TN2009-20-V1.0

GENERAL DESCRIPTION OF MODEL A3LA-X

Version 1.0

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GLOSSARY

BIS	Bureau of Industry and Security
DAV	Data After Voice
DoD EMSS	DoD Enhanced Mobile Satellite Services
DPL	Digital Peripheral Link
DTE	Data Terminal Equipment
DSN	Defense Switch Network
EAR	Export Administration Regulations
FDMA	Frequency Division Multiple Access
GPS	Global Positioning System
ISU	Iridium Subscriber Units (Modems, Phones, Trackers)
LBT	L-Band Transceiver
LED	Light Emitting Diode
LNA	Low Noise Amplifier
NIPRNET	Non-Secure Internet Protocol Router Network
NOC	Network Operation Center
OFAC	Office of Foreign Asset Controls
PSTN	Public Switch Telephone Network
RHCP	Right Hand Circular Polarization
Rx	Receiving
RUDICS	Router-Based Unrestricted Digital Internetworking Connectivity Solution
SBD	Short Burst Data
SIM	Subscriber Identity Module
SMA	Sub-Miniature Version A
SMS	Short Message Service
TDD	Time Domain Duplex
TDMA	Time Division Multiple Access
Tx	Transmitting
VSWR	Voltage Standing Wave Ratio

1.0 PURPOSE

This document describes the electrical and mechanical interfaces of the A3LA-X. Model A3LA-X is a satellite modem comprised of a 9522B L-band transceiver (LBT) with an eXtended input voltage range. It is designed to operate with the Iridium network. Similar to a standard landline modem, the A3LA-X can be controlled by any DTE (data terminal equipment) capable of sending standard AT commands via a serial port. A DTE can be a desktop computer, a laptop computer, a PDA, or even a micro-controller. With the exception of a smaller form-factor, model A3LA-X is functionally compatible with and is a 'drop in' replacement for models 9522A, A3LA-D, A3LA-D-NV and A3LA-SA. The A3LA-X has been certified to MIL-STD-810F standards for temperature, humidity, altitude, rain, shock, sand, dust and salt fog.

Services Supported:

1. Dial-Up Data
2. Direct Internet Connection (or NIPRNET Connection)
3. Direct Internet Connection using Apollo Emulator (only for DoD EMSS Gateway)
4. Short Message Service (SMS)
5. Short-burst data (SBD)
6. Router-Based Unrestricted Digital Internetworking Connectivity Solution (RUDICS)
7. Voice (when combined with the DPL audio handset)

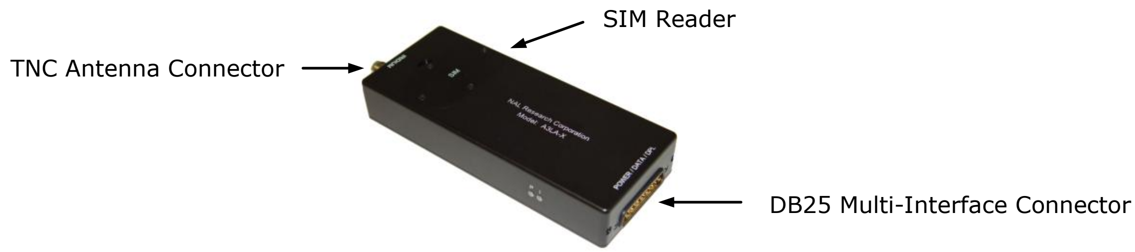


Figure 1. Iridium Satellite Modem A3LA-X.

IMPORTANT: User should not disassemble the A3LA-X for repair or services. The warranty is voided if the A3LA-X is disassembled. It should be returned to NAL Research for any services.

2.0 SPECIFICATIONS

2.1 Mechanical Specifications

Dimensions:	162 mm x 67 mm x 27 mm (6.38" x 2.65" x 1.06")
Weight:	340 g (0.75 pound)
Multi-Interface Connector:	25-Pin D-Sub
Iridium Antenna:	TNC Female
GPS Antenna Pass Thru:	SMA Female (Available upon request)
SIM Chip Reader:	Located beneath a cover plate on top of the A3LA-X
Status Display:	Two LEDs
Cooling:	Convection
Enclosure:	Aluminum/EMI shielding

2.2 RF Specifications

Operating Frequency: 1616 to 1626.5 MHz

Duplexing Method: TDD

Multiplexing Method: TDMA/FDMA

Link Margin: 13.1 dB average

Average Power during a Transmit Slot (Max): 7W

Average Power during a Frame (Typical): 0.6W

Receiver Sensitivity at 50Ω (Typical): –118.5 dBm

Receiver Spurious Rejection at offsets > 1MHz: 60dB

2.3 Electrical Specifications

Main Input Voltage Range: +4.0VDC to +32.0VDC

Main Input Voltage Nominal: +12.0VDC

Main Input Voltage Ripple: 40mV peak-to-peak

Average Standby Current: 300mA @ 5.0VDC

Average Data Call Current: 800mA @ 5.0VDC

Peak Data Call Current: 2.5A @ 5.0VDC

NOTE: The power requirements apply to DC power measured at the A3LA-X multi-interface connector input. The Average Data Call Current may vary depending on the field-of-view between the modem antenna and the Iridium satellite.

2.4 Environmental Specifications

Operating Temperature Range: –30°C to +70°C (–22°F to +158°F)

Operating Humidity Range: < 75% RH

Storage Temperature Range: –40°C to +85°C (–40°F to +185°F)

Storage Humidity Range: < 93% RH

2.5 Data I/O Specifications

Dial-Up Data/RUDICS: 2.4 Kbits/sec (average)

Direct Internet: 2.4 Kbits/sec (average)

Short-Burst Data: 1960 bytes for Mobile-Originated and 1890 bytes for Mobil-Terminated

Short Messaging: 160 Characters (maximum)

Hardware Interface: RS232

Software Interface: Standard AT Commands

2.6 Related Hardware

Antennas: SYN7391 Series, SAF2040 Series, SAF5340 Series, SAF5350 Series (These antennas are to be used with the A3LA-X transceiver only. They are NOT optimized and should not be used for pass through GPS receiver)

Data Kit/Connector: HRC-24-7X, HRC-24-8X

Power Adapters: LA-3098, LA-7021

DPL Audio Handset: DPLS0401-X, DPLS0401-412

RF Splitter: SYN-SLC-ALBT

2.7 Reference Documents

A3LA-X Product Information

Getting Started With Model A3LA-X (TN2009-21-V1.0)

AT Command Reference V2.22

Current Drawn by A3LA-X (TN2009-22-V1.0)

Current Drawn by A3LA-XP (TN2009-23-V1.0)

SatTerm Software Manual (TN2009-19-V7.0)

Additional Information on DirectIP SBD (TN2007-637-V1.0)

Additional Information on SBD (AN2007-07-V3.3.0)

3.0 MULTI-INTERFACE CONNECTOR

The multi-interface connector is a male 25-pin miniature D-Sub type that includes six interfaces—RS232, DC input power, DC output power, ON/OFF control line, analog audio and Digital Peripheral Link (DPL). The multi-interface connector pin assignments are summarized in Table 1, which is 'pin-to-pin' the same as for models 9522A, A3LA-D, A3LA-D-NV and A3LA-SA except for Pin 2.

