



# Reliable HD Transport Unit

**NAX241 and NAX241A**

**Technical Instruction Manual**

Issue 0.6 ..... 23 December 2010

Nautel Limited  
10089 Peggy's Cove Road,  
Hackett's Cove, NS, Canada B3Z 3J4  
T.877 6 nautel (628835) or +1.902.823.2233  
F.+1.902.823.3183 info@nautel.com

U.S. customers please contact:  
Nautel Inc.  
201 Target Industrial Circle, Bangor ME 04401  
T.877 6 nautel (628835) or +1.207.947.8200  
F.+1.207.947.3693 info@nautel.com

e-mail: support@nautel.com  
www.nautel.com



# Warranty

by Nautel Limited/Nautel Inc. (herein after referred to as Nautel)

---

Nautel Limited/Nautel Incorporated, hereinafter referred to as Nautel, guarantees all mechanical and electrical parts of the equipment for a period of thirteen months from date of shipment.

1. A "Part Failure" shall be deemed to have occurred when the part has become defective, or does not have the characteristics required for the specified equipment performance:
  - (a) When the equipment is operated within the design parameters, and
  - (b) When the equipment is installed and adjusted according to Nautel's prescribed procedures as stated in the instruction manual.
2. Nautel shall provide replacements for all "Parts" at no cost to the Customer when they become defective during the warranty period, and upon the return of the defective part.
3. In the event that a "Part" fails during the warranty period and causes damage to a sub-assembly that cannot be readily repaired in the field, the entire sub-assembly so damaged may be returned to Nautel for repair. The repairs will be made without charge to the Customer.
4. Where warranty replacements or repair are provided under items 2 or 3, Nautel will pay that part of the shipping costs incurred in returning the part/assembly to the Customer.
5. Warranty replacement parts and repair, which are provided under items 2 or 3, shall be guaranteed for a period of ninety days from date of shipment or until the end of the original warranty period, whichever occurs later.
6. Nautel will not assume responsibility for any charges incurred by other than Nautel employees.
7. Nautel shall have the privilege of investigating whether failures have been caused by factors beyond its control.
8. Nautel shall in no event be liable for any consequential damages arising from the use of this equipment.
9. When requesting a warranty repair/replacement, please provide complete and accurate information. Observe the instructions regarding 'Equipment Being Returned to Nautel' on page two of this warranty and provide the information requested.
10. When ordering spare/replacement parts, please provide complete and accurate information. Refer to the parts list of the Repair manual for ordering information. Provide as much of the information requested for 'Equipment Being Returned to Nautel' on page two of this warranty as is practical. The information identified by an asterisk is the minimum required.

Nautel Limited  
10089 Peggy's Cove Road  
Hackett's Cove NS Canada B3Z 3J4  
T. 877 6 nautel (628835) or 1.902.823.2233  
F. 1.902.823.3183  
24hr. Answering Service 1.902.823.3900

Nautel Inc.  
201 Target Industrial Circle  
Bangor ME USA 04401  
T. 877 6 nautel (628835) or 1.207.947.8200  
F. 1.207.947.3693

## Customer Service Notice

A 'Technical Assistance' and 'Plug-in Module Exchange' service is available to Nautel users.



# Factory Support

## TECHNICAL ASSISTANCE

Nautel's field service department provides telephone technical assistance on a 24 hour, seven days a week basis.

Requests by other media (facsimile or e-mail) will be responded to the next working day if received after Nautel's normal working hours. Contact the appropriate field service centre from the following:

U.S.A. customers use:	Nautel Inc. 201 Target Industrial Circle Bangor, Maine 04401	T. +1.207.947.8200 (24 hours) or 877 6 nautel (628835) F. +1.207.947.3693
All other customers use:	Nautel Limited 10089 Peggy's Cove Road, Hackett's Cove, NS, Canada B3Z 3J4	T. +1.902.823.3900 (24 hours) or 877 6 nautel (628835) F. +1.902.823.3183 E-Mail support@nautel.com Web www.nautel.com

## MODULE REPAIR SERVICE

During the transmitter's warranty period, repair of modules is performed at no charge to the customer. Once the warranty period has expired, module repairs will be invoiced based on material and labour costs.

## MODULE EXCHANGE SERVICE (*North American Customers Only*)

North American customers can take advantage of Nautel's module exchange service. This service gives customers a fast and efficient solution in the event of a hardware problem. When a customer's transmitter experiences a failure, Nautel can send out a factory rebuilt module to replace the faulty module. Nautel's two locations, Canada and the United States, provide quick turn around times, keeping our customers on the air.

During the transmitter's warranty period, exchange of modules is performed at no charge to the customer. Once the warranty has expired, the cost of a module exchange is only 40% of the list price for the module, provided the faulty module is returned to Nautel within 30 days and can be rebuilt; should the module not be returned an additional invoice for 40% of the list price will be issued.

## MODULE RETURN INSTRUCTIONS

All equipment being returned to Nautel for repair or replacement should be marked with a Nautel provided RMA number and addressed to the appropriate Nautel facility.

Complete and accurate information regarding the equipment will expedite shipment of replacement(s). Refer to the name plate on the transmitter and the appropriate module assembly and include with the shipment:

- Transmitter model number
- Transmitter serial number
- Module name
- Module serial number
- Return shipping address

## RETURN FACILITIES

U.S.A. customers:	RMA # Nautel Inc. 201 Target Industrial Circle Bangor, Maine 04401 USA	Telephone: (207) 947-8200 x 109 Fax: (207) 947-3693
Canadian customers:	RMA # Nautel Limited. Attention: Field Return 10089 Peggy's Cove Road Hackett's Cove, NS B3Z 3J4 Canada	Telephone: (902) 823-3900 x 100 Fax: (902) 823-3183



Contents	Page
1 OVERVIEW	1-1
1.1 INTRODUCTION	1-1
1.2 RELIABLE TRANSPORT PROTOCOL	1-1
1.3 LAN CONFIGURATIONS	1-2
2 INITIAL SETUP AND CONFIGURATION	2-1
2.1 PREPARATION	2-1
2.2 IP ADDRESS SETUP	2-1
2.3 INSTALLATION	2-5
3 OPERATION	3-1
3.1 INTRODUCTION	3-1
3.2 STATUS PAGE	3-1
3.3 STATISTICS PAGE	3-1
3.4 ADJUSTING BUFFER DEPTH	3-4
<b>3.4.1 Why Increase Receive Buffer Depth?</b>	3-4
<b>3.4.2 Why Decrease Receive Buffer Depth?</b>	3-4
<b>3.4.3 Configuration Range</b>	3-5
<b>3.4.4 Adjustment Instructions</b>	3-5
4 SOFTWARE UPGRADE	4-1
4.1 INTRODUCTION	4-1
4.2 PREREQUISITES	4-1
4.3 TFTP SERVER INSTALLATION	4-1
4.4 EXGINE SOFTWARE UPGRADE	4-1
5 TROUBLESHOOTING	5-1
5.1 INTRODUCTION	5-1
5.2 TROUBLESHOOTING	5-1
<b>5.2.1 Power Related Fault</b>	5-1
6 PARTS LISTS	6-1
6.1 PART INDEX TABLES	6-1
6.2 MANUFACTURERS' CODE INDEX	6-1



## Contents

## Page

7	WIRING LISTS	7-1
7.1	INTRODUCTION	7-1
7.2	WIRING LISTS NOT PROVIDED	7-1
7.3	PRINTED WIRING PATTERNS	7-1
7.4	WIRE COLOURS	7-1
7.5	WIRING LISTS PROVIDED	7-1
8	ELECTRICAL SCHEMATICS AND ASSEMBLY DETAIL DRAWINGS	8-1

## List of Tables

3-1	Receive Buffer Delay Values	3-4
6-1	Manufacturers' Code Index	6-1
7-1	Wiring Lists Provided	7-1
8-1	List of Drawings	8-1

## List of Figures/Drawings

1-1	Nautel's Reliable HD Transport Unit	1-1
1-2	LAN Configuration using a Bidirectional STL	1-2
1-3	LAN Configuration using two STLs	1-3
2-1	Reliable HD Transport Unit – Partial Front and Back Views	2-1
2-2	Entering IP Address – Serial Port Method	2-2
2-3	Main Screen (Status tab shown)	2-3
2-4	Network Configuration Screen	2-4
2-5	E2X Transport Configuration Screen	2-4
3-1	Status Page (Transmitter Site Reliable HD Transport Unit)	3-2
3-2	Status Page (Studio Reliable HD Transport Unit)	3-2
3-3	Statistics Page (Transmitter Site Reliable HD Transport Unit)	3-3
3-4	Statistics Page (Studio Reliable HD Transport Unit)	3-3



## Release Control Record

Issue	Date	Reason
0.1	19 November 2007	Provisional release; not approved for distribution
0.2	26 November 2007	First Article Changes; Finalized Table of Contents; Corrected page numbering error in section 3
0.3	05 December 2007	Incorporated Engineering changes; paragraphs 2.2 and 3.4.4 redone
0.4	09 May 2008	Paragraph 2.2, step (g), second bullet point: changed to read, "Set E2X Transport Protocol to Nautel E2X Encapsulation for the studio unit and to UDP for the transmitter site's unit."
0.5	30 October 2009	Various locations: added NAX241A with NAX241 as a nomenclature covered by this manual
0.6	23 December 2010	Incorporated Engineering review comments for software version 2.4; change "secure transport" to "reliable transport" throughout







# Reliable HD Transport Unit

## TECHNICAL INSTRUCTION MANUAL

### Section 1 OVERVIEW

#### 1.1 INTRODUCTION

The reliable HD transport unit (Figure 1-1) makes Nautel's *Reliable Transport* protocol available to any HD system independent of the manufacturer of the HD equipment that supports the iBiquity standard E2X protocol. In an HD system consisting of a Nautel Exporter and M50, the *Reliable Transport* protocol is an option in these components. Nautel has ported the *Reliable Transport* software from the exporter and M50 to the reliable HD transport unit.

