HD Caption Legalizer / Relocating Bridge MODEL CB512

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Section 1: Introduction

Product Description

The CB512 HD Caption Legalizer / Relocating Bridge is a powerful solution for broadcasters that virtually eliminates HD captioning problems by fixing common upconversion errors and maximizes interoperability by ensuring that all data complies completely with DTV captioning standards. The CB512 regenerates all input caption data to create a fully-compliant data stream with standardization of line number, scaling attributes, and packetization style.

Supported caption bridging capabilities are: HD to HD, HD to SD and SD to HD. The CB512 can tolerate video inputs that are not in sync.

The CB512 is also a relocating HD caption bridge which can bridge caption data between video sources in a wide variety of HD video formats, including 1080i, 720p, 24/23.98p, and 24/23.98psf, and relocate HD caption displays. Relocation is enabled by programmable GPI triggers and can be set to avoid emergency crawls across an adjustable region at the top or the bottom of the HD picture. Relocation of captioning to the left or right side of the HD widescreen display is also supported.

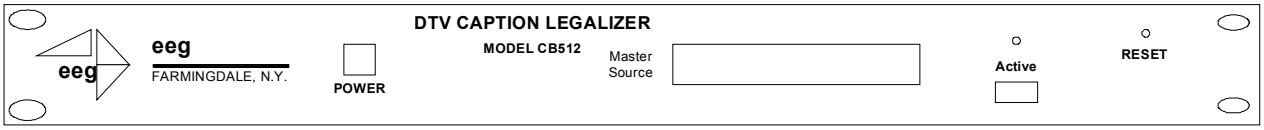
Features Overview

- Compliant with all FCC mandated EIA-608B and CEA-708 standards
- GPI-triggered closed captioning relocation to satisfy emergency alert accessibility requirements
- Transparent upconversion of captions from an SD video source to an HD video master
- Transparent downconversion of captions from an HD video source to an SD video master
- RS-232 SMPTE 333M caption output port
- Relay-bypassed master video path
- Supports a wide variety of HD transmission and mastering formats including 1080i, 1080p, 720p, 480p, 24/23.98pand 24/23.98psf.
- Eliminates common DTV captioning errors that reduce compatibility with ATSC encoders and consumer decoders

Section 2: Installation

Front Panel

The CB512 front panel is shown in the figure below.



The front panel has the following controls:

Power Turns power to the unit on and off.

Active Controls relay bypass for the master video path. In bypass, the indicator LED will be off, and the unit will pass video directly from the Master In connector to the Master Program Out connector. All other functions are inactive.

Reset Performs a hardware reset. The unit will reboot, all operations will be cleared, and status will return to the default settings stored in Non-Volatile Memory.

Front Panel LCD The front panel LCD display is divided into sections as shown below:

Master Video Present	Top Bump	Closed Caption Source
Source Video Present	Bottom Bump	Closed Caption Activity

Master Video Present displays the video type detected on the master video input, including format information for HD video.

Source Video Present indicates the video type detected on the source video input, including format information for HD video.

Top Bump indicates if a relocation function from the top of the screen is active, and how many rows it applies to.

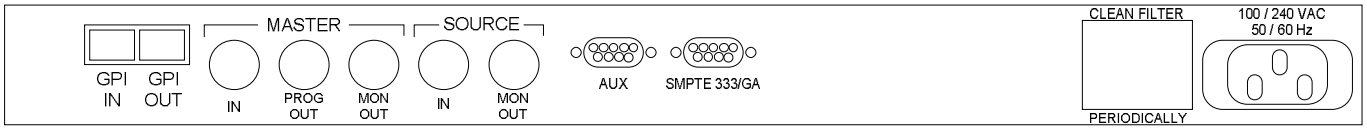
Bottom Bump indicates if a relocation function from the bottom of the screen is active, and how many rows it applies to.

Closed Caption Source indicates whether the input source of the closed caption data on the Master Video output is HD VANC or SD Line 21.

Closed Caption Activity indicates whether valid closed captioning is present through the unit.

