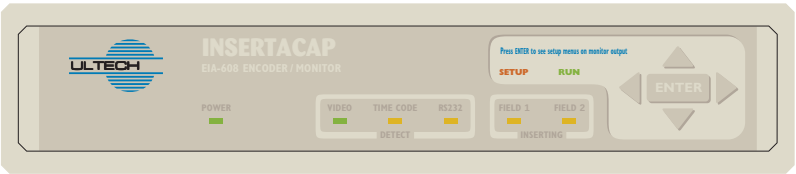

Insertacap

EIA-608 Encoder / Monitor / Character Generator

USER'S MANUAL

ULTECH Corporation
28 C Great Hill Road, Seymour, CT 06483, USA
TEL: (203) 735-5805, FAX: (203) 735-6653

WARRANTY

This product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, ULTECH Corporation will, at its option, either repair or replace defective products. For warranty service or repair, this product must be returned to a service facility designated by ULTECH Corp. Buyer shall prepay shipping charges for products returned to ULTECH for warranty service; ULTECH shall pay shipping charges to return product to the Buyer. Buyer shall pay all shipping charges, duties, and taxes for products returned to ULTECH from countries outside of the USA.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper use by Buyer. No other warranty is expressed or implied. ULTECH specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. ULTECH shall not be liable for any direct, indirect, incidental or consequential damages resulting from the use of this product.

IMPORTANT

This instrument is an AC mains-operated electrical apparatus. Maintenance, repairs, and adjustments must be carried out only by qualified personnel. Do not operate the unit without the cover in place.

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1. General Information

1.1 Introduction

Thank you for purchasing the ULTECH *Insertacap*. As the name implies, the Insertacap *inserts captions*, or more specifically, inserts *closed* captions. Inserting captions means encoding caption data in the vertical blanking interval for later use. The Insertacap can also decode/display captions from the vertical blanking interval or serial data port. What differentiates the Insertacap from other caption hardware on the market is its array of features.

Insertacap is required for off-line caption creation, editing, and encoding. It enables you to see *exactly* how your captions will appear to the viewer as you create a closed-caption data file. Insertacap emulates the way captions are decoded by a TV set. It's the only product on the market that lets you view captions in color and with transparent & semitransparent background (color and transparency are defined in EIA-608 *Recommended Practice for Line 21 Data Service*[1]). After you have created a caption/time code data file, Insertacap will produce a caption master video tape.

Insertacap was designed with two key features in mind:

1). Give the caption creator the most *complete* monitoring possible. Why? Because the one thing a caption creator cares about most is how his or her captions look on-screen.

2). Make the unit as *easy* to install and use as possible. The built-in time code reader means not having to open the cover of your PC to set up a caption editing system. And the front panel LED's help you isolate problems when things go wrong.

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Consumer Electronics Group
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1.2 Closed Caption Terminology

Every discipline involving computers and technology brings with it its own terminology and concepts—the field of closed captioning is no different. To get the most out of the Insertacap and its related equipment, it may be helpful to review a few terms.

Vertical Blanking Interval TV scan lines 1-21 of a video signal corresponding to the non-visible portion of a video signal. The vertical blanking interval (VBI) is used primarily to restart a sweep of the image on the picture tube from left to right and top to bottom. The VBI is somewhat like the top margin of a paper. The vertical blanking interval is often used to carry test signals, closed caption data, network messages, and other forms of data.

Field 1 The odd numbered scan lines that make up an entire screen. There are 262.5 scan lines in field 1 (312.5 for PAL).

Field 2 The even numbered scan lines that make up an entire screen. There are 262.5 scan lines in field 2 (312.5 for PAL).

Frame The combination of field 1 and field 2. There are 59.94 fields per second, and therefore 29.97 frames per second (25 for PAL).

Closed Caption A caption that is encoded as data in the vertical blanking interval-portion of the video signal. A closed caption, by itself, is not visible as text on a TV screen; it must be rendered as text by a closed caption *decoder*.

Open Caption A caption that appears as readable text characters on the visible portion of the TV screen. The open caption may, or may not have, a corresponding closed caption encoded in the vertical blanking interval.

Closed Caption Encoder A device that takes closed caption data in the form of computer readable data and encodes it in the vertical blanking interval as a coded video waveform.

Closed Caption Encoding A process that results in a closed caption video tape master. During a closed caption encoding session, captions, which reside on a computer disk, are sent to the encoder based on the video program's time code.

Data Service There are two other services associated with “closed captioning” besides the one that we all think of when we see the term “closed caption”. They are the *Text service* and *Extended Data Services* (XDS). The Text service provides a full screen (or half screen, depending on the decoder) of scrolling text that is unrelated to the current program. Text service is commonly used for announcements and program schedules.

Extended Data Services is normally used to provide information like program name, description, rating, category, etc. Collectively, we refer to all of these services as “Line 21 data services”. Line 21 data services may be multiplexed (sent in interleaved fashion) in a single VBI line. The following table represents the full complement of Line 21 data services.

	Field 1	Field 2
Caption service:	C1, C2	C3, C4
Text service:	T1, T2	T3, T4
Extended data:	-	XDS

Note that C1, C2, C3, and C4 may carry different caption services at the same time, perhaps in four different languages. The same goes for the Text services, although there is a practical limit to the number of services you can encode at one time, imposed by the two character per field data rate. C1, C2, C3, and C4 are called caption *channels*. You need to know what field and channel you want to encode in, and what field and channel you decode from, when using the Insertacap and associated software.

Transparent mode A mode of operation where a closed caption encoder does *not* overwrite existing (incoming) closed caption data; rather it lets the caption data pass transparently through to the output of the encoder.

Encode mode A mode of operation where a closed caption encoder overwrites any existing closed caption data.

Caption Character Generator A device or mode of operation that produces open captions on the TV screen. The source of the captions is usually a computer or stenographic machine that feeds the data port of the character generator. A caption character generator ignores line 21 data.

Closed Caption Decoder A device that converts line 21 data into readable text on the TV screen.

1.3 Applications for Insertacap

The Insertacap operates in three modes: Encoder mode, Character Generator mode, and Closed Caption Decoder mode.

1.3.1 Encoder Mode

The primary job of the Insertacap is to encode closed caption data in the vertical blanking interval (line 21 for NTSC, line 22 for PAL). Up to two characters are encoded in each field. The characters are encoded using an FCC-specified waveform—a waveform that closed caption decoders can subsequently decode.

You use the encoder mode of operation when you want to broadcast or record a program with *closed* captions added. Note: you can also broadcast or record a program with *open* captions by using the Insertacap's Decoder output.

1.3.2 Character Generator Mode (“CG” mode)

Character Generator mode is used exclusively during the process of creating off-line closed captions. It allows a caption creator to fine tune the placement and timing of captions. You may be wondering why you couldn't use the encoder mode and simply decode and monitor the resulting captions from the VBI instead. The reason is stability. If you were to pause or shuttle a video tape machine feeding the Insertacap, its built-in closed caption decoder would not be able to display captions. But in CG mode, captions remain, or continue to be displayed, on the screen. Other closed caption character generators on the market require an expensive time base corrector in order to display captions during pause or shuttle tape operations.

1.3.3 Decoder Mode

This mode is used to decode closed captions from the video feeding the Insertacap. During decoder mode, the built-in encoder is disabled so the incoming video passes through transparently. You can use this mode to check the quality of captioned video tapes.