#### 1.2 RELIABLE TRANSPORT PROTOCOL

The *Reliable Transport* protocol encapsulates the E2X protocol and adds effective data loss recovery. This is essential in systems where it is desirable to locate the exporter at a studio, connecting it to an exciter through an STL. The problem is that LANs are not designed to be highly reliable because it is expected that applications exchanging data across a LAN will handle data loss and recovery. Data reliability decreases further when the LAN contains an STL bridge that is susceptible to RF interference.

Using TCP can improve data reliability but TCP is connection-oriented and not really appropriate for streaming style data.

Another problem with E2X data loss is the effectiveness of clock recovery in the exciter. The HD system requires a high degree of synchronization between the exporter and exciter. As a result the exporter passes timing information to the exciter in the form of regularly spaced clock packets. Passing such critical information over a LAN that is both lossy and prone to congestion induced jitter can severely upset clock recovery in an exciter.

The *Reliable Transport* protocol uses robust techniques to minimize jitter and data loss. In most cases where the E2X protocol cannot reliably transport HD data between the exporter and exciter, adding the *Reliable Transport* protocol can yield significant improvements. It can be added to a network quickly and simply. In most cases, it is simply a matter of configuring a few IP addresses and plugging two reliable HD transport units into two LAN switches - one at the studio and one at the transmitter site.



Figure 1-1: Nautel's Reliable HD Transport Unit



### 1.3 LAN CONFIGURATIONS

The possible LAN configurations between a studio and transmitter site are too numerous to consider so two 'typical' scenarios will be used as examples in this manual. Figures 1-2 and 1-3 assume that there is an STL being used to bridge the studio LAN to the transmitter site. Figure 1-2 is the simplest configuration showing a bidirectional STL. Figure 1-3 shows a more complicated bridge where LAN traffic is split across two STLs. In all cases two reliable HD transport units are required - one to encapsulate E2X packets from the exporter at the studio and the other to restore the E2X protocol for the exciter at the transmitter site.

Many types of STLs, wired and wireless, are available that can provide bidirectional LAN bridging between the studio and transmitter site. The exporter is configured to send E2X data to the studio side reliable HD transport unit. The studio side reliable HD transport unit is configured to send encapsulated E2X data to the transmitter side reliable HD transport unit.

Finally, the transmitter side reliable HD transport unit is configured to send E2X data to the exciter. If the transmitter reliable HD transport unit detects missing data, it will issue a request back to the studio reliable transport device to resend the missing data.

The configuration shown in Figure 1-3 is specific in that it considers the use of a licensed 950 MHz digital STL. This type of STL can only carry LAN data one way but they tend to be very reliable. Data recovery requires a reverse path for requesting resending of missing data so a simple 802.11 style STL is added for bidirectional LAN data. As mentioned before, 802.11 STLs can be very lossy and may be unsuitable for carrying the critical E2X (or encapsulated E2X) data between the exporter and exciter, but they are well suited for occasional data resend requests. Also, adding an 802.11 STL can provide access to other LAN enabled equipment at the transmitter site.

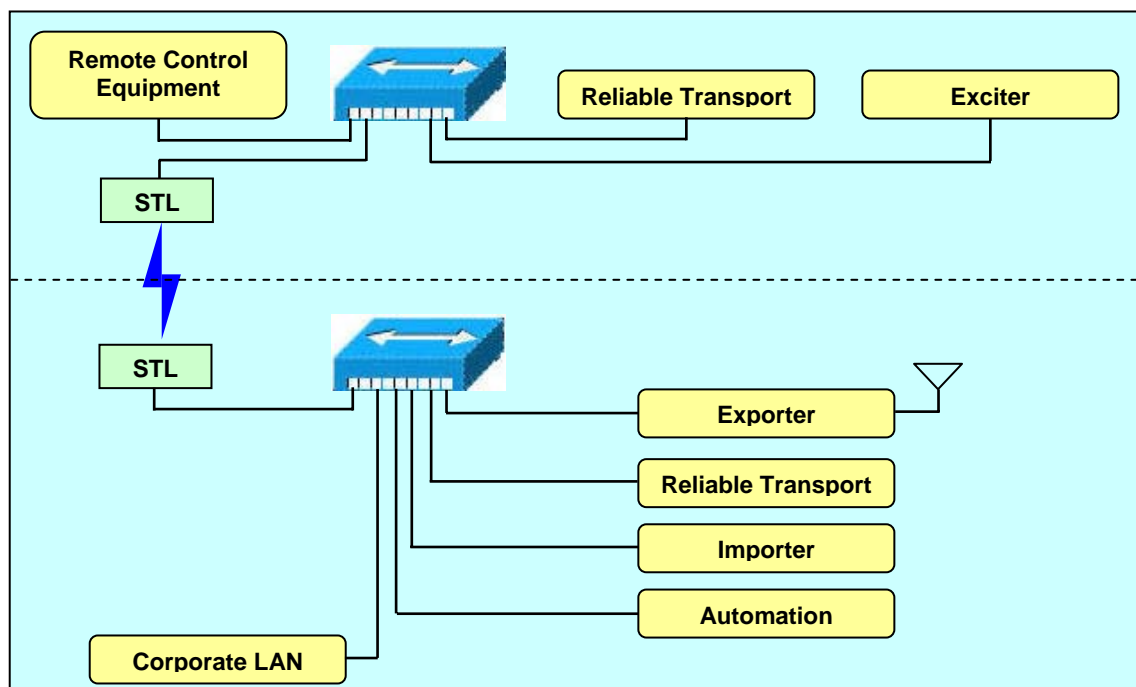


Figure 1-2: LAN Configuration using a Bidirectional STL



In order to make the configuration in Figure 1-3 function, it is necessary to put the transmitter site equipment on a separate subnet. This requires routers at the studio. The studio side reliable HD transport unit gets its data to the transmitter site reliable HD transport unit by setting its gateway address to the router in front of the 950 MHz STL. The transmitter site reliable HD transport unit (and any other networked equipment at the transmitter site) gets its connectivity back to the studio by setting its gateway address to the router in front of the 802.11 STL.

Once IP addresses are configured, the other important configuration is the buffer depth of the transmitter site reliable HD transport unit. In order for the system to recover lost data, it must hold data for an

amount of time that is longer than twice the transit time latency plus some overhead. This gives the transmitter site reliable HD transport unit time to request replacement data before it becomes too old to use. The buffer depth can be translated to a delay which will add to the overall system diversity delay between analog and HD audio. Therefore, once the reliable HD transport units are working, the system diversity delay must be recalibrated.

Finally, depending on the type of LAN switch used at the transmitter site it may be necessary to setup a periodic ping to the exciter. The problem is that some switches will forget the IP address of equipment connected to a port if the connection to the exciter is UDP due to lack of response packets.

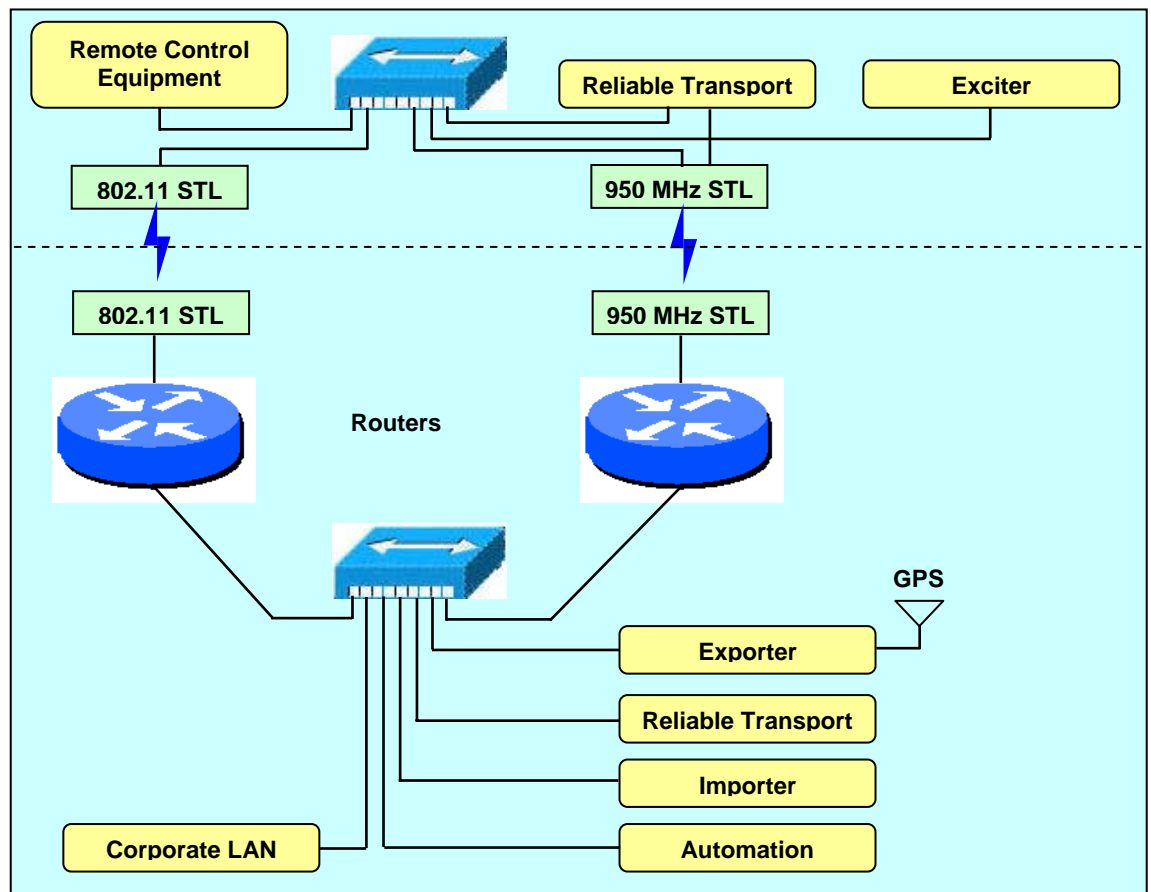


Figure 1-3: LAN Configuration using two STLs





# Reliable HD Transport Unit

## TECHNICAL INSTRUCTION MANUAL

### Section 2 INITIAL SETUP AND CONFIGURATION

#### 2.1 PREPARATION

Review the information in Section 1 – Overview to learn about the various LAN configuration options and determine the best one for your application.