PIN #	SIGNAL	DESCRIPTION	INTERFACE
1	EXT_ON_OFF	Power on/off control input	DC Power
2	+12VDC	Output Voltage to Power the DPL Handset	DC Power
3	EXT_GND	External GND input	DC Power
4	EXT_B+	External 4.0VDC – 32.0VDC input	DC Power
5	SPKR_AUD	Speaker audio output	Analog Audio
6	DA_TX	PCM digital audio output	Digital Audio
7	RI	RS232 Ring Indicate	RS232 Data
8	RTS	RS232 Request To Send	RS232 Data
9	S_TX	RS232 Transmit Data	RS232 Data
10	DCD	RS232 Data Carrier Detect	RS232 Data
11	DA_FS	PCM digital audio frame sync output	Digital Audio
12	DA_CLK	PCM digital 2.048MHz audio clock output	Digital Audio
13	S_RX	RS232 Receive Data	RS232 Data
14	SIGNAL GND	Signal ground, 0V signal reference and return	GND
15	MIC_AUD	Microphone audio input	Analog Audio
16	EXT_B+	External 4.0VDC – 32.0VDC input	DC Power
17	EXT_GND	External GND input	DC Power
18	DPL_TX	Digital Peripheral Link (DPL) data output	DPL UART
19	DTR	RS232 Data Terminal Ready	RS232 Data
20	DPL_RX	Digital Peripheral Link (DPL) data input	DPL UART
21	DSR	RS232 Data Set Ready	RS232 Data
22	CTS	RS232 Clear To Send	RS232 Data
23	SIGNAL GND	Signal ground, 0V signal reference and return	GND
24	DA_RX	PCM digital audio input	Digital Audio
25	SIGNAL GND	Signal ground, 0V signal reference and return	GND

Table 1. Pin assignment for the multi-interface connector.

3.1 RS232 Data Interface (Standard 9-Wire Configuration)

The A3LA-X supports a standard RS232 data interface to a DTE incorporating hardware handshaking and flow control. The RS232 data interface comprises of eight standard RS232 data, control and status signals plus a ground level signal reference as shown in Table 1 (pins 7-RI, 8-RTS, 9-TX, 10-DCD, 13-RX, 19-DTR, 21-DSR, 22-CTS and 23-GND). This interface allows a connected DTE to utilize the A3LA-X's modem functionality through standard AT and extended sets of AT commands. These commands are defined in the document ISU AT Command Reference V2.7. The A3LA-X will automatically adjust to the DTE baud rate and override the +IPR setting when dissimilar. Autobaud will occur on the following characters 'a', 'A' or CR (carriage return). Autobaud will also occur on the escape sequence character, provided this is an odd number of characters. Normally this is set to '+' in register S2. See the AT Command Reference for details.

3.2 RS232 Data Interface (3-Wire Configuration)

Several steps must be taken to allow 3-wire configuration (i.e. only using S_TX, S_RX, and SIGNAL GND). These steps ensure the A3LA-X and DTE to work together without having hardware handshaking.

1. The modem's DTR line must be held high. Using the modem's input voltage is fine for this purpose BUT ONLY if the input voltage is less than 5VDC (see important note below). Looping back the modem's DSR line to DTR line will NOT work. The DSR line on the modem should be left unconnected.
2. Disconnect the CTS, DCD, DSR, DTR, RTS and RI lines between the DTE and modem.
3. AT&Dn must be set to AT&D0 to ignore the DTR input from the DTE.
4. AT&Kn must be set to AT&K0 for no flow control or AT&K4 for XON/XOFF software flow control.
5. The setting can be stored on the modem permanently (until another setting overwrites it) so that it remains after a power cycle. The modem allows two profiles in which settings are stored, and user can choose either as a default profile. The relevant commands are &Wn and &Yn. &Wn stores the present configuration in profile <n>, where <n> can be either 0 or 1. &Yn designates which profile is loaded after reset or power-up, again <n> is either 0 or 1.
6. Any needs of the DTE must be addressed separately.

WARNING: DO NOT use the modem's input voltage to bring the DTR line high when the input voltage is higher than 5VDC. Supplying voltage higher than 5VDC to the DTR line will permanently damage the A3LA-X.

NOTE: The Iridium's Direct Internet service when using the Windows-based Apollo client requires DCD to be present; hence it is incompatible with a 3-wire serial configuration. The Direct Internet with Apollo client is available only on the EMSS DoD gateway and NOT on the commercial gateway.

3.3 DC Power Interface

The DC power input is through pins 4 & 16 (EXT_B+) and pins 3 & 17 (EXT_GND). Note that two pins (4 and 16) are provided for the external (EXT_B+) DC input. Two pins (3 and 17) are also provided for the associated external (EXT_GND) ground input. This is done to distribute the current across two wires, and therefore all four pins should be utilized in the external power connection. The DC power requirements for the A3LA-X are summarized on page 5.

The A3LA-X will automatically turn on/off when external DC power is applied/removed via the EXT_B+ and EXT_GND inputs. The EXT_ON_OFF (pin 1) control input is used to turn a powered A3LA-X on and off in a toggle fashion. The EXT_ON_OFF control input is normally "floating" (i.e. high). When it is pulled to GND level (i.e. low) for at least 270 ms and released, the A3LA-X will alternate from its current on/off state. The current drawn on the external load used to pull the A3LA-X to GND is no more than 0.5mA. The signal on pin 1 is considered GND when it is at 0.5V or less.

Cables used to supply power to the A3LA-X should be kept as short as possible to prevent significant voltage drop, which can cause the A3LA-X to malfunction during a data call, a voice call, an SMS session or an SBD session. Power reset by the A3LA-X during a call is an indicative of the DC power source unable to sustain voltage above 4.0VDC at peak current demand.

3.4 Audio Interface

The A3LA-X supports both digital and analog audio I/O. The digital audio is in PCM format. In such format, digital audio cannot travel far (less than one foot); this is why the analog is chosen for the A3LA-X audio handset. The analog audio input is a single-ended, unbalanced input with a minimum impedance of 10kΩ to ground. The A3LA-X accepts a maximum input level of 2.0V peak-to-peak without signal distortion. The analog audio output is also a single-ended, unbalanced output capable of driving an impedance of 600Ω or more to ground. The A3LA-X delivers undistorted audio up to 2.0V peak-to-peak at this port.

The combined analog I/O audio interface (pins 5 and 15) and the DPL UART I/O interface (pins 18 and 20) enable an analog audio handset to be connected to the A3LA-X. The signal level for the DPL I/O can be RS232 or logic level. The level can be selected using a switch that is accessible when the SIM cover plate is removed. With the DPL audio handset model DPLS0401-X and DB25 data kit model HRC-24-8X, the A3LA-X can be used both as data modem and a satellite phone (see Figure 2). This setup can be an extremely useful developmental tool since the modem status can be seen on the handset LCD similar to a 9555 Iridium phone.

Figure 2. A3LA-X Connected to a DPL Handset, AC Adapter and Data Kit.

3.5 Digital Peripheral Link (DPL)

The DPL interface is composed of two ports—a full duplex asynchronous serial link for control messages and a PCM digital audio link for audio traffic. The protocol used on these ports is made available to application developers only on a case-by-case basis and after appropriate Non-disclosure Agreements and/or License Agreements are executed.

4.0 ANTENNA CONNECTOR

The A3LA-X modem uses a single TNC female 50-ohm connector for both transmit and receive. Cable loss between the modem and the antenna is critical and must be kept less than 2dB at the operating frequency of 1616 to 1626.5 MHz. The minimum link margin of 13.1 dB must also be maintained. General RF parameters are listed in the table below.

TYPE	DESCRIPTION
Frequency Range	1616 to 1626.5 MHz
Input/Output Impedance	50 Ohms
Oscillator Stability	$\pm$1.5ppm

NAL Research offers several types of antennas for use with the A3LA-X modem. These antennas include the fixed mast, mobile magnetic/permanent mount and portable auxiliary. For low-cost and applications where small form-factor and light-weight are required, NAL Research highly recommends model SYN7391-C as shown in Figure 3.

Figure 3. NAL Research's Antenna SYN7391-C.

If the specific application requires a custom antenna, it must meet the specifications in the following table.

PARAMETER	VALUE
Operating Temperature Range	–40°C/+85°C without loss of function
Measurement Frequency Range	1616 to 1626.5 MHz
Return Loss (Minimum)	9.5 dB (<2:1 VSWR)
Gain	0.0 dBic (weighted average minimum)
Minimum 'Horizon' Gain	–2.0 dBic (82° conic average)
Nominal Impedance	50 Ohms
Polarization	Right Hand Circular (RHCP)
Basic Pattern	Omni directional and hemispherical

It should be noted that the A3LA-X power transmission profiles may vary for a number of reasons. Users are reminded to optimize their setup to attain the lowest possible power transmission by the A3LA-X. Some of the setup parameters to be carefully observed include:

1. Have a clear view of the sky for the antenna—poor visibility of the sky is when a clear line-of-sight is not available between the A3LA-X's antenna and the satellites.
2. Keep the antenna's VSWR low—the higher the antenna VSWR the higher the current consumed by the A3LA-X.
3. Keep the antenna cables' loss to less than 2dB—the higher the antenna cable loss the higher the current consumed by the A3LA-X.
4. Keep the power cable between the A3LA-X and the power source as short as possible.

