iridium

9601 Short Burst Data Transceiver
Product Developers Guide

Revision 1.25
March 23rd, 2007

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2

Revision History

Revision	Date	Comment
1.0	May 02 2005	First revision
1.2	Aug 28 2005	Second revision incorporating major updates. Key updates are: Product name change to "9601 SBD Transceiver" Physical packaging Connector types updated AT Commands added and updated
1.21	Sep 29 2005	Mechanical dimensions drawings re-imported to enable them to be read correctly. No changes to any specifications.
1.22	Nov 04 2005	1.2 Note on regulatory status of 9601-P3 and 9601-PP added. 2.1 Weight of transceiver card and final enclosure added 2.2 Updates to current consumption 2.3 & 1.2 Typographical errors corrected in list of standards 3.1 VSWR automatic trip removed from specification. 3.1.2 Power cable length restriction added 4.3 Uplink margin added
1.23	Nov 23 2005	3.2.2 Added typical power consumption profile information Change of nomenclature from "Ring Alert" to "Automatic Notification" DCD is driven OFF at all times.
1.24	Dec 05 2005	Added photograph instead of renderings 1.3 Added 3.5 Added additional detail to the "Network Available" function description
1.25	Mar 16 2007	Updates to main document: 1.1 Updated maximum MO and MT Messages sizes Figure 2 updated 2.0 Updated text to match Figure 1 2.2 Updated to document plastic pegs used for transportation from factory Table 3 updated for plastic pegs used in transportation from factory Table 5 Operating Temperature updated Figure 10 updated Figure 5 Notes updated for plastic pegs 3.3.4 Serial Port voltage information added 4.1.1 Added information on antenna connector nut tightness 4.3 Updated and rearranged Tables. Table 9 Clarified TX and RX descriptions AT Commands Updates to AT Command Descriptions: Updated maximum MT and MO message sizes SBDDSC: Removed non-implemented delivery short code 0x20. Restated parameters in required decimal values SBDSX; CSQ[F], CRIS Added description of commands to document Table 2: Numeric Result Code for "SBDRING" updated to 126, from '2' to prevent confusion in mixed transceiver applications that use the 9522A which currently uses '2' for a regular telephony "RING"

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 9601
DC	Direct Current
DCD	(V.24 signal) Data Carrier Detect
DCE	Data Communications Equipment. In this product, DCE refers to the 9601
DSR	(V.24 signal) Data Set Ready. This signal, from the 9601, 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 9601 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 9601
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 9601, 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 9601.
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

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6

1.0   Product Overview

The Iridium 9601 Short Burst Data Only Transceiver (9601) is designed to be integrated into a wireless data application with other 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 9601 only supports Iridium's Short Burst Data (SBD) capability. It does not support voice, circuit switched data, or short message service (SMS). This is a new product and has no functional predecessor.

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

The 9601 is a single board transceiver and is essentially provided as a 'black box' transceiver 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 consists of the serial interface, power input, network available output and power on/off control line.

The 9601 does not incorporate nor require a Subscriber Identity Module (also know as a SIM Card) to be inserted into the transceiver. The 9601 is designed to comply with the standards for Radio Emissions Compliance, Electromagnetic Compatibility, and AC Safety in the United States, European Union and Canada.

The 9601 is described within this document as "9601," "9601 SBD Transceiver," "9601 SBD Transceiver," and "ISU." All of these terms refer to the same product.

1.1 *Key Features*

- Single board transceiver
- Small form factor
- 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
- Uses small omni-directional antenna
- Global operating capability
- RoHS compliant

1.2 *Transceiver Packaging and Regulatory Certification*

The 9601 SBD Transceiver is a regulatory approved transceiver that is provided in an enclosure and with appropriate connectors that permit the full transceiver to be regulatory tested by Iridium and sold as a Regulatory Certified product that meets CE, FCC and IC requirements.

The 9601 is tested to the regulatory and technical certifications shown in Table 1.

Table 1: Regulatory and Technical Certifications.

Regulatory Approvals	Radio Tests	EMC Tests	Electrical / Mechanical / Operational Safety Tests
CE FCC Industry Canada	ETSI EN 301 441 V1.1.1 (2000-05) FCC CFR47 parts 2, 15, and 25 Industry Canada RSS170 Issue 1, Rev 1, November 6, 1999	ETSI EN 301 489-1 V1.4.1 (2002-08) ETSI EN 301 489-20 V1.2.1(2002-11) EN61000-4-2 : 1995/A2 : 2001 Part 4.2 EN61000-4-3 : 2002 Part 4.3 EN61000-4-4 : 1995/A1 : 2001/A2 : 2001 Part 4.4 EN61000-4-6 : 1996/A1 : 2001 Part 4.6 EN55022:1998/A1:2000/A2:2003	EN60950-1:2001 Part 1 UL60950-1 Part 1

Note: *The initial 9601 units [shipped as 9601-P3 and 9601-PP] are different from the commercially produced 9601 SBD Transceivers from a regulatory and certification perspective. Those initial units cannot and should not be used for any regulatory certification purposes or compliance. Only the commercial 9601 units conform to the regulatory approved design and the regulatory and technical certifications listed in Table 1.*

1.3 *Software Revision*

Developers should read this document in conjunction with the "Software Release Notes" relevant to the revision of the software that is loaded into their 9601 SBD Transceiver.

