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VDL Mode 3 Protocol Analyzer (VPA3)
Module Manual

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Title: VDL Mode 3 Protocol Analyzer (VPA3) Module Manual

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1.0 INTRODUCTION

This document provides installation and operation instructions for the VDL Mode 3 Protocol Analyzer (VPA3).

The VPA3 is a T1 line monitoring device that enables the capture and logging of VDL3 Mode 3 High Level Data Link Control (HDLC) messages. Unlike typical T1 test equipment, the VPA3 timestamps HDLC messages with the timing information captured in T1 slots 1 and 2 at the beginning of each HDLC message. This additional information allows NEXCOM system developers and testers to validate message timing and to troubleshoot system communication problems.

1.1 PURPOSE

The purpose of this document is to present VDL Mode 3 Protocol Analyzer (VPA3) installation and operation instructions.

1.2 DOCUMENT CONVENTIONS

None.

1.3 INTENDED AUDIENCE AND READING SUGGESTIONS

This document is intended for NEXCOM developers and testers.

1.4 REFERENCES

The following references apply to the VPA3:

- DOT/FAA Interface Control Document, Multimode Digital Radio (MDR)/Radio Interface Unit (RIU), DTFA01-01-D-03009, NAS-IC-41033502, July 23, 2001 – V3.0.

1.5 REVISION HISTORY

	Revision	Description of Changes
05/12/2003	1.0	Initial Release

2.0 GENERAL DESCRIPTION

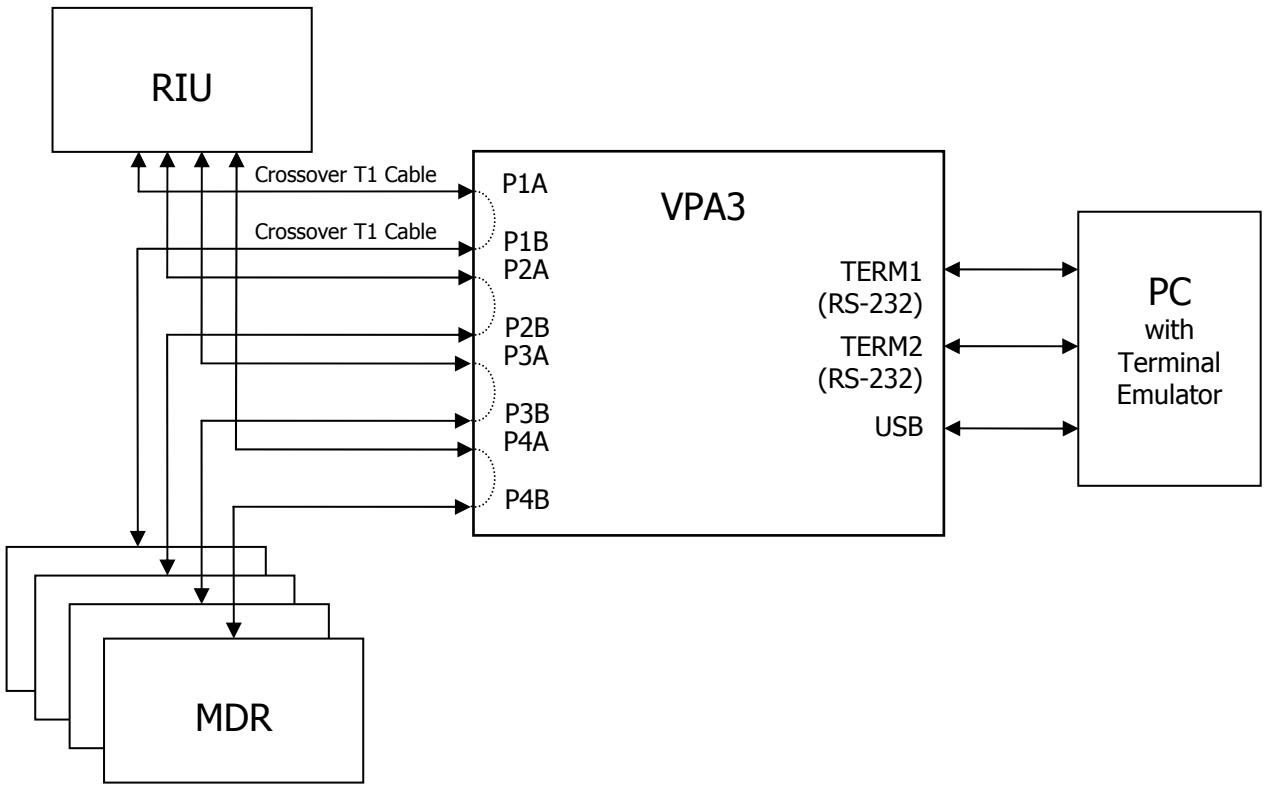
2.1 OVERVIEW

The VDL Mode 3 Protocol Analyzer (VPA3) captures HDLC messages on the RIU-MDR link and prints ASCII or Binary formatted messages to a terminal interface (TERM1, TERM2 or USB). A separate computer running a terminal emulation program, such as HyperTerminal, can be configured to capture the messages to a file for subsequent analysis. The VPA3 runs on the OTM2 hardware platform.

The VPA3 is designed to be installed inline between the MDR and RIU. The VPA3 includes internal bridge circuitry that can be configured with internal switches to "tap" the line in both directions and internally connect pairs of ports (see Figure 1). The internal switches are configured at the factory to bridge the T1 lines. Refer to Figure 2 for the location of the T1 ports.

Since the VPA3 is inline with the communication between the RIU and MDR, it is important to use the same type of cables, crossover or straight through, in the installation as shown in Figure 1. This is because the circuitry on the board crosses the Rx and Tx signals in the same manner that a crossover cable would that was connected directly between the RIU and MDR. Furthermore, the use of crossover cables instead of straight through will cause the VPA3 to receive messages from the RIU or MDR on the same T1 port that it is physically connected to and light the "Data" LEDs accordingly. If straight through cables were used, the MDR and RIU would still communicate and the VPA3 would monitor the communication, but Port A would monitor transmissions from the MDR and Port B would monitor transmissions from the RIU (referring to Figure 1). Changes in Port B's status, such as loss of T1 clock, would be reflected in Port A's "Data" LED activity and the same changes in Port A's status would be reflected in Port B's LEDs.

Figure 1. VDL Mode 3 Protocol Analyzer (VPA3) Block Diagram



2.2 FEATURES

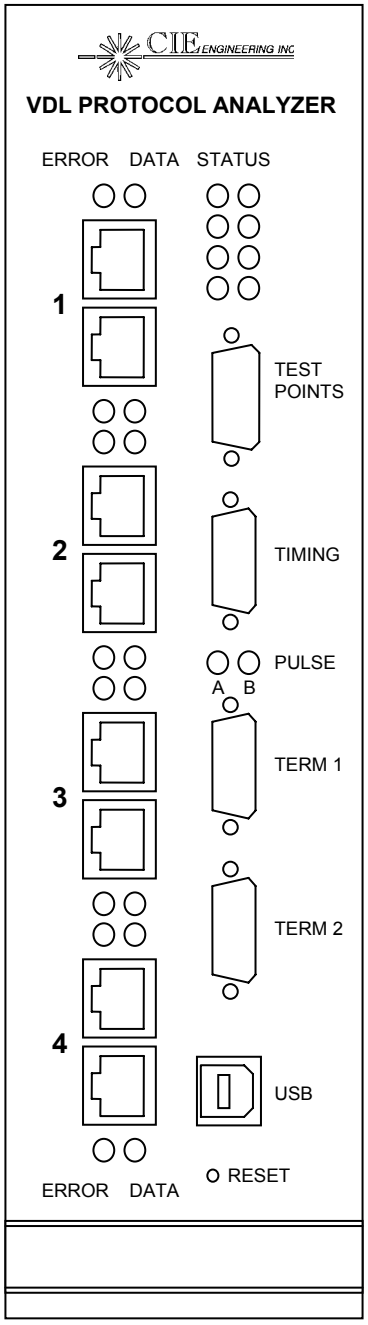
The VDL Mode 3 Protocol Analyzer (VPA3) provides the following features:

- Ability to monitor T1 HDLC traffic between MDR and RIU on any HDLC channel.
- Ability to capture the Tx and/or Rx data on the T1 interface as well as the frame count information.
- Ability to monitor the frame count on all ports and indicate non-sequential counts or out of range values.
- Ability to show information in ASCII or binary format.
- Ability to show capture statistics and error status for each port.
- Ability to print timestamps in capture output.
- Ability to direct capture data to any Terminal.
- Ability to direct error messages to any Terminal.
- Ability to synchronize T1 port timing and frame count source to any T1 port or generate internally.
- Ability to show link status and indicate capture errors on front panel LEDs.

3.0 CONTROLS, INDICATORS & INTERFACES

Figure 2 is an illustration of the VPA3 front panel showing the location of all controls, indicators and interfaces.

Figure 2. VPA3 Front Panel



3.1 T1 INTERFACES (PORT 1 - PORT 4)

The T1 interfaces use standard RJ-48 connectors and standard T1 pinouts. See Figure 2 for a front panel illustration showing the location of the T1 ports. There are eight T1 connectors on the VPA3. A pair of connectors makes up a port. The top connector in each port is referred to in the text as Port A and the bottom connector as Port B. Since the VPA3 is monitoring T1 traffic and is not the proper destination for that traffic, one port (two connections) will monitor one T1 communication path between the RIU and the MDR. When the crossover cables on VPA3 Port 1A and 1B are connected to the RIU and the MDR as shown in Figure 1, Port 1A captures data sent by the RIU on pins 1 and 2, and Port 1B captures data sent by the MDR on pins 4 and 5 of the T1 cable.

Table 1. T1 Ports 1 through 4 – Signal Descriptions

Signal	Pin	Pin Type	Description
RX Tip	1	I	Receive Tip, Positive
RX Ring	2	I	Receive Ring, Negative
	3		
TX Tip	4	O	Transmit Tip, Positive
TX Ring	5	O	Transmit Ring, Negative
	6		
	7		
	8		

3.2 TEST POINTS INTERFACE

The Test Points Interface is a standard DB-15F (sockets) connector. See Figure 2 for a front panel illustration showing the location. This interface is reserved for future use.

3.3 TIMING INTERFACE

The Timing Interface is a standard DB-9M (pins) connector. Optically isolated, differential system timing signals are routed to this connector for monitoring purposes. See Figure 2 for a front panel illustration showing the location.

Table 2. Test Points Interface – Signal Descriptions

Signal	Pin	Pin Type	Description
D1544P	1	O	1.544 MHz, Positive
D31K5P	2	O	31.5 KHz, Positive
DLPBN	3	O	Pulse B, Negative
DLPAN	4	O	Pulse A, Negative
ISOGND	5	GND	Optical Isolation Ground
D1544N	6	O	1.544 MHz, Negative
D31K5N	7	O	31.5 KHz, Negative
DLPBP	8	O	Pulse B, Positive
DLPAP	9	O	Pulse A, Positive

3.4 RS-232 TERMINAL INTERFACES (TERM 1 AND 2)

The RS-232 Terminal Interface is compatible with standard personal computer (PC) serial ports. The RS-232 TERM interface is permanently configured as a DCE device. A standard "one-to-one" interface cable (male-to-female) can be used for PC-to-VPA3 communication.

Table 3. RS-232 Terminal Interface (TERM 1 and 2) – Signal Descriptions

Signal	Pin	Pin Type	Description
COM_CD	1	O	COM Carrier Detect:
COM_RD	2	O	COM Receive Data:
COM_TD	3	I	COM Transmit Data:
COM_DTR	4	I	COM Data Send Ready:
GND	5	GND	Signal Ground
COM_DSR	6	O	COM Data Terminal Ready:
COM_RTS	7	I	COM Clear To Send:
COM_CTS	8	O	COM Request To Send:
COM_RI	9	O	COM Ring Indicator:

The VPA3 RS-232 Terminal connectors are standard DB-9F (sockets). See Figure 2 for a front panel illustration showing the location.

The TERM interface uses the standard asynchronous ASCII communication protocol configured at 115200 bps, 8 data bits, 1 stop bit, no parity, h/w handshaking.

3.5 USB TERMINAL INTERFACE (TERM 3)

The Universal Serial Bus (USB) Terminal Interface is compatible with standard personal computer (PC) USB ports. The VPA3 is configured as a self powered USB function device. A standard USB interface cable can be used for PC-to-VPA3 communication.

Table 4. USB Terminal Interface (TERM 3) – Signal Descriptions

Signal	Pin	Pin Type	Description
Vbus	1	I	+5 V Bus Power
D-	2	I/O	Data (Negative Differential)
D+	3	I/O	Data (Positive Differential)
GND	5	GND	Signal Ground

The VPA3 USB connector is a standard Series "B" plug. See Figure 2 for a front panel illustration showing the location. The PC USB connector is a standard Series "A" plug.

A terminal emulation program can be used on the PC in conjunction with the FT8U232/245 Virtual Com Port (VCP) device driver from FTDI. The VCP driver makes the VPA3 terminal look like a standard COM port device. The VCP terminal is configured at 8 data bits, 1 stop bit, no parity, and no handshaking. The baud rate setting is ignored and data is transferred at the maximum rate possible for the device driver.

3.6 RESET

The Reset Button is a recessed momentary switch that, when pushed, will cause a hardware reset to occur on the VPA3 module. See Figure 2 for a front panel illustration showing the location.

3.7 LED INDICATORS

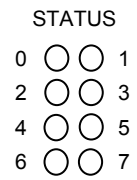
There are two LED indicators adjacent to each of the RJ-48 T1 interface connectors on the VPA3. The LEDs labeled "DATA" are used to indicate the state and activity of the Rx T1 interfaces. See Table 5 for details.

Table 5. LED TI Data Indicators

LED INDICATOR	Red	Green	Off
Data	No connection or clock, T1 errors	Data Received on T1	No data, no error
Error	N/A	N/A	N/A

Figure 3 shows a detail of the block of STATUS LEDs with numbers to reference individual LED locations with. The LED at position 0 flashes green once per second to indicate that the VPA3 processor is in good health and has an active T1 clock reference. Refer to the HSYNC command for details. The LED at position 1 indicates the "Epoch" of the T1 clock reference port. It flashes green once every six seconds when the frame count from the T1 clock reference port rolls over to zero. The LED at position 4 indicates "Capture Data". It flashes green when data is received and captured to one of the terminal ports. The LED at position 5 indicates "Capture Error". It flashes red when data is received but, due to an error, is not sent to the terminal port. The LED at position 6 lights red when a "Capture Error" occurs and stays lit until all HDLC Status has been cleared with the "HSTAT * C" command.

Figure 3. VPA3 Status LEDs



The LEDs labeled PULSE A and B light red when the corresponding Pulse signals on the "TIMING" front panel connector are set in the high state by either the **PULSE AS/BS or PULSE AP/BP** commands. Refer to Section 7.0 for details on the use of these, and all other available commands.