5.0 GPS FEED THROUGH (OPTIONAL)

As an option, a pass thru SMA connector can be added to the A3LA-X to allow an external GPS receiver to share the same A3LA-X's Iridium antenna. The RF interface of the GPS pass through is summarized in the table below.

PARAMETER	VALUE
Frequency Range	1575 MHz
Output Impedance	50Ω
Insertion Loss	± 2 dB
Noise Figure	≤ 7 dB

The GPS pass through signal is isolated from the Iridium RF board by a directional coupler after the A3LA-X Rx low-noise amplifier (LNA). The loss of the directional coupler cancels out the gain of the LNA resulting in the GPS signal gain/loss at the GPS connector of 0dB. The GPS pass through connector must be terminated with a 50Ω load when not in use. A suitable load is the Huber+Suhner 65_SMA-50-0-1/111_NE.

Figure 3. GPS Pass Through Connector Added on the A3LA-X Housing.

Either a passive or an active GPS receiver can be connected to the pass through GPS connector. Users must select a wideband Iridium antenna with appropriate sensitivity in both the Iridium frequency and the GPS frequency. GPS signal is available and is passed through to the GPS receiver when the A3LA-X is powered but not transmitting. GPS signal will be de-graded during an Iridium call. During Iridium transmit cycle there will be energy at the Iridium frequency which may adversely affect some GPS receivers.

6.0 SIM CARD INTERFACE

The A3LA-X modem contains an integrated SIM reader. The modem uses and requires an Iridium SIM chip for operation. The SIM chip is detached from the full-size Iridium SIM card. The SIM chip is inserted into the opening located on top of the modem. A plastic locking mechanism (same as with GSM wireless phones) is used hold the SIM in-place. An external SIM card reader may also be interfaced as a peripheral to the A3LA-X via the DPL bus. A SIM card in the external reader will take precedence over the SIM chip in the integrated connector when both are present.

7.0 LED DISPLAY

The A3LA-X has two status LEDs depicted as P for power indicator and I for Iridium satellite registration (see Figure 4). They offer users a quick visual check to ensure proper modem operations as well as a way to optimize antenna locations during field installation. These LEDs provide the following information:

- P (red LED): LED lights up when power is provided to the A3LA-X.
- I (green LED): LED stays solid when the A3LA-X is successfully registered with the Iridium network. The LED is off when the A3LA-X is unable to register with the Iridium network.

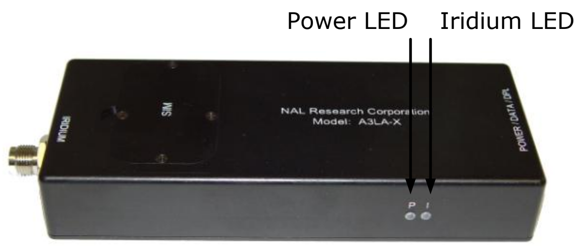


Figure 4. Iridium Satellite Modem A3LA-X.

8.0 MOUNTING RECOMMENDATIONS

The A3LA-X has four features on its bottom surface that can aid in its mounting (see Appendix E). These four features are pre-drilled at a minimum depth of 0.25 inch to accept 6-32 thread type. If the A3LA-X is to be used in a harsh environment with exposure to high humidity or water, the mating of the multi-interface connector must be further sealed to protect from moisture infiltration. It is recommended that a bead of RTV silicone sealant be placed on the connector mating to the A3LA-X's multi-interface connector. A material similar to Permatex 16B should be used.

As an option, the A3LA-X's bottom plate can be replaced with a bigger plate with the same mounting hole-pattern as the A3LA-D. Figure 4 of 4 in Appendix E shows the dimension of the optional plate.

9.0 TECHNICAL SUPPORT

FOR TECHNICAL SUPPORT, PLEASE CONTACT US AT

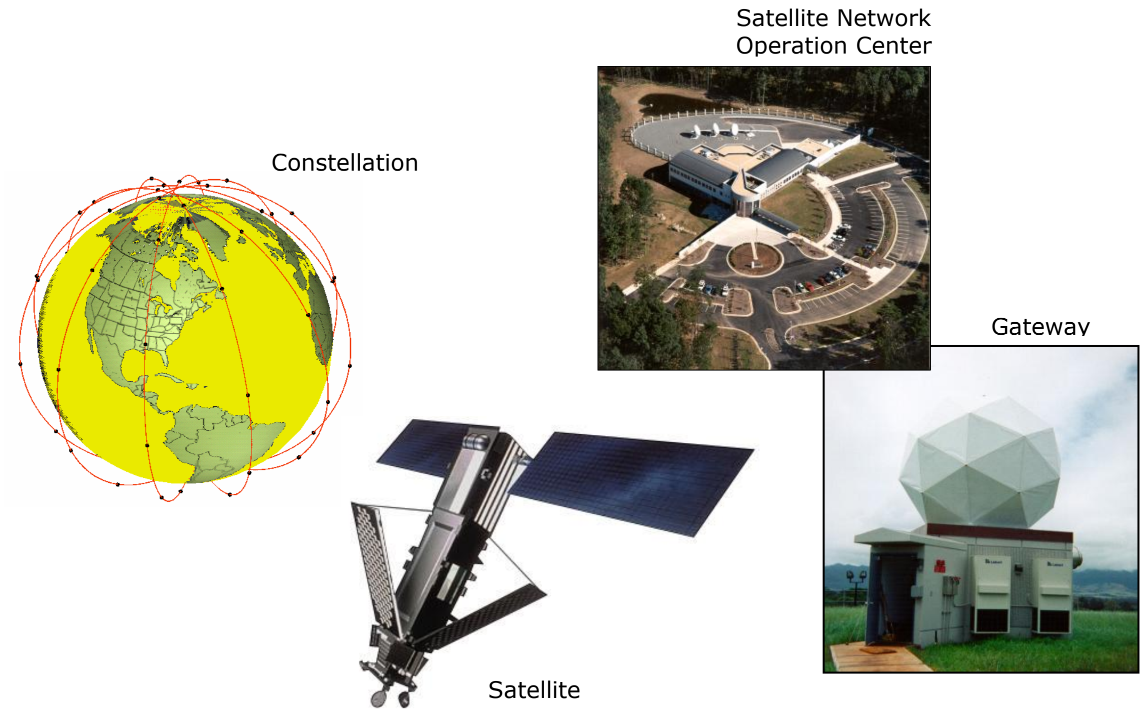
Phone: 703-392-1136
FAX: 703-392-6795
E-mail: contact@nalresearch.com

Technical documents are also available to download on NAL Research's website www.nalresearch.com under http://www.nalresearch.com/AnonymousFTPSite.html

APPENDIX A: DESCRIPTION OF THE IRIDIUM NETWORK

A.1 Description of the Iridium Network

The Iridium satellite network is owned and operated by Iridium Satellite LLC (ISLLC). It was constructed as a constellation of 66 satellites in low-earth orbit, terrestrial gateways and Iridium subscriber units (ISU). An ISU can either be an Iridium satellite phone or any of NAL Research's A3LA series modems. The satellites are placed in an approximate polar orbit at an altitude of 780 km. There are 6 polar planes populated with 11 satellites per orbit constituting the 66 satellite constellation. The near polar orbits of the Iridium constellation provide truly real-time and global coverage from pole-to-pole.



