# GENERAL DESCRIPTION OF MODEL 9603-I

Version 1.0

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# GLOSSARY

| | |
|---|---|
| BIS | Bureau of Industry and Security |
| CE | Conformite Europeene |
| DoD EMSS | DoD Enhanced Mobile Satellite Services |
| DTE | Data Terminal Equipment |
| FDMA | Frequency Division Multiple Access |
| MO-SBD | Mobile-Originated SBD |
| MT-SBD | Mobile-Terminated SBD |
| OFAC | Office of Foreign Asset Controls |
| RHCP | Right Hand Circular Polarization |
| RX | Receiving |
| SBD | Short Burst Data |
| SIM | Subscriber Identity Module |
| 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 Iridium modem 9603-I. The 9603-I is a single board transceiver allowing short-burst data (SBD) connectivity to the Iridium satellite network. It does not support voice, circuit switched data, or short message service (SMS). It is intended to be used as a daughterboard fitted on another host system motherboard via *surface mount* multi-pin connector and antenna connector. The 9603-I can be controlled by a data terminal equipment (DTE) capable of sending standard AT commands via serial interface at 3.3V digital signal levels. Level shifters are required when connected to a standard RS232 serial port. NAL Research can enable the 9603-I to utilize either the Iridium commercial gateway at Tempe, Arizona or the US DoD EMSS Gateway when requested by an authorized user. Key features of the 9603-I include:

- Supports SBD only
- Does not incorporate nor need a SIM card to operate
- Has an automatic notification indicating a message is queued at the gateway
- Offers a maximum mobile originated (MO) message size of 340 bytes
- Offers a maximum mobile terminated (MT) message size of 270 bytes

**IMPORTANT:** EMSS-enabled 9603-I must first be provisioned (signed up for airtime) with EMSS SBD Service before testing or field use. Accessing the US DoD EMSS Gateway is not authorized until the 9603-I is provisioned. Unauthorized attempts to access the DoD EMSS Gateway will result in immediate disabling of the offending device, which must then be returned to NAL Research for repair. See https://sbd.pac.disa.mil for more information regarding EMSS service provisioning.

**IMPORTANT:** User should not disassemble the 9603-I for repair or services. The warranty is voided if the 9603-I is disassembled. It should be returned to NAL Research for any services.

## 2.0 SPECIFICATIONS

### 2.1 Mechanical Specifications

| | |
|---|---|
| Dimensions: | 1.24” x 1.17” x 0.32” (31.5 mm x 29.6 mm x 8.1 mm) |
| Weight (approximately): | 0.40 oz (11.4 g) |
| Multi-Interface Connector: | Samtec ST4-10-2.5-L-D |
| Iridium Antenna: | Hirose U.FL-R-SMT-1 |
| Enclosure: | EMI shielding |

**NOTE:** The mechanical drawing of the 9603-I can be found in Appendix A including part numbers for the interface connectors for both data and RF.

### 2.2 RF Specifications

| | |
|---|---|
| Operating Frequency: | 1616 to 1626.5 MHz |
| Duplexing Method: | TDD |
| Input/Output Impedance: | 50 Ω |
| Multiplexing Method: | TDMA/FDMA |

## 2.3 Radio Characteristics

| | |
|---|---|
| Average Power during a Transmit Slot (Max): | 1.6W |
| Receiver Sensitivity at 50 Ω (Typical): | –117 dBm |
| Maximum Cable Loss Permitted: | 3dB |
| Link Margin – Downlink: | 13dB |
| Link Margin – Uplink: | 7dB |

**NOTE:** Cable loss should be kept at a minimum. The total implementation loss for an antenna, connectors, cable, lightening arrestor and any other RF component between the 9603-I and the antenna should not exceed 3dB. The total cable loss between the antenna and the 9603-I includes losses in the motherboard. Implementation loss higher than this will affect the Iridium link performance and quality of service. Solutions with a loss higher than 3dB will not meet the requirements of Iridium solution certification.