1.3.4 Limitations in Character Generator Mode

There are two minor incompatibilities between CG mode and normal decoder mode owing to the way CG mode is implemented in the Insertacap. The primary objective for CG mode is to give a display with exactly the same characters and attributes that a viewer would get from a closed caption-equipped TV set. The most faithful way to accomplish this is to use an actual TV-style closed caption decoder circuit. In CG mode, the closed caption

decoder circuit is driven from the Insertacap's on-board microcomputer. The decoder circuit has certain limitations that result in the following incompatibilities:

1. When changing the base row in caption rollup mode, the Insertacap first erases the display, whereas an EIA-608 decoder moves any displayed caption text to the new base row position.
2. When changing from pop-on mode to rollup mode, the Insertacap first erases the display, whereas an EIA-608 decoder leaves any existing caption intact.
3. When changing from rollup mode to pop-on or paint mode, the Insertacap first erases the display, whereas an EIA-608 decoder leaves any existing caption intact.

Please note that these limitations are only evident in CG mode; when using the closed caption decoder output in Encoder or Decoder modes, the Insertacap behaves exactly as an EIA-608 decoder. Also note that in CG mode, the Insertacap renders caption with exactly the same attributes and timing as an EIA-608 decoder. These include color, transparent, and semitransparent backgrounds.

2. Installation

2.1 Voltage setting

The Insertacap uses a "universal" power supply that operates from 90 VAC to 260 VAC, 48 Hz to 64 Hz, line voltage. There are no adjustments or settings required to set the power supply AC input voltage.

2.2 How to connect

2.2.1 Off-line caption creation

Fig. 2-1 shows the basic connection for creating captions off-line (not live). The goal of off-line caption creation is to create a database (disk file) containing the captions and associated timing for a video program. The video program together with time code is played back on a source VCR (your caption creation software may give you VCR control from the PC). The source video feeds the Insertacap which should be set to Character Generator mode. You may use composite video from the VCR or, preferably, Y/C component video. A caption monitor allows you to view the captions as you create and place them. An S-Video monitor is highly recommended over a composite video monitor (in this case you must use a Y/C tape machine). A PC running caption creation software allows you to enter captions, set attributes, position them, and adjust their reveal times.

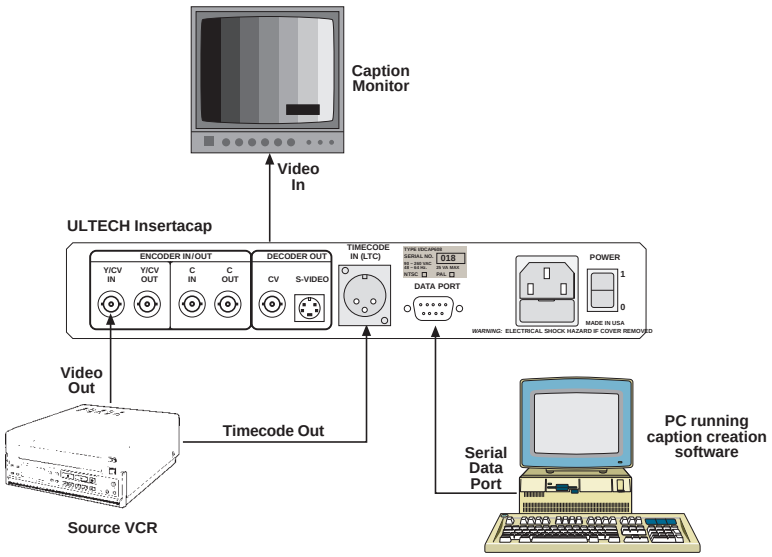

Fig. 2-1. Connection for off-line caption creation

2.2.2 Caption encoding

The goal of caption encoding is to create a caption master video tape with caption data inserted into the vertical blanking interval. You feed the Insertacap with an uncaptioned program and rerecord it with captions encoded in the VBI. The Insertacap will accept composite or Y/C component video formats. A PC running caption encoding software such as ULTECH's CCX for Windows reads captions from a file and sends them to the Insertacap for encoding. The PC sends captions to the Insertacap based on the video program's time code. The caption file is created during an off-line caption creation session prior to encoding. A composite or S-Video monitor lets you verify that captions are encoded correctly.

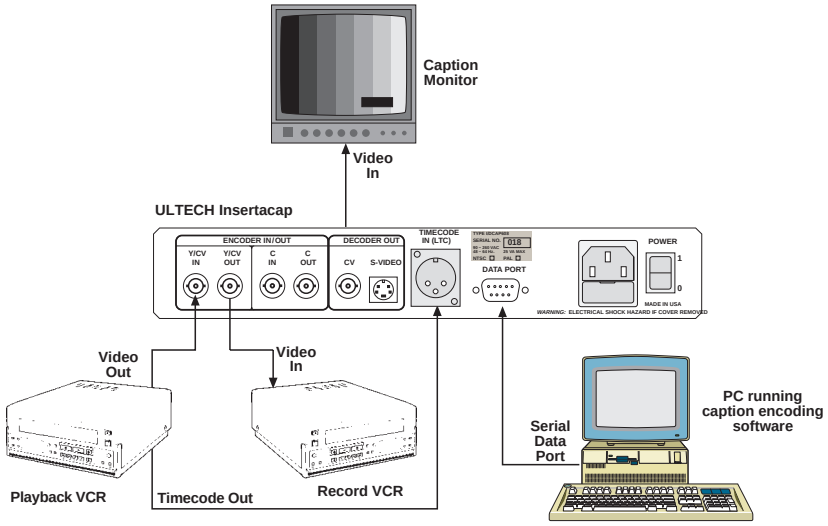

Fig. 2-2. Caption encoding

2.2.3 Live captioning

Live captioning may be used to display the ongoing dialog of a meeting on a video monitor(s). The captions may be displayed against a black background, or may be displayed on top of video fed from a video camera. This setup may also be used to broadcast live programs that are captioned in “real time”. In either case, the caption text may be entered with a stenographic-machine or PC running real-time captioning software. A variation is to feed the live caption data to a remote Insertacap via a modem.

