



**MODEL UDE400**

**Universal VBI Data Encoder**

**USER'S MANUAL**

**For Firmware Revision: 3.04**

**ULTECH Corporation**  
28 Great Hill Road, Bldg. #C, 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 covers in place.

© ULTECH Corporation 1994-1998

All rights reserved. Reproduction in any form is not permitted without written authority from the copyright owner.

Manual Publication No. PB100-UDE400, Rev. January 16, 1997

Printed in USA

---

# CONTENTS

## 1. General Information

1.1	Introduction .....	5
1.2	Data services .....	6
1.3	Output channels .....	7

## 2. Installation

2.1	How to connect .....	9
2.2	How to change voltage setting .....	11
2.3	How to change fuse arrangement .....	12

## 3. Operating Instructions

3.1	Front panel controls, indicators .....	13
3.2	Rear panel connections .....	14
3.3	Operating the UDE400 .....	15
3.4	Front panel lockout .....	15

## 4. Front Panel Operation, Menus

4.1	1). Application .....	17
4.2	2). Encoder output monitor .....	18
4.3	3). Caption/text activity monitor .....	19
4.4	4). Communications .....	20
4.5	5). Setup #1 .....	20
4.6	6). Setup #2 .....	21
4.7	7). Setup #3 .....	22

## 5. Communications

5.1	RS-232 data ports .....	25
5.2	Modem .....	26

## 6. UDE400 Command Set

6.1	Features, definitions .....	27
6.2	Data input commands .....	28
6.3	Data filter commands .....	29
6.4	Data output commands .....	30
6.5	Setup and status commands .....	31

## 7. Applications Examples

7.1	Master/Slave operation .....	33
7.2	Caption demo file .....	34
7.3	Teletext demo program .....	34

## 8. Options

8.1	OPT1 1200/2400 bps modem .....	35
8.2	OPT2 Caption monitor output .....	35
8.4	OPT6 Dual RS-232 adapter cable .....	35

## 9. Technical Reference

9.1	Theory of operation .....	37
9.2	Calibration .....	39
9.3	Programmer's reference .....	41
9.4	Specifications .....	42

## LIST OF ILLUSTRATIONS

Fig.	Title	
2-1	Connection for post production .....	10
2-2	Connection for real-time data encoding .....	10
2-3	Power entry module .....	11
2-4	Voltage selector card orientation .....	11
2-5	Fuse changing .....	12
2-6	Fuse block/cover assembly .....	12
3-1	Front panel .....	13
3-2	Rear panel .....	14
7-1	Master/slave configuration .....	33
7-2	Master/slave cable .....	33
8-1	Dual RS-232 adapter cable .....	36
8-2	Wiring diagram for dual RS-232 adapter .....	36
9-1	Block diagram .....	37
9-2	Adjustments .....	40
9-3	Ignoring UDE400 responses .....	41
9-4	Checking for errors .....	41

---

# 1. General Information

## 1.1 Introduction

Thank you for purchasing the UDE400—a broadcast quality NTSC/PAL VBI data encoder that handles Caption, Text, Extended Data Services, and teletext in a single rack unit. It is used by post production houses, caption agencies, broadcasters, and cable TV companies. Post houses and caption agencies use the UDE400 “off-line” to encode caption data together with program information into VBI line 21. In this application, the UDE400 is driven from a computer equipped with a time code reader. Broadcasters use the UDE400 to encode private data in the form of teletext data and to encode caption data for live events. Broadcasters can also encode EDS program identification data, text data, or news wire feeds while encoding captions & teletext.

The UDE400's 80 character LCD display and cursor keys give you flexibility and control never seen before in this type of equipment. It offers backwards compatibility with encoders that use a command set defined by the National Captioning Institute. Plus it handles upstream data (data which is already in the incoming video) per the EIA-608 Recommended Practice for Line 21 Data Services.

The UDE400 can operate as a stand-alone unit or it can be driven from an external computer. Varying levels of control can be assigned to an external host computer. For example, the arbitration of EDS & Text data can be handled by the UDE400's built in computer or by an external computer.

You can encode data from two independent sources at the same time. This means you can encode a live caption data stream coming from the optional modem into line 21 field 1 while you encode EDS data coming from the RS-232 port into line 21 field 2. Or you can encode data from both RS-232 ports at the same time (when the optional modem is not installed). You can encode on VBI lines other than 21 and you can redirect upstream or modem data to the RS-232 port.

For EDS VBI data insertion there is no better way to equip your facility. The UDE400 offers several innovative features besides built-in time keeping that simplify the handling of EDS data. Broadcasters and cable operators can enter network ID's, call letters, native channel, local time zone, DST use, and out-of-band channel numbers once from the front panel for storage in nonvolatile memory. Program originators can enter the program name, type, rating, audio services, caption services, aspect ratio, and program description for storage and subsequent encoding. You can enter EDS data fields from the front panel, the RS-232 serial interface, or a combination of both. You can set each field individually to allow upstream data to pass through unaffected or to be overwritten with your data. You have a myriad of options for merging locally generated EDS data with upstream data.

Other features include front panel lockout, two user presets, customized test message, user defined ID (for remote interrogation), recovery of upstream data that can be read via the serial port or displayed on the front panel LCD, modem and port settings selected from front panel, remote control of encoder by modem.

The UDE400 conforms to the RS250B short haul specification for signal quality. It uses a multilayer pc board with dedicated ground plane. It has fully shielded metal connectors and an electrostatically shielded power off bypass relay. It uses a linear power supply for low noise together with a toroidal transformer for minimal hum. Internal connectors and sockets are made from gold plated machined contacts.

## 1.2 Data Services

The FCC provides for two data services in field 1 line 21: “closed captioning” and “text”. The two data services are each broken down into two logical data channels—closed captioning consists of services “CC1” and “CC2”. The text service consists of “T1” and “T2” (line 21 text is *not* teletext or videotext). CC1 is by far the predominate service. The data bytes for the data services are time multiplexed in line 21. The UDE400 encodes data in both 525 and 625 TV modes and on VBI (Vertical Blanking Interval) lines other than 21.

The FCC also provides for data services in field 2 line 21. These include closed captioning “CC3” and “CC4”, text “T3” and “T4”, and EDS<sup>1</sup> Extended Data Services. Extended data services is a viewer-controlled service that provides information about TV programs, networks, time of day, weather, etc. Contact the EIA for a copy of the EDS technical standard:

Electronic Industries Association  
Consumer Electronics Group  
2500 Wilson Blvd.  
Arlington, VA 22201  
Tel: (703) 907-7500  
Fax: (703) 907-7501

### WST

World System Teletext. The UDE400 generates the waveform for WST system “B”. This standard consists of a bit rate of 6.9375 Mbit/s, a recommended Byte Sync of 27h, and a data length of 42 bytes. The UDE400 provides WST in 625 TV mode only and therefore cannot provide NABTS simultaneously.

### NABTS

North American Basic Teletext Specification. The UDE400 generates the waveform for NABTS which consists of a bit rate of 5.727272 Mbit/s, a recommended Byte Sync of E7h, and a data length of 33 bytes. The UDE400 provides NABTS in 525 line TV mode only and therefore cannot provide WST simultaneously.

### 1.3 Output Channels

The UDE400 introduces the concept of “data output channels”. Multiple output channels allow you to encode more than one VBI data service at a time. The UDE400 has (4) independent data output channels O0 through O3 corresponding to four different TV lines within the vertical blanking interval of the video signal. The “O” in O0-O3 stands for “Output”. O0 and O1 are always Field 1 lines, O2 and O3 are always Field 2 lines. Data can be directed to any of the output channels (i.e. video lines). The TV line number assigned to each output channel is programmable.

output channel	field	VBI line <sup>2</sup>
O0	1	10-23
O1	1	10-23
O2	2	10-23
O3	2	10-23

- <sup>1</sup> As of this writing, the EIA is renaming their service to avoid a conflict with the name “EDS”, a previously registered tradename. One proposal is “XDS”.
- <sup>2</sup> The UDE400 is capable of encoding data on any TV line from 1 to 255. Contact the factory if you need to encode on lines other than 10-23.