4.0 INSTALLATION

4.1 BASIC INSTALLATION

The VPA3 is intended to be inserted in the T1 circuit between the RIU and MDR in order to monitor HDLC traffic. Install the VPA3 as shown in Figure 1.

The following cables are required (but not supplied):

- Two T1 crossover cables per MDR-RIU connection
- Terminal Interface Cable (one or more of the following): DB9M/DB9F Serial Port Cable (up to 2 each), USB Interface Cable

Note: The recommended configuration uses one serial port and the USB port. The USB port is configured to capture messages, since it supports the fastest data transfer rate. The serial port can be used to display any system error messages.

The VPA3 is meant to be used with a terminal emulator program such as Procomm or HyperTerminal which support the capture of text to a file which can subsequently be imported into a program such as Excel for analysis.

If the USB interface is used, insure the FT8U232/245 Virtual Com Port (VCP) device driver from FTDI is installed on the PC. The VCP device driver and installation instructions can be found at http://www.ftdichip.com/FTDriver.htm - NOPNP. Be sure to select the proper driver for the operating system being used.

The default settings for the Virtual Com Port should be maintained. The settings are found in the Windows Device Manager when the USB port is connected and the VPA3 is on. To modify/verify the settings:

1. In the Windows Device Manager, select Ports (COM & LPT) - USB Serial Port (COM number that the device was installed with).
2. Right click the mouse and select "Properties".
3. On the "Port Settings" tab. Insure the following settings are selected: 9600 Bits per second, 8 Data bits, None for Parity, 1 Stop bit and None for Flow control.
4. Click on the "Advanced" button. Insure the following settings are selected: 4096 Receive (Bytes), 4096 Transmit (Bytes), 16 for Latency Timer (msec), 0 Minimum Read Timeout (msec), 0 Minimum Write Timeout (msec) and nothing checked in Miscellaneous Options are the default settings.

Note: The COM Port Number can be changed to any unused port at the user's preference.

5.0 FUNCTIONAL DESCRIPTION

5.1 SYSTEM REFERENCE TIMING

The HSYNC command is used to set the system reference timing. The selected T1 port supplies the receive clock that is used for all T1 port reception. It also selects the frame count received on that port to be the system frame count. The captured HDLC messages report the system frame count at the time that the first byte of the message was received along with a message frame count, which is the frame count from the source of the HDLC message. The system frame count is also sent to the VSS modules in the chassis over the backplane on the processor's Sport0 bus. Typically a T1 port that is connected to an RIU should be selected as the timing source since it is the source of the timing for the MDRs that are connected to it.

Since the frame counts received on all T1 ports are validated, any T1 source that is not synchronized to the source of the T1 port that is selected with HSYNC will receive periodic frame count errors. These errors will either be frame counts that did not increment or frame counts that skipped values when incrementing. Message reception on that port may also be affected by occasional dropped bytes. These errors will be reported on the terminal port that has been selected to display errors with the EVTERR command and the error status LED will flash red.

5.2 FRAME COUNT VALIDATION

The frame count validation checks the frame counts received on all T1 ports. The validation verifies that the frame count increments by one and the frame count is greater than or equal to zero and less than 48000 decimal.

5.3 CAPTURE OPERATION

HDLC messages can be captured to any terminal connected to the VPA3. In order to minimize data loss, hardware handshaking is enabled on the RS-232 terminals. The USB terminal is inherently a lossless communication device and captured messages are held in the framer queues until there is enough room in the port queue of the destination terminal.

The captured data is held in a T1 framer queue until there is enough room in the port queue. If there is a problem printing to that port queue (TERM1, TERM2, or USB) - such as flow control stopping because the terminal connector was removed or the volume of captured data is too high to print at the baud rate of the terminal - the first thing to fail is the T1 framers ability to write to the framer queue. Therefore, data throughput problems will show themselves as framer errors.

5.4 ERROR REPORTING

Error messages can be output on any terminal and, unlike captured messages; they can be output on multiple terminals simultaneously. The convenience of this is that one terminal can be dedicated to showing errors, while another terminal is dedicated to capturing data. In order to correlate errors to the data at the time they were being reported, the errors can be output on the same terminal as the data. This will interleave captured HDLC message data with error messages to give a time sequence of events.

In the error message that is generated, there is a block of common information with captured messages that shows the message sequence number, the T1 port and HDLC channel and the system frame count. Next is the error text which indicates the type of error and an error number. Framer errors, in addition to this information, also decode the

specific type of framer error. If the error is a frame count error, the two frame counts that generated the error are shown and it can be seen that they are either out of sequence or out of range of the maximum frame count value.

5.5 MULTI-TERMINAL SUPPORT

More than one terminal can be connected to the VPA3 at any one time. TERM2 is the only terminal that shows the progress of the startup sequence. It is also the terminal to use for downloading software upgrades. Any terminal can be used for command entry, event capturing and error reporting. Due to the higher speed of the USB terminal, it is best suited for event capture when the volume of captured data is expected to be high. Command responses are sent to the terminal that the command was entered on and the capture data and error reports can be directed to different ports. This is useful for entering commands or monitoring errors without disturbing active event capturing on a different terminal. Hardware handshaking is used on the RS-232 terminals (TERM1 and TERM2) to prevent data loss. The USB terminal (TERM3) is inherently a lossless communication device.

5.6 PROGRAMMABLE PULSE INTERFACE

There are two programmable pulses that are output on the TIMING connector on the front panel of the module, they are referred to as Pulse A and Pulse B. These pulses are programmed with the PULSE command. Two front panel LEDs reflect the state of the pulse signals. When the signal is high, the corresponding LED is on. The pulses can be programmed to change state on any system frame count value. This allows a square wave of any duty cycle to be generated which is synchronized to the system frame count selected with the HSYNC command. A square wave with a 50% duty cycle can be programmed on Pulse A, for example, by entering the frame count value for the rising or positive edge of Pulse A with the command syntax "PULSE AP 0" and the frame count for the falling or negative edge with "PULSE AN 5DC0". This will create a rising edge at frame count 0 and a falling edge at frame count 5DC0, which is half of the maximum value of the frame count. If a steady state signal is desired, Pulse A is always high, for example, the pulse can be programmed with "PULSE AS". The commands to set the steady state signals do not require a frame count value because they set the signal to the desired state immediately. Refer to Section 7.0 for a complete description of the PULSE command.

5.7 REAL TIME CLOCK

The VPA3 module does not have a real time clock that will maintain the time through a power cycle. It does have the ability to maintain the time of day, once it is set with TIME and DATE commands, as long as power is continuously applied to the module. The date reflects the correct number of days in a month, but does not support leap year changes. The time is updated every 125 micro seconds synchronous with the clock selected for system timing with the HSYNC command. When the time is being set, it calculates the frame count value that is represented by the entered time and waits until that frame count to set the clock. This is done to synchronize the time of day with the epoch. Consequently, if the referenced time of day used to set the clock is not synchronous to the source of the epoch, there may be as much as a 6 second difference between the set time of day and the referenced time.

5.8 ASCII MODE CAPTURE FORMATS

5.8.1 Time Stamp Format

If time stamping has been enabled with the **EVTECNT** command, the VPA3 prints a time stamp at the set period. If the time stamp occurs within the captured data, it precedes the message that is received at the indicated time.

The time stamp format is as follows:

```
NNNNNNN,--,-,SSSSS,MMM DD, YYYY HH:MM:SS<cr/lf>
```

Where:

`NNNNNNN`	Sequence Number: A sequence number is assigned to each captured message. The sequence number starts at 0000001 and increments by one for each subsequent message.
`sssss`	System Frame Count: A five-digit decimal representation of the VDL timing channel value (i.e. slots 1 and 2) from the T1 port that is being used for system timing. Valid values range from 00000 to 47999, representing a 6-second epoch.
`MMM`	Month: A three to four character month string.
`DD`	Day: A two digit day of the month.
`YYY`	Year: A four digit year.
`HH`	Hour: Two digits.
`MM`	Minute: Two digits.
`SS`	Seconds: Two digits.