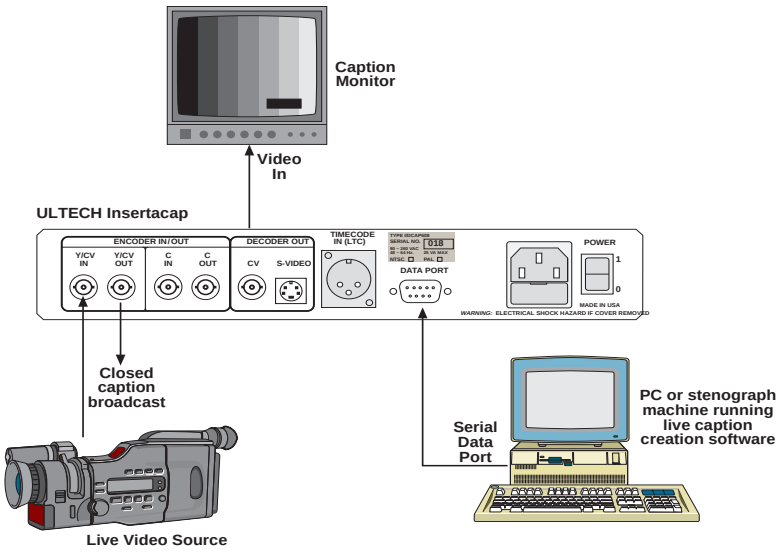

Fig. 2-3. Live captioning

3. Operating Instructions

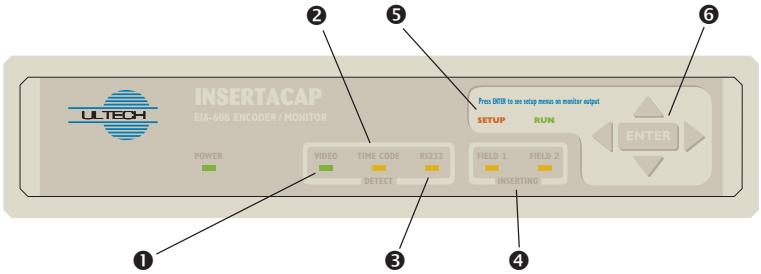

Fig. 3-1. Front panel

3.1 Front panel controls, indicators

❶ Video LED. Illuminates when the Insertacap detects proper incoming video. This indicates that your tape is playing and the video input cable is connected properly.

❷ Time code LED. Flashes once a second when LTC time code is detected. This indicates that your tape has a time code track and that your LTC cable is connected properly.

❸ Bicolor RS-232 data LED. Flashes green when some form of RS-232 data is detected. Flashes amber when properly formatted commands are received. When the LED flashes green, it indicates that your PC is sending something to the data port, and your serial cable is connected properly. When the LED flashes amber, it indicates that your PC is sending valid Insertacap commands.

❹ Inserting LEDs. Illuminates when the Insertacap is in Encode mode. When lit, the Insertacap is inserting data into the VBI of the outgoing video (and overwriting any caption data that happens to be present in the incoming video).

❺ Setup/Run LEDs. The red Setup LED illuminates when you are in setup mode. In setup mode, an on-screen menu is displayed on the decoder monitor (the Insertacap will continue to encode data while in setup mode). The green Run LED illuminates when you leave setup mode.

❻ Cursor keys. Press ENTER to bring-up the on-screen menu. Press the left, right, up, down cursor keys together with the ENTER key to move through the menu and make selections.

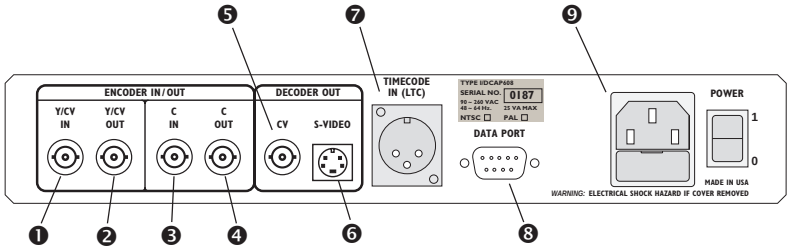

Fig. 3-2. Rear panel

3.2 Rear panel connections

❶ Y/CV Encoder In. Composite video input when driven from composite video sources; luminance input when driven from Y/C component video sources.

❷ Y/CV Encoder Out. Composite video output when used with composite video sources; luminance output when used with Y/C component video sources. This output contains the closed caption waveform inserted in line 21 when the Insertacap is set to Encode mode. This output does *not* contain "open" captions—captions that are readable on a monitor.

❸ C Encoder In. Chrominance input when driven from Y/C component video sources. Unconnected when used with composite video sources.

❹ C Encoder Out. Chrominance output when driven from Y/C component video sources. Unconnected when used with composite video sources. This output is provided in order to delay the chrominance channel exactly the same amount as the luminance channel when passed through the Insertacap.

❺ Composite Video Decoder Out. This is the composite video output of the on-board closed caption decoder. It is used for monitoring captions and for displaying on-screen menus. This output provides readable captions (in full color). The captions sent to this output are keyed into the incoming video with a linear key. The keyer provides solid, transparent, and semitransparent background boxes. Line 21 data also appears on this output.

❻ Y/C Component Video Decoder Out. This is the component video output of the on-board closed caption decoder. It is used for monitoring captions and for displaying on-screen menus. This output provides readable captions (in full color). The captions sent to this output are keyed into the incoming video with a linear key. The keyer provides solid, transparent, and semitransparent background boxes. This output is

intended for monitors with S-Video or Y/C component video inputs.

❼ Longitudinal Time Code Input. This input comes from your VCR's time code output. This may be a dedicated output or one of your VCR's audio tracks. The Insertacap decodes the incoming time code and makes it available to your PC via the RS-232 data port. Your caption creation software may or may not use the Insertacap's built-in time code reader.

❽ RS-232 Data Port. Used to connect the Insertacap to a PC via a 9 pin “straight” cable (pin 2 - pin 2, pin 3 - pin 3). The Insertacap receives commands and data via this connector.

❾ AC input/fuse holder. Apply 90 VAC to 260 VAC line voltage via the supplied power cord. The line fuse compartment is located below the AC receptacle (see Technical Reference for instructions on how to change the fuse).

3.2.1 Built-in test pattern

The Insertacap contains a built-in test pattern that appears at the decoder output. To invoke the test pattern, press and hold the ENTER key for about three seconds as you switch the power on. You should see a test pattern consisting of text, color bars, semitransparent background, and special characters on your video monitor.

3.3 On-screen menus

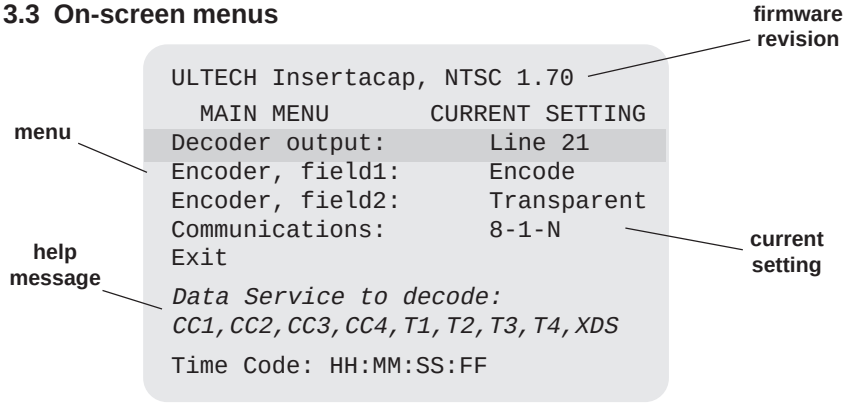

Fig. 3-3. On-screen menu

The Insertacap has an on-screen menu which is activated by pressing ENTER on the front panel. The on-screen menu appears at the CV and S-Video Decoder Outputs only. Activating the on-screen menu does not affect the Y/CV and C encoder outputs, so you can make adjustments or view time code without disrupting an encoding session.

How to make selections

1). Press ENTER to bring-up the on-screen menu.
2). Use the ⇧⇩ up/down keys to highlight a menu line.
3). Press ENTER to pop-up a menu of choices.
4). Use the ⇦⇨ left/right keys to highlight a choice.
5). Press ENTER to select the highlighted choice.

Decoder output

Sets the built-in line 21 decoder to monitor caption, text, or extended data services. The service is monitored exclusively; other services, if present in line 21, are not decoded. This setting will be remembered when power is removed and reapplied.