##### NOTE

*The following instructions assume a simple network configuration (see Figure 1-2). For other configurations, please consult with your network administrator.*

*Incorporate the reliable HD transport units into your network as described in the following paragraphs. Connections are made to the back of the units (see Figure 2-1).*

##### NOTE

*There are four LED indicators on the front panel - **Power**, **Ethernet**, **No Data** and **Offline** (see Figure 2-1). When the unit is powered and connected to a LAN but not otherwise operational, the **Power** and **Ethernet** LEDs should be on and the **No Data** alarm should be on. During power on, both the **No Data** and **Offline** LEDs will be on.*

#### 2.2 IP ADDRESS SETUP

- (a) Obtain two sets of IP address, Gateway address and Netmask from your LAN administrator. One set is required for each reliable HD transport unit.

Configure the IP addresses in each of the reliable HD transport units using one of two methods - through the serial port [see step (b)] or by a web browser [see step (e)].

##### NOTE

*The method you choose may depend on the specifics of your network and where you want to perform the configuration. Using the serial port method results in a temporary change that is lost if power to the reliable HD transport unit is removed. Using the web browser method means you cannot connect the reliable transport unit directly to a LAN since the default IP address (10.10.10.100) is likely to be incompatible. Once the IP addresses are configured, all other interaction with the reliable transport units must be done through a web browser.*

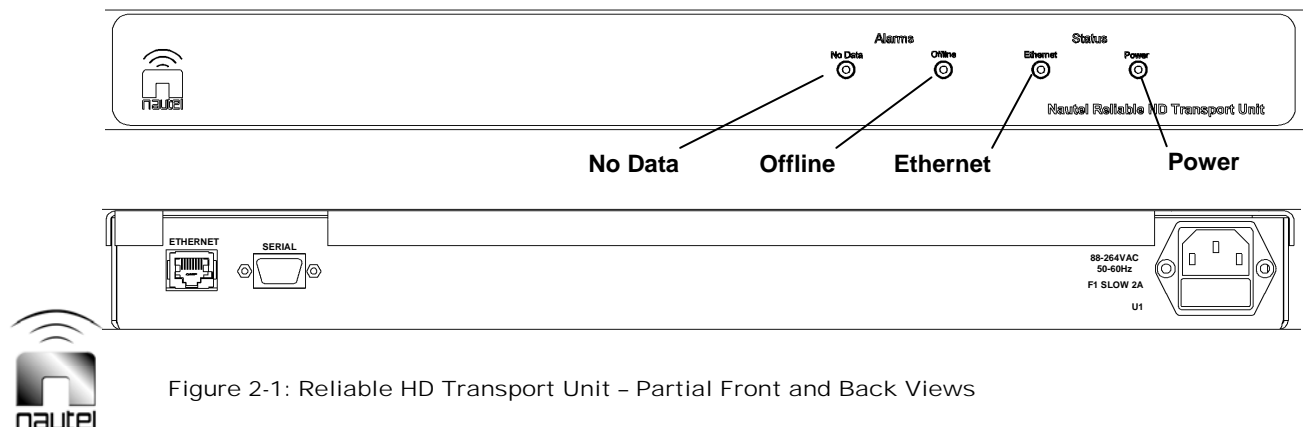


Figure 2-1: Reliable HD Transport Unit – Partial Front and Back Views

- (b) Serial Port Method: Use a PC to start a program such as Hyperterminal. Set the COM settings to:  
 Bits per second: 57600  
 Data bits: 8  
 Parity: None  
 Stop bits: 1  
 Flow Control: None
- (c) Plug the serial port of the PC into the **SERIAL** connector (DB9) on the back of the reliable HD transport unit using a standard 9-pin serial cable.
- Connect power to the reliable HD transport unit and verify that a series of boot up messages appears in the PC terminal window. When the Login prompt appears, enter 'root'. At the Password prompt, enter 'eXgine'. At the '#' prompt, enter 'ifconfig' to see the current LAN settings for eth0. As shown in Figure 2-2, enter 'ifconfig eth0 <ip address>'. Verify that the IP address has changed by entering 'ifconfig' again.
- (d) Connect the reliable HD transport unit to your network and go to a PC on the network. Startup a web browser and enter the IP address of the reliable transport. Go to step (f).
- (e) Web Browser Method: Use a standard CAT5e LAN cable to connect the reliable HD transport unit's **ETHERNET** RJ45 connector directly to a PC's RJ45 connector. Record the PC network settings and then change the IP address and mask to '10.10.10.1 and 255.255.255.0'. Start a web browser and go to address 'http://10.10.10.100'.
- (f) Verify that the page in Figure 2-3 appears in the browser. Select the **Configuration** tab and then select **Network Configuration**. Verify that the page in Figure 2-4 appears.
- Enter the **IP Address**, **Netmask** and **Default Gateway** fields as obtained from the network administrator.

Figure 2-2: Entering IP Address – Serial Port Method



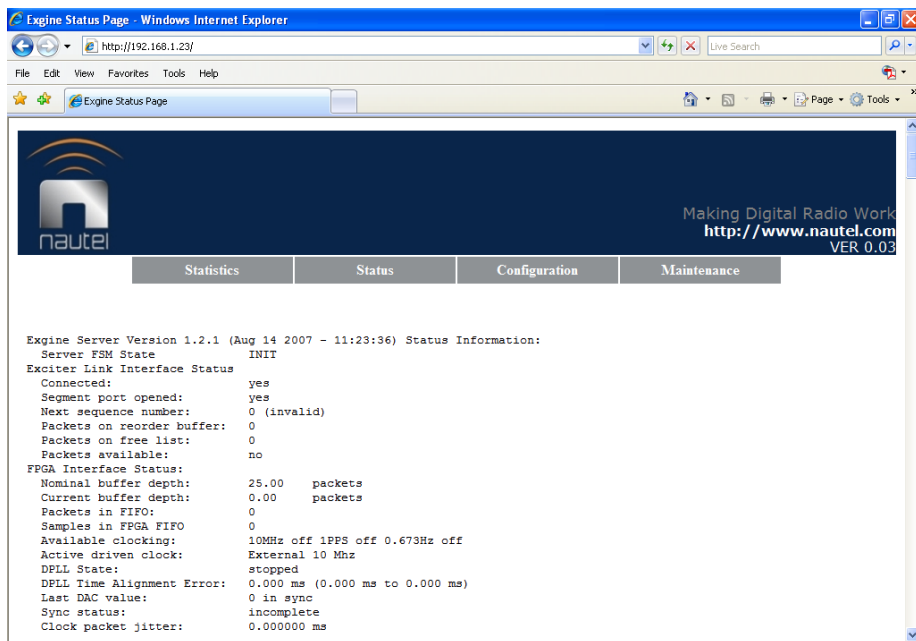


Figure 2-3: Main Screen (Status tab shown)

#### NOTE

*With the introduction of the iBiquity HDP protocol, various port numbers are employed for the Exporter to Exgine (E2X) link. By default, iBiquity IRSS software communicates on port 11000 for UDP connections and on port 10000 for TCP/IP connections. Nautel systems use port 9000 for both UDP and TCP/IP E2X links. The port settings on third party devices are unknown. To aid in configuration, this software version allows configuration of the HDP receive port under the "Network Configuration" page and the transmit port can be configured under the "E2X Transport" page.*

- Enter the **Exporter IP** field with the IP address of the device from which the reliable HD transport unit will be receiving data. For the studio unit, use the exporter's IP address. For the transmitter site's unit, use the studio unit's IP address.
- Set Use front panel network settings to 'no'.
- Set Receive E2X protocol mode to UDP.
- Enter the port number that the Exporter uses for the HDP protocol on the E2X link.

- Enter the **E2X Receive Buffer Depth** field with a value of 6 for the studio unit and a value of 30 for the transmitter site's unit.
  - Click on the **Accept Changes** button.
  - Do not select the **Reboot** link.
- (g) Return to the previous page and select **E2X Transport configuration**. Verify that the page in Figure 2-5 appears.
- For both units, set **Operating Mode** to E2X Transport mode.
  - Set **E2X Transport Protocol** to Nautel E2X Encapsulation for the studio unit and to UDP for the transmitter site's unit.
  - Enter the **Transmit Buffer Depth** field with a value of 6 for the studio unit and a value of 30 for the transmitter site's unit.
  - For the studio side unit, set **Enable Timing Recovery** to 'no'. **Accept Changes** on this page and do not select reboot. Instead, click the **configure multiple unicast** link. Enter one or more destination IP addresses as shown in Figure 2-6.