## 2.4 Electrical Specifications

| | |
|---|---|
| Input Voltage Range: | +5.0VDC ±0.2V |
| Main Input Voltage Ripple: | < 40mV peak-to-peak |
| Idle Current (Average): | 45mA |
| Idle Current (Peak): | 195mA |
| Transmit Current (Average): | 190mA |
| Transmit Current (Peak): | 1.5A |
| Receive Current (Average): | 45mA |
| Receive Current (Peak): | 195mA |
| SBD Message Transfer Current (Average): | 190mA |
| SBD Message Transfer Power (Average): | <= 1.0W |

**NOTE:** The power requirements apply to DC power measured at the 9603-I multi-interface connector input. The average power consumption may vary depending on the field-of-view between the 9603-I antenna and the Iridium satellite.

## 2.5 Environmental Specifications

| | |
|---|---|
| Operating Temperature Range: | –22°F to +158°F (–30°C to +70°C) |
| Operating Humidity Range: | < 75% RH |
| Storage Temperature Range: | –40°F to +185°F (–40°C to +85°C) |
| Storage Humidity Range: | < 93% RH |

## 2.6 Data I/O Specifications

| | |
|---|---|
| Short-Burst Data: | 340 bytes for Mobile-Originated |
| Short-Burst Data: | 270 bytes for Mobil-Terminated |
| Hardware Interface: | Serial at 3.3V Digital Signals |
| Software Interface: | Standard AT Commands |

## 2.7 Reference Documents

9603-I Product Information

General Description of Model 9603-I (TN2012-50-V1.0)

AT Commands for Models 9603 (TN2012-51-V1.1)

SatTerm Software Manual (TN2012-004-V8.5.1)

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

Additional Information on SBD (AN2012-04-V4.0)

## 3.0 MECHANICAL INTERFACES

The 9603-I is intended to be used as a daughterboard fitted within an enclosed host system (see Figure 1). With appropriate external connectors and housing designs, the integrated system can meet full transceiver regulatory tests. The 9603-I is provided with two mounting holes on the opposite side from the multi-interface connector. The 9603-I should be assembled onto the motherboard of the host system by pushing the module onto matching connectors on the motherboard and then securing the mounting holes to the motherboard using mechanical fasteners. The 9603-I incorporates two different connectors—a multi-interface connector and an RF Iridium antenna connector.