The Iridium is designed to operate in the band of 1616 to 1626.5 MHz although the exact frequencies used depend on the local regulating authorities and issued licenses in any particular region. Each satellite projects 48 beams on the surface of earth, which may be viewed as providing coverage cells on the ground similar to terrestrial systems. Each beam is approximately 600 km in diameter. The 66-satellite constellation has the potential to support a total of 3,168 spot beams; however, as the satellite orbits converge at the poles, overlapping beams are shut down. The satellite footprint is ~4,700 km in diameter. Under each footprint, a satellite is power limited to ~1,100 simultaneous circuits.

The Iridium network uses a time domain duplex (TDD) method and transmits and receives in an allotted time window within the frame structure. Since the system is TDD, the ISU transmit and receive in the same frequency band. The access technology is a FDMA/TDMA (frequency division multiple access/time division multiple access) method whereby an ISU is assigned a channel composed of a frequency and time slot in any particular beam. Channel assignments may be changed across cell/beam boundaries and is controlled by the satellite. The system will provide an average link margin of 13.1 dB.

Although there are multiple gateways, a user is registered to a single gateway. The gateways perform call connection setup and administrative duties such as billing and resource management. The satellite constellation provides connectivity between users, from a user to the Iridium system gateway, and between gateways. Within the Iridium network architecture, the satellites are cross-linked which allows ISU to ISU communication independent of gateway intervention once the call connection is established.

There are currently two commercial Iridium gateways located in Arizona, United States and Fucino, Italy. The U.S. government owns and operates an Iridium gateway located in Hawaii, United States. Each gateway generates and controls all user information pertaining to its registered users, such as user identity, geo-location and billing items. The gateway also provides connectivity from the Iridium system to the terrestrial based networks such as the PSTN.

A.2 Description of the Iridium Network Data Capabilities

For data communications, the Iridium network supports five different modes of operation as shown in Figure A1—dial-up data service, direct Internet connection, short-burst data (SBD), short-messaging service (SMS) and router-based unrestricted digital internetworking connectivity solution (RUDICS).

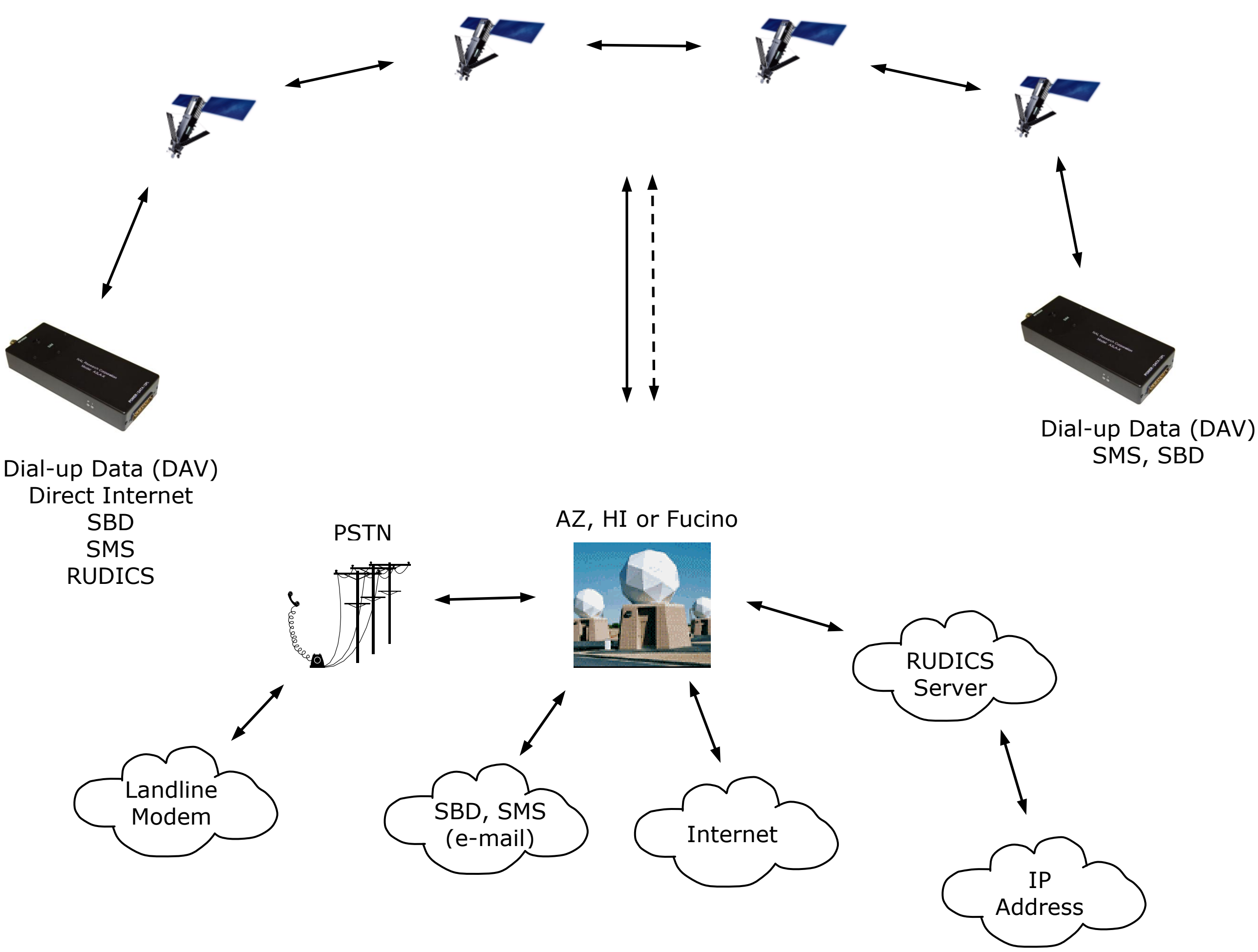


Figure A1. Iridium Network Data Capabilities.

A.3 Dial-Up Data Service

Dial-up data service provides connectivity through the Iridium satellite network to another Iridium modem, to the public switch telephone network (PSTN), to the Defense Switch Network (DSN), to a remote LAN (e.g., a corporate network) or to an Internet Service Provider (ISP) at a nominal data rate of 2.4 kilobits per second (Kbps). The connection time involving user authentication and handshaking (or modem training) can range from 15 to 30 seconds. For an Iridium-to-Iridium call, dial-up data service offers an additional option known as data after voice or DAV. Similar to a voice call, a DAV call is routed directly from one Iridium modem to another Iridium modem without going through the gateway.

Many desktop and laptop computers are equipped with either an internal or external modem to perform dial-up data applications across the landline telephone network (PSTN). On these computers, terminal emulator software or a dial-up networking connection can be configured to a specific modem with a phone number to dial, user identification and password. The modem can then be used to call another computer, a remote LAN or an Internet service provider as shown in Figure A2. The handshaking and protocols are established between the modems independent of the landline.

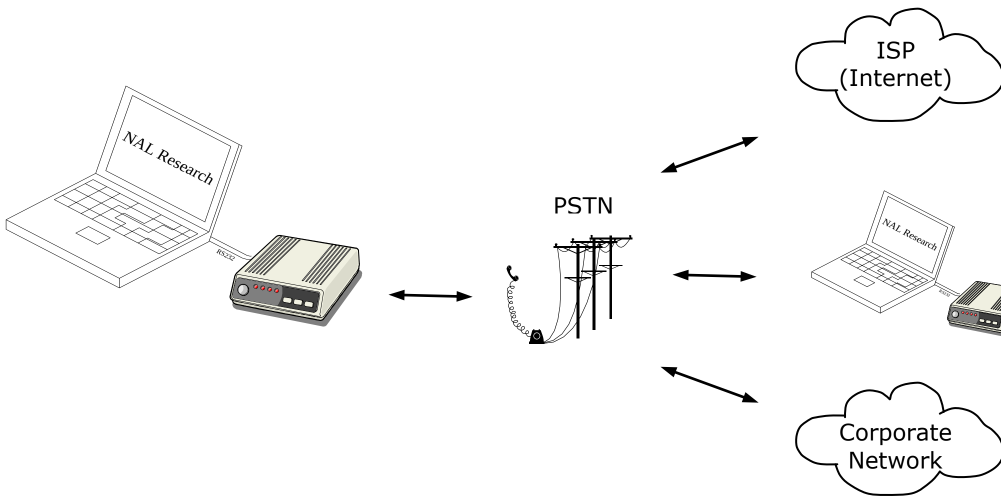


Figure A2. PSTN Dial-Up Connectivity.