Rear Panel

The Legalizer's rear panel is shown below.



100/240 VAC AC power input.

Master In Master video input. Accepts SMPTE 259M SD-SDI or SMPTE 292M HD-SDI.

Master Prog Out Program video output with relay-bypass protection.

Master Mon Out Video output for monitoring. This signal will not be generated if the unit is bypassed.

Source In Source video input for caption bridging. Accepts SMPTE 259M SD-SDI or SMPTE 292M HD-SDI.

Source Mon Out Testing only. This passes the source video through for monitoring. This video output is not relay bypassed, and should not be monitored if no signal is connected to the Source In.

GPI In RJ45 connector with 4 independent GPI input switches. See page 12 for GPI pin outs and configuration.

GPI Out RJ45 connector with 4 independent GPI output tallies.

AUX RS-232 input for configuration.

SMPTE 333/GA RS-232 output for serial delivery of captions to an ATSC encoder.

Section 3: Configuration

Using Smart Encoder Commands

The Legalizer's configuration is set through the RS-232 serial port marked AUX on the rear panel. The settings for this port are 1200 baud, 7 data bits, odd parity, and one stop bit. The CB512 uses a subset of the EEG Smart Encoder command set. Encoder commands are recognized by a leading control code of <CTRL+A>, also represented by the ASCII hex code 01. The <CTRL+A> character is non-printing on most terminal screens, but on some it appears as a smiley face. An Encoder control command must end with a carriage return, which can be entered with the <ENTER> key on a keyboard or by 0D in ASCII hex.

To send the encoder commands through the serial input ports, connect a standard 9-pin straight cable between your PC's serial port and the RJ11 to DB9 connector marked AUX on the rear panel. You can now send commands to the encoder, from your PC, using a communications application such as HyperTerminal, which is bundled with most versions of Windows. The most basic Smart Encoder command, useful for checking the operation of your communication setup, is **<CTRL+A>?<ENTER>**. If your setup is working correctly, the Encoder will respond with its model name, firmware version, and serial number. If you have trouble communicating using HyperTerminal, always check to make sure that the settings in the Port Settings menu in HyperTerminal match the settings for the Encoder port you are connecting to.

In this manual, Encoder commands will be distinguished from other text by use of a bold font. The parameters for each command will be listed in italics. Optional parameters will be enclosed in square brackets. Possible parameter values and default settings will be described in text or bullet points after the command is introduced.

Caption Port Serial Output Modes

The RS-232 port marked SMPTE 333/GA on the rear panel is an output port for sending serial caption data to an ATSC encoder. This port can be configured to interface with equipment supporting either the SMPTE 333 or the Grand Alliance protocols. The SMPTE 333 mode will be entered automatically if a SMPTE 333 device is connected to the port; the GA mode must be explicitly configured.

When either of these modes is in use, no VANC caption data will appear on the HD-SDI video outputs.

333 Serial Output

In 333 serial output, the CB512 sends its 708 caption output to a serial output queue for transport to an ATSC encoder supporting SMPTE 333M protocol. 333 is a "pull" protocol; the ATSC encoder sends synchronization requests (SYNs) to the caption encoder, which then sends the requested data bytes out through the serial port. The SMPTE 333M specification should be referred to for complete information about the protocol.

To set the CB512 for 333 serial output, simply connect the caption output port to the caption input port of a SMPTE 333M ATSC encoder. When the CB512 begins receiving SYNs it will automatically begin 333 output. The caption output port defaults to the proper communications settings for 333 (38400 Baud, 8 data bits, no parity, and one stop bit). The command to manually set the Encoder for 333 output and reset the caption port to these settings is **<CTRL+A>f 333 <ENTER>**.

GA Serial Output

In GA serial output, the CB512 sends its 708 caption output to a serial output queue for transport to an ATSC encoder supporting Grand Alliance (GA) protocol. Grand Alliance is a "push" protocol; the CB512 sends data out through P1 as it becomes available, and the ATSC encoder synchronizes the data upon reception. The Grand Alliance transport protocol in use by EEG equipment is described on page 17 of this manual.