Engine Status Page - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://10.10.10.101/

Most Visited Getting Started Latest Headlines

Engine Status Page

**nauteI** Making Digital Radio Work  
http://www.nauteI.com  
VER 0.03

Statistics Status Alarms Configuration Maintenance

**Engine Network Configuration** [help]

Use front panel network settings ☐ yes ☒ no

Receive E2X protocol mode  
(Nautel E2X protocol can always be received)

☒ UDP (uni-directional)  
☐ TCP/IP (bi-directional)

IP Address: 10.10.10.101

HDP Receive Port (UDP/TCP): 9000

Netmask: 255.255.255.0

Default Gateway: 10.10.10.10

Exporter IP: 0.0.0.0

E2X Receive Buffer Depth: 25

Reliable HD Transport Test Mode  
☒ disabled (default)  
☐ discard 1 in 10 packets  
☐ discard 1 in 50 packets  
☐ discard 1 in 100 packets

Accept Changes Clear Changes

**Note:**  
Submitting configuration changes will suspend engine operation until the system is restarted.

Figure 2-4: Network Configuration Screen

Engine Status Page - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://10.10.10.101/

Most Visited Getting Started Latest Headlines

Engine Status Page

**nauteI** Making Digital Radio Work  
http://www.nauteI.com  
VER 0.03

Statistics Status Alarms Configuration Maintenance

**E2X Transport Configuration** [help]

Operating mode  
☐ Engine mode  
☒ E2X Transport mode

E2X Transport Protocol  
☐ UDP (unidirectional)  
☐ TCP (bidirectional)  
☒ Nautel Reliable HD Transport

Enable Timing Recovery  
☒ yes ☐ no

Transmit Buffer Depth: 25

HDP TX IP (UDP/TCP): 0.0.0.0

HDP TX Port (UDP/TCP): 11000

Reliable HD Transport TX  
[configure multiple unicast](#)  
(unsubmitted changes on this page will be lost)

Control Packet Rate: 0

Main Bandwidth: 150000

Total Bandwidth: 300000

Data Plane Port: 3632

Control Plane Master Port: 3630

Control Plane Slave Port: 3631

IP TOS field (decimal): 0

Different TOS for clock packets  
☐ yes ☒ no

Clock TOS field (decimal): 0

Insert missing clock packets  
☒ yes ☐ no

Accept Changes Clear Changes

Figure 2-5: E2X Transport Configuration Screen





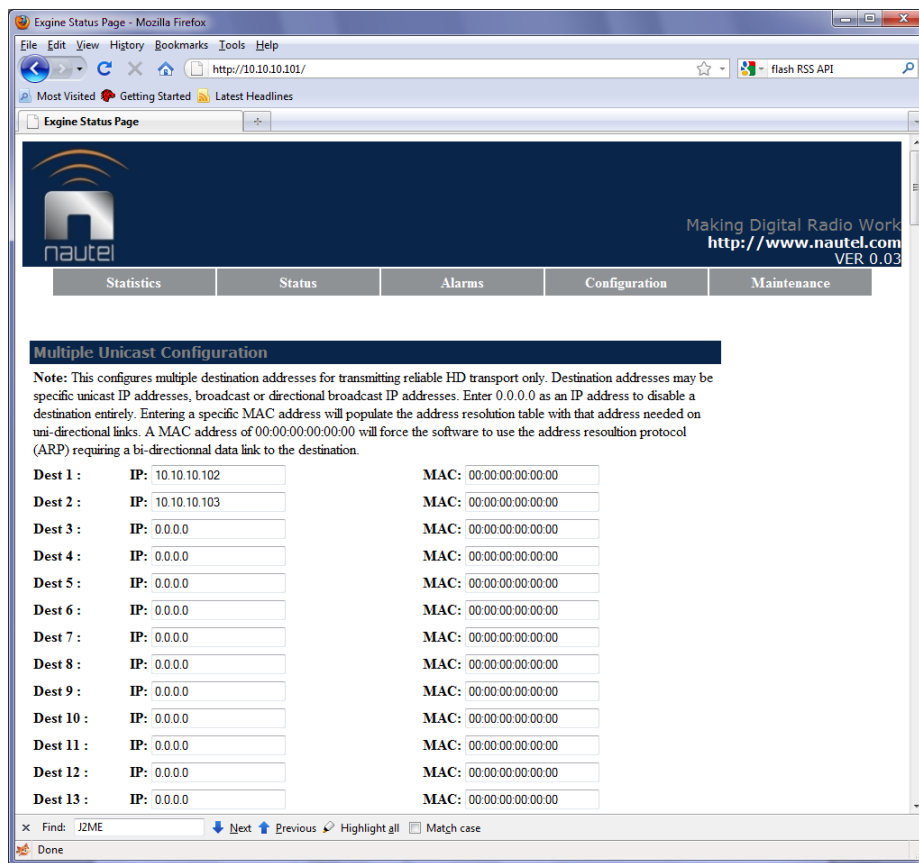


Figure 2-6: Multiple Unicast Configuration Screen

- For the transmitter site's unit, set **Enable Timing Recovery** to 'yes' and enter the **Destination IP address** field with the IP address of the exciter. Enter the HDP port number that the exciter expects to receive E2X packets.
- Verify the other fields are set with the default values in Figure 2-5.
- Click on the **Accept Changes** button
- Select the **Reboot** link and wait 30 s.
- (h) If the reliable HD transport unit is connected directly to a PC as described in step (e), connect the reliable HD transport to the network. Restore the PC network settings and reconnect it to the network as well. Verify that the IP address is OK by attempting to browse to its web pages.



## 2.3 INSTALLATION

### NOTE

To minimize the installation time, it is recommended that both units be taken to the transmitter site for initial testing. There must be a PC available at the transmitter site to carry out the install procedure. If the exporter is not at the transmitter site, then ensure someone at the studio is ready to change its exciter link settings.

- (a) At the transmitter site, connect both reliable HD transport units to the LAN. Ensure that you can browse to the web pages of each one, preferably from a single conveniently located PC. Ideally, the exporter and exciter can be accessed through a web browser interface from the same PC for configuration purposes.
- (b) Modify the exciter E2X settings (may be part of an engine configuration) so that its exporter's IP address is set to the IP address of the transmitter site's reliable HD transport unit and - if there is a choice of UDP or TCP protocol - select UDP.
- (c) Modify the exporter exciter link configuration so that the protocol is unidirectional (UDP) and the IP address points to the studio's reliable HD transport unit.
- (d) If necessary, restart the exporter and monitor the reliable HD transport unit's front panel indicators. When the exporter begins sending E2X data, the studio's reliable HD transport unit's **No Data** LED should turn off quickly. The transmitter site's reliable HD transport unit's **No Data** LED should turn off 15 to 30 s later. If the exciter had an active **No HD Data** alarm, it should now be cleared. Verify that the HD signal can be received.

### NOTE

If the exporter is at the studio and HD dropouts were frequent before starting this installation procedure, the frequency of dropouts will not change until the studio's reliable HD transport unit is properly located at the studio with the exporter.

- (e) If there is no HD signal or if the **No Data** LEDs are still on, carefully review the equipment settings to ensure nothing was missed. Review the status of the reliable HD transport units (web browser main page, click **Statistics** tab, check 'Received data bytes') and the exciter for data and error reception counters.
- (f) If the HD signal seems OK and there are no alarms, complete the installation by moving the studio side reliable HD transport unit (and the Exporter if it was at the transmitter site) to the studio.
- (g) At the studio, connect the reliable HD transport unit and exporter to the LAN. No further configuration should be required. Resuming exporter operation should restore the HD signal.



# Reliable HD Transport Unit

## TECHNICAL INSTRUCTION MANUAL

### Section 3      **OPERATION**

---

#### 3.1 INTRODUCTION

Assuming that the HD signal is stable after the reliable HD transport units are installed, then there is very little control required. Over time there may be a need to adjust the buffer depth on the transmitter site's reliable HD transport unit if there are dropouts in the HD signal. Be careful to ensure that the dropouts are not being caused by extended outages in the STL. The reliable HD transport unit is intended to correct occasional loss of individual packets of data across the network rather than long bursts of data loss, although even then it may help to reduce the length of the burst.

There are several parameters that can be monitored – using the transmitter site's reliable HD transport unit's web pages - that will provide an indication of the quality of the network.

#### 3.2 STATUS PAGE

From the web browser's main page, click on the **Status** tab. The value of most parameters should be as shown in Figures 3-1 and 3-2.

The 'DPLL Time Alignment Error' value should gradually move toward zero (0). The values shown in parentheses represent its maximum and minimum swings. Value greater than  $\pm 30$  ms indicate excessive network congestion.

The 'Clock packet jitter' parameter is of particular interest since it shows the variation of expected and actual packet arrival time. An acceptable 'Clock packet jitter' value is less than 1 ms. A high 'Clock packet jitter' value (greater than 30 ms) may indicate excessive network congestion or other problems in the network/STL. There is usually a correlation to frequency of lost data and high jitter.

#### 3.3 STATISTICS PAGE

From the web browser's main page, click on the **Statistics** web page (see Figures 3-3 and 3-4) to display information relating to lost and recovered data. The segment packet counts indicate received data so they should be continuously increasing. Ideally, error, retransmission and timeout counts should be zero (0), however the 'Retransmissions' count is expected to increase over time. Changes in the 'Retx Timeouts' count indicates unrecovered data loss, which would have corresponded to a broadcast outage. Increases in this count should be very infrequent.