The Iridium dial-up data service functions in much the same way as the PSTN dial-up connectivity. From the perspective of a computer, the Iridium modem is just another external modem. The only difference is that the dialed telephone number must conform to the international dialing pattern used by Iridium. When a data call is placed, the Iridium modem actually dials and initiates a connection with the Iridium gateway through the Iridium satellite constellation. Since the Iridium modem is requesting to establish a data connection, the switch at the gateway routes the call through another modem. The modem at the Iridium gateway then dials into and connects to another modem at the other end. Figure A3 illustrates how an Iridium dial-up data service call is routed. The handshaking and protocols established between the modems independent of the Iridium network.

For those ISU-to-ISU dial-up calls where data transmission delay is critical such as the application of TCP/IP protocol, DAV should be considered in the design. This option eliminates the Iridium gateway once authentication and registration is completed allowing ISU-to-ISU communication without the gateway in the loop.

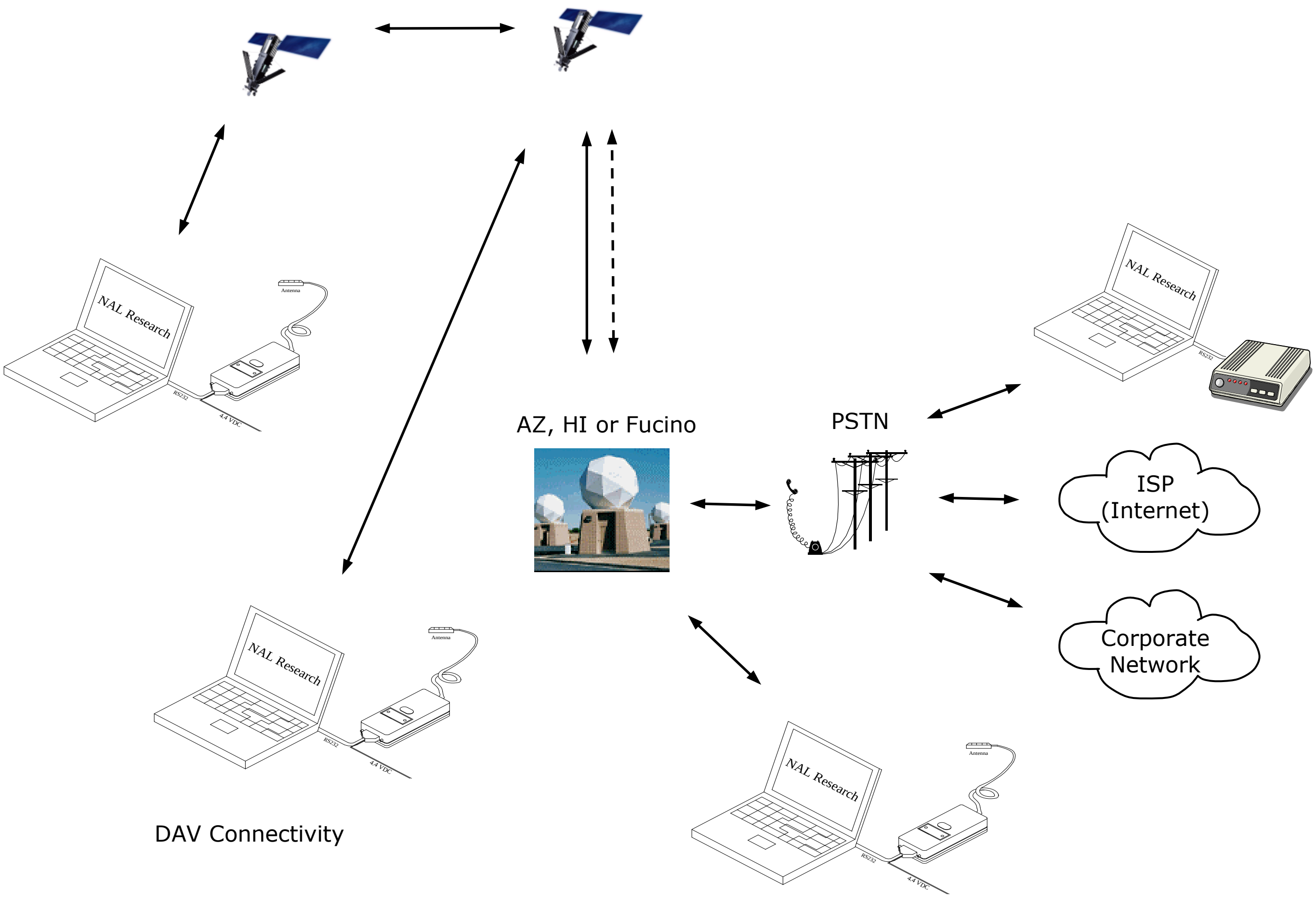


Figure A3. Iridium Dial-Up Data Service.

<u>A.4 Direct Internet Connection</u>

The Iridium Direct Internet service allows users to connect to the Internet via the Iridium gateway without having to sign up with an Internet service provider. This service utilizes a dedicated Apollo Server at the Iridium gateway, which provides high-speed connectivity to the Internet and optimizes server-to-Iridium modem communications. The dial-up networking setup is similar to the dial-up networking setup for landline telephone. The only difference is that the dialed telephone number is an international number provided by Iridium. Figure B3 illustrates how Iridium Internet (NIPRNet) call is routed.

Direct Internet service can be enhanced using Windows-based emulated point-to-point protocol (PPP) called the Apollo Emulator. With the use of the Apollo Emulator software instead of Microsoft Windows® dial-up networking, Direct Internet service can reduce connection time and improve data throughput. In addition, the Apollo Emulator offers a feature called Smart Connect™, which manages airtime by seamlessly connecting and disconnecting a user through the Iridium system. Airtime charges accumulate only while the call is connected. Improved effective data throughput is achieved through the use of user-transparent data compression. The channel rate is still 2.4 Kbps. However, 10 Kbps effective throughput can be achieved depending on content (graphics and images will result in lower effective throughput).

A.5 Short-Burst Data (SBD)

SBD is a simple and efficient bi-directional transport capability used to transfer messages with sizes ranging from zero (a mailbox check) to 1960 bytes. SBD takes advantage of signals within the existing air interface, without using the dedicated traffic channels. As a result, small amounts of data can be transferred more efficiently than those associated with circuit-switched data calls. Messages that originate from an Iridium modem can be delivered to a variety of destinations. Commonly, data are delivered across terrestrial communications networks (NIPRnet and Internet) to servers and applications that process data from one or multiple fielded Iridium modems. SBD service also supports the transfer of messages to Iridium modems, where messages may originate from terrestrial sources. Delivery methods and options are initially configured when the Iridium modem is first purchased and may be easily modified via web pages at a later time.

A.6 Short Messaging Service (SMS)

SMS is a mechanism to deliver short data messages over the Iridium satellite network to the NIPRNet/Internet. Iridium SMS service incorporates a subset of the GSM SMS features. Each SMS message can be up to 160 text characters (7-bit coded) in length. The text characters are based on a 7-bit alphabet, which is encoded and transmitted as 8-bit data, hence the 140 octet (byte) maximum message size.

SMS service is a store and forward method of transmitting messages to and from an Iridium modem. The short message from the modem is stored in a central Short Message Center (SMSC) which then forwards it to the destination. In the case that the recipient is not available, the SMSC will attempt to deliver the SMS until it is delivered or the validity period expires. SMS supports a limited confirmation of message delivery**.** The sender of the short message can request to receive a return message notifying them whether the short message has been delivered or not. With this option, the originator gets a confirmation that the message was delivered to the SMSC. Unlike standard GSM, the Iridium SMS can only acknowledge that the message was delivered to the SMSC and not the end-destination.