Since the caption device initiates data transfer with a Grand Alliance ATSC encoder, GA output must be initialized manually. The command to set the CB512 for GA output is **<CTRL+A>f ga <ENTER>**. This command will begin the GA serial output operation and set the caption output port to the proper communication settings (19200 Baud, 8 data bits, no parity, and one stop bit).

Each time the CB512 is power cycled, it will return to its default mode of writing caption output to HD VANC. If a SMPTE 333M ATSC encoder is connected to the caption output port, however, 333 serial output will begin as soon as SYNs are received. If GA serial output is always desired, the GA output initialization command should be stored in Non-Volatile Memory to

reduce setup time. If the command is stored in NVM, GA output will automatically begin each time the Encoder is power cycled. To write a command to NVM, see page 10.

Caption Processing Control

The default caption processing behavior of the CB512 is to create a legalized output stream based on the caption data found in the Master video input. If no caption data is found in the Master, data from the Source input will be used, with any necessary format conversions performed automatically.

This default processing behavior is configurable using either the commands in this section, or the GPI switches.

Upstream VANC Enable <CTRL+A>! *[ON/OFF]* <ENTER>

Instructs the Encoder to either detect and potentially regenerate (default) or ignore incoming VANC caption data. If the encoder is set to ignore upstream VANC data, output signals will include only caption data recovered from SD video inputs. Use **OFF** to ignore upstream VANC caption data, and **ON** to resume detecting upstream VANC caption data.

Disable Upstream L21 Channel <CTRL+A>6 *Channel* <ENTER>
Re-enable Upstream L21 Channel <CTRL+A>7 *Channel* <ENTER>

Instructs the Encoder to ignore any incoming Line 21 data in the specified caption channel. When Line 21 data in a channel is ignored, output signals will not contain any caption data recovered from the SD video input in that channel, even if there are no other data sources available.

- **Channel** sets the incoming Line 21 channel to be turned off. This parameter may be set for any NTSC Caption or Text channel. Upstream XDS data cannot be turned off with this command. The options are cc1, cc2, cc3, cc4, t1, and t2.

Set Caption Data Source <CTRL+A>h *[ON/OFF]* <ENTER>

Instructs the Encoder to encode caption data recovered from the Source video input onto the Master video output. Any caption data on the Master input will be ignored. This command takes precedence over the **S** and **D** GPI mapping functions described in **GPI Switch Functions.**

Section 4: Additional Features

Non-Volatile Memory

The CB512 can store up to 32 commands in Non-Volatile Memory (NVM). When the Encoder is powered up or reset, any commands stored in NVM are executed as part of the startup process.

New NVM Command **<CTRL+A>w [*List*] *Command* <ENTER>**

Enters an Encoder command for NVM storage. The command, which must be entered in complete form including the initial <CTRL+A>, will be executed as if entered through the specified port each time the Encoder is turned on or reset. NVM commands are executed in order of list number. If no list number is specified, the command will be assigned the next available number.

Example: **<CTRL+A>w <CTRL+A>f ga <ENTER>** will store the Grand Alliance output command in NVM and run it each time Encoder starts up.

List NVM Commands **<CTRL+A>x <ENTER>**

Returns a numbered list of commands stored in NVM.

Delete NVM Command **<CTRL+A>w *List* <ENTER>**

Deletes the command with the specified list number from NVM. The remaining commands in the list will be renumbered to fill the empty list number left by a deletion. If "-a" is specified as the list number, all commands in NVM will be deleted.

List PROM Messages **<CTRL+A>J <ENTER>**

Returns a list of messages stored in the Encoder's PROM. The PROM may store up to 8 factory configured commands that execute upon power up or reset. If PROM commands are present, they are executed before NVM commands.

Serial Port Configuration

Change Baud Rate

<CTRL+A>I P2 *Baud Bits Parity* <ENTER>

Changes the baud rate on P2, the AUX RS-232 input port. A change in communication settings takes effect immediately; thus, after entering this command, you must immediately begin communicating at the new settings you entered.

