Iridium 9602/9602N SBD Transceiver Developer's Guide

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Proprietary & Confidential Information

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Revision History

Revision	Date	Comment
1.1	15-Apr-10	Initial Product Release
1.2	27-Jan-15	Updated to include 9602N (Draft 2)

Contents

List of Abbreviations

Abbreviation	Description
CE	Conformité Européene
CTS	(V.24 signal) Clear To Send. This signal is used to control the flow of data to the Iridium 9602/9602N
DC	Direct Current
DCD	(V.24 signal) Data Carrier Detect
DCE	Data Communications Equipment. In this Product, DCE refers to the Iridium 9602/9602N
DSR	(V.24 signal) Data Set Ready. This signal, from the Iridium 9602/9602N, indicates readiness to accept communication over the data port
DTE	Data Terminal Equipment. In this Product, DTE refers to the FA
DTR	(V.24 signal) Data Terminal Ready. This signal, from the FA, requests the Iridium 9602/9602N to accept communication over the data port
ESS	ETC SBD Subsystem (synonymous with GSS)
ETC	Earth Terminal Controller
FA	Field Application; the application controlling the Iridium 9602/9602N
FCC	Federal Communications Commission
GND	Ground
GSS	Gateway SBD Subsystem (synonymous with ESS)
IC	Industry Canada
IMEI	International Mobile Equipment Identity
LBT	L-Band Transceiver
MO	Mobile Originated
MOMSN	Mobile Originated Message Sequence Number
MT	Mobile Terminated
MTMSN	Mobile Terminated Message Sequence Number
RHCP	Right Hand Circular Polarization
RI	(V.24 signal) Ring Indicate. This signal, from the Iridium 9602/9602N, indicates that an MT message is present at the GSS
RTS	(V.24 signal) Request To Send. This signal is used to control the flow of data from the Iridium 9602/9602N.
SBD	Short Burst Data
SMS	Short Message Service
TBA	To Be Advised
UART	Universal Asynchronous Receiver Transmitter
VAM	Value Added Manufacturer
VAR	Value Added Reseller
VSWR	Voltage Standing Wave Ratio

1 Product Overview

The Iridium 9602/9602N Short Burst Data Only Transceiver (9602/9602N) is designed to be integrated into a wireless data application with other host system hardware and software to produce a full solution designed for a specific application or vertical market. Examples of these solutions include tracking a maritime vessel or automatic vehicle location.

The 9602/9602N only supports Iridium's Short Burst Data (SBD) capability. It does not support voice, circuit switched data, or short message service (SMS).

The 9602/9602N 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. This allows the 9602/9602N to be integrated into a variety of wireless data applications or retrofitted into existing SBD only applications that utilize SBD with the current Iridium 9601, 9522A, 9522B or 9522 L-Band transceiver-based products. (Note that additional development work will be required). Such finished products, when integrated together, require regulatory and safety testing to be conducted by the integrator.

The 9602/9602N is a single board transceiver provided as a 'black box' transceiver module with all device interfaces provided by a single multi-pin interface connector in addition to the antenna connector. The Product only provides the core transceiver. All other end user Field Application functions such as GPS, microprocessor based logic control, digital and analog inputs, digital and analog outputs, power supply and antenna must be provided by the solution developer. The device interface across the user connector consists of a serial-data interface, DC power input, network available output and a power on/off control line.

The 9602/9602N does not incorporate nor require a Subscriber Identity Module (also known as a SIM Card) to be inserted into the Transceiver. The 9602/9602N is intended to be used as a transceiver module fitted within another host system. The 9602/9602N module is designed to comply with the standards for Radio Emissions Compliance, Electromagnetic Compatibility, and AC Safety in the United States, European Union and Canada, for host systems that provide safe connections to power supply and external antenna or cable distribution system.

The 9602N is a second generation version of the 9602 and is identical in form and function to the 9602. This document applies to both the 9602 and 9602N as indicated by the term '9602/9602N'. Where the contents of this document apply specifically to either the 9602 or 9602N then this is indicated by the use of the terms '9602' and '9602N' respectively.

The 9602/9602N is described within this document as "9602/9602N," "9602/9602N SBD Transceiver," "Transceiver," and "ISU." All of these terms refer to the same product.

1.1 *Key Features*

- Single board transceiver
- Small form factor
- Aluminum alloy casework (LM2 / LM24) with Alodine 2600 passivation coating
- No SIM card
- Designed to be incorporated into an OEM solution
- Maximum mobile originated message size 340 bytes
- Maximum mobile terminated message size 270 bytes
- Automatic Notification to the Transceiver that a mobile terminated message is queued at the Gateway
- Global operating capability
- RoHS compliant

1.2 *Transceiver Packaging and Regulatory Certification*

The 9602/9602N SBD Transceiver is a regulatory approved daughter module transceiver that can be fitted within an enclosed host system. With appropriate external connections, the host system can be designed to meet full transceiver regulatory tests and sold as a Regulatory Certified product that meets CE, FCC and IC requirements.

The 9602 is tested to the regulatory and technical certifications shown in Table 1 (See Note below). The 9602N has regulatory and technical certifications as shown in Table 1a.

Table 1: 9602 Regulatory and Technical Certifications.

Regulatory Approvals	Radio Tests	EMC Tests	Electrical / Mechanical / Operational Safety Tests
CE	ETSI EN 301 441 V1.1.1 (2000-05)	ETSI EN301 489-1 V1.8.1(2008-04) ETSI EN 301 489-20 V1.2.1(2002-11)	EN60950-1:2006 Part 1
FCC	FCC CFR47 parts 2, 15, and 25	EN61000-4-2 : 1995/A2 : 2001 Part 4.2 EN61000-4-3 : 2002 Part 4.3 EN61000-4-4 : 2004 EN61000-4-6 : 1996/A1 : 2001 Part 4.6 EN55022:2006	
Industry Canada	Industry Canada RSS170 Issue 1, Rev 1, November 6, 1999		

Note: *The initial 9602 FP1 & FP2 prototype units are different from the commercially produced 9602 SBD Transceivers from a regulatory and certification perspective. Those initial units cannot and should not be used for any commercial purpose or for any regulatory certification or compliance purposes. Only the commercial 9602 units conform to the regulatory approved design and the regulatory and technical certifications listed in Table 1.*

Table 1a: 9602N Regulatory and Technical Certifications.