## 2. Installation

### 2.1 How to connect

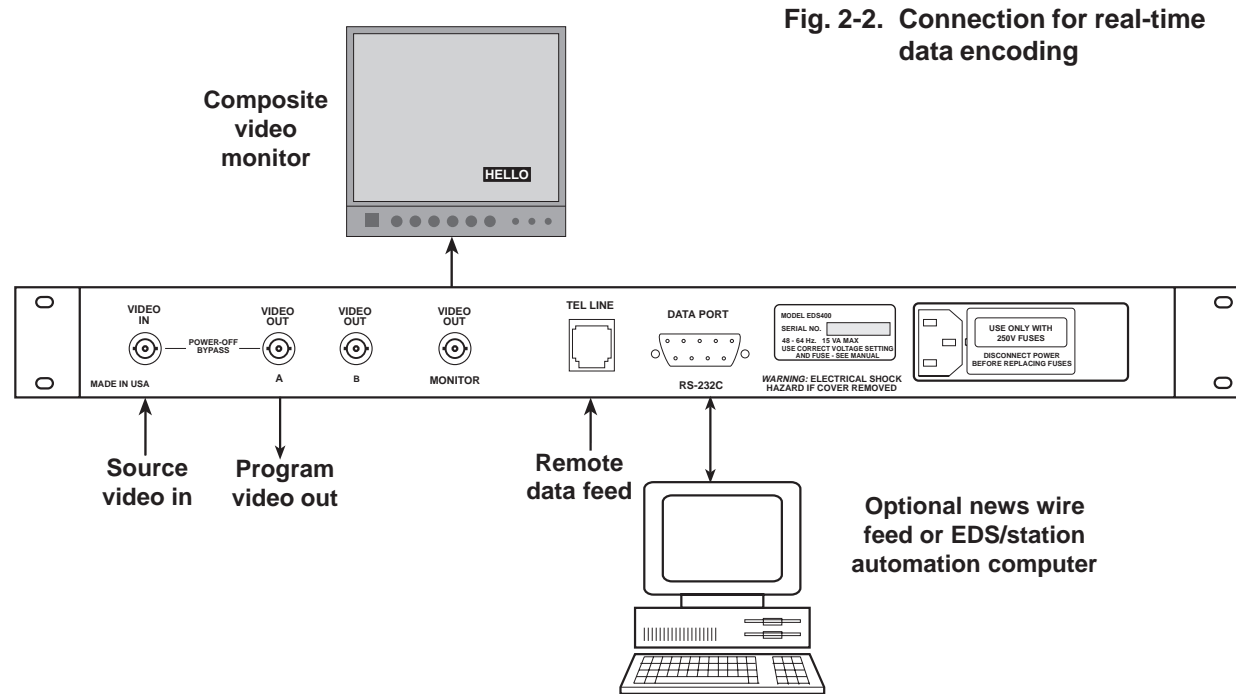
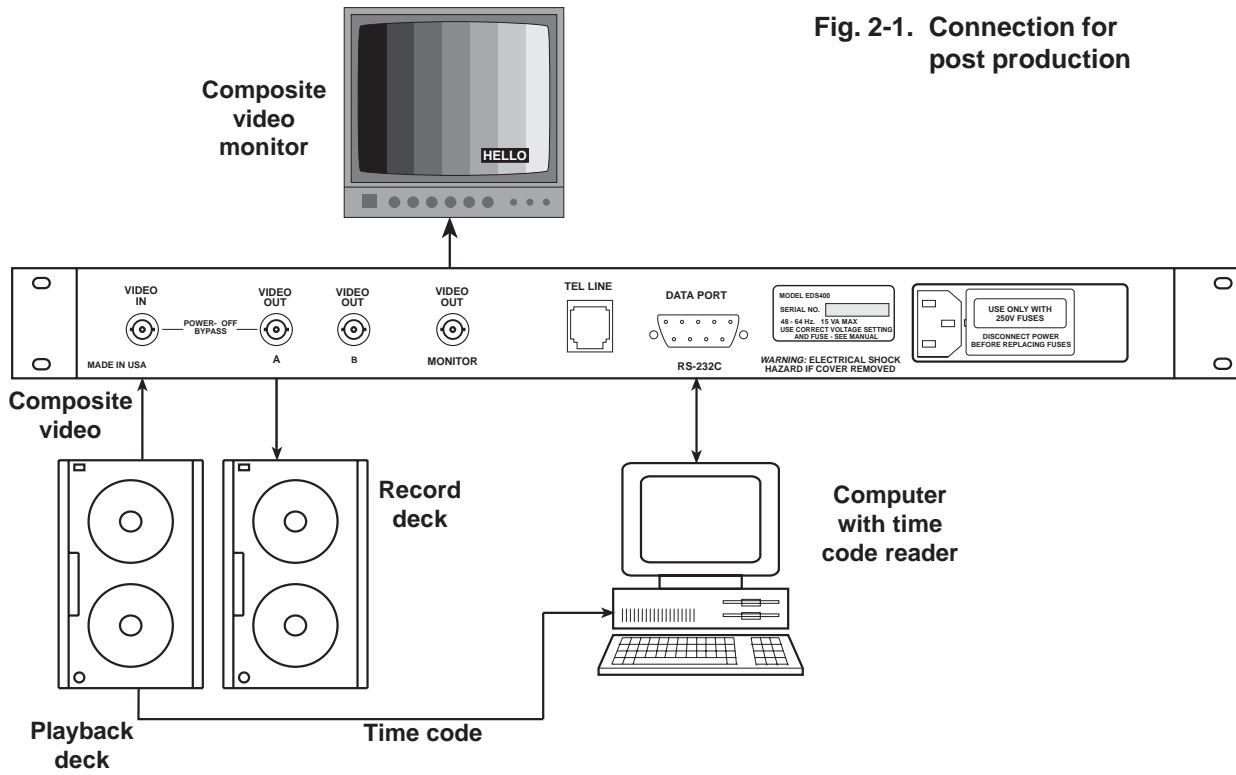
1. Apply source video to VIDEO IN connector. Source must be 1Vpp standard NTSC/PAL; the UDE400 will not work with VHS or noisy off-air video. The UDE400 terminates the source video with 75 ohms.
2. Take the program video with encoded data from VIDEO OUT A or VIDEO OUT B (VIDEO OUT A provides a power off bypass between VIDEO IN and VIDEO OUT A).
3. Connect a composite video monitor to VIDEO OUT MONITOR to monitor captions/text (your unit must be equipped with the optional caption monitor output circuitry). It is not recommended to use the monitor output to broadcast captions in “open” format; the ULTECH SG401 Subtitle Generator is recommended instead.
4. Connect the data source to the RS-232 data port using a 9 pin D-Sub connector (male). The UDE400 expects data on pin 3 (see section 5. “Communications”). Alternatively, connect a telephone line to the 6 pin RJ11 TEL LINE connector if your data source will be received by the optional modem.
5. Apply AC line power to the unit via the detachable three wire cord.

#### Grounding (earthing)

The UDE400 must be connected to a protective earth conductor via the three wire AC line (mains) cord. The AC power plug shall be inserted only into a receptical outlet that has a protective earth contact. The ground wire must not be defeated by use of a two wire extension cord.



**WARNING:** Any interruption of the power line ground circuit inside or outside the UDE400, or removal of the AC receptical ground wire, will create a potential shock hazard.



## 2.2 How to change voltage setting

The UDE400 comes with a dual primary power transformer enabling it to work from either 120 VAC or 240 VAC line voltages. A voltage selector card inside the power entry module wires the primary windings in parallel (120VAC) or series (240VAC) depending on the orientation of the card. The factory setting, which is indicated by the pin on the cover of the power entry module, should already be appropriate for your country. If you need to change the setting, please use the following procedure.

Procedure to change line voltage setting — please use caution when changing the voltage setting:

Detach AC power cord. Open power entry module cover using a small blade screwdriver or similar tool; set aside cover/fuse block assembly. Pull voltage selector card straight out of the housing. Using indicator pin, orient the selector card so that the desired voltage is readable at the bottom. Orient indicator pin to point up when desired voltage is readable at the bottom. Insert voltage selector card in housing, printed side of card facing toward the power connector (left side of unit when facing the rear of the unit). Change fuse arrangement according to the following section. Replace cover and verify that the indicator pin shows the desired voltage.

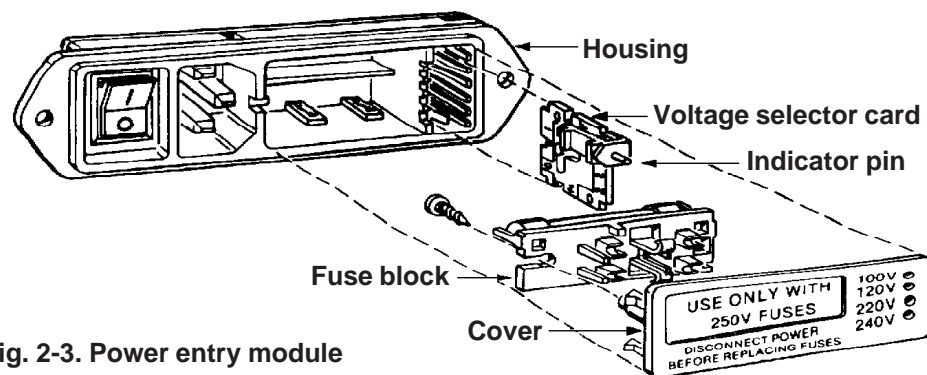
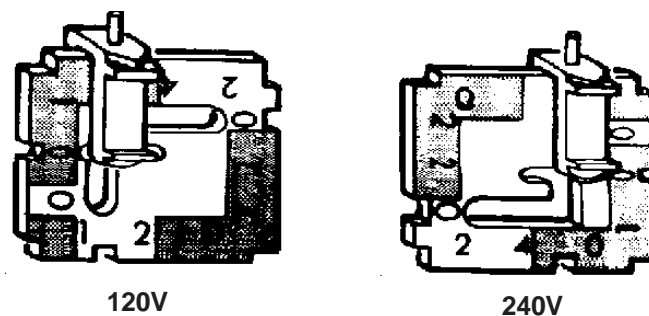



Fig. 2-3. Power entry module

Fig. 2-4. Voltage Selector Card Orientation



### 2.3 How to change fuse arrangement (North American - European)

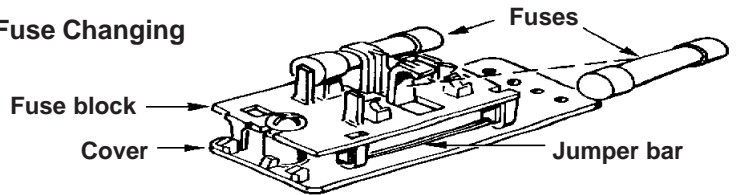
To change from North American to European fusing: Detach AC power cord. Open power entry module cover using a small blade screwdriver or similar tool. Loosen Phillips screw two turns; remove fuse block by sliding up then away from screw and lifting up from pedestal. Change fuses according to the following table. Note: two 5x20mm European fuses are required. Invert fuse block and slide back onto Phillips screw and pedestal. Tighten Phillips screw, and replace cover.