- **Baud** sets the new baud rate for the port. Supported rates are 1200, 2400, 4800, and 9600.
- **Bits** sets the number of data bits. Choose either 7 or 8.
- **Parity** sets the parity bit. Choose either o for odd, e for even, or n for none.

Serial Port Pin Assignments

Serial ports 1 and 2 use 9-pin DB9 connectors with the following pin assignments:

Pin	DB9 Adapter
1	
2	Tx
3	Rx
4	
5	Ground
6-9	

These ports can be connected directly to a standard PC serial port with a 9-pin, three wire straight serial cable. A “null modem” cable MAY NOT be used for this purpose since it will reverse the connections of pins 1 and 2.

GPI Connector Pin Assignments

The GPI and GPO ports use 8-pin RJ45 connectors. The pin assignments are given in the table below, with pin numbers beginning with '1' on the left side of the connector.

Pin	GPI/GPO
1	Ground
2	GPI-B
3	Ground
4	GPI-C
5	Ground
6	GPI-D
7	Ground
8	GPI-A

GPI Switch Functions

Each GPI Switch is activated when closed (connected to ground), and inactive when open (left floating). The default GPI functions are defined as follows:

GPI-A: Relocate Captioning – Top 3 Rows (T3)

GPI-B: Relocate Captioning – Top 2 Rows (T2)

GPI-C: Relocate Captioning – Bottom 2 Rows (B2)

GPI-D: Relocate Captioning – Bottom 3 Rows (B3)

The default functions of these GPI switches enable remapping of caption displays to avoid either the top rows or bottom rows of the television screen. This function should be used to avoid blocking emergency information, news crawls, or other important graphics. The FCC requires that emergency alert information be visible to closed caption viewers.

For CEA-708 HD captioning, the CB512 can also be configured to map all captions to the left or right half of the 16:9 screen. The default setting is for HD captioning to appear the 4:3 center cut area in the middle of the screen. Horizontal position of CEA-608 captions is not affected by these settings.

Configure GPI Switches <CTRL+A>R *switchA switchB switchC switchD* <ENTER>

Each of the four parameters assigns a function to the respective GPI switch.

Each parameter should be set to either:

- **"-"**(hyphen), to indicate that the switch should perform its default function (described above).
- A custom two or three character string that will create a new caption relocation function (described below).

When mapping the parameters to a custom caption relocation function, the correct format is *abX*, where the first character *a* is optional and may be set to **L** to map all HD captions to the left of the screen, or **R** to map all HD captions to the right of the screen.

The second character *b* must be set to either **T** to protect an area at the top of the screen by bumping captions down, when necessary, or **B** to protect an area at the bottom of the screen by bumping captions up.

The third character *X* should be an integer between 2 and 4, indicating the number of captioning rows at the top or bottom that should be protected. There are 15 caption rows defined in the safe title area of the video, so a row value of 2 will protect 2/15 of the safe title area.

Once a caption remapping function has been created, simply short the corresponding GPI switch input to ground in order to activate the function.

As an additional option, *SwitchA* may be set to **S** which remaps GPI-A to source input select mode. This setting is not valid for other switches. When GPI-A is mapped to **S**, the switch behaves as follows:

- If GPI-A is asserted, caption data from the Source Video input is bridged to the Master Video.
- If GPI-A is not asserted, caption data from the Master Video input is maintained.

These rules are always maintained, regardless of whether caption data is or is not present on the Source or Master Video inputs. Automatic caption detection is disabled.

Similarly, *SwitchB* may be set to **D** which remaps GPI-B to disable bridging from source mode. This setting is also not valid for other switches. When GPI-B is mapped to **D**, the switch behaves as follows:

- If GPI-B is asserted, bridging from the Source Video input is disabled.
- If GPI-B is not asserted, source/master switching is based on automatic caption detection, as in the default mode.

Setting GPI-B to any other function also turns off this source disable mode.