SMS messages can be sent and received simultaneously while a voice call is in progress. This is possible because SMS messages travel over and above the radio channel using the signaling path, whereas the voice call uses a dedicated "traffic" radio channel for the duration of the call.

A.7 RUDICS

RUDICS is an enhanced gateway termination and origination capability for circuit switched data calls across the Iridium satellite network. When an Iridium modem places a call to the RUDICS Server located at the Iridium Gateway, the RUDICS Server connects the call to a pre-defined IP address allowing an end-to-end IP connection between the Host Application and the Iridium modem. There are three key benefits of using RUDICS over the conventional PSTN circuit switched data connectivity or mobile-to-mobile data solutions: (1) elimination of analog modem training time, (2) increased call connection quality, reliability, and maximized throughput and (3) protocol independence.

A.8 Iridium Geo-Location

The Iridium network makes calculations of the geographical location (geo-location) of an ISU each time a call is placed. The technique employed to determine the geo-location of an ISU is based on measurements of the ISU and satellite propagation delay and Doppler frequency shift. These measurements are used to estimate cosines of spherical angles that identify the ISU's location relative to the satellite by the gateway.

The Iridium network can locate an ISU to within 10 km only about 78% of the time. The so-called error ellipse can have a large eccentricity with the major axis oriented in the azimuth dimension and the minor axis oriented in the radial dimension. The position of the ISU in the radial dimension relative to the satellite can almost always be determined to within 10 km with just one measurement. Errors in the azimuth dimension relative to the satellite are largest along the satellite's ground path and tend to increase with distance from the satellite. Geo-location errors in the east-west dimension, therefore, are sometimes more than 100 times greater than in the north-south dimension.

APPENDIX B: STANDARDS COMPLIANCE

The 9522B L-band transceiver is designed to comply with the standards for Radio Emissions Compliance, Electromagnetic Compatibility, and AC Safety in the United States, European Union and Canada assuming an antenna with a gain of ~3dBi.

FCC Compliance: The 9522B is certified under 47 CFR Part 25 as FCC ID: Q639522B. It also complies with Part 15 of the FCC Regulations. Operation is subject to the condition that this device does not cause harmful interference. Any changes or modifications, including the use of a non-standard antenna, not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CE Compliance: The 9522B, when marked with the CE symbol, complies with the European Community Council Directive for R&TTE, 99/5/EC, provided that the integrator/user adheres to the instructions detailed in this LBT Interface Specification. This product is in compliance with applicable ETSI standards. Compliance with the requirements of ETSI EN 301 489 requires the use of a shielded digital data interface cable.

Industry Canada: The 9522B is compliant with Industry Canada RSS-102 for RF Exposure.

IMPORTANT: To comply with FCC RF exposure experiments, a minimum separation of 20 cm is required between the antenna and all persons.

APPENDIX C: EXPORT COMPLIANCE INFORMATION

The A3LA-X is controlled by the export laws and regulations of the United States of America (U.S.). It is the policy of NAL Research to fully comply with all U.S. export and economic sanction laws and regulations. The export of NAL Research products, services, hardware, software and technology must be made only in accordance with the laws, regulations and licensing requirements of the U.S. Government. NAL Research customers must also comply with these laws and regulations. Failure to comply can result in the imposition of fines and penalties, the loss of export privileges, and termination of your contractual agreements with NAL Research.

The export and re-export of NAL Research products and services are subject to regulation by the Export Administration Regulations (15 CFR 730-744), as administered by the U.S. Department of Commerce, Bureau of Industry and Security ("BIS"). See: http://www.bxa.doc.gov for further information on BIS and the Export Administration Regulations (EAR). Additional export restrictions are administered by the U.S. Department of the Treasury's Office of Foreign Asset Controls ("OFAC"). See: http://www.ustreas.gov/ofac for further information on OFAC and its requirements.

National
Technical
Systems

36 Gilbert Street South
Tinton Falls, NJ 07701
Tel: (732) 936-0800
Fax: (732) 936-0700

24 June 2009

CERTIFICATE OF COMPLIANCE

June 24, 2009

Customer: NAL Research Corporation
9300 West Courthouse Road
Suite 102
Manassas, VA 20110

Purchase Order #: 1377
NTS MJO #: 41382-09

Test Items:

Item #	Qty	Description	Model #	IMEI #
1	1	Iridium Satellite Modem	A3LA-XG	300025010203980
1	1	Iridium Satellite Modem	A3LA-X	300025010203980
1	1	Iridium Satellite Modem	A3LA-XM	300025010203980
1	1	Iridium Satellite Modem	A3LA-XGS	300025010203980

Test Specifications:

NAL Research Corporation Purchase Order No. 1377 dated 2/27/09
MIL-STD-810F, Department of Defense, Test Method Standard for Environmental Engineering Considerations and Laboratory Tests dated 1 January 2000.

Test Performed	Results
High/Low Temperature and Humidity Operational Method 505.4	Pass
High Temperature Method 501.4 Procedure I	Pass
Altitude Method 500.4	Pass
Relative Humidity Method 507.4 Procedure 2	Pass
Blowing Rain Method 506.4	Pass
Shock Non-Operating Method 516.5	Pass
Sand and Dust Method 510.4	Pass
Salt Fog Method 509.4 Procedure I	Pass

National Technical Systems (NTS) certifies that the above referenced item(s) has/have been tested in accordance with the above Requirements set forth in the above referenced documents.