	<p><b>CAUTION:</b> Do not substitute a fuse with a larger current rating than indicated in the table above.</p>
-----------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------

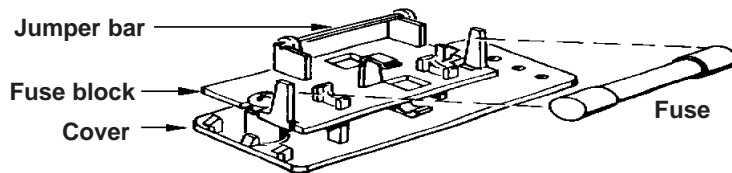
For 115 VAC setting: 250 mA, 250V, slow blow, ¼" Dia. x 1¼" long, Littelfuse® 313 series or equivalent.

For 230 VAC setting: 125 mA, 250V, time-lag, 5x20mm, Wickmann 19195 series or equivalent.

Fig. 2-5. Fuse Changing

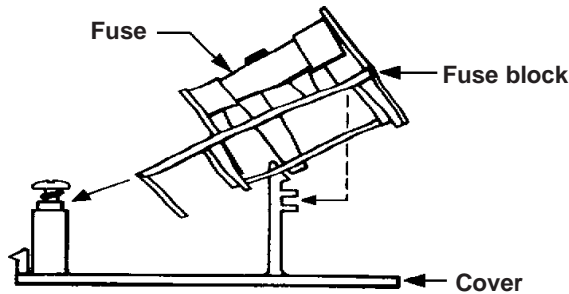


North American Fuse Arrangement



European Fuse Arrangement

Fig. 2-6. Fuse Block/Cover Assembly



## 3. Operating Instructions

### 3.1 Front panel controls, indicators

- ❶ Power on/off switch. Off is indicated by “0”; on by “1”. The power switch disconnects both sides of the AC line for VDE compliance. When power is off, a video bypass exists between VIDEO IN and VIDEO OUT A.
- ❷ 40 character x 2 row backlit LCD display. You can adjust R77 inside the unit to obtain the best contrast (see section 9.2 Calibration). LCD contrast is greatly affected by the viewing angle.
- ❸ Cursor/Enter keys. The keys can be “locked-out” by pressing the left and right cursor keys simultaneously while the unit is on (see section 3.4).



Fig. 3-1. Front panel

### 3.2 Rear panel connections

- ❶ Video input. Source must be 1Vpp standard NTSC/PAL; the UDE400 will not work with VHS or noisy off-air video. The UDE400 terminates the source video with 75 ohms.
- ❷ Program video output with power off bypass relay.
- ❸ Program video output.
- ❹ Program video output with decoded captions/text (only if OPT. 2 is installed). All of the operating parameters for the decoder are set from the front panel, including on-screen display brightness & contrast.
- ❺ Telephone line. Connects to optional 1200/2400 bps internal modem. There should be an FCC registration notice directly below the serial number label on the back panel if your unit is equipped with a modem. Also, “modem” will appear in various menus on the front panel if the modem option is installed; otherwise there will be a reference to port 2.
- ❻ RS-232 serial data port. This connector contains port 1 on pins 2 & 3. If the modem is not installed then port 2 appears on pins 6 & 8 (pins 6 & 8 must remain unconnected if the modem is installed). The data port accepts a “straight thru” (pin 2-pin 2, pin 3-pin 3) connection from a personal computer.
- ❼ Serial number label. Please refer to your unit's serial number when contacting the factory for technical support.
- ❽ Power entry module. Contains IEC power connector, RFI power line filter, fuse(s), and line voltage selector card.
- ❾ IEC power connector for detachable three wire AC line cord.
- ❿ Cover for fuses & line voltage selector card.

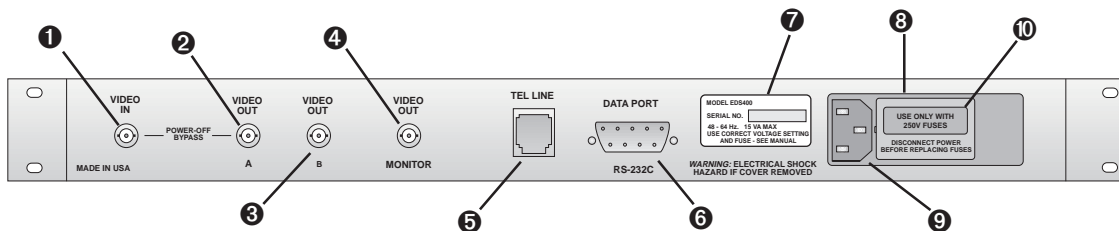


Fig. 3-2. Rear panel

### 3.3 Operating the UDE400

#### Power on

When power is first applied to the UDE400 a self-test routine is run to verify the integrity of the hardware. A failure message will appear on the LCD display if a problem is found during self-test; otherwise a firmware version message followed by the Applications menu appears. An asterisk, “\*”, is sent out Port 1 indicating “ready for command”.

#### Menus/Cursor keys

The UDE400 uses six main menus. The main menus are numbered 1-6. Most of the main menus contain submenus “underneath”. You scroll through the main menus by pressing the up or down cursor keys. You select items on a given menu line by pressing the left or right cursor keys followed by the ENTER key. You return to the menu above by pressing ENTER twice or by selecting the ↑ symbol. A (↓↑) next to a menu means there are menus above and below.

### 3.4 Front Panel Lockout

You can prevent somebody from accidentally changing the encoder settings by using the *front panel lockout* feature. The front panel is “locked out” by pressing the left & right cursor keys simultaneously. A message “FRONT-PANEL SETUP HAS BEEN LOCKED, press a key to return” appears on the LCD. The LCD returns to its previous display when a key is pressed. In lockout mode, you are able to select the various monitors — activity, LCD monitor, etc., but you cannot change any of the encoding parameters. If you try to change a parameter while the unit is locked, the message “FRONT-PANEL SETUP HAS BEEN LOCKED, press a key to return” appears on the LCD. To unlock the front panel, press the left & right cursor keys. The unit will remember whether or not it was locked even if power is removed.

**To Lock:** Press ⇐⇒ at the same time.

**To Unlock:** Press ⇐⇒ at the same time.



## 4. Front Panel Operation, Menus

### 4.1 Application

The UDE400 contains two built-in applications, *Caption* and *NABTS*, and two “reconfigurable” applications, *WST625* and *User*. The reconfigurable applications are stored in nonvolatile memory and can be changed or renamed at any time. When an application is loaded, the UDE400 configures itself accordingly. However, you are able to change any of the settings from the front panel. The UDE400 saves its current state in nonvolatile memory. If power is removed then reapplied, the unit will come up in its previous state—you do not have to reload an application after a power failure.

**Caption:** Use this application to generate the caption waveform and to disable the teletext waveform. To select Caption, press the  $\Rightarrow$  key to position the cursor at Caption and hit ENTER.

\*\* "Caption" HAS BEEN LOADED \*\*

should appear on the LCD display. You *can* encode teletext data along with caption data if you set “Teletext Lines” in menu 6 after loading the Caption application. Ports 1 & 2 are set to 1200 bps, 7 bit, odd parity.

**NABTS:** Use this setting to enable NABTS teletext exclusively and to set the 525 TV standard. To select NABTS, press the  $\Rightarrow$  key to position the cursor at NABTS and hit ENTER.

\*\* "NABTS" HAS BEEN LOADED \*\*

should appear on the LCD display. You *can* encode caption data along with teletext data if you set “Lines” in menu 5 after loading the NABTS application. Port 1 is set to 19.2 Kbps, 8 bit, no parity; Port 2 is disabled.

**WST625:** This is a reconfigurable application that has been preset at the factory. Use this setting to enable WST teletext exclusively and to set the 625 TV standard. To select WST625, press the  $\Rightarrow$  key to position the cursor at WST625 and hit ENTER.