The **S** function mapped to GPI-A takes precedence over the **D** function mapped to GPI-B. If the **S** function is mapped to GPI-A, then GPI-B has no effect on the caption source.

The **<CTRL+A>h** command, described on page 8, takes precedence over both the **S** and **D** GPI settings. This means that if the **<CTRL+A>h** mode has been enabled, only the Source Video is used for caption data regardless of GPI settings.

Entering the **<CTRL+A>R** command with no parameters will display the current GPI configuration.

Entering the **<CTRL+A>R** command with four hyphens will return the GPI configuration to the factory default.

The following table identifies the valid settings for each of the GPI switches. Valid setting options are:

	Switch A	Switch B	Switch C	Switch D
-	✓	✓	✓	✓
RT/LT/RB/LB/T/B	✓	✓	✓	✓
S	✓			
D		✓		

- Hypen = default functionality
T/B(n) Top or Bottom, followed by the row number
S Caption source input select mode
D Disable bridging from Source Video (when GPI asserted)

Examples:
<CTRL+A>R - B4 T4 - <ENTER> assigns the GPI-B switch to protect the bottom 4 rows of the screen from caption overlay and GPI-C to protect the top 4 rows, and leaves the GPI-A and GPI-D switches to perform their default operations.

<CTRL+A>R s B4 LT4 RT4 <ENTER> maps GPI-A to source input select mode, assigns the GPI-B switch to protect the bottom 4 rows of the screen from caption overlay, GPI-C to protect the top 4 rows while mapping all HD captions to the left, and GPI-D to protect the top 4 rows while mapping all HD captions to the right.

To place the above command in NVM so that the encoder will automatically power up in the mode described in the example above, you would enter:
<CTRL+A>w <CTRL+A>R s B4 LT4 RT4 <ENTER>

Encoder Status Commands

Report Identification **<CTRL+A>? <ENTER>**

Returns the Encoder's model, serial number, and firmware version.

Report HD Status **<CTRL+A>f <ENTER>**

Returns the Encoder's current HD operation setting (334M VANC Insertion, 333M VANC Recovery, or GA VANC Recovery) and the availability of an HD video source (HD-SDI Present or HD-SDI Not Present). If an HD signal is present, the video format of the source and whether or not VANC caption data is present are also reported.

Recovery Status **<CTRL+A>A <ENTER>**

Returns the data recovery status of each Line 21 channel for incoming SD video. ON indicates that data on the channel is being recovered and processed. OFF indicates that the channel has been turned off (see page 9) and incoming data is being ignored.

SD Video Presence **<CTRL+A>b <ENTER>**

Reports either Video Present or No Video Present to indicate whether or not the Encoder is receiving an SD video signal.

Read LCD Display **<CTRL+A>N <ENTER>**

Returns the current readings on the front panel LCD display. The format is identical to that of the front panel display (see page 4).

Report Switch Setting **<CTRL+A>S <ENTER>**

Returns the current setting of the front panel ENCODER ON bypass switch.

Report Battery Level **<CTRL+A>Y <ENTER>**

Returns the status of the battery that maintains the Encoder's Non-Volatile Memory. GOOD will be returned for a properly functioning battery. BAD will be returned for a battery in need of replacement.

Monitor Line 21 **<CTRL+A>5 [*Channel*] [*I/O*] <ENTER>**
End Monitoring **<CTRL+C>**

Monitors and displays the EIA-608B caption data encoded in the specified channel. The I/O parameter determines whether the incoming (enter as I) or outgoing (O) data is monitored. The default settings are incoming and CC1.

Appendices

Appendix A: Grand Alliance Interface Protocol

The following table describes the Data Packet Structure used by EEG equipment to send caption data to Grand Alliance protocol ATSC encoders. This protocol has been proven compatible with encoders from all major manufacturers supporting GA protocol.