MMM is a three to four character month string, **DD** is a two digit day of the month, **YYYY** is a four digit year, **HH** is a two digit hour, **MM** is a two digit minute and **SS** is a two digit seconds field.

5.8.2 Header Format

The VPA3 prints a header at the start of every capture and every 10,000 entries thereafter. The header describes the fields in the data message.

```
| SEQ# |P |C|SFCNT|MFCNT|ADR|CTL|MID|SID|LEN|------------ MESSAGE,CKSM,STAT<cr/lf> -----------|
```

5.8.3 Data Message Format

The data message format of the captured data is as follows:

NNNNNNN,TT,H,SSSSS,MMMMM, AA, CC, PP, SS,LLL, DDDDDDD…,EEEE,UUUU<cr/lf>

Where:

NNNNNNN Sequence Number: A sequence number is assigned to each captured message. The sequence number starts at 0000001 and increments by one for each subsequent message.

TT T1 Port Number: A one-digit and one-character field representing the T1 port number. If the installation conforms to Figure 1, Port 1A indicates messages output from the RIU and Port 1B indicates messages output from the MDR.

H HDLC Channel Number: A one-digit field representing the HDCL channel number. The VPA3 supports data capture for channel 01 through channel 05. Channel 01 uses timeslots 5 through 8 and each consecutive channel uses the next 4 sequential timeslots up to timeslot 21 through 24 for channel 05.

SSSSS System Frame Count: A five-digit decimal representation of the VDL timing channel value (i.e. slots 1 and 2) from the T1 port that is being used for system timing. Valid values range from 00000 to 47999, representing a 6-second epoch.

MMMMM Message Frame Count: A five-digit decimal representation of the VDL timing channel value (i.e. slots 1 and 2) from the T1 port that the message was received on, read coincident with the detection of the opening byte of the HDLC message. Valid values range from 00000 to 47999, representing a 6-second epoch.

AA HDLC Address Field: A two-digit ASCII hex field. Valid values include 01, 02 and 03 for RIU, MDR-TX and MDR-RX, respectively. This value is copied from the first byte of the Message Field.

CC HDLC Control Field: A two-digit ASCII hex field. This value is copied from the second byte of the Message Field.

PP HDLC Message ID: A two-digit ASCII hex field. This value is copied from the third byte of the Message Field.

SS HDLC Sub-Message ID: A two-digit ASCII hex field. This value is copied from the fourth byte of the Message Field.

LLL HDLC Message Length: A three-digit ASCII decimal field representing the length (in bytes) of the HDLC message including address, control and information.

DDDDDDD… HDLC Message Field: A variable length field containing an ASCII hex representation of the message including address, control and information fields.

EEEE HDLC Frame Check Field: A four-digit ASCII hex field representing the checksum of the message.

UUUU HDLC Information Field: A four-digit ASCII hex field. The lower two digits represent the value of the HDLC Information (RHIR) register, upon the reception of a complete message, for the receiving Framer and the upper two digits indicate a Max Msg Size Overflow Error, a Missed Close Byte Error and a Missed Open Byte Error. Table 6 shows the bit positions of the respective values.

Table 6. HDLC Information Field		
Bit	**Description**	
12+	Reserved	
11	Max Msg Size Overflow Error	
10	Missed Close Byte Error	
9	Missed Open Byte Error	
8	RHIR RABT	Abort Sequence Detected
7	RHIR RCRCE	CRC Error
6	RHIR ROVR	Overrun Error
5	RHIR RVM	Valid Message (HDLC Packet)
4	RHIR RX Empty	Receive FIFO Empty
3	RHIR POK	Packet OK
2	RHIR Close Byte	Closing Byte Received
1	RHIR Open Byte	Opening Byte Received

5.8.4 Error Message Format

The error message format of the captured data is as follows:

NNNNNNN,TT,H,SSSSS, AA, CC, PP, SS,LLL, EEEEEEE…<cr/lf>

Where:

NNNNNNN Sequence Number: A sequence number is assigned to each captured message. The sequence number starts at 0000001 and increments by one for each subsequent message.

TT T1 Port Number: A one-digit and one-character field representing the T1 port number. If the installation conforms to Figure 1, Port 1A indicates messages output from the RIU and Port 1B indicates messages output from the MDR. If the error is not T1 port specific, dashes will appear instead of a number.

H HDLC Channel Number: A one-digit field representing the HDCL channel number. The VPA3 supports data capture for channel 01 through channel 05. Channel 01 uses timeslots 5 through 8 and each consecutive channel uses the next 4 sequential timeslots up to timeslot 21 through 24 for channel 05. If the error is not T1 port specific, a dash will appear instead of a number.

SSSSS System Frame Count: A five-digit decimal representation of the VDL timing channel value (i.e. slots 1 and 2) from the T1 port that is being used for system timing. Valid values range from 00000 to 47999, representing a 6-second epoch.

EEEEEEE… Error Message Field: A variable length field containing an ASCII string indicating the type of error, the error number and additional information about the error.

5.9 BINARY MODE CAPTURE FORMATS

5.9.1 Time Stamp Format

If time stamping has been enabled with the **EVTECNT** command, the VPA3 prints a time stamp at the set period. If the time stamp occurs within the captured data, it precedes the message that is received at the indicated time. The time stamp format is as follows:

```
02 20 NN NN NN TH SS SS LL LL MM DD YY HH MM SS 03
```

Where:

`02`	Opening flag.
`20`	Message type: Time.
`NN NN NN`	Sequence Number upper, middle and lower byte: A sequence number is assigned to each captured message. The sequence number starts at 000001 and increments by one for each subsequent message.
`TH`	T1 Port Number and HDLC Channel Number: The message is not T1 port specific, 0xFF will appear.
`SS SS`	System Frame Count upper and lower byte: The VDL timing channel value (i.e. slots 1 and 2) from the T1 port that is being used for system timing. Valid values range from 00000 to 47999, representing a 6-second epoch.
`LL LL`	Length upper and lower byte: The length of the remainder of the message, not including the closing flag.
`MM`	Month:
`DD`	Day:
`YY`	Year Offset: Number of years since the year 2000.
`HH`	Hour:
`MM`	Minute:
`SS`	Seconds:
`03`	Closing flag.

5.9.2 Data Message Format

The data message format of the captured data is as follows:

02 10 NN NN NN TH SS SS LL LL MM MM DD DD DD … EE EE UU UU 03

Where:

02	Opening flag.
10	Message type: Data.
NN NN NN	Sequence Number upper, middle and lower byte: A sequence number is assigned to each captured message. The sequence number starts at 000001 and increments by one for each subsequent message.
TH	T1 Port Number and HDLC Channel Number: The upper nibble represents the T1 port number from 1 to 8, where 1 is Port 1A, 2 is Port 1B, 8 is Port 4B and the lower nibble represents the HDLC Channel Number. If the error is not T1 port specific, 0xFF will appear.
SS SS	System Frame Count upper and lower byte: The VDL timing channel value (i.e. slots 1 and 2) from the T1 port that is being used for system timing. Valid values range from 00000 to 47999, representing a 6-second epoch.
LL LL	Length upper and lower byte: The length of the remainder of the variable length message, not including the closing flag.
MM MM	Message Frame Count upper and lower byte: The VDL timing channel value (i.e. slots 1 and 2) from the T1 port that the message was received on, read coincident with the detection of the opening byte of the HDLC message. Valid values range from 00000 to 47999, representing a 6-second epoch.
DDDDDD…	HDLC Message Field: A variable length field containing the message.
EE EE	HDLC Frame Check upper and lower byte: The checksum of the message.
UU UU	HDLC Information Field upper and lower byte: The lower byte is the value of the HDLC Information (RHIR) register, upon the reception of a complete message, for the receiving Framer and the upper byte contains a Maximum Message Size Overflow Error, a Missed Close Byte Error and a Missed Open Byte Error. Table 6 shows the bit positions of the respective values.
03	Closing flag.