CC1: Monitor closed caption data channel 1 (field 1)
CC2: Monitor closed caption data channel 2 (field 1)
CC3: Monitor closed caption data channel 3 (field 2)
CC4: Monitor closed caption data channel 4 (field 2)
T1: Monitor Text data channel 1 (field 1)
T2: Monitor Text data channel 2 (field 1)
T3: Monitor Text data channel 1 (field 2)
T4: Monitor Text data channel 2 (field 2)
XDS: Monitor Extended Data Services (field 2, only Call Letters, Time in show, and Program Description are shown).

Encoder, field 1

Sets the field 1 encoder-portion of the Insertacap. This option can be changed from the front panel, or from your PC. In either case, changes will be immediately reflected in the current setting. This setting will be remembered when power is removed and reapplied.

Encode: Generate closed caption waveform locally. Incoming captions are overwritten.

Transparent: No local captions are generated. Incoming captions are passed.

CharGen: Open captions are produced at the Decoder Output but are not encoded into the VBI.

Encoder, field 2

Same as above but for field 2. Note that field 2 may be set independently from field 1 for Encode or Transparent modes only; for Character Generator mode, field 2 and field 1 will automatically be set the same.

Communications

Sets the data rate between the Insertacap and your PC.

1200: 1200 bps (bits per second)

9600: 9600 bps

19200: 19.2 Kbps

38400: 38.4 Kbps

Note that the word length is always set to 8 bits with 1 stop bit and no parity bit. This setting will be remembered when power is removed and reapplied. Note to programmers: the Insertacap ignores the most significant bit, so it will actually work with 7 bits, 1 stop bit, and odd parity. However, when sending information *out* the port, the Insertacap uses 8-1-N.

If your caption creation program or caption encoding software reads time code from the Insertacap, it is recommended to use a data rate of at least 19.2 Kbps.

Exit

Erases the menu from the screen.

4. Programmer's Reference

The following section is intended for *applications software developers*. It contains a detailed description of commands for the Insertacap Closed Caption Encoder/Character Generator.

The Insertacap accepts encoder control commands and data remotely via an RS-232 interface. *Encode r control commands* ("commands") refer to those commands that are intended for the encoder's use only—they are never encoded in line 21. *Data* refers to closed caption control codes and text data that are required by closed caption decoders to render a caption as intended by a caption creator. *Data* is always encoded in line 21. *Commands* may differ from one model encoder to the next but *data* never differs—*data* is based on an industry standard.

Commands and data come from a "data server" (usually a PC). Most commands have been designed to be backwards compatible with existing equipment such as the ULTECH EDS400 rack-mounted XDS/Caption Encoder.

The Insertacap contains some commands not found on older encoders. These include commands to:

- Encode Caption/Text/XDS data in both fields simultaneously.
- Poll time code from the Insertacap's built-in time code reader.
- Instruct the Insertacap to send a "trigger" through the RS-232 port when a certain time code has been reached.

The Insertacap omits some commands found on older encoders. These include:

- Enter/Delete/Output Text article.
- Enter Newswire/Real Time Caption/Text.

4.1 Functional Requirements

The command set developed for the Insertacap was designed to meet the following objectives:

- Transmit non-caption (binary) data as well as Caption/Text/XDS data.
- Transmit data in line 21 Field 1 and line 21 Field 2 simultaneously.
- Do not pass or otherwise process upstream line 21 data when local caption data is encoded.
- Pass line 21 video (upstream captions) if requested ("transparent break").

- Transmit interleaved Caption/Text/XDS packets. Interleaving is done by the PC.
- Provide a simple command protocol that is backwards compatible to the familiar “Control-A” protocol to allow easy porting of existing caption software.

4.2 Communications

The Insertacap contains a single RS-232 serial port that is wired to a 9 pin DB-9F connector. Data comes into the Insertacap on pin 3 and leaves on pin 2. DTR, pin 6, and RTS, pin 8 are pulled high. The port can be configured for 1200, 9600, 19.2K, or 38.4K bps from the front panel (front panel settings are saved in nonvolatile memory). You can *send* data to the Insertacap as 8 data bits, 1 stop bit, no parity (8-1-N) or 7 data bits, 1 stop bit, odd parity (7-1-O), but you must *receive* data in 8-1-N format. The Insertacap uses Xon/Xoff to control the flow of data into the unit from the data server. Insertacap has limited receive buffers so your data server *must* respond to Xon/Xoff handshaking. The Insertacap itself does not respond to Xon or Xoff from the data server.

4.3 Commands

4.3.1 Command syntax

An Insertacap command can have one of two formats:

1. [SOM][command ID]<command parameters>[CR]
2. [SOM][command ID]<command parameters>[CR]<caption/text data>[EOM]<CR>

Spaces (20 hex), tabs (09 hex), or commas (2C hex) can be used to separate command parameters.

Definitions

ACK	Acknowledge: ^F (06 hex)
class	XDS class identifier (two digit ASCII hex number): 01..0Fh
CR	Carriage Return: ^M (0D hex)
End	XDS end character: 0Fh
EOM	End Of Message: ^C (03 hex)
F1	Field 1 specifier (ASCII “F” or “f”, “1”, “2”)
F2	Field 2 specifier (ASCII “F” or “f”, “1”, “2”)
HMSF	Packed binary coded decimal ASCII chars for Hours, Minutes, Seconds, Frames with offset of 20H added
LF	Linefeed: ^J (0A hex)
mode	data preprocessing mode: 1, 2, 3, 5; default: 3 (ASCII “1”..”3”, “5”)

SOM	Start Of Message: ^A (01 hex)
text	ASCII text
type	XDS type identifier (two digit ASCII hex number): 01-7Fh
XOFF	Flow control stop character: ^S (13 hex)
XON	Flow control start character: ^Q (11 hex)
[ ]	indicates a mandatory parameter
< >	indicates an optional parameter

4.3.2 Command Acknowledgment

The Insertacap will acknowledge a valid command with '*'[CR][LF] (in hex: [2A][0D][0A]). The Insertacap will return an "E" for a syntax error or invalid command (in hex: [45]). The Insertacap will flash the RS-232 LED green when it detects incoming data on the serial port, and will flash it amber when it recognizes a valid command. Commands ending in mandatory [CR] are not acted on until the CR is received.

4.3.3 Command Set

- **Reset Encoder**

  Syntax: [ACK][ACK]

  The encoder's field 1 and field 2 buffers are erased. Local encoding is terminated and all upstream data is passed (the Insertacap becomes "transparent"). This command is acted on as soon as it is received—even in the middle of an Enter Caption/Text/XDS command unless mode = 1 or 5 (if mode = 1 or 5, XDS data entry is assumed, and ACK ACK may occur as a valid XDS sequence).

- **Enter Caption/Text/XDS**

  Syntax: [SOM]3 <mode> <F1 or F2> [CR] <caption/text data/XDS data>[EOM]<CR>

  The caption/text lines input through the data port are encoded in field 1 or field 2 with varying degrees of processing as determined by <mode>.

  mode = 1: All data except ASCII 03 is allowed and passed.

  mode = 2: Valid two byte caption control codes are field aligned, that is, they are transmitted in the same field. A valid caption control code is any two byte sequence in the range of 10h..1Fh (the Insertacap does not check the validity of the second byte). The encoder may automatically insert a null byte (ASCII 00h) in order to group a two byte control code sequence in a single field.

  mode = 3: Same as mode 2 plus all valid control codes are doubled

(repeated in the next frame). EIA-608 recommends control code doubling only for field 1.

mode = 5: Used for XDS encoding. See below.