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. This document was written to Software Release TD06002. Developers are advised to ensure that production procedures for finished goods confirm that the software used in the Developer application is designed for the Software Release actually loaded in the 9601 SBD Transceiver.

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8

2.0   Physical Specifications

For illustrative purposes a picture of the 9601 ISU is shown in Figure 1.

Figure 1: The 9601 SBD Transceiver.

2.1 *Dimensions*

The overall dimensions of the 9601 and its weight are summarized in Table 2 and represented graphically in third angle projection in Figure 2

Table 2: 9601 Mechanical Dimensions

Parameter	Value
Length	106 mm
Width	56.2 mm
Depth	13 mm
Weight (approximate)	117g

Note that these dimensions are for the enclosure and do not take into account the connectors or mounting hardware. Additionally developers should plan for additional space for the reciprocal connectors for the antenna and user connector.
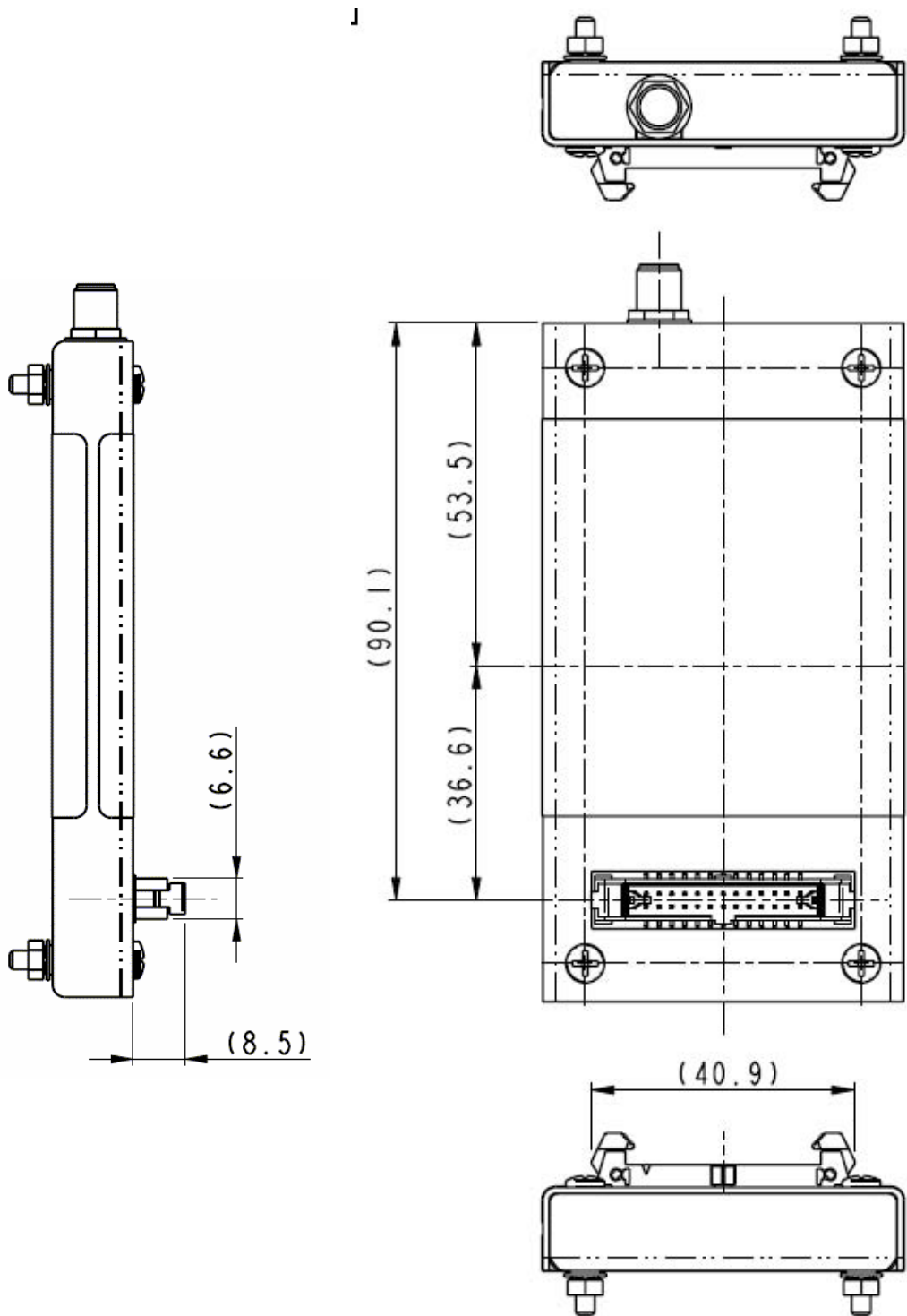
Figure 2 (Part 1 of 3): Dimensions of the 9601 SBD Transceiver.
[Note that the screws and nuts are shown for illustrative purposes only.]
(Not to scale, dimensions in millimeters)
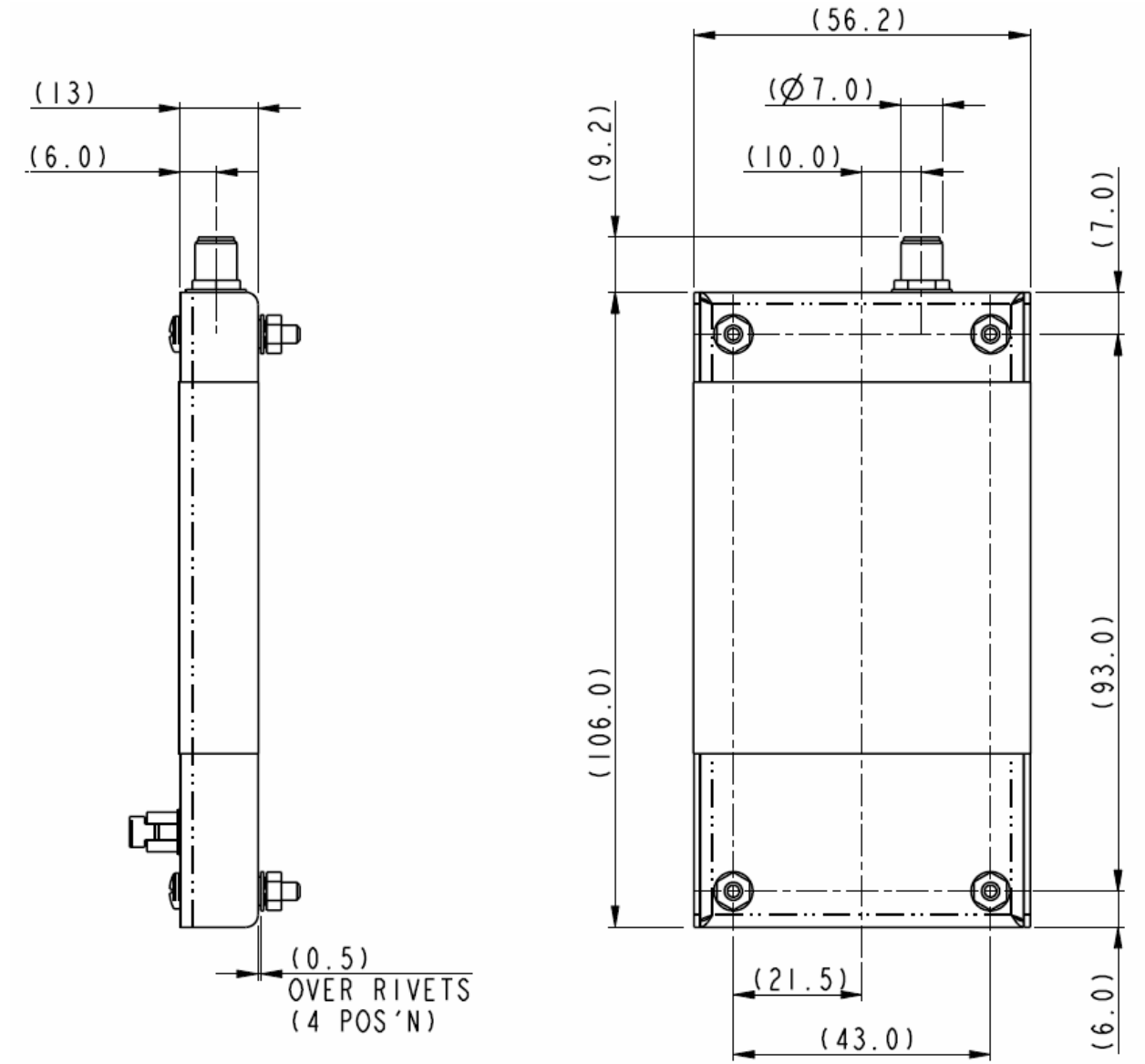
Figure 2 (Part 2 of 3): Dimensions of the 9601 SBD Transceiver.
[Note that the screws and nuts are shown for illustrative purposes only.]
(Not to scale, dimensions in millimeters)