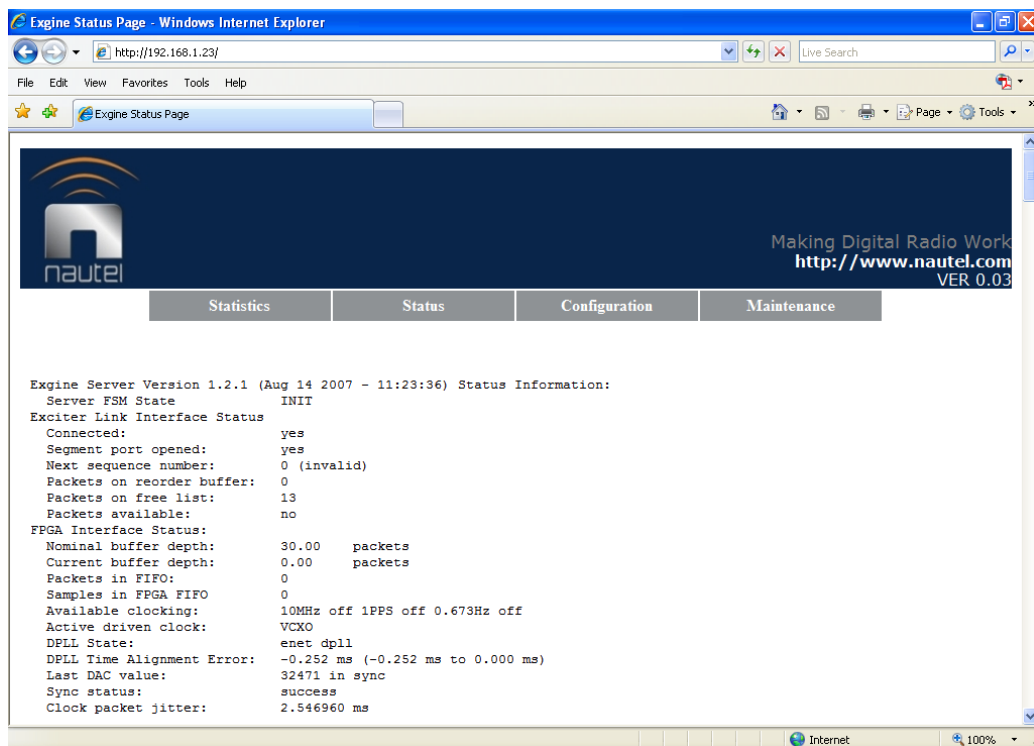


Figure 3-1: Status Page (Transmitter Site Reliable HD Transport Unit)

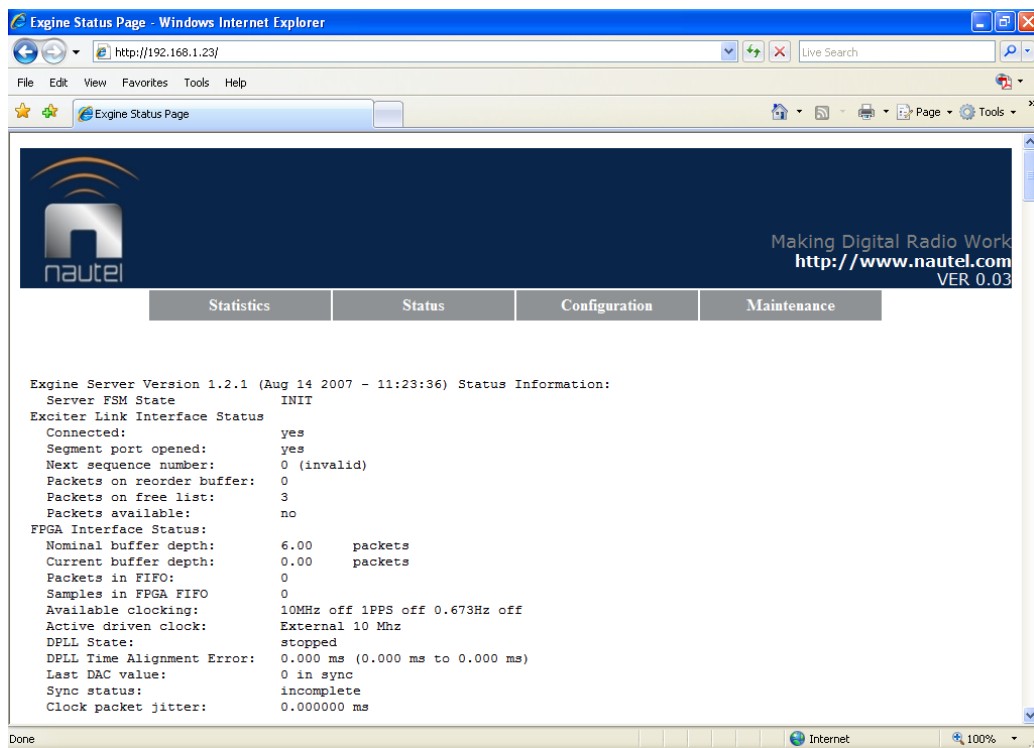


Figure 3-2: Status Page (Studio Reliable HD Transport Unit)



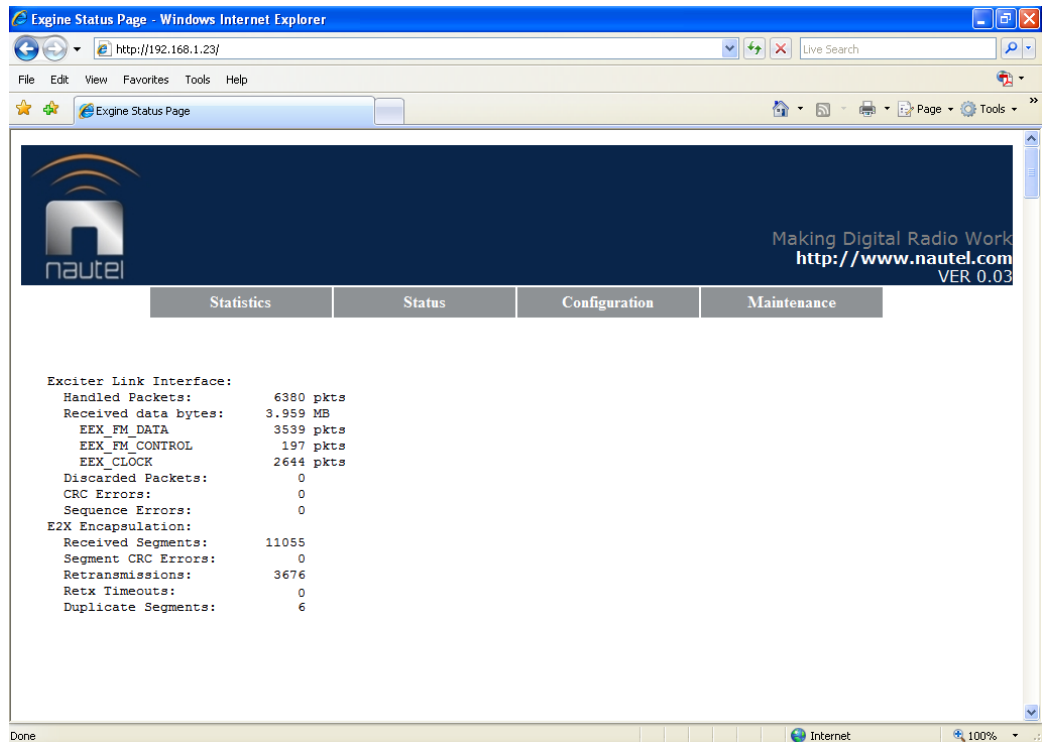


Figure 3-3: Statistics Page (Transmitter Site Reliable HD Transport Unit)

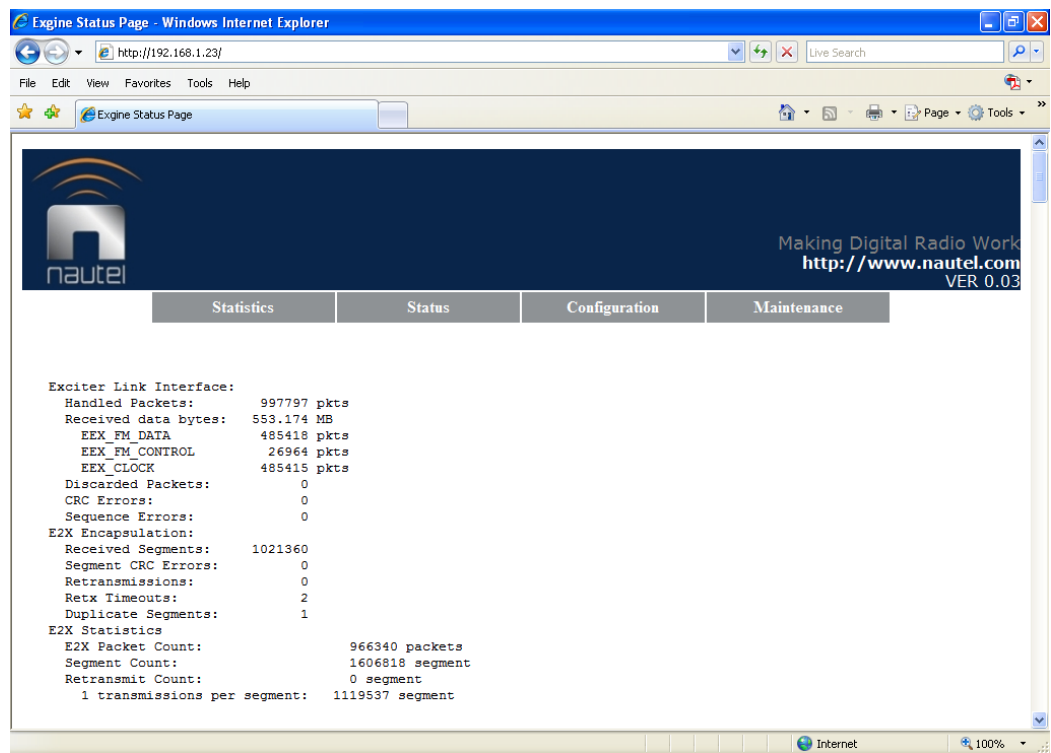


Figure 3-4: Statistics Page (Studio Reliable HD Transport Unit)



### 3.4 ADJUSTING BUFFER DEPTH

The only parameter in the reliable HD transport unit that may require adjustment is the receive buffer depth of the transmitter site unit. The following paragraphs describe the reasons and procedure for adjusting the receive buffer depth.