\*\* "WST625" HAS BEEN LOADED \*\*

should appear on the LCD display. You *can* send caption data in 625 mode along with teletext data if you set “Lines” in menu 5 after loading the WST625 application. Port 1 is set to 19.2 Kbps, 8 bit, no parity; Port 2 is disabled.

**[USER]:** This is a reconfigurable application that you may use to store your own settings (see menu 6: Save). For example, you may want to save an application called “NABTS\_20” that sets the default teletext line to 20.

## 4.2 Encoder Output Monitor

The UDE400 provides (3) independent output monitors to verify closed caption data encoding. You can select an output and a data service for each monitor.

- 1). **LCD display.** Captions/text are displayed on the front panel LCD.  
Note: UDE400 will not display upstream captions/text that are not reencoded locally (i.e. upstream data will not be displayed if Passthru mode is enabled).
- 2). **Port 1** (Port 2 if the optional modem is not installed). Data is sent to the serial port and may be captured by a PC via a terminal emulator or communications program. The UDE400 does not support flow control for data which is sent out the ports. The monitor data which is sent to the ports is the same data which the UDE400 inserts into the output video stream. Because of this it is possible to set Port 1 to a speed other than that of the data source. For example, the modem could be set to 1200 bps while Port 1 is set to 9600 bps. Or, the modem could be set to 2400 bps and Port 1 set to 1200 bps. Port 1 can be set to a speed lower than the data source because the UDE400 always meters out caption data at a rate of two bytes per frame (480 bps) which is slower than the slowest port rate (1200 bps). Note that the UDE400 does not output encoder control commands as part of the monitor function (to capture encoder commands together with caption data, see *redirection* under Setup #2) nor will it output upstream captions/text that are not reencoded locally (i.e. Passthru mode enabled).
- 3). **Video** (optional). A composite video monitor connected to the monitor output BNC connector on the rear panel will display captions/text as decoded by a built-in closed caption decoder. You can adjust the contrast and brightness of the decoded captions from the front panel.

To monitor captions on the LCD display:

1. Position the cursor next to “LCD” using the  $\Rightarrow$  key. Press ENTER.
2. Select a data service to monitor (CC1, CC2, T1, T2). Press ENTER.

The title **\*\* CAPTION MONITOR \*\*** appears on the first line of the LCD display and decoded captions/text appears on the second line. Press ENTER to return to the menu.

To select a different output channel to monitor:

1. Position the blinking cursor next to “LCD” using the  $\Rightarrow$  key. Press ENTER.
2. Press the  $\Downarrow$  key to drop down to the “output channel to monitor” menu.

3. Position the blinking cursor next to the output channel to monitor (O0, O1, O2, O2) using the  $\Rightarrow$  key. Press ENTER. Press the  $\uparrow$  key to return to the “data service to monitor” menu.
4. Select a data service to monitor (CC1, CC2, T1, T2). Press ENTER.  
The title **\*\* CAPTION MONITOR \*\*** appears on the first line of the LCD display and decoded captions/text appears on the second line. Press ENTER to return to the menu.

To send captions to the serial port:

1. Position the cursor next to “Port1/2” using the  $\Rightarrow$  key. Press ENTER.
2. Select a data service to monitor (CC1, CC2, T1, T2). Press ENTER.
3. Press ENTER to begin monitoring or press  $\downarrow$  to drop down to the “output channel to monitor” menu.
4. Position the blinking cursor next to the output channel to monitor (O0, O1, O2, O2) using the  $\Rightarrow$  key. Press ENTER twice to begin monitoring.

To send captions to the EIA-608 video output monitor:

1. Position the cursor next to “Video” using the  $\Rightarrow$  key. Press ENTER.
2. Select a data service to monitor (CC1, CC2, CC3, CC4, T1, T2, T3, T4, XDS). Press ENTER.
3. Press ENTER to begin monitoring or press  $\downarrow$  to drop down to the “Horizontal Adjust” menu.

Note that the video monitor decodes data only from line 21 (line 22 in PAL mode). Setting CC1, CC2, T1, or T2 automatically decodes captions/text from field 1. Setting CC3, CC4, T3, T4, or XDS automatically decodes from field 2. XDS mode displays the following data if present in line 21 field 2: network name, call letters, program title, program length, program type, time in show, and program description. EIA-608 provides for other XDS data packets as well. You can encode the full range of available packets with the UDE400 even though you can only monitor those packets mentioned above.

### 4.3 Caption/Text Activity Monitor (for caption only)

The UDE400 receives data from three sources: upstream VBI data decoded from the incoming video signal, Port 1, and modem (Port 2 if no modem is installed).

The activity screen indicates source activity for a selected output. If incoming data for a specific data service is detected, a “source symbol” is displayed next to the data service label. The source symbols are *V* for upstream video, *P1* for port 1 and *M* for

modem (*P2* for port 2 if no modem is installed). Note: the activity screen does not indicate if incoming data is actually being encoded (see section 2. Encoder Output Monitor).

To monitor activity:

1. Select the desired output channel using the  $\Rightarrow$  key. Press ENTER.

The title **\*\* ACTIVITY \*\*** appears on the first line of the LCD and data service labels appear on the second line:

CC1: *V P1 M*      CC2: *V P1 M*      T1: *V P1 M*      T2: *V P1 M*

The source symbols *V*, *P1*, *M* will illuminate whenever the UDE400 detects data from the respective source. For example, if the UDE400 detects Text 1 data coming from upstream video, the *V* symbol will illuminate next to the T1 data service label.

Press ENTER to return to the menu.

## 4.4 Communications

You can set the data rate for the RS-232 serial ports from 1200 bps to 38.4K bps. You can set the modem to 1200 or 2400 bps or you can keep it from answering incoming phone calls by selecting “disable”. The serial ports and modem operate using Xon/Xoff flow control for incoming data only. Port 2 is only available if the optional modem is not installed. You can set the ports for either 7 data bits, 1 stop bit, odd parity; 8 bits, 1 stop bit, no parity; or 8 bits, 2 stop bits, no parity (please contact the factory if your needs are different).

## 4.5 Setup #1 (for caption only)

### Reset

An output channel can be reset to bring it into a known state. Reset flushes all data input & output buffers and enables all upstream data to be passed through to the video output. You can reset the output channels independently.

### Filters

This menu provides a means to delete upstream data services. Usually captioning software handles upstream filters. Caption data sent to the encoder is preceded by filter commands to delete upstream data. During commercial breaks, for example, captioning software will send a filter command to enable upstream data. Captioning software usually handles the CC1 filter only and therefore has no effect on upstream CC2, T1 and T2 data. The UDE400 allows you to set filters on CC2, T1, T2 as well as CC1. Note: remote filter commands have higher priority than front panel settings and might override operator settings. Also, you will not be allowed to change the CC1 filter if CC1 data is being encoded locally.

You can set CC1, CC2, T1, and T2 filters individually for output channels O0 and O2 but not for output channels O1 and O3. For output channels O1 and O3 you must filter CC1, CC2, T1, and T2 as a group. This is due to the fact that the UDE400's upstream data decoder can only decode data from one line at a time.

Note that the O1 and O3 filter settings can be used to overwrite any VBI line (from 10..24) with the caption waveform.

### Lines

This menu allows you to assign a VBI line to an output channel. VBI lines in the range of 10..24 for field 1 are assigned to output channels O0 and O1; VBI lines for field 2 are assigned to output channels O2 and O3. Most applications will assign F1, line 21 to O0 and F2, line 21 to O2.

### Passthru

There are two modes available for passing upstream data (this only applies if none of the filters are set i.e. all upstream data is passed through to the output) —

- Passthru: No waveform is produced. The output line is “untouched”.
- Reencode: A closed caption waveform is always produced and upstream data is reencoded.

Reencoding delays upstream data by one frame delay but it always provides a waveform in the caption line and it “cleans up” the upstream data waveform. Some caption decoders work better if the waveform is present a few frames before actual data is encoded. Reencoding is the preferred mode if you can tolerate a delay of one frame.

## 4.6 SETUP #2

### Redirection (for caption only)

Redirection allows you to redirect data to Port 1. The redirected data comes from either upstream video, Port 2, or the modem. The redirected data includes all null bytes and encoder commands as well as caption control codes & data. For example, if you select Field 1 or Field 2 upstream video as the data source then you will get the two caption bytes every frame whether or not caption data is actually present. Similarly, if you select the modem as the data source then you will get every byte which comes across the phone line.

A good application for redirection is the “master/slave” operation described in section 7.1. This allows TV networks to broadcast multiple feeds from a single caption data source. Another application for redirection would be to capture and save all upstream or modem data to a disk file for subsequent playback. Your receiving device must be fast enough to accept data at the rate sent by the UDE400 (usually 2 bytes per frame for upstream data, or in bursts of 1200 bps for modem or Port 2). If the data source is Port 2 then you should set the receiving device connected to Port 1 to the same speed or higher.