Byte	Name	Value	Meaning
0	SOH	0x01	ASCII SOH, start of packet
1	Type	0x41	ASCII "A", ATVCC data
		0x31	ASCII "1", NTSC field 1 data
		0x32	ASCII "2", NTSC field 2 data
2	Count	5+n	Packet size, in bytes, including header and trailer bytes.
3	Data 1	EIA-708 data bytes.	
4	Data 2		
2+n	Data n		
3+n	Checksum	<varies>	1 byte checksum. The sum of all bytes in the packet must be zero, modulo 256.
4+n	EOT	0x04	ASCII EOT, end of packet

Notes:

1. The maximum packet size is 128 (0x80).

2. Because the packet size (Count) includes the header and trailer bytes, the minimum valid count is 5. This corresponds to a packet with zero data bytes.

3. This packet structure is applied only to the data for the closed caption serial stream input to the ATSC encoder. Outgoing bytes in the ATSC stream follow the EIA-708B standard.

CB512 Specifications

SDI INPUT VIDEO CHARACTERISTICS	
Number of Inputs	2
Connector	BNC per IEC 169-8
Format	SMPTE 292M 1.485 Gbit/s 1080i, 720p, 480p, 24psF or SMPTE 259M 270 Mb/s
Input Impedance	75 Ohms
Equalization	Automatic up to 100m @ 1.5 Gb/s w/ Belden 1694 (or equivalent)
Video Input Level	800 mV p-p ± 10%, Out 1 bypass protected

HD-SDI OUTPUT VIDEO CHARACTERISTICS	
Number of Outputs	2 Program Outputs (Output 1 bypass relay protected), 1 Source Output
Connector	BNC per IEC 169-8
Format	SMPTE 292M 1.485 Gbit/s or SMPTE 259M 270 Mb/s (matches input format)
Output Impedance	75 Ohms
Output Level	800 mV p-p ± 10%
DC Offset	0V ± 0.5V
Rise/Fall Time	200pS nominal
Overshoot	< 10% of amplitude
Wide Band Jitter	< 0.2 UI

DATA INPUT CHARACTERISTICS	
Data Ports	Two serial RJ-11 jacks, selectable RS232C / RS422 Serial Data Format 7 data bits, odd parity, 1 stop bit, 1200 baud default
GPIO Input	Four switches on RJ45 connector
GPIO Output	Four switches on RJ45 connector

FRONT PANEL CONTROLS & DISPLAY	
Display	2 x 24 LCD, back-lit display showing unit operating conditions
Power (On/Off)	Push-button switch with integral circuit breaker, white band indicates Off state
Encoder ON	Push-button switch controls bypass state, LED lit for non-bypassed state
Reset	Flush momentary switch, resets the encoder

PHYSICAL CHARACTERISTICS	
Height	1.75 inches (4.4 cm)
Width	19 inches (48.3 cm)
Depth	10 inches (25.4 cm)
Mounting	Designed for rack mounting with or without chassis slides
Weight	9 lbs. (4.1kg)
Ambient Operating Temp	0° C to 50° C

POWER REQUIREMENTS	
Line Voltage	117 VAC 10%
Line Frequency	50/60 Hz
Line Current	0.3 A maximum
Input Power	36 W
Circuit Protection	Internal to On/Off switch, 0.4 A
EMI/RFI	Complies with FCC Part 15 Class A, EU EMC Directive

References

The following specifications have been incorporated into the design of all EEG closed captioning products. They are the definitive sources for additional information regarding the respective technologies that they describe.

ATSC A/53B, ATSC Digital Television Standard, 2001.

EIA/CEA-608-B, Line 21 Data Services, 2000.

EIA-708-B, Digital Television (DTV) Closed Captioning, 1999.

SMPTE 259M, 10-bit 4:2:2 Component and 4fsc Composite Digital Signals – Serial Digital Interface, 1997.

SMPTE 291M, Ancillary Data Packet and Space Formatting, 1998.

SMPTE 292M, Bit-Serial Digital Interface for High Definition Television Systems, 1998.

SMPTE 333M, DTV Closed Caption Server to Encoder Interface, 1999.

SMPTE 334M, Vertical Ancillary Data Mapping for Bit-Serial Interface, 2000.