#### 3.4.1 Why Increase Receive Buffer Depth?

The transmission medium between the exporter and engine is based on an Ethernet/IP network, which is asynchronous in nature. Data packet arrival times (i.e., latency) are not guaranteed across all types of Ethernet links or even consistent across the same link. One major factor of latency variations is the packet serialization delay, which is the time it takes to transform a packet into a serial bit stream, send it across a data link and reassemble the complete packet at the receiver.

The exporter to exciter data protocol (E2X protocol) is composed of variable sized data packets of varying length. Depending on the available link bandwidth, some packets may be delivered very quickly while others can take up to 600 ms. Further delays may be incurred if other traffic congests the data link.

Since data packets are processed at a fixed rate, any variation in link latency must be absorbed by the receive buffer in order to avoid late packet delivery to the modulator, which would cause an HD dropout. Increasing the receive buffer depth makes the HD data connection more robust to changing link characteristics and latency variations.

On any link less than a 10/100 Ethernet connection, it is highly recommended to set the receive buffer depth to a minimum of 16 packets (one IBOC layer 1 frame time) in order to absorb the latency variation inherent in the E2X data stream.

When using the *Reliable Transport* protocol that employs a retransmission scheme, increasing the receive buffer depths improves transmission quality by allowing a greater number of retransmissions to occur on packet loss before a packet is required for on-air transmission. When experiencing HD dropouts using the reliable HD transport protocol, increase the receive buffer depth.

#### 3.4.2 Why Decrease Receive Buffer Depth?

Increasing the buffer depth makes the HD connection more robust, but at the cost of adding digital transmission throughput delay to the HD system. Every increment in the HD buffer depth increases the throughput delay by 92.8 ms. Table 3-1 shows an overview of sample buffer depth configurations. This table does not encompass the average transmission delay across the data link, which may vary from site to site, but usually is comparatively low (30-100 ms). It does, however, include the 7.5 s minimum diversity delay inherent in an HD system.



Table 3-1: Receive Buffer Delay Values

E2X Receive Buffer Depth + Transmitter Buffer Depth (packets)	Buffer Depth (s)	Combined Digital Delay** (s)
16	1.48	8.98
25	2.32	9.82
35	3.20	10.70
50	4.64	12.14
75	6.96	14.46

\*\* Delay times are based on Nautel equipment

Increasing the reliable HD transport buffer depth will provide diminishing returns once increased beyond a certain site specific point. It may then become more important to reduce the digital throughput delay in order to minimize the required analog diversity delay buffering, which may exceed the maximum delay setting of the exporter, exciter or other audio processor.

#### 3.4.3 Configuration Range

The receiver buffer depth can be configured within these parameters:

**Recommended Value:** 30 packets

**Minimum Value:**

4 packets 10/100/1000 Ethernet  
16 packets Bandwidth limited STL

**Maximum Value:** 75 packets

#### 3.4.4 ADJUSTMENT INSTRUCTIONS

The following procedure can be performed using a web browser on a PC connected to the LAN.

- (a) For an all-digital (HD) transmitter, turn off transmitter power for the duration of this procedure. For a hybrid transmitter, it is permissible to continue broadcasting the analog FM portion only; however it is recommended you use a standby transmitter, if available.
- (b) Disable the exporter data output by disconnecting the Cat5 cable from the exporter or the studio's reliable HD transport unit.
- (c) Browse to the transmitter site's reliable HD transport unit using a Laptop or PC. The screen in Figure 3-1 should appear.
- (d) Select the **Configuration** tab and then select **Network Configuration**. Enter the new buffer setting in the E2X Receive Buffer Depth field.
  - Click on the **Accept Changes** button.
  - Do not select the **Reboot** link.
- (e) Return to the **Configuration** page and select **E2X Transport Configuration**. Enter the new buffer setting in the Transmit Buffer Depth field.
  - Click on the **Accept Changes** button
  - Select the **Reboot** link and wait 30 s.
- (f) Reconnect the HD data link from the exporter.
- (g) Verify that data is being received by both reliable HD transport units by reviewing the **Status** web page of both units.







# Reliable HD Transport Unit

## TECHNICAL INSTRUCTION MANUAL

### Section 4 SOFTWARE UPGRADE

---

#### 4.1 INTRODUCTION

This procedure describes how to perform a software upgrade.

The reliable HD transport software consists of two parts - the operating system and the application software. To upgrade from any version of 1.2 or higher, you only need to upgrade the application software.

#### 4.2 PREREQUISITES

The following items are required in order to perform the software upgrade:

- Windows PC with a TFTP server application installed (see 4.3). The importer can be used as the PC. This procedure can be performed remotely over the STL. Nautel recommends you establish a local connection – direct or through a switch - between the PC and reliable HD transport unit.

#### NOTE

*Throughout the software upgrade, the exporter should either be turned off or be disconnected from the Ethernet.*

#### 4.3 TFTP SERVER INSTALLATION

Exgine software updates are accomplished with TFTP. This requires that a TFTP server be installed on the same Ethernet subnet as Exgine. Various TFTP server implementations are available for Windows. SolarWinds Network Management provides a free TFTP server at:

[http://www.solarwinds.net/Tools/Free\\_tools/TFTP\\_Server/](http://www.solarwinds.net/Tools/Free_tools/TFTP_Server/)



Refer to your TFTP server's software package for specific installation instructions. TFTP servers require a designated folder to act as the TFTP servers root directory (e.g., C:\TFTP-Root). Ensure that the TFTP server is configured to both receive and transmit files to avoid TFTP timeout conditions.

#### 4.4 EXGINE SOFTWARE UPGRADE

A software upgrade reconfigures the on-board program FLASH memory. A FLASH program operation carries the inherent danger of leaving the reliable HD transport unit in an unusable state should the operation be terminated prematurely. In this case, the reliable HD transport unit may have to be reprogrammed at the factory. The installation process will not attempt to write any files to FLASH, if the files have not been transferred correctly to the reliable HD transport unit platform.

Perform the following steps to upgrade the reliable HD transport unit software (note **bold** text is typed by operator):

- (a) Connect the Windows PC to the Ethernet and configure its IP address according to your subnet. Verify the connection by pinging the reliable HD transport unit's IP address:

#### NOTE

*This document shows the reliable HD transport unit's IP address as 10.10.1.100. Please replace this with the IP address of your reliable HD transport unit.*

```
C:\Documents and Settings\Importer>ping 10.10.1.100
```

```
Pinging 10.10.1.100 with 32 bytes of data:
```

```
Reply from 10.10.1.100: bytes=32 time=26ms TTL=63
```

```
Reply from 10.10.1.100: bytes=32 time=15ms TTL=63
```

```
Reply from 10.10.1.100: bytes=32 time=26ms TTL=63
```

```
Ping statistics for 10.10.1.100:
```

```
Packets: Sent = 3, Received = 3, Lost = 0 (0% loss),
```

```
Approximate round trip times in milli-seconds:
```

```
Minimum = 15ms, Maximum = 26ms, Average = 22ms
```

- (b) Copy the reliable HD transport unit software files into the TFTP-Root directory of the Windows PC. The reliable HD transport unit software should consist of the following files:

```
engine_vx_x.tar.gz  
install.sh  
update.sh
```

These files may have been distributed in a ZIP file archive and may have to be extracted directly into the TFTP Root directory first.

- (c) Launch the TFTP server.
- (d) Browse the reliable HD transport unit and select the Maintenance web page. Enter the IP address of the TFTP server in the Engine Firmware Upload field and click on update.

- (e) When the text 'update complete' appears, reload the Maintenance web page and click on 'RESTART Engine' at the bottom of the page.

- (f) After the reboot is complete, verify the reliable HD transport software version by pointing your web browser to the reliable HD transport IP address. The version should be the new software version. Review settings to ensure proper operation.

#### NOTE

*If the reliable HD transport unit's web page does not respond, repeat the installation setup and configuration procedure.*



# Reliable HD Transport Unit

## TECHNICAL INSTRUCTIONS

### Section 5 TROUBLESHOOTING

---

#### 5.1 INTRODUCTION

If the reliable HD transport unit becomes non-operational, some simple troubleshooting procedures can be followed to return the unit to operational status. This section outlines some common errors and warnings that may occur along with the procedures to correct each problem.

#### 5.2 TROUBLESHOOTING

##### NOTE

*Troubleshooting information is limited to module level checks and sub-assembly replacement. Component level troubleshooting is not practical. See Figure MD-1 and MD-2 for mechanical drawings of the reliable HD transport unit and interface PWB.*

#### 5.2.1 Power Related Fault

If the **Power** LED is not on, a problem has occurred:

- (a) Measure the ac input applied to ac entrance module U1. Check fuse F1. Replace fuse if necessary, but continue troubleshooting the source of the fault.
- (b) If the ac voltage and fuse are OK, remove the top cover from the reliable HD transport unit and measure the low level dc voltages on the interface PWB (A2):
  - +5 V between CR1-cathode and ground (TP1)
  - +3.3 V between U3-3 and ground (TP1).
- (c) If the voltages in step (b) are not satisfactory, suspect a problem with the ac/dc power supplies (U2 and U3), 3.3 V regulator U3 on the interface PWB, or the wiring between the ac/dc power supplies and the interface PWB.