5.9.3 Error Message Format

The error message format of the captured data is as follows:

```
02 30 NN NN NN TH SS SS LL LL EE EE EE … 03
```

Where:

`02`	Opening flag.
`30`	Message type: Error.
`NN NN NN`	Sequence Number upper, middle and lower byte: A sequence number is assigned to each captured message. The sequence number starts at 000001 and increments by one for each subsequent message.
`TH`	T1 Port Number and HDLC Channel Number: The upper nibble represents the T1 port number from 1 to 8, where 1 is Port 1A, 2 is Port 1B, 8 is Port 4B and the lower nibble represents the HDLC Channel Number. If the error is not T1 port specific, 0xFF will appear.
`SS SS`	System Frame Count upper and lower byte: The VDL timing channel value (i.e. slots 1 and 2) from the T1 port that is being used for system timing. Valid values range from 00000 to 47999, representing a 6-second epoch.
`LL LL`	Length upper and lower byte: The length of the remainder of the variable length message, not including the closing flag.
`EEEEEE…`	Error Message Field: A variable length field containing an ASCII string indicating the type of error, the error number and additional information about the error.
`03`	Closing flag.

5.10 HSTAT STATISTICS FORMAT

When the HSTAT user command is entered on one of the terminals, the following statistics are provided. Refer to Figure 6 for a sample of displayed statistics.

Port ID – The individual T1 port that the following row of statistics applies to. An asterisk appears next to the channel if it has been selected as the timing source with the HSYNC command.

Drop Msg – A count of dropped messages. A dropped message is one that was not written into the receive queue from the T1 framer.

Max Msg – A count of max message errors in the receiving framer. A max message error is when a received message has exceeded the maximum defined size of 520 bytes.

Miss Open – A count of missed opening bytes in the receiving framer. An opening byte is the first byte of a message in the receive FIFO.

Drop Byte – A count of dropped bytes in the receiving framer.

Fram Cnt – A count of frame count errors on the receiving framer.

Frmr Rd Q – A count of framer read queue errors. A framer read queue error is when a message could not be read from the receive queue.

Port Wr Q – A count of port write queue errors. A port write queue error is when a message could not be written into the transmit queue for the terminal displaying the captured messages.

Link Stat – An indication of Carrier Loss or Sync Loss in the T1 framer. Table 7 shows the bit positions of the respective values.

Min Size – The minimum message size that was captured on that T1 port.

Max Size – The maximum message size that was captured on that T1 port.

Captured Msgs – The total number of messages captured on that T1 port.

Table 7. Link Status Field

Bit	Description
4	Line Interface Receive Carrier Loss
3	Receive Loss of Sync
2	
1	

6.0 OPERATION

6.1 TYPICAL OPERATING PROCEDURES

6.1.1 Configuring HyperTerminal

1. Start up HyperTerminal; this will usually prompt you for the creation of a new connection template. If you have already started with a connection, then you will need to go to the 'Call' menu and disconnect. This will enable you to modify the properties under the 'file' menu.
2. On the "Connect To" tab, select the connection using the terminal port that the VPA3 is connected to.
3. Press the 'Configure' button and select 115,200 baud, 8 data bits, 1 stop bit, no parity, and h/w flow control.
4. On the "Settings" tab, select Backspace key sends "Del", emulate a VT100 terminal and, in Terminal Setup, check "132 column mode" for the best viewing of the captured data.
5. Save the configuration in the "file" menu to some convenient name. You may create a shortcut using Windows Explorer, to this configuration file and place it on your Desktop or Start Menu to allow easy access when restarting HyperTerminal.

6.1.2 Capturing VDL3 Messages using HyperTerminal

Here is an example of a session using the Terminal Emulator program HyperTerminal on a PC.

1. When the power is supplied to the VPA3 you should see the text of the VPA3 startup screen appear within the HyperTerminal display window. If you are connected to the USB Terminal port and the Terminal Emulation program is running when power is applied to the VPA3, you must perform a "disconnect" and "call" in the Terminal Emulation program to start communicating with the VPA3. This is due to the fact that a USB device is removed from the system when it is powered off, so the connection is lost.
2. Use the "**?**" at any time to display a short help screen summarizing the commands available within the VPA3. Use the "**?** " followed by a command or parameter to display a short help screen summarizing the command or parameter options.
3. Set the date by typing "**DATE MM/DD/YYYY**", then **<ENTER>** on the terminal where **MM** is the two digit month, **DD** is the two digit day of the month, **YYYY** is the four digit year. Set the time of day by typing "**TIME HH:MM:SS**", then **<ENTER>**, where, **HH** is the two digit hour, **MM** is the two digit minute and **SS** is the two digit seconds.
4. Set the port and mode to print ASCII captured data by typing "**CMODE 3 A**", then **<ENTER>**. This will print capture date to the USB as ASCII data.
5. Set the period of the time stamp by typing "**EVTECNT 3 1**", then **<ENTER>**. This will print a time stamp on the USB every 6 seconds (once per epoch).
6. Set the port to print error messages on by typing "**EVTERR 2 E**", then **<ENTER>**. Also enable error printing to the USB port by typing "EVTERR 3 E", then <ENTER>. Enabling error printing on TERM2 allows error monitoring while actively capturing to the USB port.
7. Set the time source to T1 Port 1A by typing "**HSYNC 1A**", then **<ENTER>**. This will cause the framer receive clock on T1 Port 1A to be used to clock all of the other framers and to use the frame count received on T1 Port 1A to be used as the system frame count.

8. By default HDLC channel 1 will be captured on all ports. That can be changed by typing "**HCHAN * 2**", then **<ENTER>** to change all 8 T1 ports to HDLC channel 2 or typing "**HCHAN 1 2**", then **<ENTER>** to change only the T1 port 1 to HDLC channel 2.

9. To capture the data to a file, use the HyperTerminal "Transfer" menu and select "Capture Text". Then specify a file name in order to start capturing to a file. All text that is displayed on the HyperTerminal screen is also written to the specified file until you stop the capture in the "Capture Text" sub-menu or exit HyperTerminal.

10. Begin capturing messages by typing "**EVTCAP 3 11111111**", then **<ENTER>**. This will print capture data for all 8 T1 ports to the USB.

11. During, or after data capture, type "**HSTAT ***" on the TERM2 to view the status and statistics for each T1 port. Typing "HSTAT 1 C" will display the status statistics for only T1 port 1 and then clear the values.

Figure 4 shows a sample of test messages captured on the USB Terminal Interface. The messages are 39 bytes (plus 2 CRC bytes). Figure 5 shows the simultaneous output of the RS-232 Terminal Interface at system startup. The user can access statistics and debug commands on either terminal without disturbing data capturing on the other terminal. Figure 6 shows the statistics output when the user enters "**HSTAT ***" after capturing data. The USB Interface is capable of higher speeds than the RS-232 Interface so it is best suited for message capture if traffic is expected to be high. However, message capture and the command interface can be accessed on any terminal. Command responses are sent to the terminal that generated the command and captured messages are sent to the terminal indicated in the "**EVTCAP**" command.

