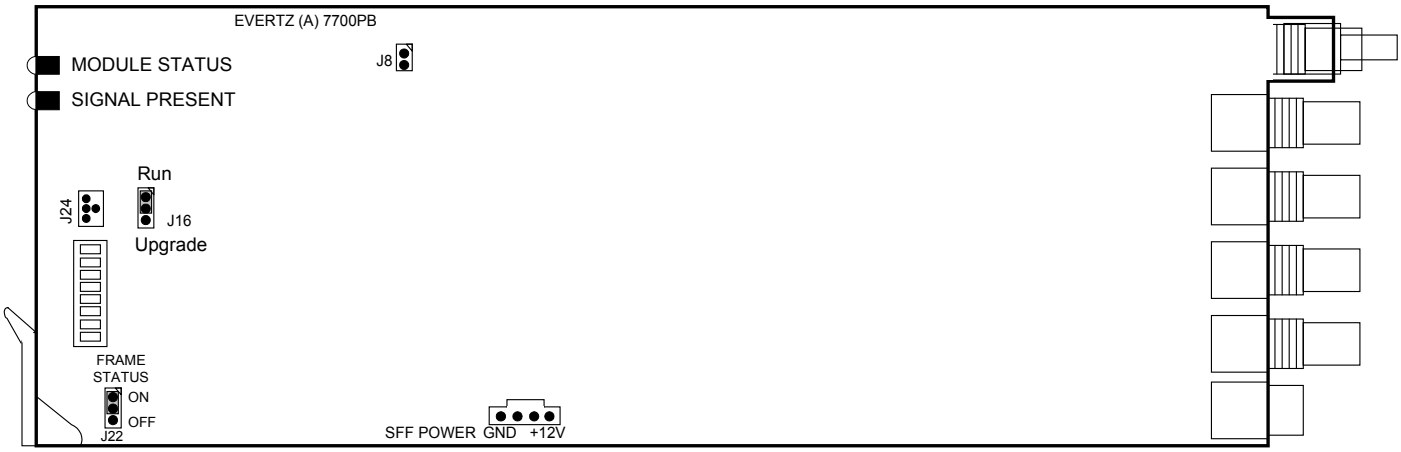

Figure 5: Location of Jumpers on 7720AD-OE-HD

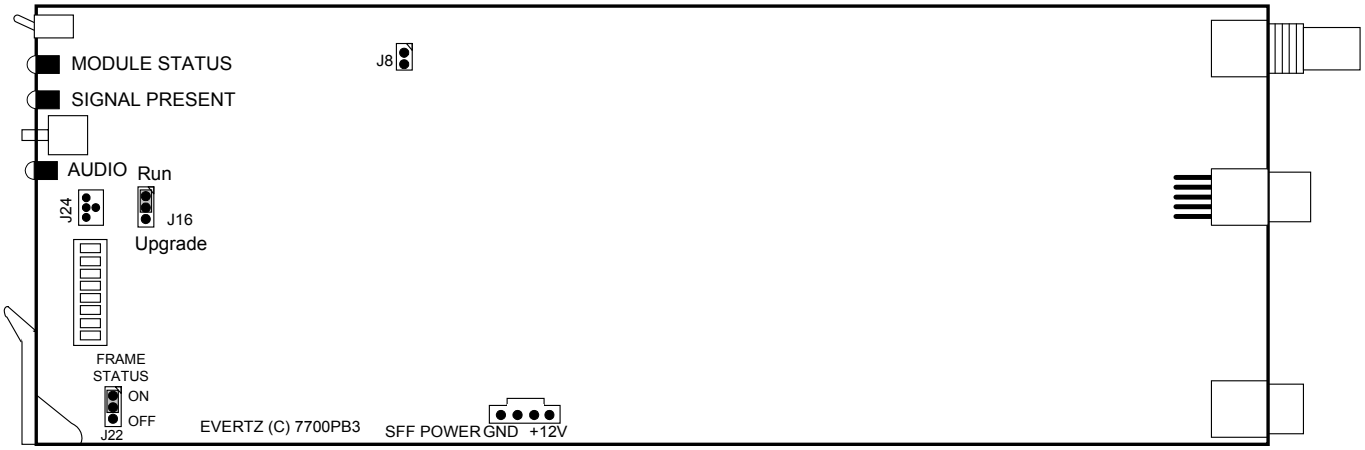

Figure 6: Location of Jumpers on 7720AD4-HD and 7720AD-A4-HD

6.1. SELECTING WHETHER LOCAL FAULTS WILL BE MONITORED BY THE GLOBAL FRAME STATUS

FRAME STATUS

The FRAME STATUS jumper J22 located at the front of the module determines whether local faults (as shown by the Local Fault indicator) will be connected to the 7700FR frame's global status bus.

To monitor faults on this module with the frame status indicators (on the PS FRAME STATUS LED's and on the Frame's Fault Tally output) install this jumper in the On position. (Default)

When this jumper is installed in the Off position, local faults on this module will not be monitored.

6.2. CONFIGURING THE MODULE FOR FIRMWARE UPGRADES

UPGRADE

The UPGRADE jumper J16 located at the front of the module is used when firmware upgrades are being done to the module. For normal operation it should be installed in the *RUN* position. On Rev 1 versions of this board the upgrade jumper is located in another location. See the *Upgrading Firmware* chapter in the front of the manual binder for more information.

To upgrade the firmware in the module unit pull it out of the frame. Move Jumper J16 into the *UPGRADE* position. Install the Upgrade cable provided (located in the vinyl pouch in the front of the manual binder) onto header J24 at the card edge. Re-install the module into the frame. Run the upgrade as described in the *Upgrading Firmware* chapter in the front of the manual binder. Once the upgrade is completed, remove the module from the frame, move J16 into the *RUN* position, remove the upgrade cable and re-install the module. The module is now ready for normal operation.

7. SOFTWARE CONTROL

7.1. STATUS MONITORING

The audio de-embedder status messages can be monitored using the RS232 upgrade cable on the card edge. The serial port settings are 57600 baud, 8 bits, no parity. The status messages are output on power up and each time one of the DIP switches is changed.

7.2. SETTING THE AUDIO DELAY

The 7720AD-HD is capable of adding delay between the embedded audio and the AES audio outputs. This audio delay can be set and retrieved using the RS232 upgrade cable on the card edge. The user set audio delay value in samples is written to the nonvolatile memory after approximately 20 seconds and is recalled on bootup. The factory default delay is 9 samples.

When entering the audio delay commands there is no command prompt. Simply type on a new line to enter commands. The syntax for the command to set or read the audio delay is:

```
audio_delay [samples]
```

If you omit the optional *samples* parameter the 7720AD-HD will return the current setting of the audio delay register. If you supply the optional *samples* parameter, that will delay the AES audio on both AES1 and AES2 by the specified number of samples. The *samples* parameter must fall in the range from 9 to 131081 samples. The minimum delay through the product is 9 samples. Table 11 shows the number of samples per frame for various video frame rates.

Video frame rate	Samples per Frame
30	1600
29.97	1602 ‡
25	1920
24	2000
23.98	2002‡

Table 11: Number of samples (48 kHz) per frame

‡ Approximate number of samples per frame for non integer frame rates

Example1: Read back the audio delay

```
audio_delay <enter>
Audio Delay is set to 33 samples.
```

Example2: Set the audio delay to 48 samples

```
audio_delay 48 <enter>
Audio Delay = 48 samples
```