Regulatory Approvals	Radio Tests	EMC Tests	Electrical / Mechanical / Operational Safety Tests
CE	ETSI EN 301 441 V1.1.1 (2000-05)	ETSI EN 301 489-1 V1.9.2 (2011) ETSI EN 301 489-20 V1.2.1 (2002-11) EN61000-4-2 : 2009 EN61000-4-3 : 2006 + A1: 2008 + A2: 2010 EN61000-4-4 : 2004 + A1: 2010 EN61000-4-6 : 2009 EN55022:2006 + A1: 2007	EN60950-1:2006 + A11: 2009 + A1: 2010 + A12: 2011
FCC	FCC CFR47 parts 2 (2013), 15B (2013), and 25 (2013)		
Industry Canada	Industry Canada RSS170 Issue 2, March, 2011 Industry Canada ICES-003 (2012)		

Note: The OEM integrator is responsible for ensuring that their end-product complies with additional compliance requirements required with this module installed, such as digital device/unintentional emissions requirements and any additional potential RF Exposure requirements, such as portable use or co-location requirements.

1.3 *Software Revision*

Product Developers should read this document in conjunction with the "Software Release Notes" relevant to the revision of the software that is loaded into their 9602/9602N SBD Transceiver.

Product Developers should take into account in their software design that it is possible that a transceiver may have an earlier software release and may therefore have different capabilities to those listed in this document. Product Developers are advised to ensure that production procedures for finished goods confirm that the software used in the Product Developer application is designed for the Software Release loaded in the 9602/9602N SBD Transceiver. This can be read out of the module using the AT command interface. A software upgrade utility is provided with each SW release. The utility runs on a Windows compatible OS and will automatically upgrade the modem with the latest version.

1.4 *Unauthorised Changes*

Iridium has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Iridium n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

1.5 *Radio Interference*

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

1.6 *RF Exposure*

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body. Antenna gain must be below: 3.0 dBi. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la IC pour un environnement non contrôlé. L'antenne doit être installé de façon à garder une distance minimale de 20 centimètres entre la source de rayonnements et votre corps. Gain de l'antenne doit être ci-dessous: 3.0 dBi. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

1.7 *FCC Class B Digital Device Notice*

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be
determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

1.8 *Labelling Requirements for the Host device*

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the FCC ID and IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

<u>9602</u>

Contains FCC ID: Q639602 or Contains transmitter module FCC ID: Q639602
Contains IC: 4629A-9602 or Contains transmitter module IC: 4629A-9602

<u>9602N</u>

Contains FCC ID: Q639603N or Contains transmitter module FCC ID: Q639603N
Contains IC: 4629A-9603N or Contains transmitter module IC: 4629A-9603N

L'appareil hôte doit être étiqueté comme il faut pour permettre l'identification des modules qui s'y trouvent. L'étiquette de certification du module donné doit être posée sur l'appareil hôte à un endroit bien en vue en tout temps. En l'absence d'étiquette, l'appareil hôte doit porter une étiquette donnant le FCC ID et le IC du module, précédé des mots « Contient un module d'émission », du mot « Contient » ou d'une formulation similaire exprimant le même sens, comme suit:

9602

Contains FCC ID: Q639602 or Contains transmitter module FCC ID: Q639602
Contains IC: 4629A-9602 or Contains transmitter module IC: 4629A-9602

9602N

Contains FCC ID: Q639603N or Contains transmitter module FCC ID: Q639603N
Contains IC: 4629A-9603N or Contains transmitter module IC: 4629A-9603N

1.9 *CAN ICES-3 (B) / NMB-3 (B)*

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme canadienne ICES-003.

1.10 *R&TTE Statement*

Iridium Communications Inc. hereby declares that the 9602N is in compliance with the essential requirements and other relevant provisions of Directive1999/5/EC. A copy of the Declaration of Conformity is given below.

iridium Everywhere

E C Directive

Declaration of Conformity

We, Iridium Communications Inc. of 1750 Tysons Blvd, Suite 1400, McLean, VA 22102 USA declare under our sole responsibility that the product 'Iridium 9602N Short Burst Data Transceiver' to which this declaration relates, is in conformity with the following standards and/or other normative documents:

Standard	Description
EN60950-1:2006 + A11:2009 + A1:2010 + A12:2011	Information technology equipment – Safety – Part 1: General requirements
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
EN301 489-20 V1.2.1 (2002-11)	Electromagnetic compatibility and Radio Spectrum Matters (ERM)
EN301 489-01 V1.9.2 (2011)	Electromagnetic Compatibility (EMC) standard for radio equipment and services
ETSI EN 301 441 V 1.1.1 2000-05	Satellite Earth Stations nod Systems (SES); Harmonised EN for Mobile Earth Stations (MESs)

We hereby declare that all essential radio test suites have been carried out and that the above named product is in conformity to all the essential requirements of Directive 1999/5/EC.
The conformity assessment procedure referred to in Article 10 and detailed in Annex IV of Directive 1999/5/EC has been followed with the involvement of the following Notified Body:
TÜV SÜD BABT, Octagon House, Concorde Way, Segensworth North, Fareham, Hampshire, PO15 5RL, UK.

The technical documentation relevant to the above equipment will be held at Iridium Communications Inc.,1750 Tysons Blvd, Suite 1400, McLean, VA 22102 USA.

Hermon Pon
VP of Technology Development and Network Engineering
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January 15, 2015

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2 Physical Specification

For illustrative purposes a picture of the Iridium 9602 SBD Transceiver Module is shown in Figure 1.

Figure 1 Iridium 9602 SBD Transceiver Front and Back Views

*Note: The appearance of the 9602N is identical to the 9602 with the exception of the part marking on the label.

2.1 *Module Dimensions*

The overall dimensions of the 9602/9602N module and its weight are summarized in Table 2 and represented graphically in Figure 2

Table 2: 9602/9602N Mechanical Dimensions

Parameter	Value
Length	41.0 mm
Width	45.0 mm
Depth	13.0 mm
Weight (approximate)	30g

Additionally host system Product Developers should plan space for connection to the host system motherboard, including robust and electrically grounded connections to the antenna/cable distribution system.