Figure 4. Screen Capture – Test Messages on VPA3 USB Terminal Interface

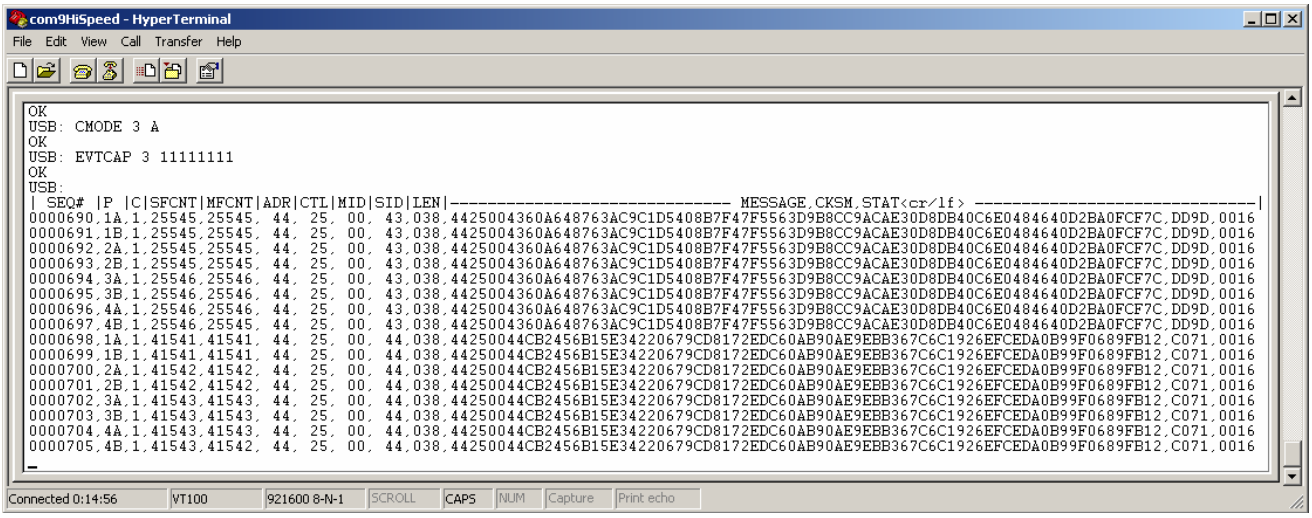


Figure 5. Screen Capture – At Startup on VPA3 Term 2 Terminal Interface

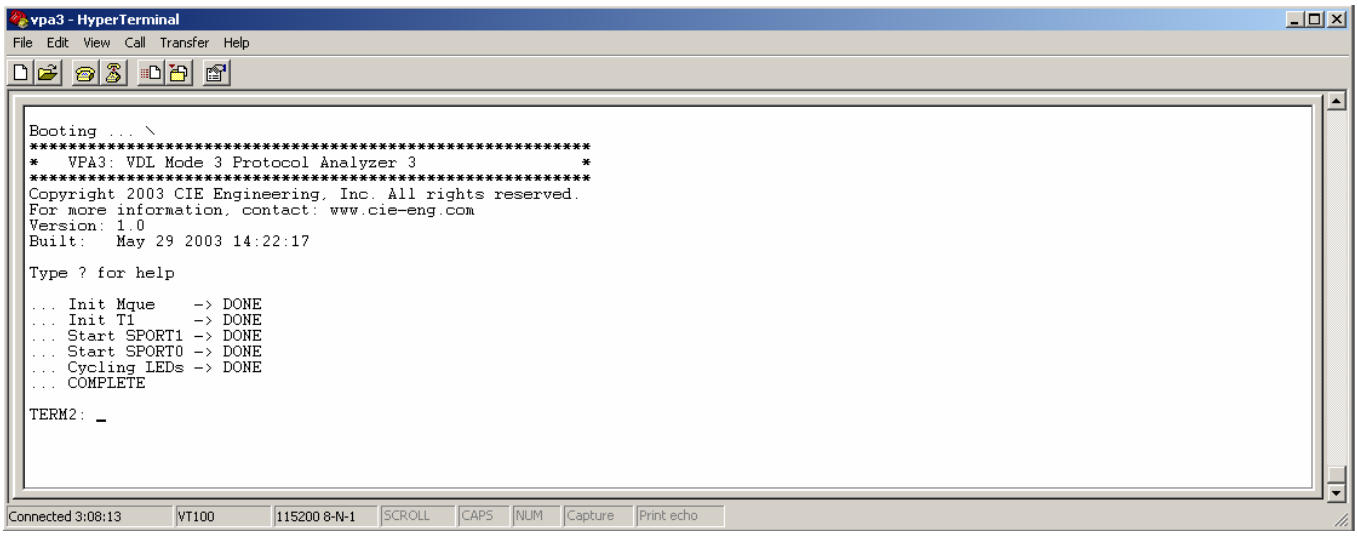
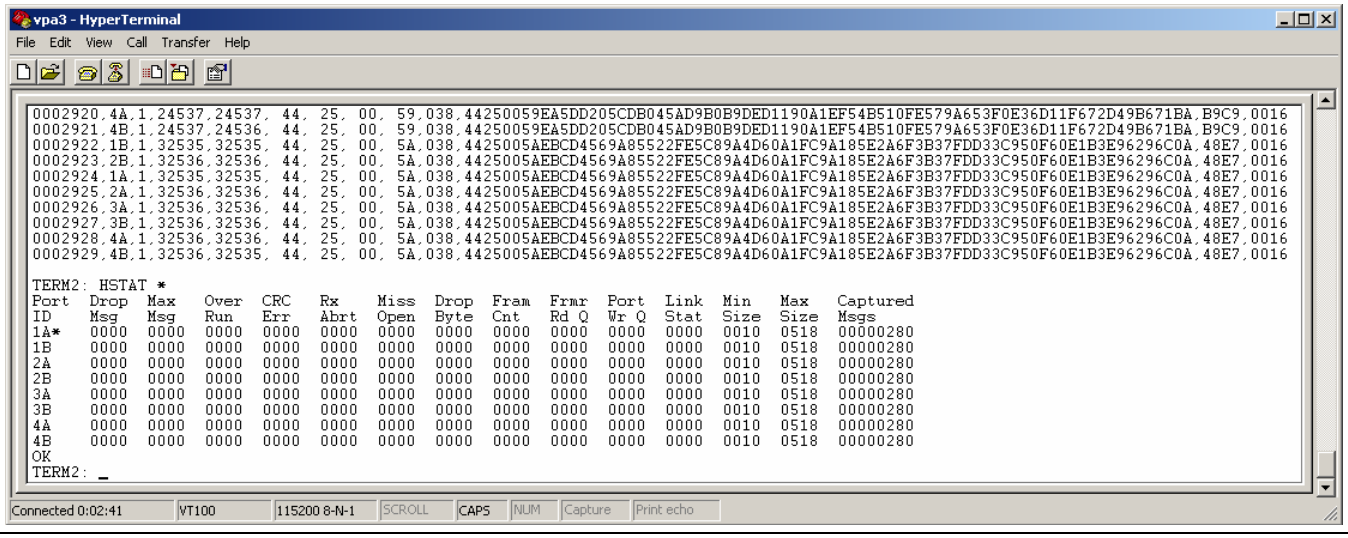


Figure 6. Screen Capture – Statistics on VPA3 Term 2 Terminal Interface



6.1.3 Upgrading VPA3 Software

The Firmware program contained in the VPA3 is field upgradeable via the serial port on TERM2. Please contact CIE Engineering regarding the availability of upgrade programs.