Another application for redirection is to pass data through video compression systems such as MPEG2. In this application, the UDE400 is set to redirect closed caption data from both fields using the “Both-O0, O2” menu selection. The UDE400 recovers data from both fields and sends it to Port 1 together with a frame sync character (80h). The recovered data is sent to an auxiliary RS232 data input on the video compressor. The data is recovered at the receive site and sent to another UDE400 or EDS400 that reinserts it into the proper line and field. When you direct data from both fields to the port, you *must* set the port speed to 4800 bps or higher.

Redirecting data does not divert it away from the UDE400. The encoder operates on the data the same way whether or not redirection is enabled.

### **TV-Standard**

Sets either 525 or 625 TV standard. This setting determines what teletext standard will be used when generating the teletext waveform (525: NABTS, 625: WST).

### **Teletext**

Allows you to specify the Byte Sync and the teletext line for either NABTS or WST. The teletext type, NABTS/WST, is selected by the next menu item, TV-Standard; the teletext type is displayed in the Teletext menu but it is not settable. The Byte Sync is displayed in hex. A new Byte Sync is entered in binary notation, one bit at a time. The resulting byte is transmitted lsb first—please note that some teletext standards publish the Byte Sync with the lsb in the left most position.

The teletext VBI line number may be selected from 12 to 21 (please contact the factory if you need additional range). You can disable the teletext waveform by selecting “Off”.

---

## 4.7 SETUP #3

### **Encoder-ID** (*Not implemented in this version*)

Lets you to assign a unique identification number to your encoder. The Encoder-ID is stored in non-volatile memory and is accessed remotely using the query command ^A?. Assigning a unique encoder identification number allows a caption agency to verify that connection to the proper encoder has been made when accessing the encoder by modem.

You can set the Encoder-ID to any string up to 15 characters. The default Encoder-ID from the factory is usually the customer's name (or initials) followed by the encoder's serial number.

The UDE400 will return a message similar to the following in response to a query command, ^A?:

```
Model: ULTECH UDE400  
Firmware: 1.40  
ID number: Encoder-ID
```



# 5. Communications

## 5.1 RS-232 data ports

The data ports are used primarily to get caption, text, EDS, and teletext data into the UDE400 for encoding. However, the ports can be used to monitor data decoded from incoming video or data coming in from the optional modem. The ports can also be used to redirect encoder commands plus data from one UDE400 to another (“master/slave” or “bridge” mode). Encoder control commands coming from the ports or modem override front panel settings.

A UDE400 without the optional modem has two RS-232 serial ports, *port 1* and *port 2*; a UDE400 with the optional modem has one serial port, *port 1*. To conserve space on the rear panel, UDE400's with two ports share the same 9 pin D-Sub connector. You can use option 6, a dual RS-232 “Y” adapter cable, to gain access to ports 1 & 2 on individual 9 pin connectors. With dual ports, or with one port and a modem, you can encode data from two independent sources at the same time. You can set the data rate for the RS-232 serial ports from 1200 bps to 38.4K bps. Note: For dual port units, the combination 19.2K bps for one port and 38.4K bps for the other is not allowed. You can select from three combinations of data bits/stop bits/parity: 7-1-O; 8-1-N; 8-2-N (7 data bits, 1 stop bit, odd parity; 8 bits, 1 stop bit, no parity; or 8 bits, 2 stop bits, no parity). Please contact the factory if you need other settings.

Data port pin assignment:

<u>Pin</u>	<u>Function</u>
1	(open)
2	port 1 RXD, receive data, from UDE400 to PC
3	port 1 TXD, transmit data, from PC to UDE400
4	(open)
5	ground
6	port 2 RXD, receive data, from UDE400 to PC
7	(open)
8	port 2 TXD, transmit data, from PC to UDE400
9	(open)

## 5.2 Modem

An optional 1200/2400 bps modem is used to receive data remotely. You can set the modem to 1200 or 2400 bps or you can keep it from answering incoming phone calls by selecting “disable” from menu #4 *Communications*. The UDE400 will answer a call from any menu after two rings. The UDE400 will display a “ring” message when it detects an incoming call and will immediately generate a carrier when it answers (goes “off hook”). The UDE400 will disconnect the phone line (go “on hook”) if a carrier from the calling modem is not detected with 30 seconds; otherwise a “carrier detect” message will be displayed on the front panel. The carrier detect message stays on the front panel until cleared by hitting the ENTER key or until the carrier is lost. A CD carrier detect icon will remain on the upper right corner of the LCD display while the remote carrier is present. A “carrier lost” message will be displayed when the remote carrier goes away. The UDE400 terminates the incoming call when the remote carrier is lost. You can manually terminate a call by selecting “disable” from menu #4 *Communications*. The modem operates using Xon/Xoff flow control for incoming data. Port 2 pins on the 9 pin Data Port connector must not be connected if the modem is installed.

## 6. UDE400 Command Set

### 6.1 Features/definitions

The UDE400 will accept encoder control commands remotely. The command set has been designed to be backwards compatible with existing equipment. Encoder commands override front panel settings.

Extensions to standard command set:

- Encode caption/text/EDS data in four different lines (two lines per field) simultaneously.
- Encode from two different sources (port 1 & port 2, or port 1 & modem) simultaneously.
- Delete upstream caption/text/EDS data selectively for two specific lines (one line per field).

#### Command syntax:

An RS-232 command can have one of two formats:

1. [SOM][command number]<command parameters>[CR]
2. [SOM][command number]<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.

The encoder will acknowledge a valid command with [CR][LF]. If a command error occurs, it will respond with [CR][LF][error code]. If an invalid command number is received, it will respond with [CR][LF]1.

The encoder uses XOFF/XON flow control to prevent buffer overflow.

#### Definitions:

SOM	Start Of Message: ^A (01 hex)
EOM	End Of Message: ^C (03 hex)
ACK	Acknowledge: ^F (06 hex)
CR	Carriage Return: ^M (0D hex)
LF	Linefeed: ^J (0A hex)
XOFF	Flow control stop character: ^S (13 hex)
XON	Flow control start character: ^Q (11 hex)
[ ]	indicates a mandatory parameter
< >	indicates an optional parameter
input	input channel: O0, O2. (O1 and O3 not allowed); default: O0.

output output channel: O0, O1, O2, O3; default: default: O0.  
dataservice caption/text data service: C1, C2, T1, T2; default: C1.  
rows height of caption roll-up window: 2, 3, 4; default: 3.  
mode data preprocessing mode: 1, 2, 3, 4; default: 4.  
count 0, 1; default: 1.  
text ASCII text.  
class XDS class identifier (two digit ASCII hex number): 01,03,05,07,09,0B,0D.  
type XDS type identifier (two digit ASCII hex number): 01-7F.  
line VBI line: 10 - 24.  
error code 0 - 9, A - Z.

## 6.2 Data input

- **Enter Text Article**

Syntax: [SOM]0 <output> <dataservice>[CR]  
<article text line>[CR] ...  
<article text line>[CR]  
[EOM][CR]

A text article is input into the encoder's article memory. The encoder can store one article per output channel. Data service is either T1 or T2.

Delays of 1 to 9 seconds may be included in the article as <^Bn> with n being the number of seconds to delay the output.

A color change may be input into the article text by including <^Dc> with c = W, G, B, C, R, Y, M, or I for White, Green, Blue, Cyan, Red, Yellow, Magenta or Italics. An uppercase character indicates no underline, a lower case characters indicates underline.

The valid data range is: 0, 2, 4, 20h - 7fh. Invalid data bytes are ignored. The article memory must be empty before sending this command, otherwise the encoder will return an error code. (See "Delete Text Article"). If the article exceeds the buffer size (1000 bytes), the encoder will return an error code and drop the article.

*Errors:*

2	Invalid command argument(s)
3	Article already exists
7	Article buffer size exceeded

- **Delete Text Article**

*Syntax:*[SOM]4 <output>[CR]

The text article in the specified output memory is deleted. If the article is currently being output, it is not removed until the current transmission has been completed.

Note: An article has to be deleted before a new one can be input into memory.

*Errors:*           2       Invalid command argument(s)  
                  4       Article not accessible or does not exist

- **Enter Newswire/Real Time Caption/Text**

*Syntax:*           [SOM]2 <output> <dataservice> <rows>[CR]  
                  <caption/text line>[CR] ...  
                  <caption/text line>[CR]  
                  [EOM][CR]

The caption/text lines input through the serial port are output to <output>. Output delays may be included in the data portion as <^Bn> with n = 1-9 seconds.

If data service is T1 or T2, the display is in normal text (data is formatted for text and sent to the T1 or T2 output queue). If data service is C1 or C2, the display is in roll-up mode as specified by the <rows> parameter (data is formatted for roll-up caption and sent to the C1 or C2 output queue).

The valid data range is: 0, 2, 10h - 0x7fh. Invalid data bytes are ignored. All upstream caption/text data is lost while this command is active.