David J Potpinka

David Potpinka
NTS Quality Manager

Mark Betts

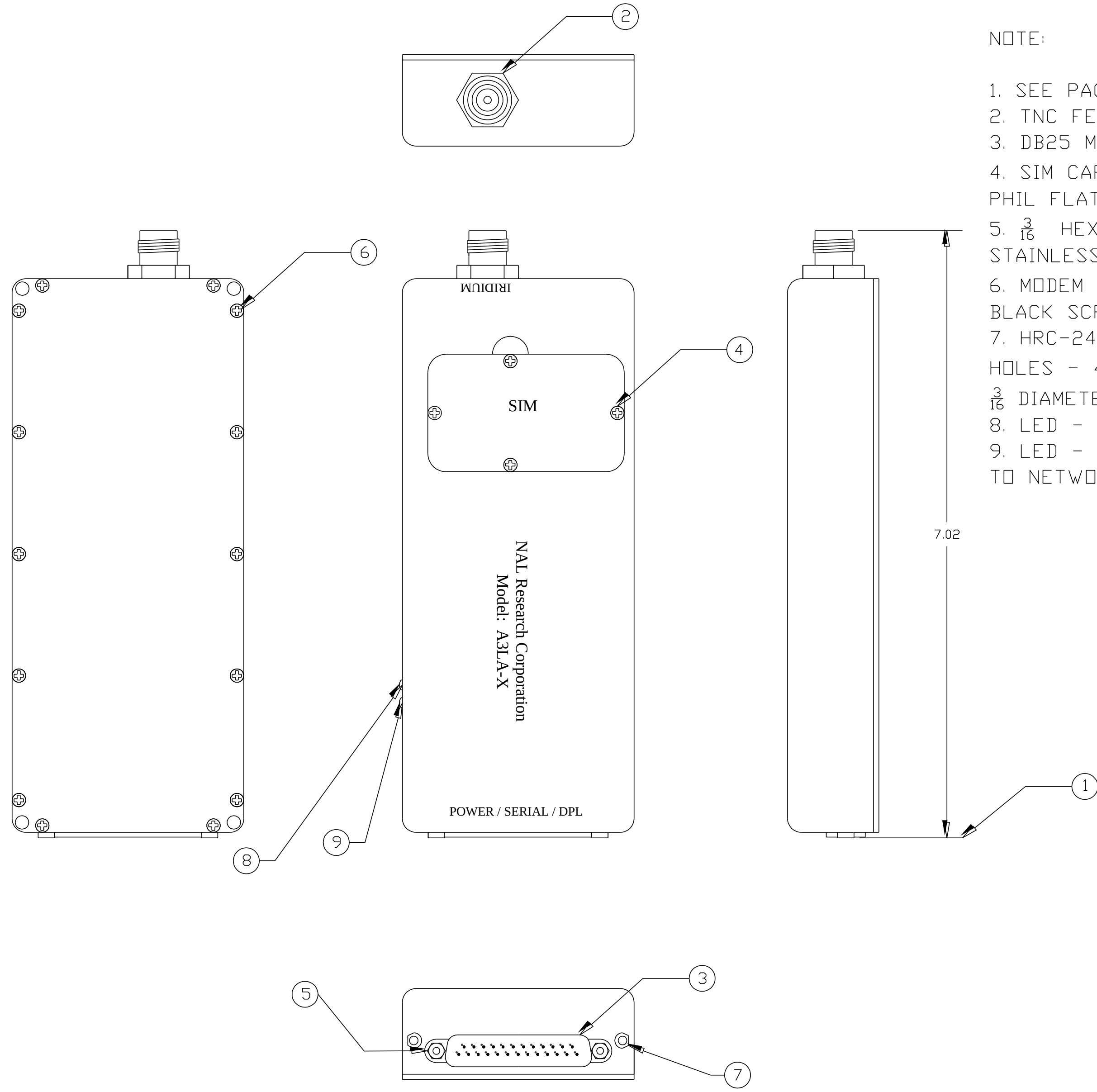
Mark Betts
NTS Project Manager

DWG. NO. 92343 SH. 1 REV. A

DWG REV	A
BD REV	
A/W REV	

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
		FINAL RELEASE	02/13/09	NTH



NOTE:

1. SEE PAGE 2 AND PAGE 3 FOR DIMENSIONS
2. TNC FEMALE IRIDIUM ANTENNA CONNECTOR
3. DB25 MALE POWER / SERIAL CONNECTOR
4. SIM CARD READER DOOR SCREWS - 2-56 × $\frac{3}{16}$ PHIL FLAT BLACK SCRWS- QTY = 4
5. $\frac{3}{16}$ HEX 4-40 × $\frac{1}{4}$ MALE / FEMALE (JACK SCREWS) STAINLESS STEEL SCREWS - QTY = 2
6. MODEM COVER SCREWS 2-56 × $\frac{3}{16}$ PHIL FLAT BLACK SCREWS - QTY = 14
7. HRC-24-7X/XU & HRC-24-8X/XU ATTACHMENT HOLES - 4-40 × $\frac{3}{16}$ - QTY = 2; COUNTER BORE $\frac{3}{16}$ DIAMETER × $\frac{1}{40}$ DEPTH
8. LED - "P": ILLUMINATES WHEN POWER IS SUPPLIED
9. LED - "I": ILLUMINATES WHEN MODEM IS CONNECTED TO NETWORK

DWG. NO. 92343 SH. 1 REV. A

APPENDIX E: MECHANICAL DRAWINGS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ± DECIMALS .xx ± .01" .xxx ± .005" ANGLES ±
MATERIAL
FINISH

CONTRACT NO.

APPROVALS		DATE
DESIGNER	M. MARKOS	02/13/09
CHECKER	H. CHARLES FILE	02/13/09
PROJ. ENG.	EAC	
APPROVED	N. HOANG FILE	02/13/09

NAL RESEARCH CORP.

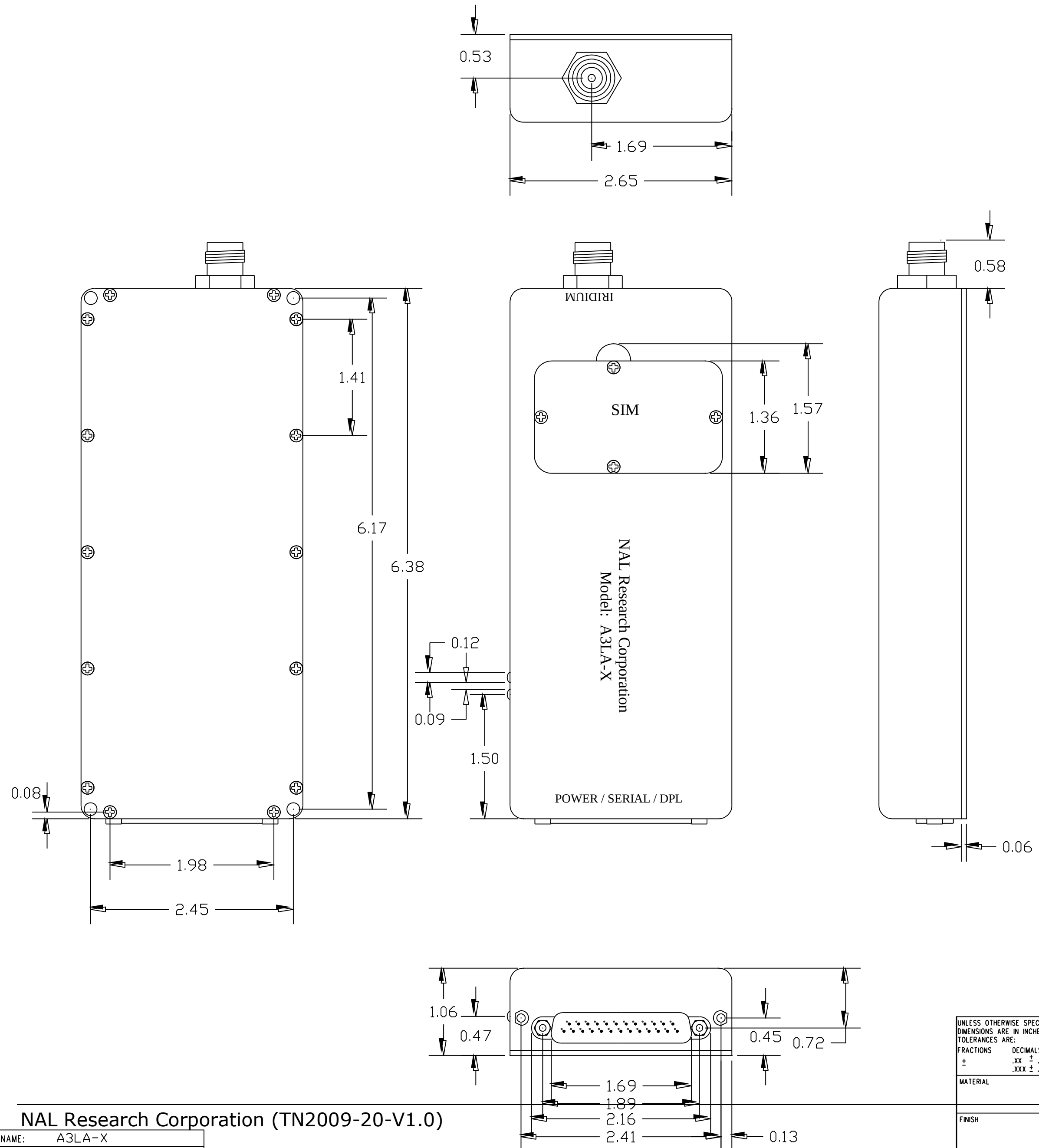
DRAWING NAME A3LA-X

SIZE C | CAGE CODE | DWG NO. 92343 | REV A
SCALE | SHEET 1 of 4

CAD DRAWING FILE NAME: A3LA-X
CAD GENERATED DRAWING, MANUAL CHANGES NOT ALLOWED

DWG REV	A														

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
		FINAL RELEASE	02/13/09	NTH



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .01" .XXX ± .005" ANGLES ±

CONTRACT NO.			NAL RESEARCH CORP.
APPROVALS		DATE	DRAWING NAME
DESIGNER	M. MARKOS	02/13/09	A3LA-X
CHECKER	H. CHARLES FILE	02/13/09	C CAGE CODE DWG NO. 92343 REV A
PROJ. ENG.	EAC		
APPROVED	N. HOANG FILE	02/13/09	SCALE SHEET 2 of 4