# Reliable HD Transport Unit

## TECHNICAL INSTRUCTIONS

### Section 6 PARTS LISTS

#### 6.1 PART INDEX TABLES

Part index table(s) for all electrical and mechanical parts that have been assigned a reference designation are provided. Refer to the preamble in the Parts List section, of the host transmitter's instruction manual, for explanation of list contents. Individual part number indexes are provided for all assemblies that have been assigned a Nautel configuration control number (e.g., NAX241). The part number indexes, which are presented in alphanumeric order, are divided into columns to aid in locating specific information.

#### 6.2 MANUFACTURERS' CODE INDEX

Table 6-1 provides a cross-reference from the original equipment manufacturers (OEM) codes to the manufacturer's name.

To determine a specific part's manufacturer contact information, enter the five-character OEM (CAGE) code for that part in the following website:

[https://www.bpn.gov/bin/cs/begin\\_search.asp](https://www.bpn.gov/bin/cs/begin_search.asp)

Upon entering the OEM (CAGE) code number, manufacturer pertinent information (address, telephone number, fax number, etc.) shall be displayed. Please contact Nautel if a part cannot be obtained.

Table 6-1: Manufacturers' Code Index

00779	Amp Incorporated	75915	Littelfuse Inc.
01295	Texas Instruments Incorporated	96095	AVX Corporation
09482	AMP of Canada	BELKIN	Belkin Components
27014	National Semiconductor Corporation	DIALIGHT	Dialight Corporation
37338	Nautel Limited	KYCON	Kycon Cable and Connector Inc.
56289	Sprague Electric Company	MEANWEL	Mean Well USA, Inc.
57655	Nautel Incorporated	ONSEMI	ON Semiconductors
59124	KOA Speer Electronics Inc.	SCHURTE	Schurte AG



**198-3376****Cable Assy**

REFDES	DESCRIPTION	NAUTEL #	VENDOR #	OEM CODE
P01	Conn, Recept, Ribbon Cable, 10 pin	JP50	746285-1	00779
P02	Conn, Recept, Ribbon Cable, 10 pin	JP50	746285-1	00779

**NAPI92****Interface PWB Assy, E2X**

REFDES	DESCRIPTION	NAUTEL #	VENDOR #	OEM CODE
C01	Capacitor, Ceramic, 0.01uF 10% 100V	CCG04	CKR05BX103KRV	56289
C02	Capacitor, Tantalum Dipped, 10uF, 35V	CCP36	T351G106K035AT(Ro HS) KEMET	96095
C03	Capacitor, Ceramic, 0.01uF 10% 100V	CCG04	CKR05BX103KRV	56289
C04	Capacitor, Ceramic, 0.01uF 10% 100V	CCG04	CKR05BX103KRV	56289
C05	Capacitor, Tantalum Dipped, 10uF, 35V	CCP36	T351G106K035AT(Ro HS) KEMET	96095
CR01	Diode, Schottky Rectifier, 3A,20V PRV	QK49	1N5820G(ROHS)	ONSEMI
CR02	Diode, Schottky Rectifier, 3A,20V PRV	QK49	1N5820G(ROHS)	ONSEMI
J01	Conn, Jack, RJ45, PWB Mount	JM44	556591-1	09482
J02	Conn, Socket, D-Sub, 9 pin, PWB Mt	JQ34	K22-E9S-NJ	KYCON
J03	Conn, Header, Ribbon Cbl, 10-Pin	JQ54	103308-1	00779
J04	MTA, Keyed Square Post Header Assy, 12 Pin	JU23	1-647123-2	00779
J05	Conn, Jack, RJ45, PWB Mount	JM44	556591-1	09482
J06	Conn, Jack, RJ45, PWB Mount	JM44	556591-1	09482
R01	Resistor, MF, 221 Ohms, 1PC 1/4W	RAB17	MF1/4DL2210F	59124
R02	Resistor, MF, 221 Ohms, 1PC 1/4W	RAB17	MF1/4DL2210F	59124
R03	Resistor, MF, 221 Ohms, 1PC 1/4W	RAB17	MF1/4DL2210F	59124
R04	Resistor, MF, 221 Ohms, 1PC 1/4W	RAB17	MF1/4DL2210F	59124
U01	IC, SMT, CMOS, Hex Schm, Trig, Inv, SOIC-14	UDLS03	SN74AHCT14D(STATI C)	01295
U02	IC, SMT, Quad LVDS Rxcvr, 3.3V, SOIC-16	UX76	DS90LV048ATM(STAT IC)	27014
U03	IC, Voltage Regulator, +3.3V, 1A	UT59	LM3940IT-3.3	27014



**NAX241****Nautel Reliable HD Transport**

REFDES	DESCRIPTION	NAUTEL #	VENDOR #	OEM CODE
A01	Exgine PWB Assy,M50	NAPE74	198-3076	37338
A02	Interface PWB Assy, E2X	NAPI92	198-3350	37338
DS01	Diode,LED,Red,Panel Mount,Chrome	QM59	605-1111-110F	DIALIGHT
DS02	Diode,LED,Red,Panel Mount,Chrome	QM59	605-1111-110F	DIALIGHT
DS03	Diode,LED,Green,Panel Mount,Chrome	QM58	605-1211-110F	DIALIGHT
DS04	Diode,LED,Green,Panel Mount,Chrome	QM58	605-1211-110F	DIALIGHT
F01	F use, 2A 250V, 5x20mm, Anti-surge	FA39	215 002	75915
P01	MTA, Keyed Closed End Housing,8 pin,22AWG	JU28	644463-8	00779
P02	MTA, Keyed Closed End Housing,12pin,22AWG	JU26	1-644463-2	00779
U01	Conn,Power Entry,C14,c/w fuseholder	JT91	6200.2300(ROHS)	SCHURTE
U01	Conn,Rear Cover,for Schurter6200 Series	JT92	0859.0047(ROHS)	SCHURTE
U02	Power Supply,5V@5A,88-264 Vac,EMI	UW84	RS-25-5	MEAN WEL
U03	Power Supply,5V@5A,88-264 Vac,EMI	UW84	RS-25-5	MEAN WEL
W01	Cable, Cat5e, 1', Molded	UA73	A3L791-01	BELKIN
W02	Cable, Cat5e, 1', Molded	UA73	A3L791-01	BELKIN
W03	Cable Assy	198-3376	198-3376	37338

**NOTE:** The exgine PWB (A1, NAPE74) is a non-repairable assembly. As such, its parts list is not provided.







# Reliable HD Transport Unit

## TECHNICAL INSTRUCTIONS

### Section 7 WIRING LISTS

#### 7.1 INTRODUCTION

This section contains wiring information for hard-wired assemblies of the subject unit. Refer to Table 7-1 for an itemized listing of assemblies that have wiring lists.

#### 7.2 WIRING LISTS NOT PROVIDED

Separate wiring lists are not provided for some assemblies. These assemblies include:

Assemblies that have separate maintenance manuals are not provided. Refer to the associated maintenance manual for detailed wiring information of these assemblies.

Assemblies that have their wiring information adequately depicted/ tabulated on their assembly detail drawings are not provided. Refer to the associated assembly detail drawing for detailed wiring information of these assemblies.

#### 7.3 PRINTED WIRING PATTERNS

The need for printed wiring pattern information is beyond the scope of this manual, therefore, detailed printed wiring patterns for printed circuit boards are not included.

#### 7.4 WIRE COLOURS

Every effort is made to manufacture the assemblies using wire that is the colour tabulated in the 'Code' column of the wiring list tables. In some instances, a white wire will be substituted. In this case identification must be determined by locating the assigned identification number.

#### 7.5 WIRING LISTS PROVIDED

The wiring lists tabulated in Table 7-1 are provided. These lists provide, non-printed wiring pattern, point-to-point (source/ destination) inter-connecting information.

Table 7-1: Wiring Lists Provided

TABLE	TITLE
Table 7-2	Wiring List – NAX241 and NAX241A Reliable HD Transport Unit
Table 7-3	Connector Mating Information – NAX241 and NAX241A Reliable HD Transport Unit



Table 7-2: Wiring List – NAX241 and NAX241A Reliable HD Transport Unit

SOURCE	DESTINATION	CODE	SIZE	REMARKS
U1-L	U2TB1-L	1	White	16
U1-N	U2TB1-N	2	White	16
U1-E	E1	3	Black	16
U2TB1-L	U3TB1-L	4	White	16
U2TB1-N	U3TB1-N	5	White	16
U2TB1-GND	U3TB1-GND	6	Black	16
U2TB1-(-V)	P2-10	7	White	22
U3TB1-(-V)	P2-08	8	White	22
U2TB1-(+V)	P2-11	9	White	22
U3TB1-(+V)	P2-12	10	White	22
P2-09	P1-06	11	White	22
P2-07	P1-08	12	White	22
P2-05	P1-05	13	White	22
P2-02	DS2-A	14	White	22 Thin leg of DS2
P2-01	DS1-A	15	White	22 Thin leg of DS1
P2-03	DS3-A	16	White	22 Thin leg of DS3
P2-04	DS4-A	17	White	22 Thin leg of DS4
DS4-K	P2-06	18	White	22
U2TB1-GND	E1	19	Black	16
DS1-K	DS2-K	-	TCW	24 Jumper
DS2-K	DS3-K	-	TCW	24 Jumper
DS3-K	DS4-K	-	TCW	24 Jumper

Table 7-3: Connector Mating Information – NAX241 and NAX241A Reliable HD Transport Unit