*Errors:*           2       Invalid command argument(s)

- **Enter Pass Through Caption/Text**

*Syntax:*[SOM]3 <mode> <output>[CR]  
                  <caption/text data>[EOM][CR]

The caption/text data input through the serial port is output to <output> with varying degrees of processing as determined by <mode>.

mode = 1    All data is allowed and passed.  
mode = 2    Legal caption control codes are transmitted in the same field.  
mode = 3    Same as mode = 2, except that control codes are automatically doubled.  
mode = 4    Same as mode = 3, except that no non-caption codes are transmitted.

The valid data range is: 0, 10h - 0x7fh. Invalid data bytes are ignored. All upstream caption/text data is lost while this command is active.

*Errors:*           2       Invalid command argument(s)

- **Enter XDS**

*Syntax:*           [SOM]\* [class] [type] [CR]  
                  <XDS data packet>[CR]

XDS data is entered as data packets preceded by their class and type identifiers.

The valid data range is: 0, 20h - 7fh. The maximum packet size is 32 (excluding class and type identifiers).

*Errors:*           1       Unrecognized command  
                  2       Invalid command argument(s)  
                  8       XDS data packet exceeds 32 characters

- **Enter Teletext**

*Syntax:*           [SOM]@[Teletext data packet]

Teletext data is input as data packets preceded by [SOM]@ (NOTE: no space or tab allowed after @). Whenever a complete packet has been received, the data will be inserted into the teletext line specified by Setup #2 LCD menu. For NABTS the data packet size is 33 bytes; for WST the data packet size is 42 bytes.

*Errors:*           2       Invalid command argument(s)

## 6.3 Data Filter

- **Disable Upstream Data**

*Syntax:*[SOM]6 <input> <dataservice>...<dataservice>[CR]

Deletes upstream caption/text data for specified input and data service(s). The status of any unspecified data service is unchanged.

*Errors:*           2       Invalid command argument(s)

- **Enable Upstream Data**

*Syntax:*[SOM]7 <input> <dataservice>...<dataservice>[CR]

Enables upstream caption/text data for specified input and data service(s) to be passed through to the encoder's output. The status of any unspecified data service is unchanged.

*Errors:*           2       Invalid command argument(s)

## 6.4 Data Output

- **Output Text Article**

*Syntax:*[SOM]1 <output> <count>[CR]

The text article for the specified output is transmitted <count> times. If <count> is 0, the article will be transmitted continuously until a second command with a different <count> is issued or the "Delete Text Article" command is sent.

The encoder will return an error if no article is in the specified article memory. Upstream text data *only* is lost while this command is active (upstream captions are passed through without delay).

*Errors:*           2       Invalid command argument(s)

                  4       Article not accessible or does not exist

## 6.5 Encoder Setup and Status

- **Reset Encoder**

*Syntax:* [ACK][ACK]

The encoder's 4 output channels are reset. This will stop any local encoding and all upstream data will be passed through unfiltered.

- **Set Output Channels**

*Syntax:* [SOM]% [output][line][CR]

Assigns VBI lines to the four output channels (O0-O3). O0 and O1 are always field 1 lines; O2 and O3 are always field 2 lines. The status of any unspecified output is unchanged.

The VBI line range is 10-24. Setting line to 0 will disable an output channel.

*Errors:*

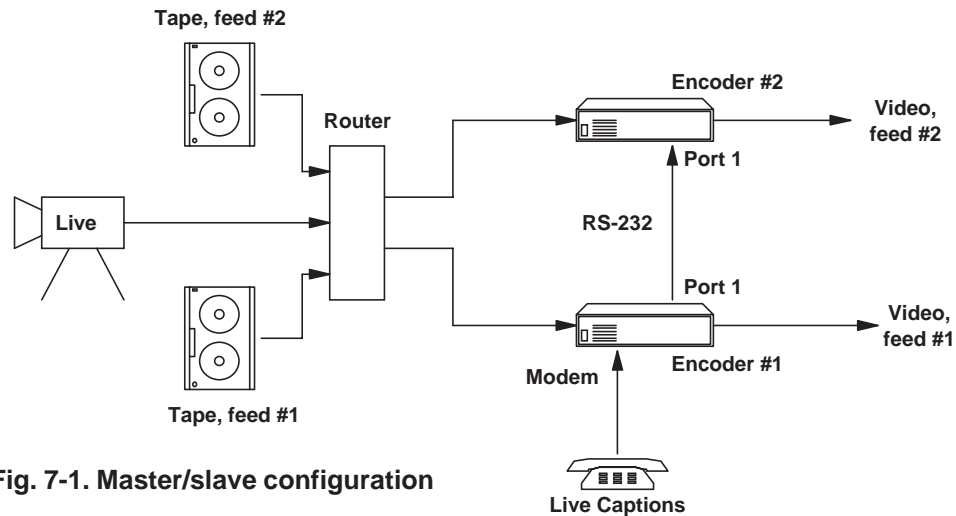
1	Unrecognized command
2	Invalid command argument(s)
9	Line already reserved

Note: The caption waveform for output channels O1 and O3 will only be present while the encoder is actively encoding data unless you set "Filter Upstream Data" to "On" in Setup Menu #1. Otherwise, the waveform is disabled and video is passed through when the encoder is idle.

# 7. Applications Examples

## 7.1 Master/slave operation

A UDE400 can bridge data to a second UDE400 as in the following configuration:



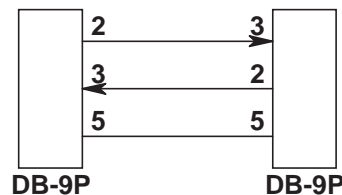
**Fig. 7-1. Master/slave configuration**

Encoder #1 encodes live captions from a modem and simultaneously redirects the modem data out Port 1. Encoder #2 encodes the live caption data stream coming in Port 1. During a commercial break, the caption agency sends an “enable upstream data” command to the encoders. During the commercial, encoder #1 and encoder #2 may receive different video sources together with different encoded captions. When the main program resumes, the caption agency begins sending data which causes the encoder #1 to revert back to encoding data from the modem. Likewise, encoder #2 reverts back to encoding data from Port 1.

The serial ports in both units must be set to the same baud rate and the rate must be greater than or equal to the modem data rate (usually 1200 bps).

### Port 1-to-Port 1 Master/Slave cable

A cable should be constructed in the following manner to allow one UDE400 to talk to another:



**Fig. 7-2. Master/slave cable**

The cable is a “null modem” configuration and contains a 9 pin male D-sub connector on each end. The cable length should not exceed 50 feet (15.2 meters) per the RS-232C standard.

## 7.2 Caption demo file

UDE400 users who do not have access to caption creation software may find it difficult to verify encoder operation. We have therefore created a sample caption file, CC1.CAP, that you can send to the UDE400. CC1.CAP is a DOS file on the 3½" diskette that accompanies this manual. The file consists of CC1 captions and is intended to be encoded in UDE400 output channel O0. You can use your favorite terminal program (e.g. Windows Terminal, Mirror, Crosstalk, etc.) to send the ASCII file to the UDE400. Make sure the communications settings match the encoder's settings, usually 1200 7-1-O (1200 bps, 7 data bits, 1 stop bit). Make sure no output filters are on: the terminal program must pass all control codes. Use XOn/XOff flow control. Use a 9 pin serial cable with pin 3 - pin 3, pin 2 - pin 2. To view the encoded captions, set the caption monitors (LCD and/or Video output) to O0, CC1 with UDE400 menu #2 (or load the "Caption" application, UDE400 menu #1).

We have included startup files for Windows Terminal (UDE400.TRM) and Mirror (UDE400.XTK) that set the proper communications parameters.

## 7.3 Teletext demo program

A teletext demo program is included on the 3½" diskette that accompanies this manual. The source program, TTXENC.C as well as the DOS executable program, TTXENC.EXE is included. The program sends an incrementing sequence of ASCII characters from 0 to 99 to the UDE400 encoder. The program works with both NABTS and WST. A Byte Sync of E7h is used for NABTS; 27h is used for WST (you can easily change these by modifying the source program). You can decode the encoded count sequence by using a suitable teletext decoder. Make sure the baud rate you select with the program (9600/19.2Kbps) match the UDE400's (Menu 4). Use a 9 pin serial cable with pin 3 - pin 3, pin 2 - pin 2.

## 8. Options

### 8.1 OPT1 1200/2400 bps modem (installed by factory)

Option 1 is a 1200/2400 bps asynchronous modem that conforms to the CCITT V.22 bis, V.22/V.21, and Bell 212A/103 standards. The modem is FCC Part 68 registered—UDE400's equipped with the optional modem should have an FCC registration sticker directly below the serial number label on the rear panel.

The optional modem is used to receive data remotely. You can set the modem to either 1200 or 2400 bps and you can keep it from answering incoming phone calls by selecting “disable” from menu #4 *Communications*. The UDE400 will answer a call from any menu after two rings. The UDE400 will display a “ring” message when it detects an incoming call and will immediately generate a carrier when it answers (goes “off hook”). The UDE400 will disconnect the phone line (go “on hook”) if a carrier from the calling modem is not detected with 30 seconds; otherwise a “carrier detect” message will be displayed on the front panel. The carrier detect message stays on the front panel until cleared by hitting the ENTER key or until the carrier is lost. A CD carrier detect icon will remain on the upper right corner of the LCD display while the remote carrier is present. A “carrier lost” message will be displayed when the remote carrier goes away. The UDE400 terminates the incoming call when the remote carrier is lost. You can manually terminate a call by selecting “disable” from menu #4 *Communications*. The modem operate using Xon/Xoff flow control for incoming data. Port 2 pins on the 9 pin Data Port connector must not be connected if the modem is installed.