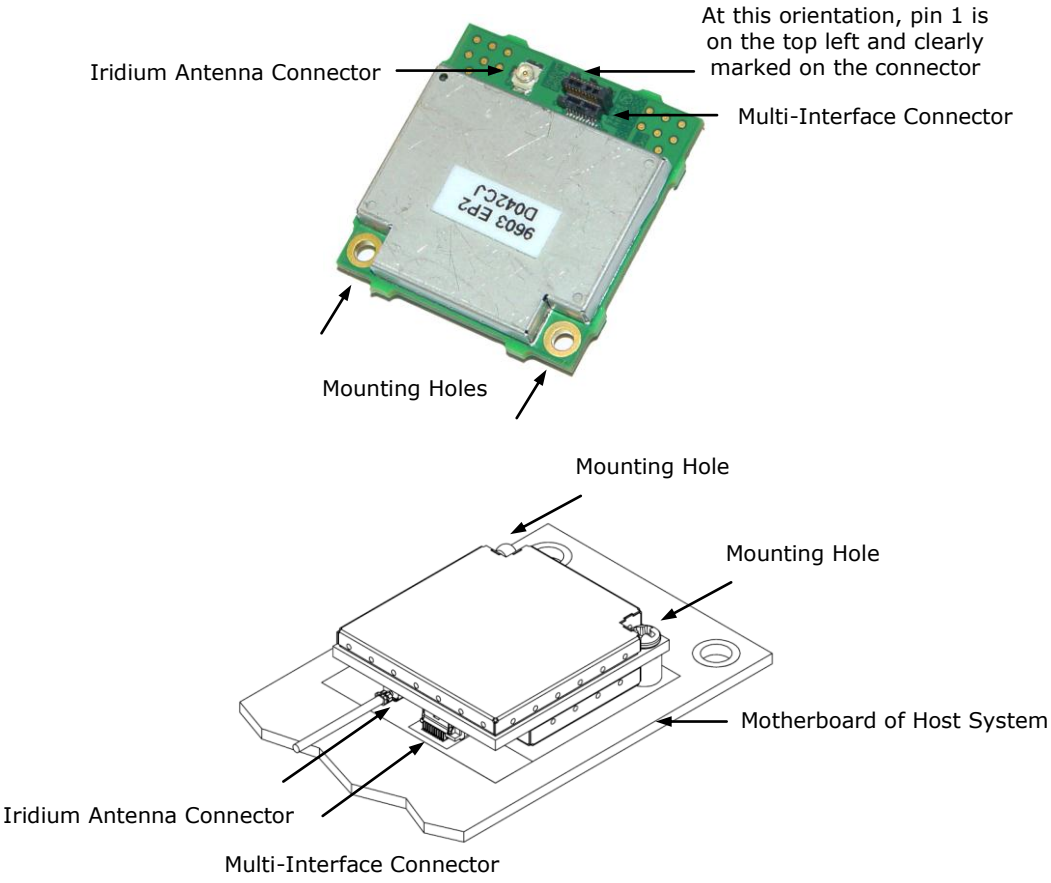


**Figure 1.** Recommended mounting for the 9603-I transceiver.

Two mounting options can be implemented to fasten the 9603-I onto a motherboard as shown in Figure 2. One option is to use 2-56 x 7/16” pan head screws (McMaster part number 90272A080), locknuts and

spacers (McMaster part number 94669A100). The second option is to use snapped-on standoffs, which can be found in Pingood catalog (www.pingood.com.tw).

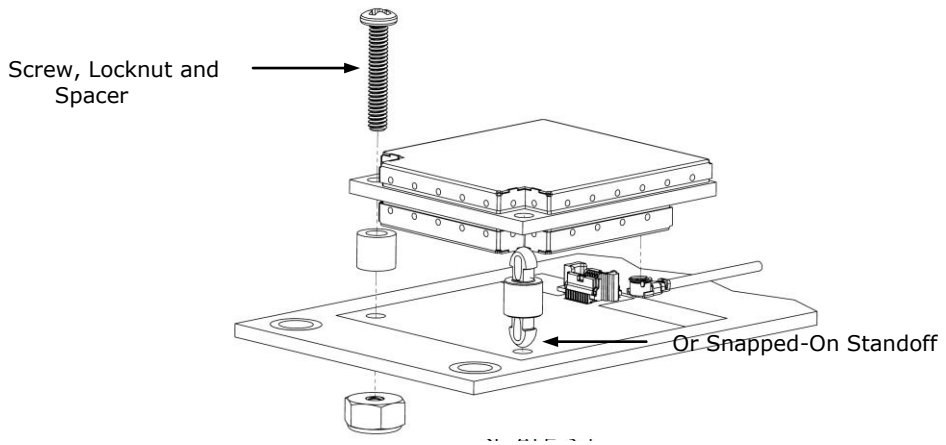


**Figure 2.** Mounting options for the 9603-I transceiver.

## 4.0 MULTI-INTERFACE CONNECTOR

The multi-interface connector is a Samtec low-profile header part number ST4-10-2.5-L-D. This connector provides the ability for a stackable board-to-board configuration allowing the mating to a host system motherboard. A suitable mating motherboard socket is the Samtec SS4-10-3.00-L-D. The multi-interface connector provides the following connections to the 9603-I modules: DC power input, power on/off control, serial data interface, network availability output and supply power indicator output. Individual pin assignments are summarized in Table 1 and the limits for the digital signals are listed in Table 2. Pin 1 is clearly marked on the Samtec connector. Multiple power lines are provided and ALL are required to be connected to the power source in order to limit the current on any one pin. Multiple signal grounds are provided to reduce cross-talk.