CONNECTOR	MATE
P1	A1J5
P2	A2J4
W1P1	A1J1
W1P2	A2J6
W2P1	A1J2
W2P2	A2J5
W3P1	A1J9
W3P2	A2J3



# Reliable HD Transport Unit

## TECHNICAL INSTRUCTIONS

### Section 8 ELECTRICAL SCHEMATICS AND ASSEMBLY DETAIL DRAWINGS

---

Table 8-1: List of Drawings

Figure	Description
Figure 8-1	Electrical Schematic – NAX241 and NAX241A Reliable HD Transport Unit
Figure 8-2	Assembly Detail – NAX241 and NAX241A Reliable HD Transport Unit
Figure 8-3	Assembly Detail – NAPI92 Interface PWB

---

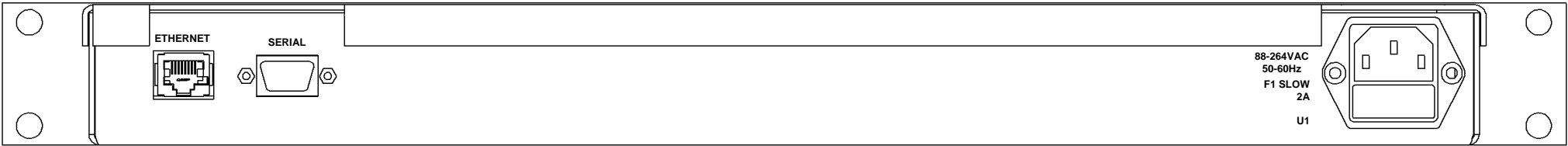
**NOTE:** The engine PWB (A1, NAPE74) is a non-repairable assembly. As such, its electrical schematic and assembly detail drawing is not provided.



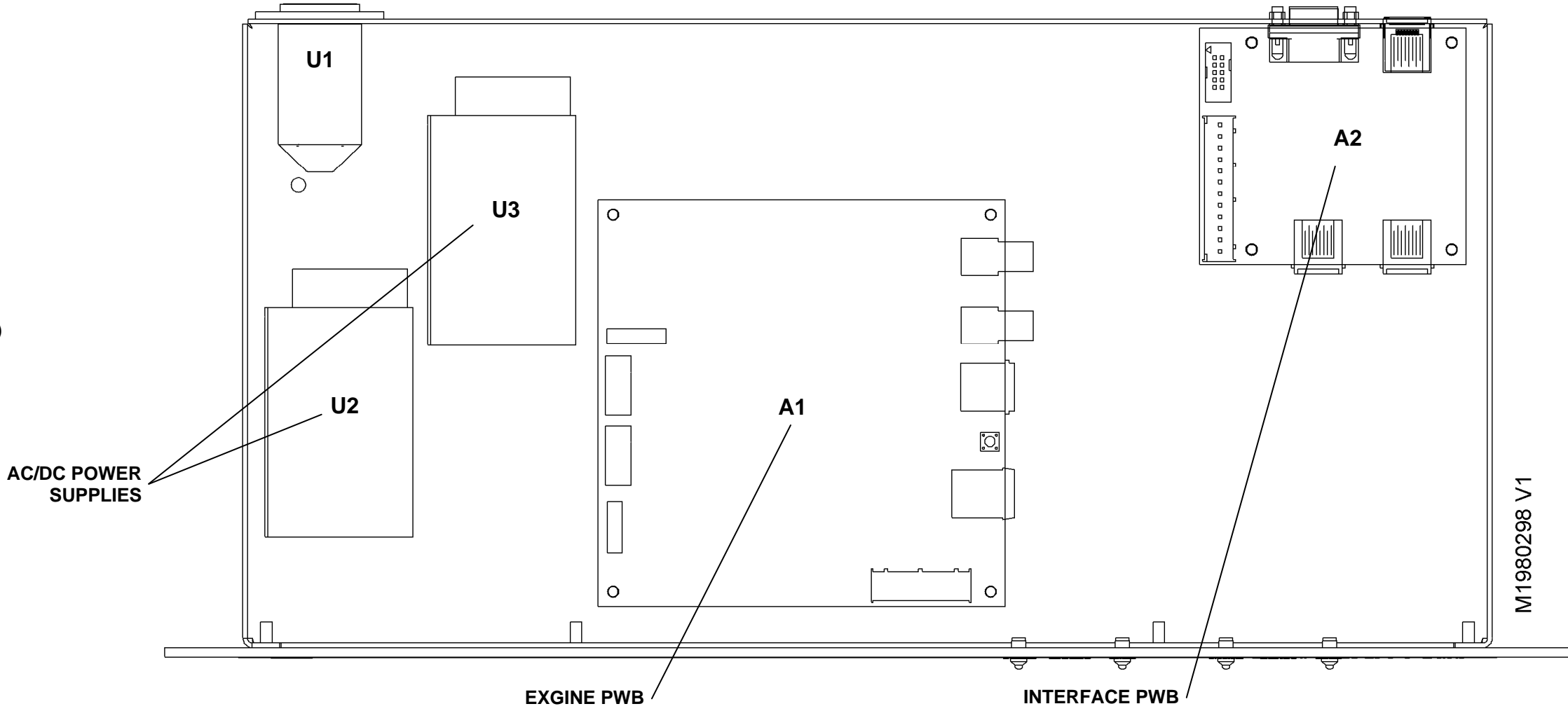




REAR  
VIEW



TOP  
VIEW  
(cover removed)



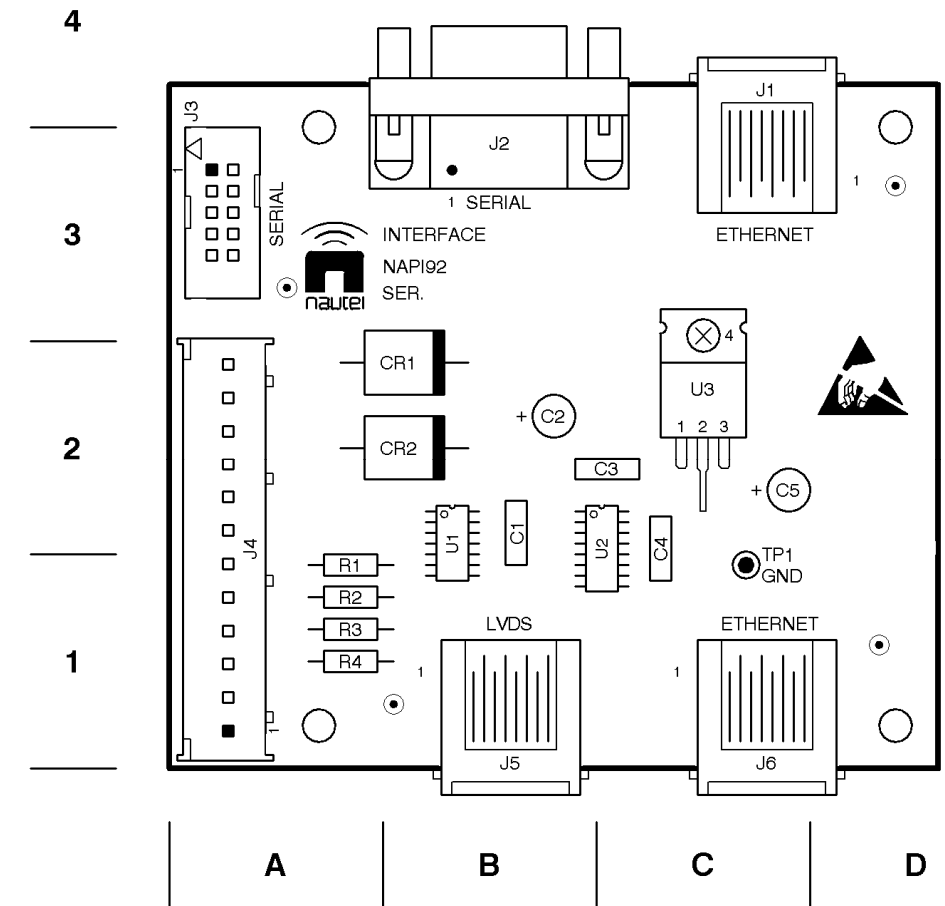
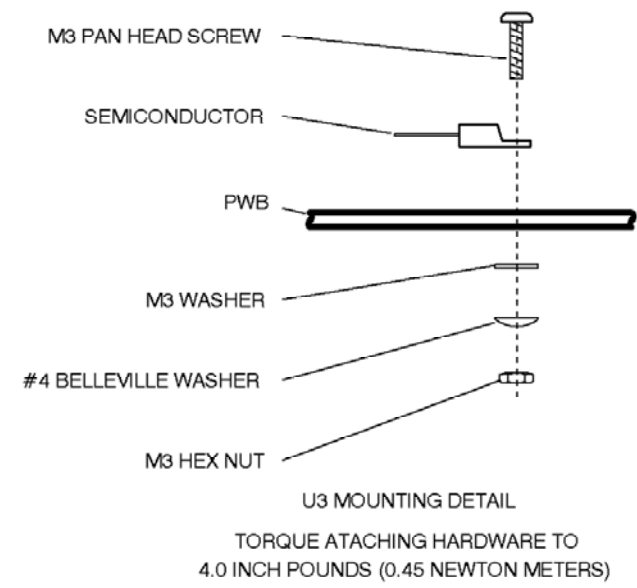
FRONT  
VIEW



Dimensions = mm (inches)

Assembly Detail - NAX241 and NAX241A Reliable HD Transport Unit

Issue 0.6	Not to Scale	Figure 8-2	Sheet 1 of 1
-----------	--------------	------------	--------------



Dimensions = mm (inches)

Assembly Detail - NAPI92 Interface PWB			
Issue 0.6	Not to Scale	Figure 8-3	Sheet 1 of 1