If mode is entered as "4"—a valid option for encoders such as the EDS400—the Insertacap will revert to mode 3. Default mode is 3; default field is F1.

To encode XDS data, use the following sequence:

[SOM]3 5 <F2>[CR][class][type]<data>[end][EOM]<CR>

XDS data is entered as data packets preceded by their class and type identifiers, followed by an End of Packet character (0Fh). Insertacap will insert the XDS checksum up reception of the [EOM].

Character	Range
class:	01..0Fh
type:	01..7Fh
data:	20..7Fh
end:	0Fh

The Insertacap does not check these ranges. The data portion of the packet cannot exceed 32 characters (not checked by Insertacap).

Insertacap doesn't check for [EOM] until after class & type have been received (the first two characters are not checked for [EOM]).

If *field* is not entered then the default is field 2. If field 1 is entered then an error is returned.

- **Disable Upstream Data**

  Syntax: [SOM]6 <F1 or F2>[CR]
  Deletes upstream caption/text/XDS data. Inserts a locally generated line 21 waveform into Field 1 of outgoing video ("opaque mode"). Default field is F1.

- **Enable Upstream Data**

  Syntax: [SOM]7 <F1 or F2>[CR]
  Enables upstream caption/text/XDS data. Disables locally generated line 21 waveform of outgoing video. Line 21 video passes through the encoder transparently. A subsequent ^A3... command/caption sequence containing Field 1 data *will* insert data and *will* generate a local line 21 waveform (unless user selected mode is Character Generator). The locally generated waveform will remain indefinitely or until another ^A7 is received. Default field is F1.

- **Read the current time code**

  Syntax: [SOM] R[CR]

  This command is intended for encoder software that would otherwise poll a PC plug-in time code card. It returns the current time code in packed binary coded decimal format "HMSF" (Hours, Minutes, Seconds, Frames). An offset of 20h is added to each of the four bytes sent from the Insertacap to the PC. This keeps the four time code bytes in the range of 20h to 79h. If time code bytes below 20h were allowed, it would be possible for the PC to confuse a time code byte with an XON or XOFF flow control character.

  If you send a ^AR "Read time code" command to the Insertacap, you must receive the four time code bytes before issuing a new command. This command is not acknowledged by the Insertacap.

- **Quick read the current time code**

  Syntax: ^G

  This command is identical to the above ^AR "Read current time code" command except it enables you to read time code while in the middle of a ^A3 "Enter caption" command. With ^AR you have to exit the ^A3 mode, issue ^AR[CR], read four resulting time code bytes, then reenter ^A3... for the next caption. With ^G "Quick read current time code", you do not have to leave the ^A3 mode. However, you must be *in* ^A3 mode 2 or 3 for ^G to work.

  ^G (07h) returns the current time code in packed binary coded decimal format "HMSF" (Hours, Minutes, Seconds, Frames). An offset of 20h is added to each of the four bytes sent from the Insertacap to the PC. If you send a ^G "Quick read current time code" command to the Insertacap, you must receive the four time code bytes before issuing a new command. This command is not acknowledged by the Insertacap.

- **Wait for specified time code**

  Syntax: [SOM]WHMSF[CR]

  This command can trigger the PC to send a caption or End Of Caption control code ("flip memories") to the encoder at a specific time. The encoder waits for a match between the requested time code and the current time code (encoder time code >= specified time code). When the time code is reached the encoder sends a "T" to the PC. This command allows the encoding software to be interrupt driven. You must add an offset of 20h to each of the four bytes you send to the Insertacap. This keeps the four time code bytes in the range of 20h to 79h. This command is not acknowledged by the Insertacap. No

separator is allowed between “W” and “H”; you must follow the “W” immediately with the hours character.

- **Query Encoder**

  Syntax: [SOM] ?[CR]

  Returns a serial number, model number, version, and firmware revision date in the following format:

  ```
  nnnn Insertacap, NTSC 1.XX  [CR][LF]
  ```

  where nnnn is a four digit serial number in ASCII decimal format. The serial number is programmed in the factory and is unique for each Insertacap. Serial numbers range from 0000 to 9999 and match the serial number label on the rear of the Insertacap. Caption software companies can control the distribution of their software when bundled with an Insertacap by way of the serial number.

  This command *is* acknowledged by the Insertacap.

4.3.4 Examples

The following examples show all characters transmitted between PC and Insertacap in hexadecimal format. Each character is enclosed in square brackets [ ]. Comments are preceded by a double slash //.

Reset the encoder

PC-to-Insertacap:	[06][06]		// Reset encoder
Insertacap-to-PC:		[2A][0D][0A]	// Acknowledge

Enable upstream data, Field 1 (during a commercial break, for example)

PC-to-Insertacap:	[01][37][46][31][0D]		// Pass upstream data
Insertacap-to-PC:		[2A][0D][0A]	// Acknowledge

Disable upstream data, Field 1

PC-to-Insertacap:	[01][36][0D]		// Disable upstream
Insertacap-to-PC:		[2A][0D][0A]	// acknowledge

Transmit a CC1 pop-up caption “HELLO” (CC1 goes in Field 1)

PC-to-Insertacap:	[01][33][20][33][0D][14][20][14][70]		// ^A3 mode 3, field 1 //RCL, row 14 white,0
	[48][45][4C][4C][4F][14][2F]		// HELLO, EOC
	[03][0D]		// End of message
Insertacap-to-PC:		[2A][0D][0A]	// Acknowledge

Transmit a CC3 pop-up caption "HELLO" (CC3 goes in Field 2)

PC-to-Insertacap:	[01][33][20][32][20][46][32][0D]	// ^A3 mode 2, field 2
	[15][20][15][70]	// RCL, row 14 white,0
	[48][45][4C][4C][4F][15][2F]	// HELLO, EOC
	[03][0D]	// End of message
Insertacap-to-PC:	[2A][0D][0A]	// Acknowledge

Transmit an XDS Program ID number

PC-to-Insertacap:	[01][33][35][0D]	// ^A3, mode 5, CR
	[01][01]	// class, type,
	[40][48][46][43]	// data,
	[0F]	// XDS End
	[03][0D]	// End of message
Insertacap-to-PC:	[2A][0D][0A]	// Acknowledge

Read the current time code

PC-to-Insertacap:	[01][52][0D]	// Read current time
Insertacap-to-PC:	[21][47][25][42]	// Code "01:27:05:22"

Quick read the current time code (only while in ^A3 modes 1 or 2)

PC-to-Insertacap:	[07]	// Read current time
Insertacap-to-PC:	[21][47][25][42]	// Code "01:27:05:22"

Wait for specified time code

PC-to-Insertacap:	[01][57][21][47][25][42][0D]	// wait for "01:27:05:22
Insertacap-to-PC:	[54]	// Insertacap sends
		// "T" at 01:27:05:22

Query Encoder

PC-to-Insertacap:	[01][3F][0D]	// query encoder
Insertacap-to-PC:	[31][32][33][34][20]	// serial #: 1234
	[49][6E][73][65][72][74][61][63][61][70]	// Insertacap
	[2C][20][4E][54][53][43][20][31][2E][35][30]	// , NTSC 1.50
	[20][0D][0A][2A][0D][0A]	// CR/LF, acknowledge

4.4 Buffering Data

Line 21 data sent to the Insertacap is buffered in two queues—one for Field 1 and one for Field 2. The buffer size is 58 bytes for each queue. Xon/Xoff flow control is used to inform the PC if a buffer is full (Xoff) or if it can continue to receive data (Xon). The Insertacap uses a single flow control mechanism to control incoming data for *both* buffers, so it is possible to stop the flow of data to the Field 1 buffer by filling up the Field 2 buffer and visa versa. For this reason, it is important that you divide the available bandwidth in such a way that the primary captioning service has priority. For example, if you are encoding C1 captions in Field 1 and XDS data in Field 2, you should make sure that you never fill the Field 2 buffer.