MATERIAL

FINISH

CAD DRAWING FILE NAME: A3LA-X

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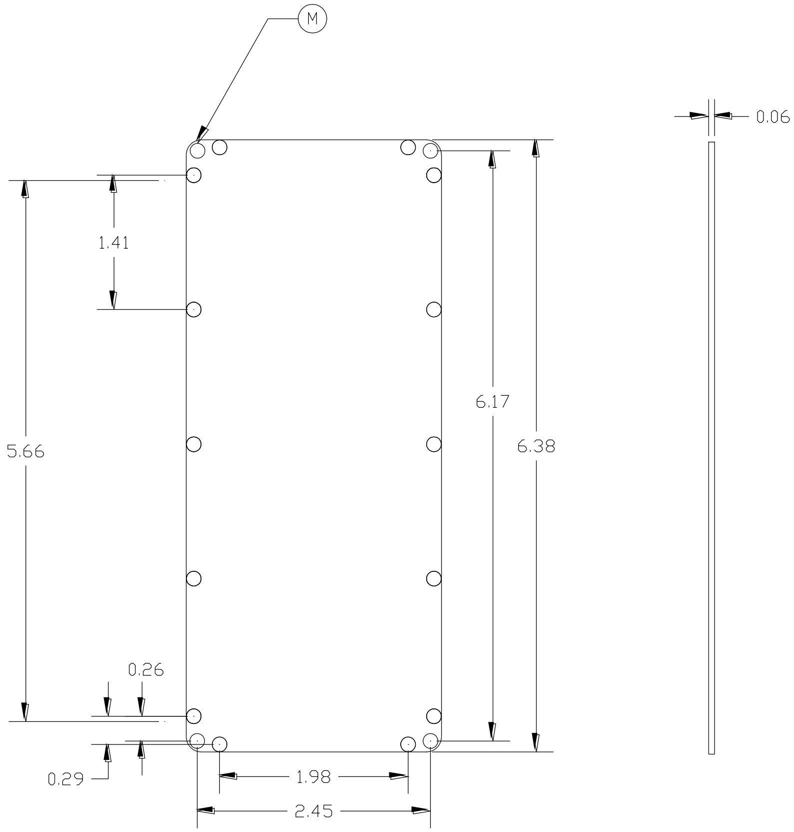
DWG. NO. 92343 SH. 3 REV. A

DWG REV	A
BD REV	
A/W RFV	

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
		FINAL RELEASE	02/13/09	NTH



NOTE:

M = MOUNTING HOLES - QTY = 4
THREADED FOR 6-32 SCRWS
DEPTH = 0.22 INCHES INTO THE MODEM

DWG. NO. 92343 SH. 3 REV. A

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .01" .XXX ± .005" ANGLES ±

MATERIAL

FINISH

CONTRACT NO.

APPROVALS		DATE
DESIGNER	M. MARKOS	02/13/09
CHECKER	H. CHARLES FILE	02/13/09
PROJ. ENG.	EAC	
APPROVED	N. HOANG FILE	02/13/09

NAL RESEARCH CORP.

DRAWING NAME

A3LA-X

SIZE C CAGE CODE DWG NO. 92343 REV A

SCALE SHEET 3 of 4

CAD DRAWING FILE NAME: A3LA-X

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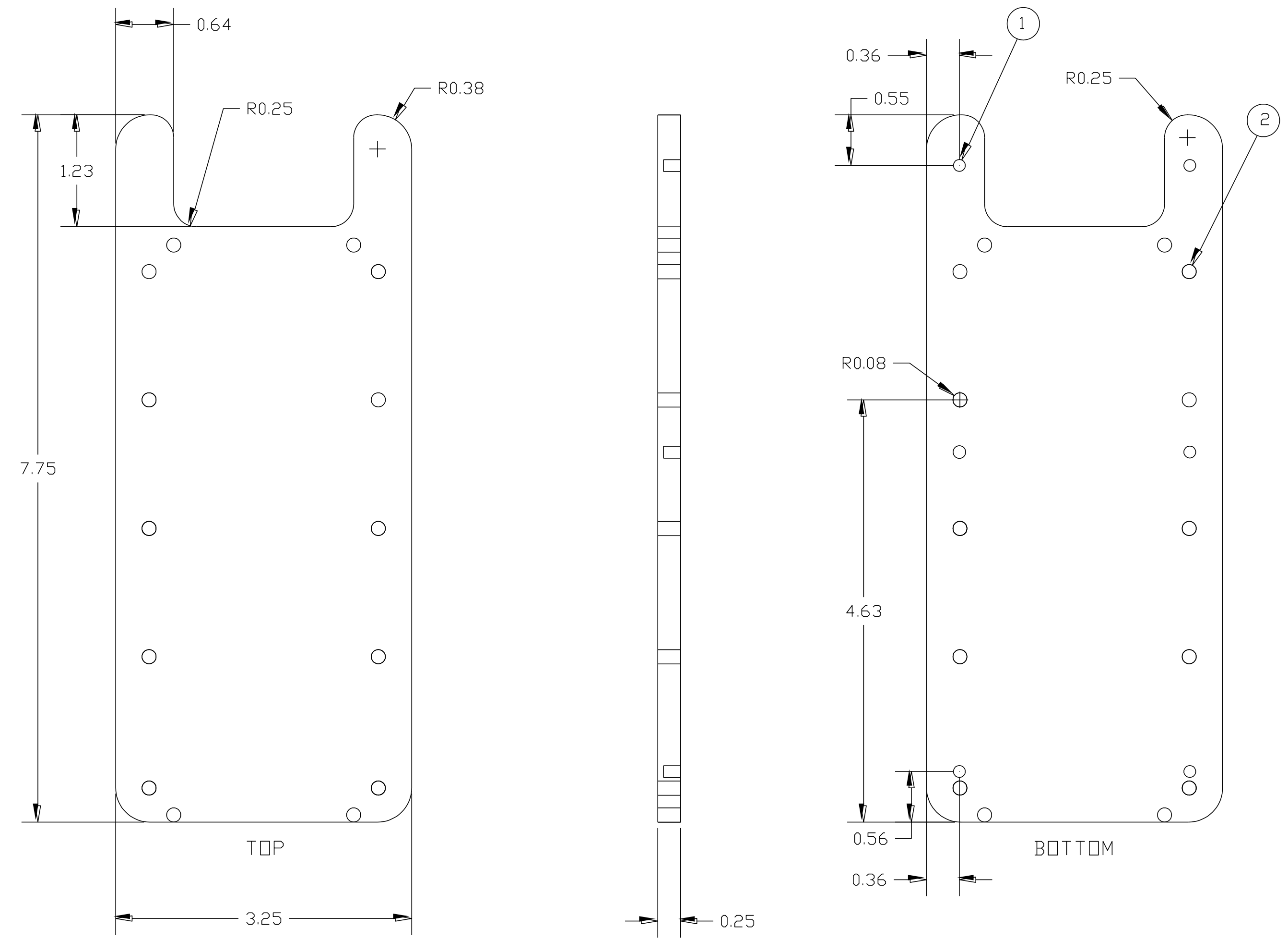
DWG. NO. 92343	SH. 4	REV. A

DWG REV	A																	
BD REV																		
A/W REV																		

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
		FINAL RELEASE	02/13/09	NTH



NOTES:

1) CHASSIS MOUNTING HOLES, THREAD TYPE: 6-32 x 3/16 LONG (X 6)
2) MOUNTING PLATE ATTACHMENT SCREWS: 2-56 x 3/8 LONG (X14)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .01" .XXX ± .005" ANGLES ±	CONTRACT NO.		NAL RESEARCH CORP.		
MATERIAL	APPROVALS	DATE	DRAWING NAME A3LA-X		
	DESIGNER M. MARKOS	02/13/09			
FINISH	CHECKER H. CHARLES	02/13/09	C	CAGE CODE	DWG NO. 92343 / REV A
	PROJ. ENG. EAC				
	APPROVED N. HOANG	02/13/09	SCALE		SHEET 4 of 4

CAD DRAWING FILE NAME: A3LA-X

CAD GENERATED DRAWING. MANUAL CHANGES NOT ALLOWED

DWG. NO. 92343 SH. 4 REV. A