| PIN # | SIGNAL | DESCRIPTION | INTERFACE |
|---|---|---|---|
| 1 | EXT_PWR | External DC Power Input | +5.0VDC ±0.2V |
| 2 | EXT_PWR | External DC Power Input | +5.0VDC ±0.2V |
| 3 | EXT_GND | External GND Input | 0V |
| 4 | EXT_GND | External GND Input | 0V |
| 5 | ON/OFF | ON/OFF Control Input; ON>=2.0V; OFF<=0.5V | Analog |
| 6 | S_TX | Serial Transmit Data Input | 3.3V Digital |
| 7 | S_RX | Serial Receive Data Output | 3.3V Digital |
| 8 | SIG_GND | Signal Ground, 0V Signal Reference and Return | 0V |
| 9 | DCD | Serial Data Carrier Detect Output | 3.3V Digital |
| 10 | DSR | Serial Data Set Ready Output | 3.3V Digital |
| 11 | CTS | Serial Clear To Send Output | 3.3V Digital |
| 12 | RI | Serial Ring Indicator Output | 3.3V Digital |

| | | | |
|---|---|---|---|
| 13 | RTS | Serial Request To Send Input | 3.3V Digital |
| 14 | DTR | Serial Data Terminal Ready Input | 3.3V Digital |
| 15 | SIG_GND | Signal Ground, 0V Signal Reference and Return | 0V |
| 16 | Reserved | Reserved | Reserved |
| 17 | Reserved | Reserved | Reserved |
| 18 | SIG_GND | Signal Ground, 0V Signal Reference and Return | 0V |
| 19 | NET AVAIL | Network Availability; Avail=High, Not Avail=Low | 3.3V Digital |
| 20 | SUPPLY_OUT | Supply Power Indicator Output | +3.3V, 5mA Max. |

**Table 1.** Pin assignments for the multi-interface connector.

| PARAMETER | SYMBOL | MIN | MAX | UNIT |
|---|---|---|---|---|
| Input High Voltage | VIH | 2.0 | 5.5 | V |
| Input Low Voltage | VIL | –0.3 | 0.8 | V |
| Output High Voltage | VOH | 2.4 | | V |
| Output Low Voltage | VOL | | 0.4 | V |
| Low Level Output Current | IOL | | 4.4 | mA |
| High Level Output Current | IOH | | 5.5 | mA |

**Table 2.** Limits for 3.3V digital signals.

4.1 Serial Data Interface (9-Wire Configuration)

The 9603-I supports a standard serial data interface to a host system DTE incorporating hardware handshaking and flow control. The serial data interface comprises of eight 3.3V digital signals and a ground signal as shown in Table 1. Level shifters are required if the serial interface to the DTE is an RS232. The serial interface allows a connected DTE to utilize the 9603-I's functionality through AT commands. Note that the ring indicator is used by the 9603-I to indicate that a mobile-terminated SBD (MT-SBD) message is queued at the gateway. The DTE can monitor this pin and use appropriate AT commands to retrieve the MT-SBD message. The 9603-I does not support autobaud. The baud rate must be set using the AT+IPR command. The default factory-set baud rate is 19.2 kbits/sec.

4.2 Serial Data Interface (3-Wire Configuration)

By default, the 9603-I's serial interface operates as a 9-wire connection and it is a recommended configuration. However, the 9603-I may also be operated with a 3-wire connection, where only transmit, receive and ground signals are used with no flow control. Several steps must be taken to allow 3-wire configuration. These steps ensure the 9603-I and DTE to work together without having hardware handshaking.

1. AT&Dn must be set to AT&D0 to ignore the DTR input
2. AT&Kn must be set to AT&K0 to disable RTS/CTS flow control
3. The other output signals may be connected and operate as follows:
    a. CTS driven ON (low)
    b. DSR operates as normal
    c. RI operates as normal
    d. DCD driven ON (low)

Note that RTS/CTS flow control, when enabled, is only used when the data port is in SBD data mode. In AT command mode, RTS is ignored and CTS is driven ON (low). Moreover, if the DC input to the 9603-I is to be disconnected, user will need to "tri-state" the serial interface to prevent a possible latch-up condition.