The procedure to upgrade the software is as follows:

1. Connect a terminal to TERM2. Make sure that the terminal has hardware handshaking disabled for this procedure.
2. Apply power to the module or perform a reset with the recessed button on the front panel.
3. "Booting …" and a spinning cursor will appear on the terminal for a few seconds.
4. Press the escape key during the spinning cursor, before the startup sequence begins printing to the screen.
5. This will stop the boot sequence and provide a DSP Debugger prompt, which is a "!".
6. Type "DL" and then <ENTER> on the terminal.
7. The flash memory will be erased and the user will be asked to pick a file.
8. Transfer the file from the terminal program. In HyperTerminal go to the "Transfer" menu and click on "Send File".
9. Select the S record file that has been supplied for upgrade and use the Xmodem transfer protocol.
10. Send the file.
11. The file will be transferred and validated. It may take several minutes to transfer the file, do not remove power or reset during the transfer.

Cycle power or perform a reset. The new software version will be displayed at startup or with the VERSION command.

6.2 SYSTEM LIMITATIONS

6.2.1 Message Size Limitations

The maximum length of any one HDLC packet that can be captured is 520 bytes (including address, control, information field, and CRC).

6.2.2 Captured File Size Limitations

There may be a limitation in your Operating System for the maximum size of the text capture file. This is not a limitation of the VPA3 software. In normal operation, the data capture file can grow to enormous proportions. If you are using the Windows® operating system, it may be useful to acquire a copy of the Cygwin tools, which is a free download, from http://www.cygwin.com/. UNIX style utilities for Windows® like grep, awk and less, can handle text files up to 2 gigabytes.

6.2.3 Capture Rate Limitations

The VPA3 capture rate is limited by the terminal communication speed. The USB port provides the highest capture rate. The VCP driver implementation limits overall transfer rates to 900 kbps. The RIU/MDR traffic for all four T1 ports can typically be captured via the USB in ASCII mode without data loss. Internal data queues support limited peak T1 traffic rates without overflow. The average transfer rate should not exceed 900 kbps to prevent queue overflows. If an overflow condition occurs, the VPA3 will drop entire HDLC messages and will flash the STATUS LED at position 4 on the front panel. Use the terminal port to display message capture/drop statistics via the HSTAT command.

Higher effective capture rates can be supported with binary transfer modes since one character is required for each byte received, rather than the two characters required for ASCII mode. Insure you select binary transfer mode for capture. Finally, a software program may need to be written to interpret the binary data. Reference the FUNCTIONAL DESCRIPTION section for information concerning the binary transfer format.

7.0 TERMINAL COMMAND REFERENCE

7.1 GENERAL

The command interface is structured so that each command may have optional parameters. If the parameters are entered, the command will set the values supplied. If the parameters are not entered, the command will display the state of the settings for the parameters that were supplied. The optional parameters are shown inside square brackets **[]**. If there are multiple optional parameters and the second optional parameter is supplied, the first must also be supplied.

For example, **EVTCAP** has two optional parameters **[CPORT]** and **[HPORTS]**. If **EVTCAP** is entered with no parameters, the settings for all ports will be displayed. If **EVTCAP** and a value for **[CPORT]** are entered, then the setting for only that port will be displayed. If **EVTCAP** and a value for **[CPORT]** and **[HPORTS]** are entered, then the **[HPORTS]** values will be set for the given **[CPORT]**. If **EVTCAP** and a value for **[HPORTS]** are entered without a value for **[CPORTS]**, an error message will be displayed indicating an invalid parameter. If a command that is not recognized is entered with or without parameters, an error message will be displayed indicating an invalid command.

7.2 EVENT RELATED COMMANDS

7.2.1 Event Capture

Command:	EVTCAP
Description:	Displays/modifies the state of event capture on ports.
Syntax	EVTCAP [CPORT] [HPORTS]
Parameters:	If [CPORT] is supplied, displays/modifies the state of event capture for that port. Valid port numbers are 1 – 3 where 1 is TERM1, 2 is TERM2 and 3 is USB. Valid [HPORTS] parameters are eight digits, one for each T1 port starting at 1A on the top and ending with 4B on the bottom. Each digit is either a 1 or a 0. A 1 indicates that events should be printed for the associated T1 port and a 0 indicates that events should not be printed for that T1 port.
Notes:	

Examples:	`TERM2: EVTCAP`
	`CPORT = USB, HPORTS = 11111111`
	`TERM2: EVTCAP 2 00000011` *{capture set to TERM2 for ports 4A and 4B}*
	`OK`

Related Commands:	
Non-Volatile:	No

7.2.2 Event Epoch Count

Command:	EVTECNT
Description:	Displays/modifies the state of time stamping on ports.
Syntax	EVTECNT [CPORT] [ECNT]
Parameters:	If [CPORT] is supplied, displays/modifies the state of time stamping for that port. Valid port numbers are 1 – 3 where 1 is TERM1, 2 is TERM2 and 3 is USB. Valid [ECNT] parameters are positive decimal values. A 0 indicates no time stamping and all other numbers are multiples of the epoch count that occurs every six seconds.
Notes:	The recommended setting for ECNT is 1. This will print a message on epoch boundaries.

Examples:	`TERM2: EVTECNT`
	`CPORT = USB, ECNT = 0`
	`TERM2: EVTECNT 2 1 {Time stamp on TERM2 every 6 seconds}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.2.3 Event Error

Command:	EVTERR
Description:	Displays/modifies the state of time stamping on ports.
Syntax	EVTERR [CPORT] [ENABLE]
Parameters:	If [CPORT] is supplied, displays/modifies the state of error reporting for that port. Valid port numbers are 1 – 3 where 1 is TERM1, 2 is TERM2 and 3 is USB. Valid [ENABLE] parameters are E for Enable and D for Disable.
Notes:	

Examples:	`TERM2: EVTERR`
	`CPORT = TERM2, ENABLE = disabled`
	`CPORT = TERM1, ENABLE = disabled`
	`CPORT = USB, ENABLE = disabled`
	`TERM2: EVTERR 2 E {Enable error reporting on TERM2}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.3 CAPTURE PORT RELATED COMMANDS

7.3.1 Capture Port Mode

Command:	CMODE
Description:	Displays/modifies the output port and mode for captured data.
Syntax	CMODE [CPORT] [MODE]
Parameters:	If [CPORT] is supplied, displays/modifies the mode for captured data on that port. Valid port numbers are 1 – 3 where 1 is TERM1, 2 is TERM2 and 3 is USB. Valid [MODE] parameters are A for ASCII and B for Binary data.
Notes:	

Examples:	`TERM2: CMODE`
	`CPORT = USB, MODE = ASCII`
	`TERM2: CMODE 2 B {Set output on TERM2 to Binary}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.3.2 Capture Port Prompt

Command:	CPROMPT
Description:	Displays/modifies the state of prompting on ports.
Syntax	CPROMPT [CPORT] [ENABLE]
Parameters:	If [CPORT] is supplied, displays/modifies the state of prompting on that port. Valid port numbers are 1 – 3 where 1 is TERM1, 2 is TERM2 and 3 is USB. Valid [ENABLE] parameters are E for Enable and D for Disable.
Notes:	

Examples:	`TERM2: CPROMPT`
	`CPORT = TERM2, ENABLE = enabled`
	`CPORT = TERM1, ENABLE = enabled`
	`CPORT = USB, ENABLE = enabled`
	`TERM2: CPROMPT 2 D {Disable prompt on TERM2}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.3.3 Capture Port Echo