Xoff	ASCII 13h	Field 1 and/or Field 2 buffer is nearly full
Xon	ASCII 11h	Field 1 and Field 2 buffers are able to receive data (XON)

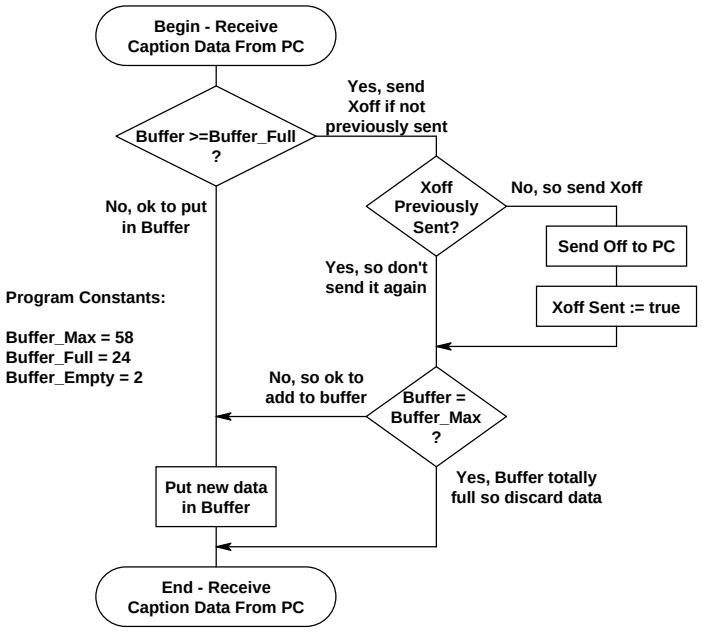

Fig. 4-1. How the Insertacap receives data into its buffers

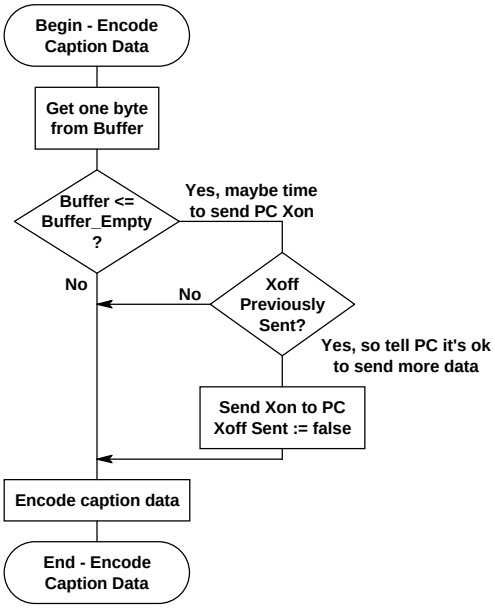

Fig. 4-2. How the Insertacap encodes data from its buffers

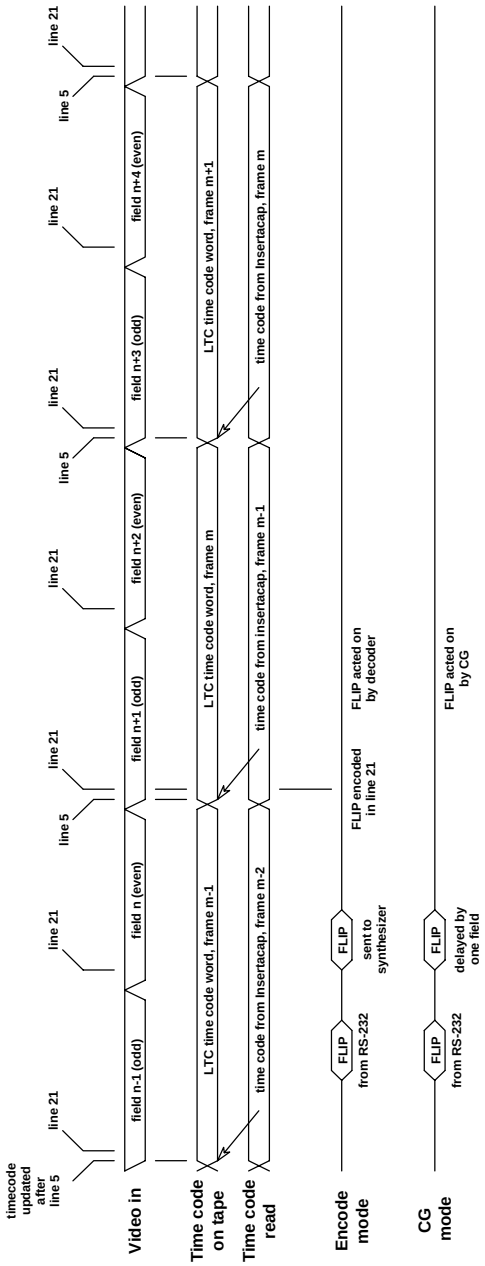

Fig. 4-3. Caption timing diagram

4.5 Caption Timing

An important goal when *creating* closed captions is to establish the optimum timing of captions with respect to the action on the screen. Likewise, an important goal when *encoding* closed captions is to preserve the timing that was established during caption creation. This section will help you understand how the Insertacap handles caption timing. Fig. 4-1. shows how the Insertacap encodes captions in relation to time code and serial data commands.

Video in

This time line shows a series of video fields beginning with an odd field "n-1". The Insertacap can encode two caption data bytes in line 21 of each field. Note that two fields—an odd field and an even field—make up a single frame.

Time code on tape

This line shows the relationship between the time code present on tape and the current video frame.

Time code read

This line shows how the Insertacap reads time code. At the end of a frame, the Insertacap reads the last portion of time code for that frame and stores it in memory. If you poll the Insertacap for time code after line 5 of frame m-1 and before line 5 of frame m, you will read back the time code for frame m-2. Why don't you get the time code representing frame m-1? Because the time code for that frame is still being decoded from the tape; the Insertacap does not "look ahead" and guess the incoming time code. If you use the Insertacap for creating captions, as well as encoding captions, then the timing will always be correct. If you use another device then you may have to adjust the caption timing in your encode software if the other device handles time code differently. ULTECH's Windows-based CCX encoding software allows you to adjust caption timing in steps of +/- one frame from a setup menu.

If you set the Insertacap to interrupt the PC when a certain time code is reached, it will send the trigger character "T" out the serial port at approximately line 5.

Encode mode

The encode mode graph shows the relationship between RS-232 serial data and the resulting line 21-encoded data. The example given here is for the two byte Flip command. Data received before line 1 of field n is encoded in line 21 of field n+1. In the example, RS-232 data is received by the Insertacap during field n-1, an odd field. The data is sent to the

waveform synthesizer-portion of the Insertacap during field n. The waveform synthesizer encodes the data in line 21 of field n+1. The example shows that data destined for encoding in a given field must be sent to the Insertacap two fields earlier. Note that the built-in caption decoder acts on the data in the same field it is decoded from.