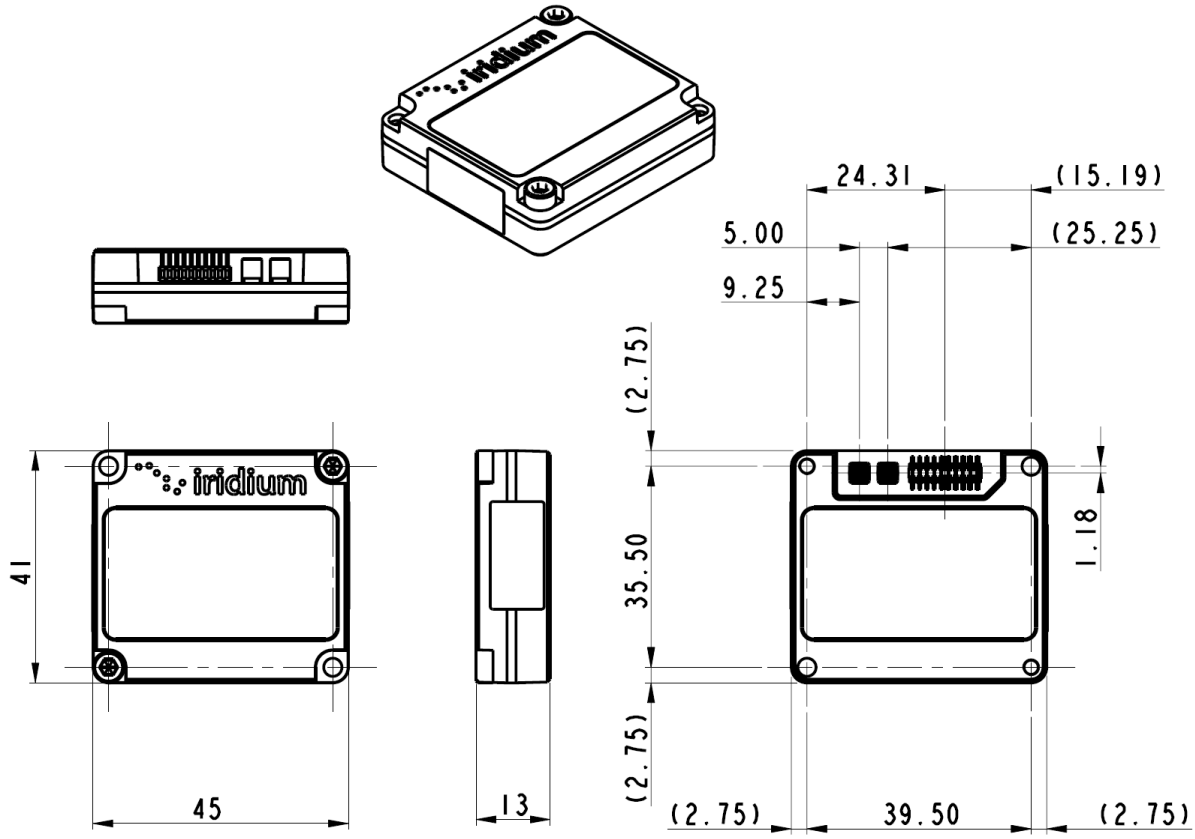


Figure 2 General Assembly and Dimensions of the 9602/9602N SBD Transceiver Module

(Not to scale, dimensions in millimeters)

This drawing shows some of the key dimensions within the 9602/9602N specify the mechanical position of its connectors with respect to its mounting holes.

Note: Iridium is currently working on providing updated Figure 2, to reflect the diameter of the mounting holes and tolerance drawings for the cut out. At the time of this documentation release these items were not available and will be provided in a later release.

2.2 *Mechanical Dimensions – Motherboard Mounting*

The 9602/9602N SBD Transceiver must be fitted within an enclosed host system. With appropriate external connections, the host system motherboard and host system enclosure can be designed to meet full transceiver regulatory tests.

The 9602/9602N SBD Transceiver is provided with two mounting holes, one at each diagonal corner. The module should be assembled onto the motherboard of the host system, by pushing the module onto matching connectors on the motherboard and then securing the diagonal mounting holes to the motherboard using mechanical fasteners.

The figures and tables below provide mechanical information design information to connect a 9602/9602N module to a host system motherboard.