### 4.3 DC Power Interface

DC power interface comprises of the DC power inputs and a control signal as summarized in Table 1. The +5V inputs and 0V supply returns are used to supply DC power to the 9603-I and to ensure that enough current can be drawn across the connector without the 9603-I malfunctioning during an SBD transmit due to lack of current supply. Note that all power and ground pins should be connected externally.

DC power supply requirements for the 9603-I must guarantee the followings:

- The supply voltage drop over for a 8.3msec burst of 1.5A current should not be more than 0.2V.
- The power supply should limit the in-rush current to 4A maximum. If current exceeds this value damage can occur to the 9603-I.
- The power supply should provide for over current protection in case of device malfunction.
- The supply noise should be less than the limits in the following profile:

| | |
|---|---|
| 100mV peak-to-peak | from 0 to 50kHz |
| 5mV peak-to-peak | at 1MHz measured in 50kHz bandwidth |
| 10mV peak-to-peak | at 1MHz measured in 1MHz bandwidth |
| 5mV peak-to-peak | above 5MHz measured in 1MHz bandwidth |

### 4.4 Power On/Off Control

An external on/off input is provided on pin#5 of the multi-interface connector. The 9603-I starts up when power is applied and pin#5 input is high. As long as the input voltage is applied, logic high on this pin turns the 9603-I on and a logic low turns it off. If controlling pin#5 is not required then it must be connected directly to the +5 V supply. Note that this on/off control is similar to the 9602 products.

Prior to turning off the 9603-I a "flush memory" (AT*F) command should be issued to ensure all memory write activity is completed. When a 9603-I has been turned off, users should not reapply power on a unit until more than 2 seconds has elapsed after power has reached 0V. Additionally, if a unit does not respond to AT commands, power off the module, wait for 2 seconds and then power it back on. When a 9603-I is powered off the power on reset circuit requires 2 seconds for voltages to decay. If the 2 second wait time is not adhered to the reset circuit may not operate and the 9603-I could be placed in a non-operational state. The state is not permanent and can be rectified by the above procedure.

### 4.5 DC Supply Indicator Output

A DC supply indicator signal is provided by the 9603-I on pin#20, which could be used directly for driving an LED to provide a visible indication that the 9603-I supply is on. Alternatively the output signal could be used in application logic to determine if the internal 9603-I power supply is on.

### 4.6 Network Availability Output

The digital output of pin#19 can be used to determine when the 9603-I has visibility to the Iridium satellite network or the Iridium network is "available". Network Available means only that the 9603-I can successfully receive the Ring Channel, or, put more simply, it can see an Iridium satellite. Network Available is not a guarantee that a message can be successfully sent. The Network Available state is evaluated every

time the Ring Channel is received or missed. If the Ring Channel is visible, then it is updated every 4 seconds. If the Ring Channel is not currently visible, then the update period can be as long as 2 minutes, depending on how long the lack of satellite visibility existed. This is because the 9603-I attempts to conserve power by increasing the ring search interval while the satellites are not visible. Every time a ring search fails, the time to wait is increased and eventually limits at 120 seconds. The wait time between search windows is reset to 4 seconds every time a search succeeds.

If Network Available is currently off, user may still attempt an SBDI[X] session. This will force the 9603-I to look for the Ring Channel immediately, and on finding it, to attempt to send the message. In this case Network Available will not come on immediately. The Network Available does not turn on while in a +SBDI session. It will, however, turn on 4 seconds later assuming that the Ring Channel is present. After the SBD session completes, the 9603-I performs a new Ring Channel search sequence, at the end of which Network Available gets turned on. That can take between 4 and 12 seconds. If the +SBDI attempt fails to find the ring channel, the search window does not reset to 4 seconds. Note that the behavior of +CIEV:1 is identical in to that of the Network Available output.