CG mode

This portion of the figure shows the relationship between RS-232 serial data and the resulting on-screen display produced by the caption character generator. The timing is the same as encode mode except that a one-field delay is introduced in order to generate the caption in the same field as in encode mode. The Insertacap exhibits identical timing in both Encode/ Decode mode and Character Generator mode.

4.6 Polling for Time Code

There are two methods for deriving time code from the Insertacap:

1. Continuously reading time code using the “Read” command.
2. Letting the Insertacap interrupt the PC using the “Wait” command.

From PC software’s point of view, the *wait* method is the best choice since it involves only one transaction between the PC and the Insertacap. Plus, it allows the PC to do other tasks while waiting for a specified time code to arrive. However, most current caption creation/encoding software is based on the *polling* method, where the PC continuously reads time code from an internal time code card until the desired time arrives. Polling the Insertacap takes more time than waiting for a trigger, so you should be aware of its impact, particularly at lower baud rates.

The following table shows how long it takes to read time code from the Insertacap. The time is shown in milliseconds and in number of scan lines.

Baud Rate	Transaction Time	# of Scan Lines	# of Reads Per Frame
9600	7.29 mS	115	4.5
19.2K	3.64 mS	58	9.0
38.4K	1.82 mS	29	18.1

Fig. 4-4. Reading time code using polling method

Clearly, communicating with the Insertacap at 38.4 Kbps allows the greatest number of time code reads per frame. But reading at a baud rate as low as 9600 bps is also viable since you have up to four read transactions to “catch” any given frame.

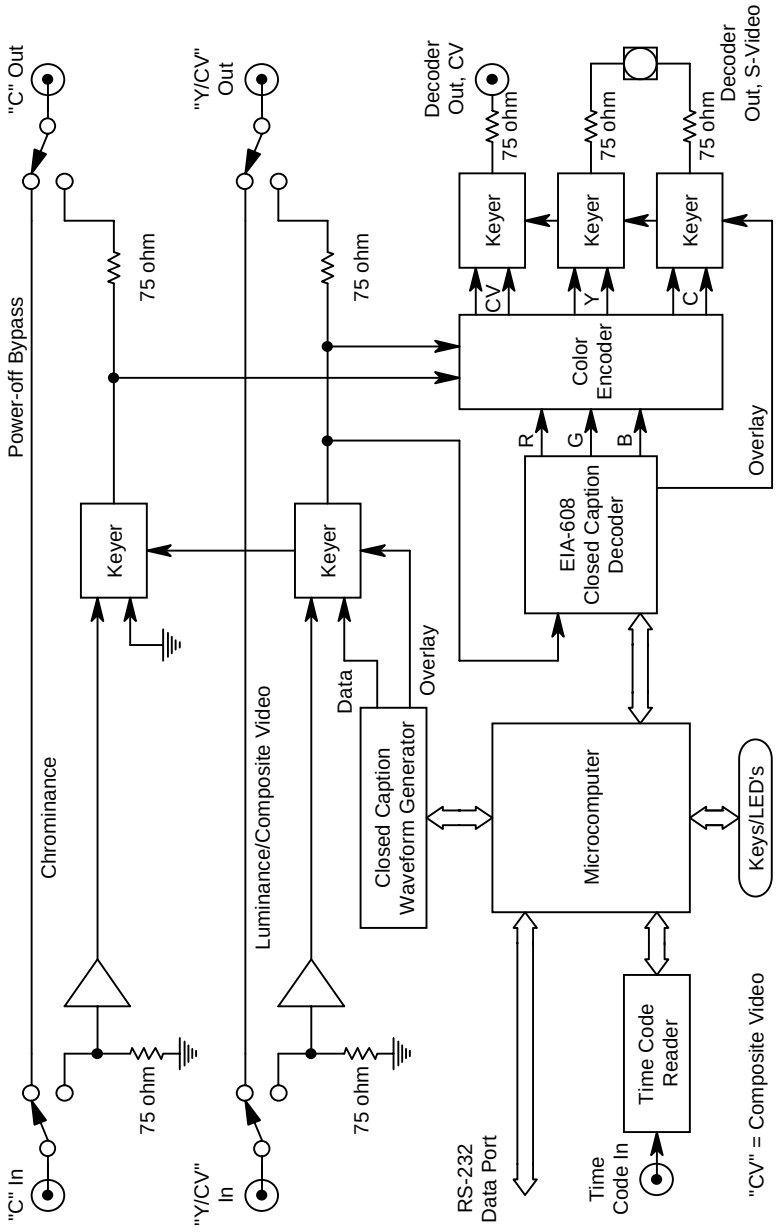

Fig. 5-1. Block diagram

5. Technical Reference

5.1 Theory of operation (refer to Fig. 5-1 Block Diagram)

The Insertacap has two signal paths: a chrominance path (“C”) and a luminance path (“Y”). If composite video is used (where Y and C are combined) then only the luminance path is used. The keyer inserts the closed caption waveform in line 21 whenever the unit is in Encode mode. The chrominance path has a “dummy” keyer in order to have an identical delay with respect to the luminance channel. The video with encoded closed caption data is sent directly to an EIA-608 closed caption decoder that provides caption monitoring. In Character Generator mode, the EIA-608 decoder gets its data from the on-board microcomputer instead of line 21. The RGB outputs of the closed caption decoder are encoded via an RGB-to-NTSC encoder to produce composite video, luma, and chroma outputs that are keyed on top of incoming video. The microcomputer, in addition to controlling the EIA-608 caption decoder, handles RS-232 communications, the LTC time code reader, and closed caption waveform synthesizer.

5.2 How to remove cover

1. Disconnect AC line cord from rear of unit.
2. Gently pry off (4) decorative screw covers from top of unit with a flat blade screwdriver (Fig. 5.2).
3. Remove (4) Phillips head screws.
4. Lift cover off unit.

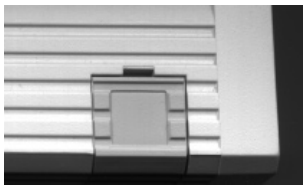

Fig. 5-2. Screw cover

A shock hazard exists with the cover removed—only qualified personnel should remove the top cover.