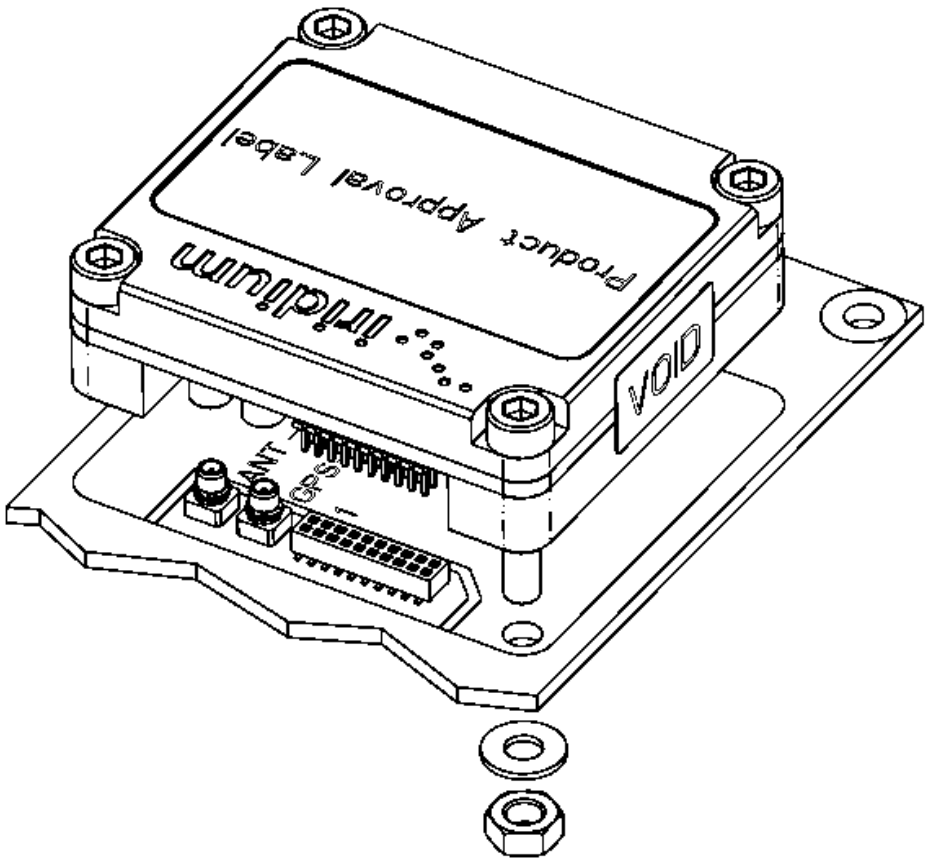
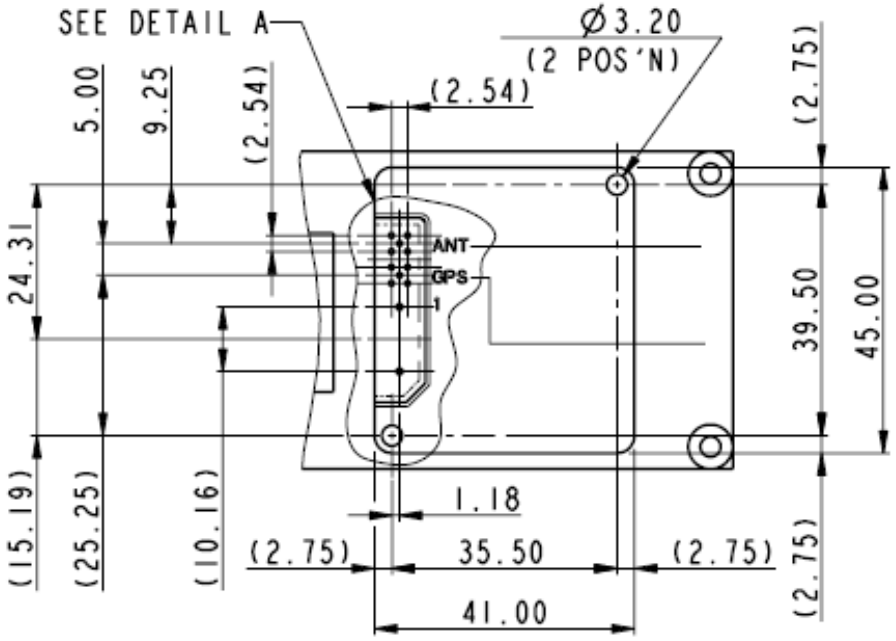
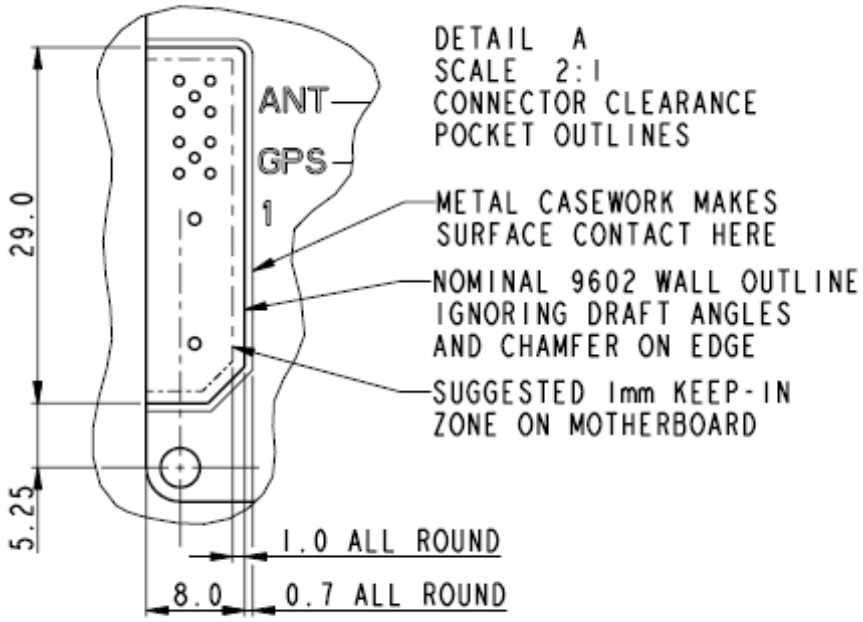


Figure 3 General assembly of the 9602/9602N onto motherboard of the host system.

Figure 4 Example host system motherboard footprint showing mounting position of 9602/9602N

(Not to scale. Dimensions in millimeters)





Notes for Figure 4

1. This example of a host system motherboard footprint is shown for illustrative purposes only. The host system may require a different PCB layout or mechanical arrangement.
2. The 9602/9602N is designed to be incorporated within a host system. As such, the antenna or cable distribution system that feeds the host system should be terminated in a robust RF connector that is suitable for the end-application.
3. Safety isolation requirements for external antennas or cable distribution systems should also be taken into consideration when designing the motherboard. A suitably safe design for the RF connections should be incorporated into the host system motherboard, ideally using a chassis-bonded ground connection to the antenna cable shield.
4. The surface below the modem should be a conductive ground plane such that the modem bonds to the motherboard ground system thus reducing the possibility of radiated emissions. This also requires that the mounting screws get properly tightened to 7 pound-inches of torque.
5. The modem is to be installed in a “service access only” area not accessible by untrained personnel.

Warning- Although the modem dissipates very little power, its use in ambient temperatures in excess of 60 deg C will make the caseworks considerably hot.

2.3 *Environmental*

2.3.1 Environmental Specification

The environmental specifications of the 9602/9602N are summarized in Table 5 below.

Table 5: Environmental Specifications

Parameter	Value
Operating Temperature Range[1]	-40ºC to + 85ºC
Operating Humidity Range	≤ 75% RH
Storage Temperature Range	-40ºC to + 85ºC
Storage Humidity Range	≤ 93% RH

2.3.2 Environmental Tests Performed

The 9602 complies with the specifications listed in Table 6. The 9602N complies with the specifications listed in Table 6a.

Table 6: 9602 Environmental Tests

Test Name	Test Reference	Test Description
Thermal Shock	EN60068-2-14:2000	Change of Temperature, -25°C to +70°C, 5 cycles of 1 hour each
Humidity	IEC60068-2-78:2002	Damp heat steady state 40^{O}C 93% RH for 4 days
Vibration	EN 60068-2-36:1996	0.96 m2/s3 from 5Hz to 20Hz 21Hz to 500Hz dropping -3dB per octave
Vibration	J1455 Society of Automotive Engineers	10-40Hz at 0.02g^{2}/Hz 40-500Hz dropping 6dB per octave
Shock	EN60068-2-27:1993 (NF c20-727)	
Shock	J1455 Society of Automotive Engineers	Drop 1m onto concrete in 3 perpendicular orientations (3 drops) Also 10G shock over a period of 12ms

[1] Operating Temperature Range based on a duty-cycled usage model with 9602 sending one SBD message per hour and is otherwise turned off during the hour. Iridium has tested the 9602 per these temperature conditions and partners venturing outside of these stated conditions need to ensure they have engineered a solution appropriate to the stated environmental conditions for the 9602.