### 4.7 S-Meter Performance

The S-meter readings reported over the AT command interface indicate the signal strength of a 9603-I. Care should be taken when using the S-meter readings for comparisons between devices. Of particular note are the followings:

1. There is a 0.5 dB tolerance on calibrating the S-meter.
2. Each signal strength bar represents a 2 dB increment.
3. Multiple ring channels can be present at the same time so units can lock to different signals.
4. If the reading is near the decision threshold it would be easy to see a 1 bar difference

## 5.0 IRIDIUM ANTENNA CONNECTOR

The 9603-I uses a single Hirose U.FL connector for both transmit and receive of Iridium signals. The mating connector can be any U.FL compatible connector readily available from a range of manufacturers. The RF connector on the 9603-I is intended for an inter-board connection to the host system motherboard and should not be directly connected to an external antenna cable or cable distribution system. Paragraph 7.3 of EN60950-1:2006 safety standard requires that users are protected against high voltages that might appear on these cables. This can be achieved either by inserting a high-voltage isolating capacitor in series with the signal or by grounding the shield of the coaxial cable. The 9603-I RF connector has limited voltage capacity and; therefore, protection needs to be provided in the host application. Developers are encouraged to review the EN60950-1:2006 standard for additional details.

The 9603-I should be connected to an Iridium-band antenna with the following characteristics.

| PARAMETER | VALUE |
|---|---|
| Input/Output Impedance | 50 Ω nominal |
| Gain (maximum) | 3 dBi |
| Polarization | RHCP |
| VSWR (1616 to 1626.5MHz) | 1.5 to 1 |
| VSWR (1.2GHz to 2.0GHz) | 3 to 1 |

## 6.0 MODES OF OPERATIONS

The serial interface between the 9603-I and a host system DTE is always in one of three modes: command mode, SBD data mode or SBD session mode. When the data port is in command mode, AT commands can be entered to control the 9603-I. In command mode, flow control has no effect, with the RTS input ignored and the CTS output driven ON (low). When in SBD data mode, the 9603-I is transferring binary or text SBD message data to or from the DTE.

In SBD data mode:

- All characters from the DTE not forming part of the message data are ignored (i.e. no AT commands may be entered).
- No unsolicited result codes are issued.
- RTS/CTS flow control, if enabled, is active. When RTS is OFF (high), the 9603-I suspends transfer of data to the DTE; when CTS is OFF (high), the 9603-I expects the DTE to suspend transfer of data to the 9603-I.

When in SBD session mode, the 9603-I is attempting to conduct an SBD session with the Iridium network. In SBD session mode:

- The DTE must wait for the +SBDI [X][A] session result code.
- All characters from the DTE are ignored.
- Unsolicited result codes are issued where those codes have been enabled.

Transitions between the modes of operation are performed automatically by the 9603-I in response to the SBD AT commands; the DTE has no other control over the mode.

## 7.0 HARDWARE FAILURE REPORTING

If the 9603-I detects a hardware problem during initialization, it may not be able to function. Under such case, the 9603-I will notify the DTE by issuing an unsolicited result code at the end of initialization:

HARDWARE FAILURE: <subsys>,<error>

where <subsys> identifies the software subsystem that detected the error, and <error> is the subsystem-specific error code. Any AT commands that cannot be handled in the failure condition will terminate with result code 4 (“ERROR”).

## 8.0 TECHNICAL SUPPORT

**FOR TECHNICAL SUPPORT, PLEASE CONTACT US AT**

Phone: 703-392-1136
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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