### 8.2 OPT2 Caption monitor output (installed by factory)

Option 2 is a closed caption/text decoder circuit with an on-screen display video output. The decoder monitors UDE400 video outputs A & B directly. The decoder operates independently from the encoder—the decoder will display text/captions whether or not they were encoded by the UDE400. Likewise, the monitor cannot display text/captions unless there is a valid caption waveform at video outputs A & B. The decoder can be set to monitor any VBI line from 10-23 and in either field. The decoder monitors only one data service at a time (text or captions). You can control the brightness and contrast of the text/captions (“box” and “character” adjust in caption terminology). The on-screen display circuitry overlays text/caption characters on the encoded video for delivery to the caption monitor video output.

### 8.3 OPT6 Dual RS-232 adapter cable

Option 6 is a “Y” cable adapter that gives you access to ports 1 & 2 on individual 9 pin connectors. Dual ports let you encode data from two independent sources at the same time. One source could be a news wire feed while the other could be an EDS or station automation computer.

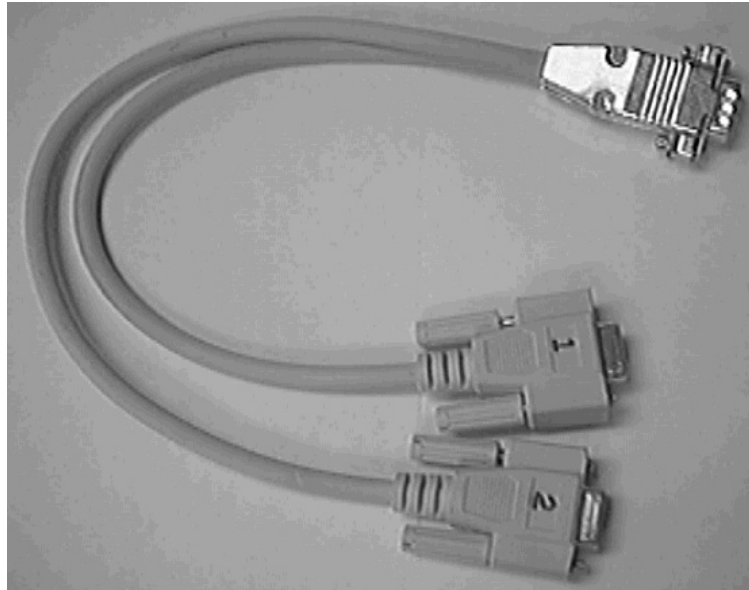


Fig. 8-1. Dual RS-232 adapter cable

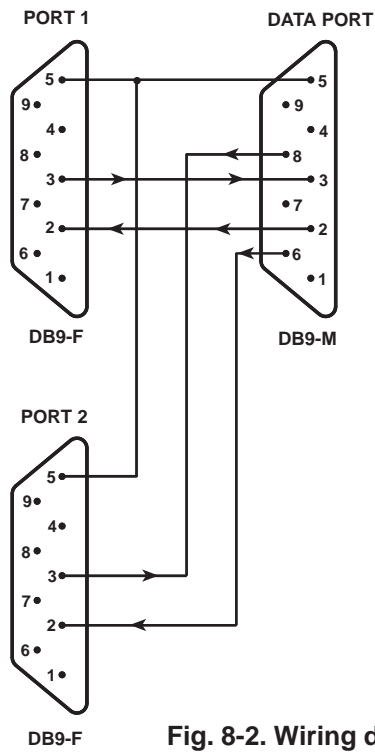


Fig. 8-2. Wiring diagram for dual RS-232 adapter

# 9. Technical Reference

## 9.1 Theory of Operation

### Hardware (refer to Fig. 9-1 Block Diagram)

1Vpp video enters the Video In connector where it is terminated into 75 ohms and amplified by a factor of 2. The 2X amplifier feeds a sync processor which derives field and line timing together with a line-locked data clock. The output of the 2X amplifier also feeds a clamping circuit which establishes a reference with respect to the data waveform to be inserted. The data waveform is synthesized in a digital waveform generator that is under control of a microcomputer. The output of the digital waveform generator is converted into an analog waveform by a high speed 8 bit digital-to-analog converter. The analog waveform is inserted into the source video during the appropriate VBI line. The combined video signal feeds two independent 75 ohm buffer amplifiers as well as an optional caption decoder for monitoring purposes.

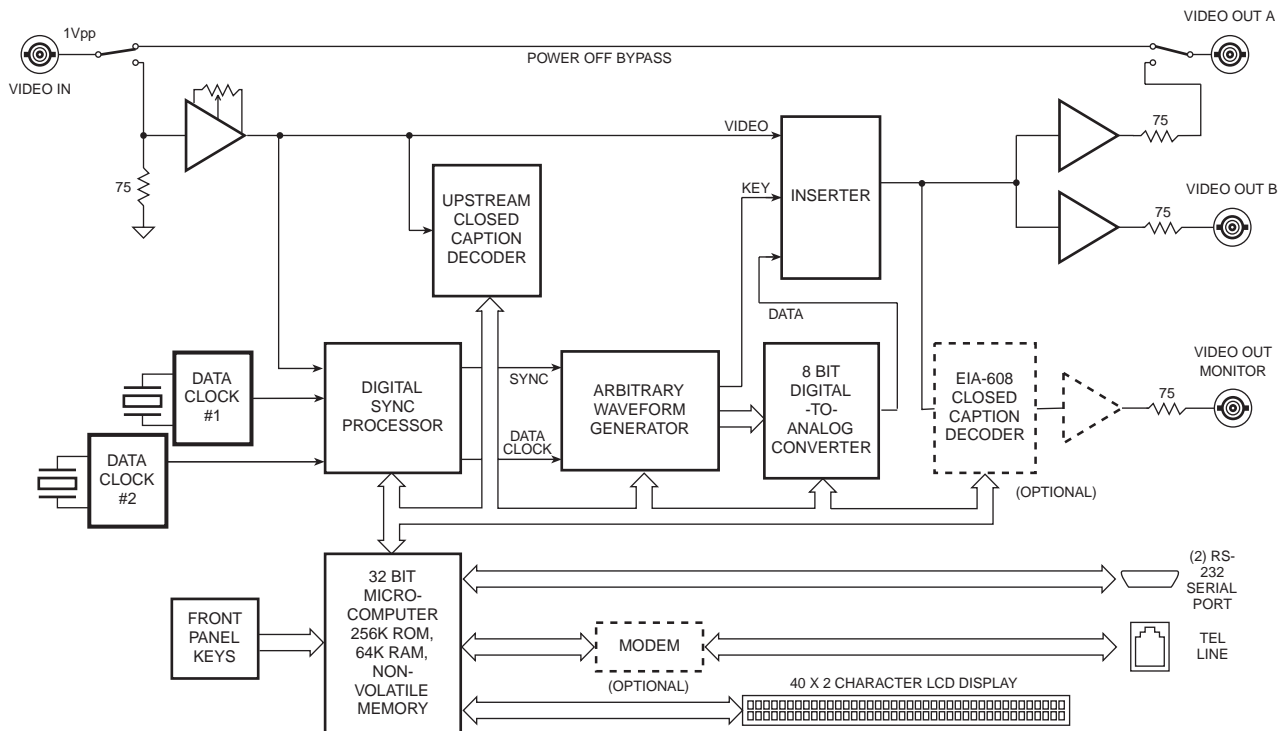


Fig. 9-1. Block diagram

## Software

The algorithms used to handle the various line 21 data services were derived from the EIA-608 specification *Recommended Practice for Line 21 Data Service*. In particular, the methods described in section 10.8 *Line 21 Data Flow* were followed. A copy of the EIA-608 specification may be ordered from the EIA:

Electronic Industries Association  
Consumer Electronics Group  
2500 Wilson Blvd.  
Arlington, VA 22201  
Tel: (703) 907-7500  
Fax: (703) 907-7501

## 9.2 Calibration

### Test Equipment

DC voltmeter, accuracy  $\pm 1\%$  at -15VDC to +15VDC  
 AC voltmeter, 100KHz minimum response, RMS reading  
 Video pattern generator  
 75 ohm BNC terminator, 1%  
 Waveform monitor or ULTECH TV Trigger Mate & 20 MHz oscilloscope

### Procedure

- ❑ 1. Disconnect AC line cord from rear of unit. Remove (6) phillips screws from top cover. Remove top cover.
- ❑ 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 power entry module, transformer, or AC line switch. Apply a stable 1Vpp stairstep pattern to Video In. Connect the 75 ohm terminator to Video Out "A".
- ❑ 3. DC voltages.  
 Verify that the DC supply voltages are within specification before beginning calibration (attach ground clip of DC voltmeter to J1 BNC connector housing on inside of panel):
  - +5VDC: measure +5VDC  $\pm 5\%$  at U39 pin 40.
  - +12VDC: measure +12VDC  $\pm 5\%$  at U8 pin 8.
  - 12VDC: measure -12VDC  $\pm 5\%$  at U8 pin 4.
- ❑ 4. Gain adjust.  
 Adjust R50 for unity gain at Video Out "A". This may be accomplished by using the AC voltmeter or waveform monitor to check Video In with Video Out. Video Out "A" must be terminated with a single 75 ohm 1% terminator.
- ❑ 5. DAC scale adjust.  
 Set the encoder to generate the caption waveform in line 21: TV Std: NTSC, output channel O0=line 21, Passthru=reencode (as in step 7).  
 Monitor line 21 with a waveform monitor or oscilloscope. Adjust R14 so the highest portion of the line 21 waveform is at 50 IRE.