Table 6a: 9602N Environmental Tests

Test Name	Test Reference	Test Description
Thermal Shock	EN60068-2-14:2009	Change of Temperature, -25°C to +70°C, 5 cycles of 1 hour each
Humidity	IEC60068-2-78:2002	Damp heat steady state 40^{O}C 93% RH for 4 days
Vibration	IEC60068-2-64:2008	0.96 m2/s3 from 5Hz to 20Hz 21Hz to 500Hz dropping 6dB per octave
Vibration	SAE J1455: 2012 Section 4.10	10-40Hz at 0.02g^{2}/Hz 40-500Hz dropping 6dB per octave
Shock	EN60068-2-27:2009	10G peak shock over a period of 11ms, 3 shocks in 3 perpendicular orientations
Shock	SAE J1455: 2012 Section 4.11 Society of Automotive Engineers	Drop 1m onto concrete in 3 perpendicular orientations (3 drops)

2.4 *Physical Interface Connectors*

The Iridium 9602/9602N SBD Transceiver incorporates three connectors:

- A multiway user connector
- An RF antenna connector
- A GPS RF pass-through connector

The physical characteristics of the connectors and their electrical interfaces are described in more detail in Sections 3.1.1 and 4.1 respectively.

3 Electrical Interfaces

The following subsections contain information for the electrical interfaces of the 9602/9602N SBD Transceiver for the non-RF connections. The RF interfaces are covered in section 0.

3.1 *User Connector*

The user connector provides the following connections to the 9602/9602N module:

- DC power supply input
- Power on/off control
- Serial data interface
- Network available output
- Supply power indicator output

3.1.1 User Connector Type

The connector on the 9602/9602N is a Samtec low-profile header connector, part number FTSH-110-01-L-DV.
This connector provides the ability for a stackable board to board configuration, allowing connection to the host system motherboard.

Data sheets on these connectors can be found at: http://www.samtec.com

A suitable motherboard female socket that matches this connector is the SAMTEC header part number CLP-110-02-L-D.

3.1.2 User Connector Pin Allocation

The user connector is a 2-row 20-way header. Individual pin assignments are shown in Table 7 and the limits for the digital signals are listed in Table 8. Multiple supply grounds are provided and all supply and supply grounds are required to be connected to the power supply in order to limit the current on any one pin. Multiple signal grounds are provided to reduce cross-talk.

Table 7: User Connector Pin Allocation

Pin No.	Signal Name	Signal direction (WRT 9602/9602N)	Signal function	Signal level
1	EXT_PWR	Input	Supply	+5 V +/- 0.5 V
2	EXT_PWR	Input	Supply	+5 V +/- 0.5 V
3	EXT_GND	Input	Supply return	0 V
4	EXT_GND	Input	Supply return	0 V
5	ON/OFF	Input	On/Off control input	Analog On: >=2.0V Off: <=0.5V
6	DF_S_TX	Input	Data port, serial data input	3.3V Digital
7	DF_S_RX	Output	Data port, serial data output	3.3V Digital
8	SIG_GND	Input	Signal ground	0V
9	DF_ DCD	Output	Data port, Data Carrier Detect	3.3V Digital
10	DF_ DSR	Output	Data port, Data Set Ready	3.3V Digital
11	DF_ CTS	Output	Data port, Clear-to-Send	3.3V Digital
12	DF_RI	Output	Data port, Ring Indicator	3.3V Digital
13	DF_ RTS	Input	Data port, Request-to-Send	3.3V Digital
14	DF_ DTR	Input	Data port, Data Terminal Ready	3.3V Digital
15	SIG_GND	Input	Signal ground	0V
16	Reserved			
17	Reserved			
18	SIG_GND	Input	Signal ground	0V
19	NETWORK AVAILABLE	Output	Signals when the 9602/9602N can see an available satellite network	3.3V Digital Available = high Not available= low
20	SUPPLY_OUT	Output	Supply power indicator output	+3.3 V 5mA maximum

Table 8: Limits for 3.3V Digital Signals

Parameter	Symbol	Min	Typ	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

Figure 5 provides a reference for the pin designation. This view is not to scale and not representative of the connector mechanical layout. This view is for illustrative purposes only. This view designation is when looking into the user connector towards the 9602/9602N module.

The numbers indicate pin designation. Additionally, on the 9602/9602N PCB, pin 1 on the user connector is indicated on the board silkscreen.

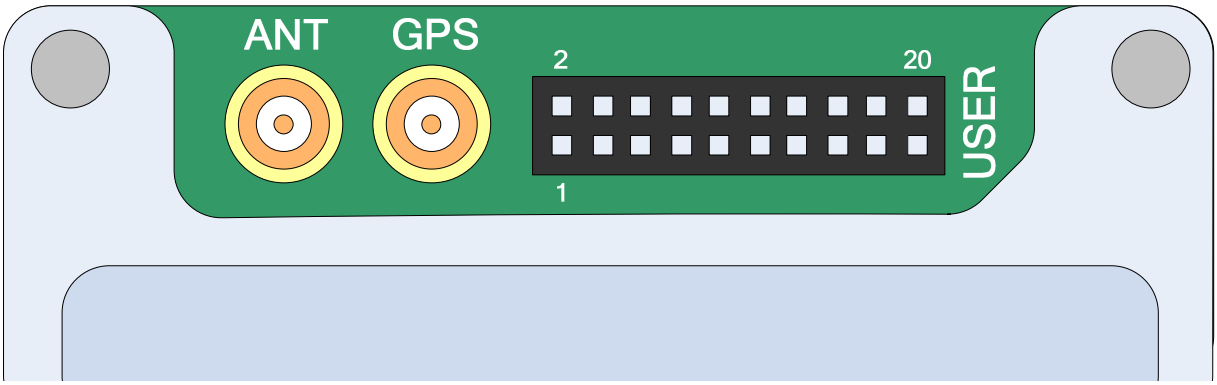


Figure 5 User Connector Pin Number Designation (from below module)

3.2 *DC Power Interface*

The DC power interface is comprised of the DC power inputs and a control signals as summarized in Table 7. The +5V Inputs and 0V supply returns are used to supply DC power to the 9602/9602N and ensure that enough current can be drawn across the connector without the 9602/9602N malfunctioning during transmit due to lack of current supply. Note that all power and ground pins should be connected externally.