5.3 Calibration

Test Equipment Required

Video pattern generator
AC voltmeter, 100 KHz minimum response, RMS reading
DC voltmeter, ±0.01VDC accuracy
75Ω BNC terminator, 1%
6 MHz Waveform monitor or ULTECH TV Trigger Mate
Composite video monitor
40 MHz dual trace oscilloscope; 10X probe
BNC-to-BNC cable

Calibration Procedure

- ❑ 1. Remove cover as described in section 5.2.
- ❑ 2. Attach AC line cord. Turn unit on. Allow unit and test equipment to warm-up for 15 minutes. Caution: a shock hazard exists with the top cover removed. Do not touch the power entry module or power supply!
- ❑ 3. Apply a stable 1Vpp stairstep pattern to Y/CV In. Connect Y/CV Out to one channel of a dual trace oscilloscope and terminate with 75Ω. Connect the 10X probe to the other channel.
- ❑ 4. Horizontal Frequency adjust.
  Connect CV Decoder Out to a composite video monitor. Put Insertacap in Setup mode. Adjust R54 until the on-screen menu is centered on your composite video monitor.
- ❑ 5. Vertical Frequency adjust.
  Adjust R63 until falling edge of vertical sync pulse at left side of R47 is 6.5 µS ± 1 µS past falling edge of first equalizing pulse of vertical interval.
- ❑ 6. Luminance Gain adjust.
  Connect Y/CV Out to the waveform monitor and terminate with 75Ω. Adjust R23 for unity gain at Y/CV Out. This may be accomplished by using the AC voltmeter or waveform monitor to check Y/CV In with Y/CV Out. It may also be accomplished using an oscilloscope with a differential input and adjusting R23 for a null display.
- ❑ 7. Closed caption waveform offset adjust.
  Adjust R97 to reference cc waveform to 0 IRE at Y/CV Out.
- ❑ 8. CC waveform amplitude adjust.
  Adjust R49 for 50 IRE closed caption waveform at Y/CV Out.

- ❑ 9. Chrominance Gain adjust.
  Connect C Out to the waveform monitor and terminate with 75Ω. Loop Y/CV Out to C in with a BNC-to-BNC cable. Adjust R22 for unity Gain at C Out.
- ❑ 10. OSD Reference adjust.
  Adjust R83 for +0.67 VDC at U27, pin 6.
- ❑ 11. Chroma lock adjust.
  Adjust trimcap C117 for maximum DC voltage at U24 pin 3.
- ❑ 12. OSD Mix adjust.
  Turn the unit off. Turn the unit back on while holding the ENTER key for about 3 seconds. This displays a built-in test pattern at the decoder output. Adjust R55 until the semitransparent background-portion of the test pattern is approximately half way between transparent and full background.
- ❑ 13. Hue adjust.
  Adjust R89 until the color bar-portion of the test pattern shows the proper colors: red, green, blue, yellow, cyan, and magenta. You can use a vectorscope connected to CV decoder out for more accuracy.

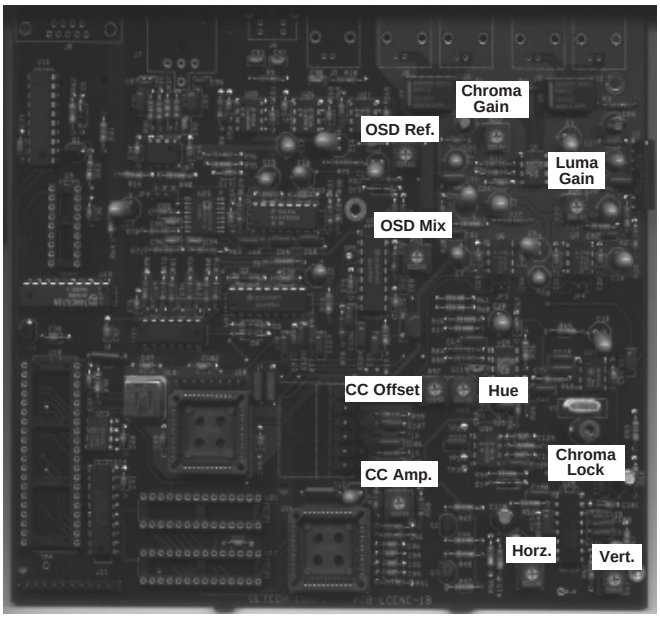

Fig. 5-3. Adjustments

5.4 RS-232 Data Port Pinouts

Pin	Function
1	(no connect)
2	Data Out, from Insertacap to PC
3	Data In, from PC to Insertacap
4	(no connect)
5	Signal ground
6	DTR, connected to +12VDC
7	(no connect)
8	RTS, connected to +12VDC
9	(no connect)

5.5 Specifications

Front panel controls and indicators

LED's: power, video, time code, PC data, line 21 data, setup/run modes
Menu-specific cursor/enter keys

Rear panel controls and connectors

1Vpp analog composite video/Y input BNC, terminated into 75Ω
C (chrominance) video input BNC, terminated into 75Ω
1Vpp analog composite video encoder/decoder output BNCs, 75Ω source impedance
S-Video decoder output, 4 pin mini-DIN
Time code input, balanced, 3 pin XLR plug
DB9F RS-232 serial port

Video performance

Meets or exceeds EIA-250B Short Haul, between Y/CV Encoder In and Y/CV Encoder out.

Power

25 Watt, 48 ~ 64 Hz
90 VAC to 260 VAC Universal input

Enclosure

Dimensions: 11.45" W x 2.45" H x 7.85" (291mm x 62mm x 199mm)
EMI shielded

5.6 Ordering information, options

ICAP608-N	INSERTACAP, NTSC version
ICAP608-P	INSERTACAP, PAL version
OPT8	XLR jack-to-phono jack adapter
OPT9	S-Video Y-C break-out cable

Fig. 5-4. OPT8, XLR jack-to-phono jack adapter

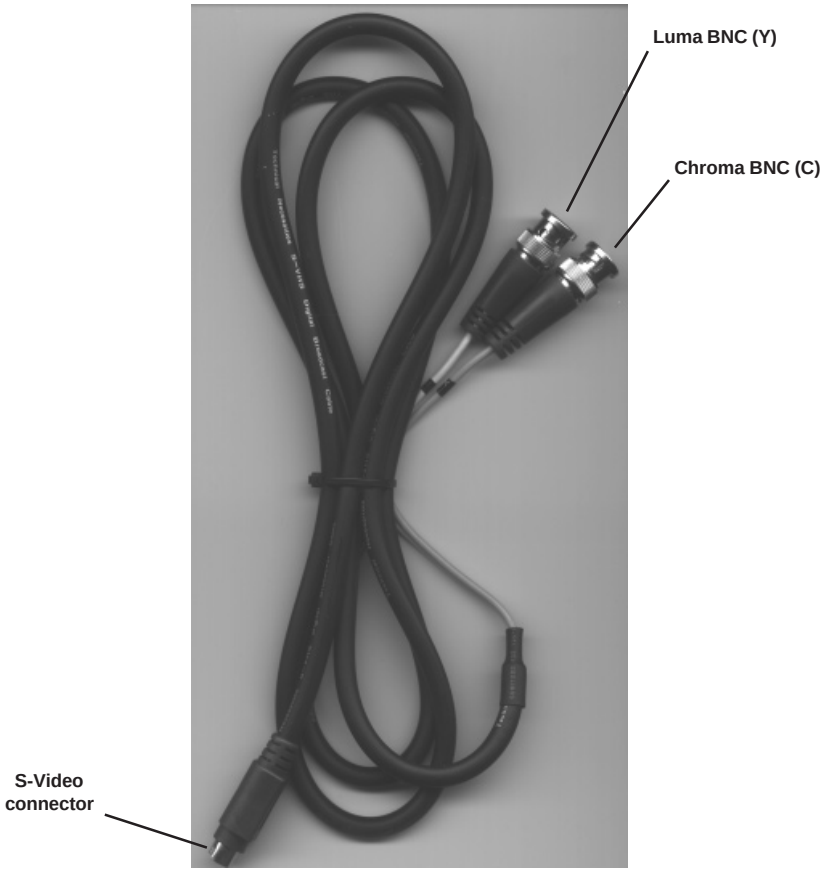

Fig. 5-5. OPT9, S-Video Y-C break-out cable