Command:	CECHO
Description:	Displays/modifies the state of echoing on ports.
Syntax	CECHO [CPORT] [ENABLE]
Parameters:	If [CPORT] is supplied, display/modify the state of echoing on that port. Valid port numbers are 1 – 3 where 1 is TERM1, 2 is TERM2 and 3 is USB. Valid [ENABLE] parameters are E for Enable and D for Disable.
Notes:	

Examples:	`TERM2: CECHO`
	`CPORT = TERM2, ENABLE = enabled`
	`CPORT = TERM1, ENABLE = enabled`
	`CPORT = USB, ENABLE = enabled`
	`TERM2: CECHO 2 D {Disable echo on TERM2}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.4 TIME RELATED COMMANDS

7.4.1 Pulse

Command:	PULSE
Description:	Displays/modifies the values that drive the Pulse A and Pulse B signals.
Syntax	PULSE [EDGE] [SYSFCNT]
Parameters:	If [EDGE] is supplied, display/modify the state of that edge. Valid edge values are AP, AN, AC and AS for Pulse A and BP, BN, BC and BS for Pulse B. AP and BP represent the positive edge of the Pulse A and Pulse B signal, AN and BN represent the negative edge of the Pulse A and Pulse B signal. If [SYSFCNT] is entered for one of these edge values, the Pulse signal edge will occur at the set frame count. AS and BS will immediately Set the Pulse signal to a fixed positive state. AC and BC will immediately Clear the Pulse signal to a fixed negative state.
Notes:	AS, BS, AC and BC do not require a frame count parameter.

Examples:	`TERM2: PULSE`
	`AC, BC {Pulse A and Pulse B are both cleared}`
	`TERM2: PULSE AS {Immediately set Pulse A}`
	`OK`
	`TERM2: PULSE BC {Immediately clear Pulse B}`
	`OK`
	`TERM2: PULSE BP 100 {Set Pulse B positive edge at frame count 100}`
	`OK`
	`TERM2: PULSE BN A00 {Set Pulse B negative edge at frame count A00}`
	`OK`
	`TERM2: PULSE`
	`AS, BP = 100, BN = A00 {Reflect previous setting in example}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.4.2 Time

Command:	TIME
Description:	Displays/sets the time of day.
Syntax	TIME [HH:MM:SS]
Parameters:	If [HH:MM:SS] is supplied, set the time of day. HH the two digit hour (24 hour format) MM the two digit minute SS the two digit seconds
Notes:	

Examples:	`TERM2: TIME 14:10:00 {Set the time to 2:10PM}`
	`14:10:00.000`
	`TERM2: TIME`
	`14:10:23.658 {Display the current time, including msecs}`

Related Commands:	DATE
Non-Volatile:	No

7.4.3 Date

Command:	DATE
Description:	Displays/sets the date.
Syntax	DATE [MM/DD/YYYY]
Parameters:	If [MM/DD/YYYY] is supplied, set the date. MM the two digit month DD the two digit day of the month YYYY the four digit year
Notes:	

Examples:	`TERM2: DATE 5/12/2003 {Set the date to May 12, 2003}`
	`May 12, 2003`
	`TERM2: DATE`
	`May 12, 2003 {Display the current date}`

Related Commands:	TIME
Non-Volatile:	No

7.5 HDLC MESSAGE RELATED COMMANDS

7.5.1 HDLC Synchronization

Command:	HSYNC
Description:	Displays/modifies the port used for the HDLC timing source.
Syntax	HSYNC [HPORT]
Parameters:	If [HPORT] is supplied, set the timing source to that port. Valid port values are 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, INT 1A – 4B are the individual T1 port connectors on the front panel INT selects the internal clock
Notes:	Selecting a timing source selects the T1 receive clock on that port to be used for receiving data on all ports and also selects the same port as the source of the frame count to be used as the system frame count. The system frame count is displayed in the data capture and it is sent to the VSS modules in the chassis. Typically the RIU transmit signal is used as a timing source (since it provides timing for itself and the MDRs. A T1 port that is not timed to the RIU reference will experience frame repeat/slip events. These events cause the frame count value to be repeated or skipped. The VPA3 reports frame count errors for a T1 port that is not synchronized to the selected timing reference port,

Examples:	`TERM2: HSYNC`
	`HPORT = INT {Internal timing is being used}`
	`TERM2: HSYNC 1A {Set timing source to Port 1A}`
	`OK`

Related Commands:	HSTAT
Non-Volatile:	No

7.5.2 HDLC Channel

Command:	HCHAN
Description:	Displays/modifies the HDLC channel. The RIU/MDR ICD supports 5 different HDLC channels. The default HDLC channel uses T1 time slots 5 through 8. Four other HDLC channels are available from timeslots 9 through 24. Each HDLC channel uses four T1 timeslots.
Syntax	HCHAN [HPORT] [CHAN]
Parameters:	If [HPORT] is supplied, set the timeslots for that port. Valid port values are 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, * 1A – 4B are the individual T1 port connectors on the front panel An * indicates all ports are to be set or displayed Valid channel numbers are 1 – 5
Notes:	

Examples:	`TERM2: HCHAN`
	`HPORT = 1A, CHAN = 1`
	`HPORT = 1B, CHAN = 1`
	`HPORT = 2A, CHAN = 1`
	`HPORT = 2B, CHAN = 1`
	`HPORT = 3A, CHAN = 1`
	`HPORT = 3B, CHAN = 1`
	`HPORT = 4A, CHAN = 1`
	`HPORT = 4B, CHAN = 1`
	`TERM2: HCHAN 1A 2 {Set Port 1A to HDLC channel 2, timeslots 9-12}`
	`OK`
	`TERM2: HCHAN * 5 {Set all Ports to HDLC channel 5, timeslots 21-24}`
	`OK`

Related Commands:	
Non-Volatile:	No

7.5.3 HDLC Statistics

Command:	HSTAT
Description:	Displays the HDLC statistics.
Syntax	HSTAT [HPORT] [SCLEAR]
Parameters:	If [HPORT] is supplied, display the statistics for that port. Valid port values are 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, * 1A – 4B are the individual T1 port connectors on the front panel An * indicates all ports are to be displayed If [SCLEAR] is supplied, clear the statistics for the specified T1 port The value for [SCLEAR] is C
Notes:	When clearing, the current port statistics will be displayed first and then cleared. When all ports are cleared with HSTAT * C, the status LED at position 6 indicating that a capture error has occurred is turned off. An * is displayed next to the Port ID that has been set to the system timing source with the HSYNC command
Examples:	Refer to Figure 6 for a screen shot of the output for the command.
Related Commands:	HSYNC
Non-Volatile:	No

7.6 MISCELLANEOUS COMMANDS

7.6.1 Version

Command:	VERSION
Description:	Display the version number of the software and the build date and time.
Syntax	VERSION
Parameters:	
Notes:	

Examples:	`TERM2: VERSION`
	`Version: 0.90`
	`Built:  May 23 2003 16:21:57`

Related Commands:	
Non-Volatile:	No

7.6.2 Help

Command:	?
Description:	Display a list of commands or help for a specific command or parameter.
Syntax	? [COMMAND/PARAMETER]
Parameters:	If [COMMAND/PARAMETER] is supplied, show detailed help for that command or parameter. A list of parameters for a specified command is shown when "? [COMMAND]" is entered.
Notes:	

Examples:	`TERM2: ?`
	`**********`
	`COMMAND LIST:`
	`  EVTCAP  EVTECNT  EVTERR  CMODE`
	`  CPROMPT  CECHO  PULSE`
	`  HSYNC  HCHAN  HSTAT`
	`  TIME  DATE  VERSION`
	
	`Type ? followed by space then command for more info`
	`**********`

Related Commands:	
Non-Volatile:	No