The DC power supply requirements for the 9602/9602N are summarized in Table 9 below. Note that these requirements apply to DC power measured at the 9602/9602N User connector input and not at the output of the power supply. Long power supply cables can cause a voltage drop sufficient to cause the voltage to be out of specification at the physical power supply input to the 9602/9602N.

Table 9: DC Power Input Specifications

Parameter	9602 Value	9602N Value
Supply Input Voltage Range	5.0V DC +/-0.5V	5.0V DC +/-0.5V
Supply Input Voltage Ripple	< 40 mV pp	< 40 mV pp
Typical Power Consumption at +5.0 VDC	*9602 Value*	*9602N Value*
Idle Current (average*)	45mA	35mA
Idle Current (peak)	195mA	170mA
Transmit Current (peak)	1.5 A	1.3A
Transmit Current (average*)	190mA	140mA
Receive Current (peak)	195mA	170mA
Receive Current (average*)	45mA	40mA
SBD message transfer - average current*	190 mA	150mA
SBD message transfer - average power*	<= 1.0 W	<=0.8 W

* Note: The average power consumption will vary depending on the view of the satellite constellation from the antenna.

The external power supply needs to **guarantee** the following:

- The supply voltage droop over for a 8.3ms burst of 1.5A (9602)/ 1.3A (9602N) current should not be more than 0.2 Volts.
- The power supply should limit the in-rush[2] current to 4 Amps maximum
- The power source shall provide for over current protection in case of device malfunction.
- The supply noise should be less than the limits in the following profile:
  - 100 mVpp from 0 to 50 kHz
  - 5 mVpp at 1 MHz measured in 50 kHz bandwidth
  - 10 mVpp at 1 MHz measured in 1MHz bandwidth
  - 5 mVpp above 5 MHz measured in 1 MHz bandwidth.

[2] In rush limit refers to the impedance of the modem when it is unpowered is very low. When power is supplied from an unlimited supply the instantaneous current can exceed 4 Amps. If the current exceeds this value damage can occur. This can be limited in several ways, included using a supply that cannot provide more than 4 Amps instantaneously; or providing some series inductance/resistance to the supply lead.

3.2.1 Power On/Off Control

An external on/off input is provided on a pin of the User connector. The 9602/9602N starts up when power is applied and the power on/off input is high. As long as the input voltage is applied, logic high on this line turns the transceiver on and a logic low turns it off. If this line is not required then it must be connected directly to the +5 V supply.

Note that this on/off control is similar to the 9601 product but it is **not** the same as the 9522, 9522A or 9522B products.

Prior to turning off the modem a "flush memory" (AT*F) command should be issued to ensure all memory write activity is completed. When a transceiver has been turned off, Product Developers 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 9602/9602N 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 modem could be placed in a non-operational state. The state is not permanent and can be rectified by the above procedure.

3.2.2 Typical Power Usage Profile

This section is designed to give the Product Developer some insight to the electrical power profile that the 9602/9602N uses. It does not describe every situation and permutation possible. It should be used as a starting point for the Product Developer to continue its own development design. The actual usage profile can vary for a number of reasons:

1) View of the sky – if in poor visibility of the sky where a clear line of sight is not available between the transceiver and the satellite.
2) The higher the antenna VSWR the higher the current consumed
3) How often the 9602/9602N module is activated/deactivated by the Host Controller system
4) Manufacturing variation from transceiver to transceiver.

The host system designer should ensure their design covers for worst case power consumption scenarios. Figure 6 provides a graphical representation of the typical supply current profile of a 9602 SBD Transceiver sending and receiving SBD messages.

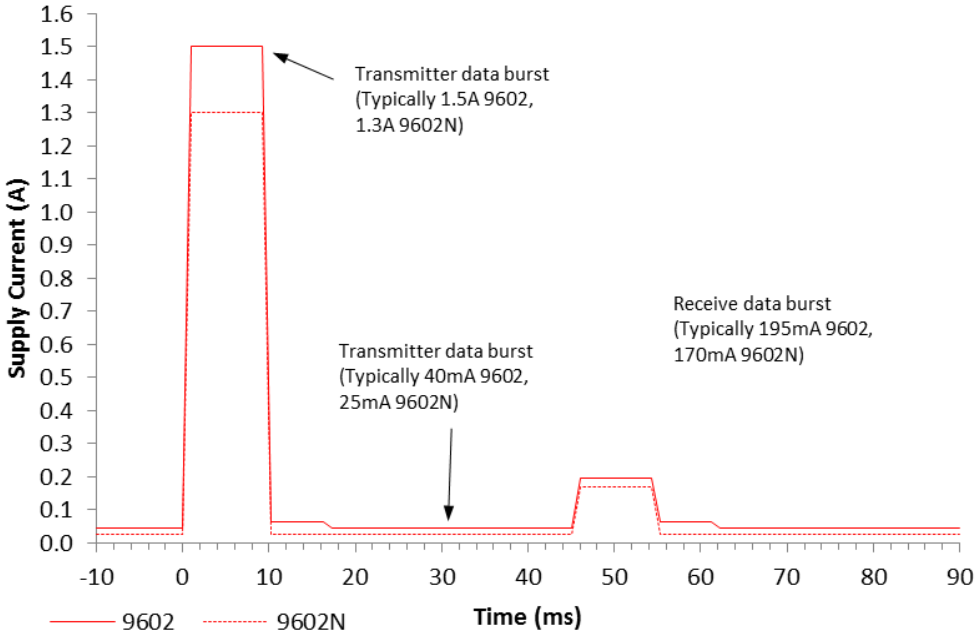


Figure 6 9602/9602N Typical Supply Current Profile

3.3 *Serial Data Interface*

The Serial data interface is used to both command the 9602/9602N and transfer user data to and from the Transceiver. The 9602/9602N presents a 9-wire data port to the FA (Field Application), where the interface is at 3.3V digital signal levels. With respect to this interface, the 9602/9602N behaves as a DCE (Data Communication Equipment), and the FA behaves as a DTE (Data Terminal Equipment).