| DWG. NO. | SHEET | REV. |
|---|---|---|
| 92371 | 1 | 1.0 |

| REVISIONS | | | | |
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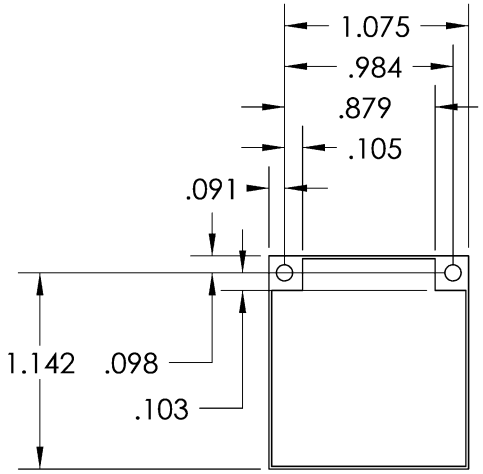
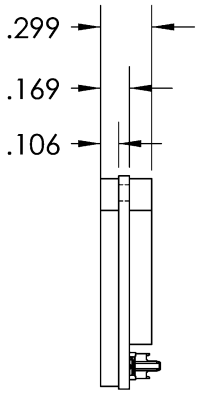
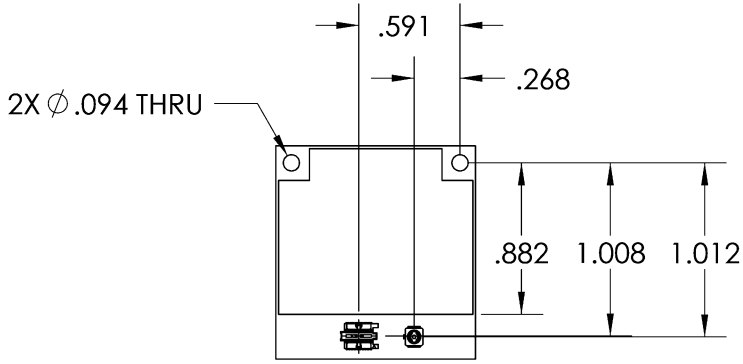
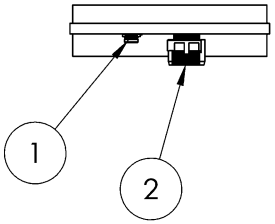
| ZONE | REV. | DESCRIPTION | DATE | APPROVED |
| | 1.0 | INITIAL RELEASE | 5/11/2012 | DG |




NOTES:

1. IRIDIUM ANTENNA CONNECTOR
   PN: SAMTEC RSP-122811-01
   MATING PN: U.FL PLUG (CABLE ASSEMBLY)

2. 9603-I MULTI-INTERFACE CONNECTOR
   PN: ST4-10-2.50-L-D
   MATING PN: SS4-10-3.00-L-D OR SS4-3.50-L-D

DWG. NO. 92371 | SHEET 1 | REV 1.0

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| UNLESS OTHERWISE SPECIFIED:<br>DIMENSIONS ARE IN INCHES<br>TOLERANCES:<br>FRACTIONAL DECIMALS .XX ± .01" .XXX ± .005" ANGLES | CONTRACT NO. | | NAL RESEARCH CORP. |
| MATERIAL | APPROVALS | DATE | DRAWING NAME: 9603-I |
| FINISH | DESIGNER: E. RODERICK | 5/11/2012 | A \| CAGE CODE \| DWG. NO. 92371 \| REV 1.0 |
| | CHECKER | | SCALE: 1:1 \| SHEET: 1 OF 1 |
| | PROJECT ENGINEER | | |
| | APPROVED: D. GAIBROIS | 5/11/2012 | |

DRAWING FILE NAME: 9603-I

CAD GENERATED DRAWING. MANUAL CHANGES NOT ALLOWED

APPENDIX B: STANDARDS COMPLIANCE

The 9603-I is designed to meet the regulatory requirements for approval for FCC, Canada, and CE assuming an antenna with a gain of ~3 dBi and adequate shielding. The 9603-I is tested to the regulatory and technical certifications shown in table below.

| Regulatory Approvals | Radio Tests | EMC Tests | Mechanical/ Electrical Tests |
|---|---|---|---|
| CE | ETSI EN 301 441 V1.1.1 (2000-05) | ETSI EN 301 489-20 V1.2.1(2002-11)<br>ETSI EN 301 489-1 V1.8.1(2008-04)<br>EN61000-4-2 : 1995/A2 : 2001 Part 4.2<br>EN61000-4-3 : 2002 Part 4.3<br>EN61000-4-4 : 2004<br>EN61000-4-6 : 1996/A1 : 2001 Part 4.6<br>EN55022:2006 | EN60950-1:2006 Part 1 |
| FCC | FCC CFR47 Parts 2, 15, and 25 | | |
| Industry Canada | Industry Canada RSS170 Issue 2, March, 2011 | | |

## APPENDIX C: EXPORT COMPLIANCE INFORMATION

The 9603-I 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.

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