/Continued...

6. LCD contrast

Adjust R77 to obtain the best contrast on the LCD display (R77 located on edge of pcb near LCD). Note: the contrast of the LCD display is greatly affected by the viewing angle. When performing this adjustment, you should view the LCD from the same angle as you would if the equipment were installed in its normal place.



A shock hazard exists with the top cover removed—only qualified personnel should perform the calibration procedure.

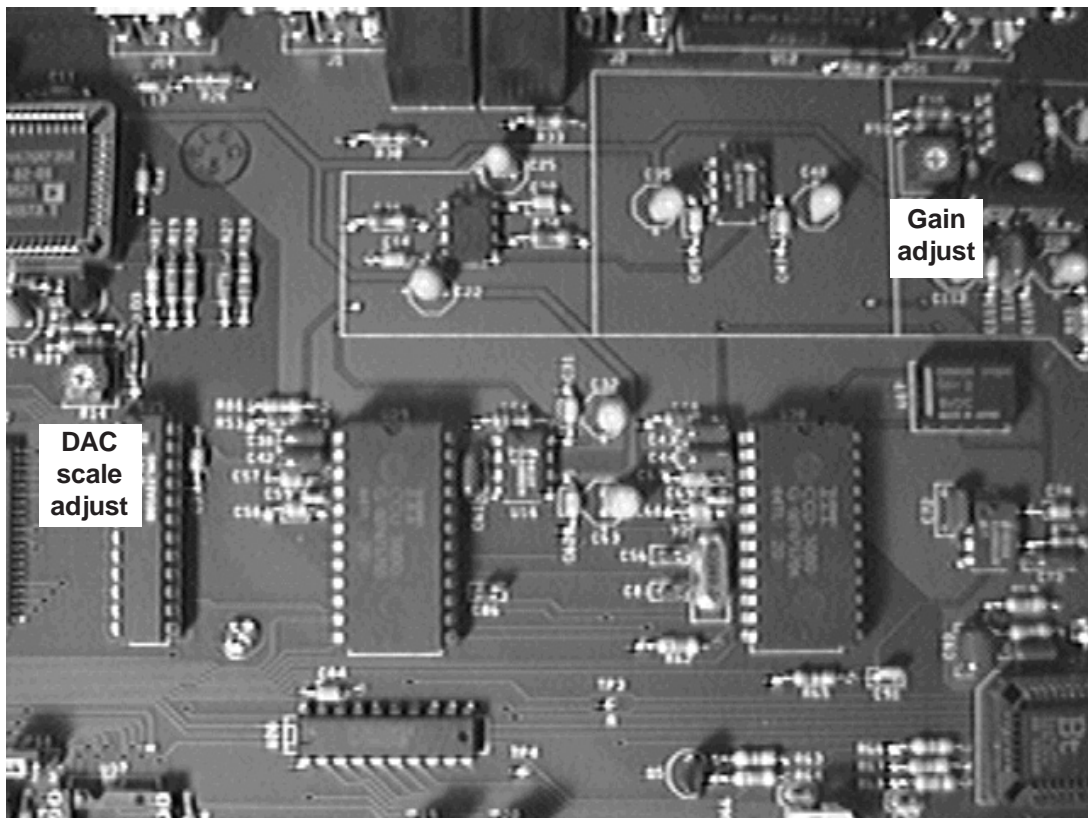


Fig. 9-2. Adjustments

### 9.3 Programmer's reference

#### Sending commands

RS-232 commands are of the form:

<^A> <command number> <parameter list> <CR>

The UDE400 will acknowledge any valid command with:

<CR><LF>\*<CR><LF>

When the encoder is first turned on, it also sends a "\*" to indicate it's ready.

If the command number is invalid (no function assigned), or invalid parameters are specified, the UDE400 will respond with:

<CR><LF><error code><CR><LF>

Application software can wait for the UDE400 to acknowledge commands or it can ignore any encoder responses (see Fig. 9-3, 9-4).

#### Sending data

Since data can be sent to the UDE400 at a higher rate than it can encode, flow control must be used to insure that the encoder's data buffers do not overflow. The UDE400 sends an Xoff when its buffers are 2/3 full and, if an Xoff has been sent, an Xon when its buffers drop below 1/3. We recommend that your PC software handle data sent by the UDE400 with a serial interrupt routine.

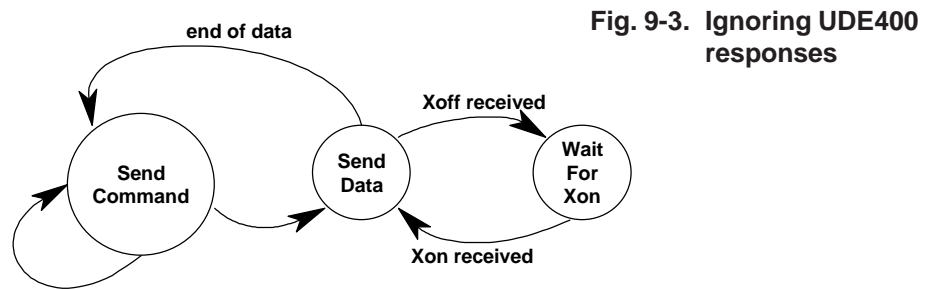


Fig. 9-3. Ignoring UDE400 responses

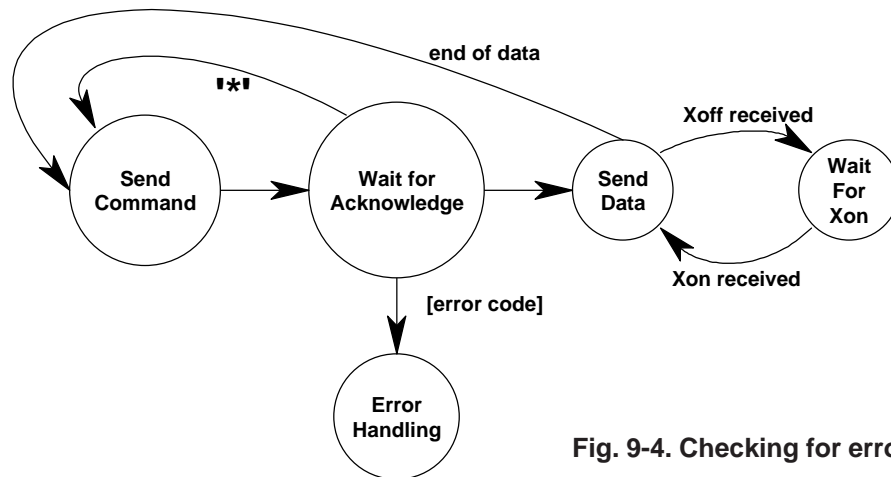


Fig. 9-4. Checking for errors

## 9.4 Specifications

### Front panel controls & indicators

Power on/off switch  
40 character x 2 row LCD display  
Menu-specific cursor/enter keys

### Rear Panel controls & connectors

Line voltage select  
(1) 1Vpp analog composite video input BNC, terminated into 75 ohm  
(2) 1Vpp analog composite video output BNC,  
75 ohm source impedance  
Video input bypassed to output "A" via power off relay  
DB9F RS-232 serial port

### Electrical Performance

Differential gain: 0.1%, A/B outputs  
Differential phase: 0.1°, A/B outputs  
Insertion jitter, field to field  
NTSC caption/text, NABTS:  $\pm 8\text{nS}$   
PAL caption/text, WST:  $\pm 9\text{nS}$   
Delay, video in to video out: 100nS  
Clamp: back porch, 0 IRE = 0.0VDC  
TV Standards: NTSC, PAL  
All other parameters per EIA-250B short haul

### Power

10 Watt, 50/60 Hz  
104 VAC to 126 VAC (120 VAC setting)  
207 VAC to 253 VAC (240 VAC setting)

### Enclosure

Dimensions: 19" W (483) x 1.74" H (44.2) x 9.5" D (241)  
Front panel: 0.125" steel, painted, lexan front panel overlay  
Rear, tray, top: 18ga. steel, painted, silk screen lettering on rear  
Weight: 8 lbs. (3.8 kg.)