The terms “FA” and “DTE” are used interchangeably throughout this document; similarly for the terms “9602” and “DCE”. Autobaud is not supported in 9602/9602N SBD Transceiver. The baud rate can be set via the AT+IPR command. The default rate is 19200 bps.

3.3.1 9-Wire and 3-Wire Operation

By default, the serial interface operates as a 9-wire connection. Table 10 describes each of the signals, where “input” means an input to the 9602/9602N, and “output” means an output from the 9602/9602N SBD Transceiver.

Table 10 – Serial Interface Signals

Signal	Description
RX	Active high data output [The DTE receives the data from the 9602/9602N]
TX	Active high data input [Data is transmitted from the DTE to the 9602/9602N]
GND	0V
RTS	Active low flow control input
CTS	Active low flow control output RTS and CTS are used together to implement hardware flow control when enabled with AT&K3
DTR	Active low handshaking input AT&Dn controls how the 9602/9602N uses DTR: • If set to AT&D0, DTR is always ignored. • Otherwise DTR set to OFF places the data port into UART test mode after 10 seconds, or immediately on boot-up. A subsequent transition of DTR to ON returns the data port to DCE mode and resets it to its power-on state. • The UART test mode is provided for factory testing of the data port UART. An FA should never activate test mode; if it does, the 9602/9602N will stop responding to AT commands until the data port is returned to DCE mode.
DSR	Active low handshaking output The 9602/9602N drives DSR ON when the data port is in DCE mode, and OFF when the data port is in test mode. The DTE may use this signal as an indication that the 9602/9602N is powered up and ready to receive AT commands.
RI	Active low ring indicator output The 9602/9602N drives RI ON when it receives a Automatic Notification from the network that a Mobile Terminated SBD Message is queued at the Gateway, and drives RI OFF after 5 seconds or when the DTE initiates an SBD session, whichever occurs first.
DCD	Active low handshaking output DCD is driven OFF at all times.

Note that the Ring Indicator (RI) pin is used by the 9602/9602N SBD Transceiver to indicate that a Mobile Terminated SBD (MT-SBD) message is queued at the Gateway. The Field Application can monitor this pin and use appropriate AT Commands to command the Transceiver to retrieve the MT-SBD message.

The serial interface may be operated with a 3-wire connection, where only transmit, receive and ground signals are used. However the 9 wire interface offers better control and is the recommended implementation. Iridium is only able to provide limited 3-wire interface support. Due to the small code space and limited processing resources of the 9602/9602N the flow control is limited.

When operating with a 3-wire connection, the following rules apply:

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

Notes:

1. 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).
2. If the DC input to the modem is to be disconnected, the developer will need to "tri-state" the serial interface to prevent a possible latch-up condition.

3.3.2 Configuration Settings

The 9602/9602N allows the DTE to configure the data port communication parameters. The three configuration types are active, factory default, and stored. The active configuration is the set of parameters currently in use. They can be changed by the DTE individually via specific AT commands. The factory default configuration is stored in permanent memory. This configuration can be recalled at any time through use of the AT&Fn command.

Two groups of settings, or "profiles", can be stored as user-defined configurations. The DTE first creates desired active configurations and then writes them to memory using the AT&Wn command. These profiles can be designated to be loaded as the active configuration upon 9602/9602N power-up through use of the AT&Yn command. The 9602/9602N can be reset without loss of power to these profiles through use of the ATZn command.

The configuration settings are stored in "S-register" locations and are detailed further in the "ISU AT Command Reference".

3.3.3 Modes of Operation

The serial interface 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 9602/9602N. 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 9602/9602N 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 9602/9602N suspends transfer of data to the DTE; when CTS is OFF (high), the 9602/9602N expects the DTE to suspend transfer of data to the 9602/9602N.

When in SBD session mode, the 9602/9602N is attempting to conduct an SBD session with the 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 9602/9602N in response to the SBD AT Commands; the DTE has no other control over the mode.

3.3.4 Serial port signal levels

3.3.4.1 Data Port Inputs

The inputs on the 9602/9602N serial port (RTS, DTR and TXD) will operate correctly at 3.3V digital signal levels.

RS-232 interface chips can be fitted to the host system motherboard if connection to an external RS232 link is required. Note that these may invert the digital logic level, so another inversion may be required.

3.3.4.2 Data Port Outputs

The five outputs from the 9602/9602N serial port (DCD, DSR, CTS, RI and RXD) are all at 3.3V digital levels.

3.4 *Hardware Failure Reporting*

If the 9602/9602N detects a hardware problem during initialisation, the 9602/9602N may be unable to function correctly. The 9602/9602N notifies the DTE of this situation by issuing an unsolicited result code at the end of initialisation:

```
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").

3.5 *Network Available Output*

This is a digital output that can be used by an application to know when the transceiver has visibility to the satellite network. This is useful in applications where the transceiver may move around terrain that reduces the amount of time that clear line of sight to the satellite constellation is available. The Product Developer can use this output to preserve battery life by reducing the number of attempted transmissions by including this logic output in the application decision logic.

Network Available means only that the 9602/9602N 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 that is typically 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 9602/9602N 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.

If Network Available is currently off, the Field Application may still attempt an SBDI[X] session. This will force the 9602/9602N Transceiver 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 9602/9602N 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.

The wait time between search windows is reset to 4 seconds every time a search succeeds. Otherwise it continues to increase. So 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.

3.6 *DC Supply Indicator Output*

A DC supply indicator signal is provided by the 9602/9602N which could be used directly for driving an LED to provide a visible indication that the Transceiver supply is on. Alternatively the output signal could be used in application logic to determine if the internal Transceiver power supply is on.

4 RF Interface

This section describes the physical characteristics of the RF connectors and specifications of the RF Interface.

4.1 *RF Connector Types*

When mating to the 9602/9602N RF connector use MMCX male connectors from SAMTEC part number MMCX-P-P-H-ST-TH1. This is a thru hole printed circuit mount connector with the correct mechanical spacing to allow the 9602/9602N to fit flush on the motherboard.

Note - this 9602/9602N module has a different antenna connector than Iridium transceivers.

Both RF connectors on the 9602/9602N module are 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.

Additional information can be found at: http://www.samtec.com

4.2 *ANT Connector*

The main RF connector for the 9602/9602N is the antenna connector, labeled “ANT” in the board silkscreen. This provides the RF connection between the 9602/9602N module and the host system motherboard.

Note that for safety reasons, both RF connectors on the 9602/9602N module are 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. The EN609502 compliance standard outlines that telecommunications equipment needs protection from a 2KV spike. The MMCX connectors are not capable of 2KV operations therefore protection needs to be provided on the developer’s motherboard and a larger connector needs to be used. Developers are encourages to review the EN609502 compliance standards for additional details.

4.2.1 Antenna Characteristics

The 9602/9602N should be connected to an Iridium-band antenna with the following antenna connector characteristics as described in Table 11.

Table 11: Antenna Characteristics

Parameter	Value
Impedance	50 Ohms nominal
Gain	3dBi
Polarization	RHCP
VSWR (maximum operational)	1.5 : 1

Note:

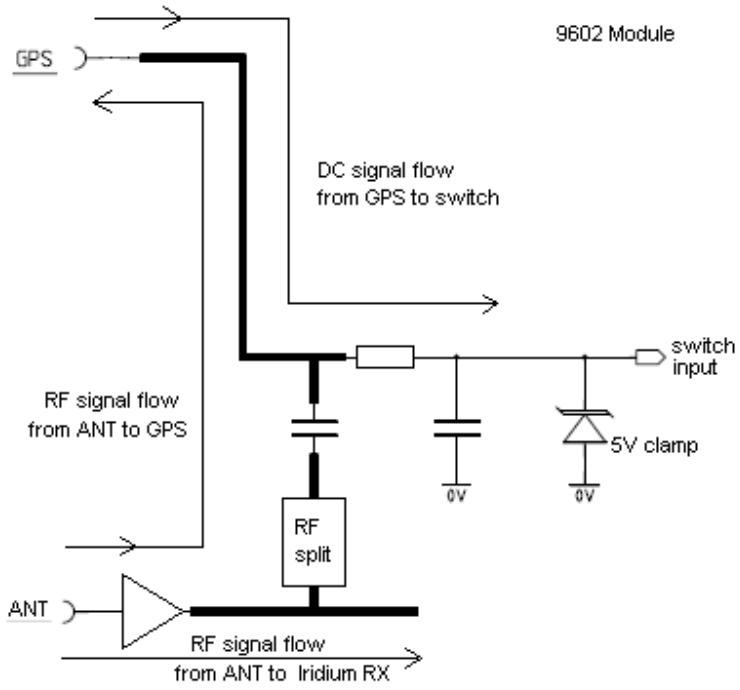
- Existing qualified Iridium antennas may be used. (i.e. antennas designed for the 9601, 9522, 9522A and 9522B)
- Existing antennas will require different RF connector types to than those for the 9601, 9522, 9522A and 9522B

4.3 *GPS Connector*

The second RF connector, labeled “GPS” in the board silkscreen, is a pass-through connection from the antenna path and is provided for GPS receivers that wish to share the main antenna. An overview of this circuit is provided in Figure 7. The following operational points should be noted when using GPS receivers connected to this point.

- The GPS pass-through path is activated by detecting the presence of a DC voltage on the center-pin of the GPS connector. The 9602/9602N uses the voltage from the GPS center pin to switch on the RX path and requires minimal current (<100uA). The GPS path activated when this center-pin voltage is higher than 1.2V (9602) / 1.6V (9602N).
- There is a gain of approximately -3dB (9602) / +5.0dB (9602N) in the receive direction from ANT to GPS.
- The GPS receive path is temporarily switched off during transmissions from the 9602/9602N.
- As long as the 5V supply to the 9602/9602N is connected and the DC voltage on the GPS connector is present, the GPS pass-through path is made available. The GPS path is available even when the 9602/9602N module has been turned off using its ON/OFF control signal.
- If the GPS port is not used it may be left un-terminated with no adverse affect.
- The GPS receiver must present 50 ohm impedance across the Iridium band or SBD performance could be degraded.
- The output return loss is typically -8 dB.

Figure 7: Equivalent circuit for GPS connection when GPS path is active and 9602/9602N is not transmitting



4.4 *Radio Interface Specifications*

The RF interface requirements for the 9602/9602N are summarized in Table 12 below.

Table 12: General RF Parameters

Parameter	Value
Frequency Range	1616 MHz to 1626.5 MHz
Duplexing Method	TDD (Time Domain Duplex)
Input/Output Impedance	50Ω
Multiplexing Method	TDMA/FDMA

4.5 *Radio Characteristics*

Table 13 contains radio characteristics of the 9602/9602N SBD Transceiver.

Table 13: Radio Characteristics

Parameter	9602 Value	9602N Value
Average Power during a transmit slot (max)	1.6 W	1.6 W
Receiver sensitivity (Typical level at module connector)	-117dBm	-116dBm
Max Cable loss permitted (Note 1)	2dB	2dB
Link Margin – Downlink (Note 2)	13dB	13dB
Link Margin – Uplink (Note 2)	7dB	7dB

Note 1: Cable losses should be minimized. The total implementation loss for an antenna, connectors, cable, lightening arrestor and any other RF component between the transceiver and the antenna should not exceed 3dB. The total cable loss between the antenna and the modem 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.

Note 2: Link Margins are given assuming a free-space propagation model.

4.6 *S-meter Performance*

The numbers “reported over the AT command interface indicate the signal strength of the ring channel. Care should be taken when using the S-meter readings for comparisons between devices. Of particular note are the following:

1. There is a 0.5 dB tolerance on calibrating the S-meter.
2. Each 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. The Test Interface Card (TIC board) implementation adds about 0.6 dB loss in the antenna path.
5. If the reading is near the decision threshold it would be easy to see a 1 bar difference

5 AT Command Set Description

The 9602/9602N is configured and operated through the use of AT commands. See the “ISU AT Command Reference” for the full set of AT commands and responses. For differences in AT command support between 9602/9602N software releases, see the relevant software release notes, which are made available to authorized Iridium VARs and VAMs on the Iridium Developer Extranet. It is the responsibility of Product Developers to check compatibility of applications software with the AT Commands on all 9602/9602Ns used for both development and commercial deployments. See also the “Iridium Short Burst Data Service Developers Guide” for information on how SBD operates on the Iridium system.