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11
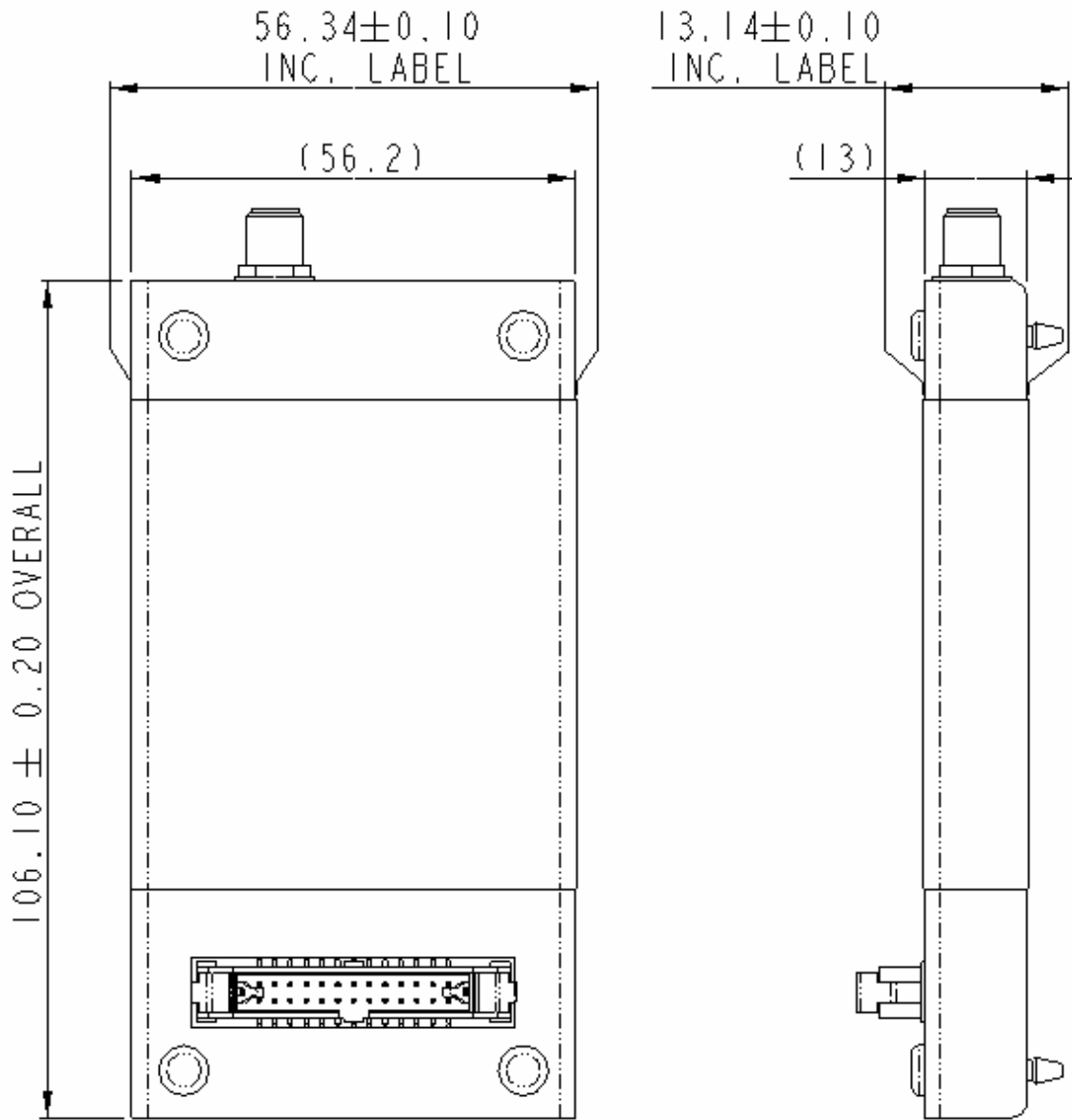
Figure 2 (Part 3 of 3): Dimensions of the 9601 SBD Transceiver.
[Note: Plastic transportation pegs are shown in this diagram, they should be replaced with developer provided mounting during integration into a final product.]
(Not to scale, dimensions in millimeters)

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12

2.2 *Mechanical Dimensions – Mounting*

The 9601 SBD Transceiver is provided with four mounting holes, one at each corner. During manufacture four plastic pegs are inserted for shipping purposes. These pegs need to be removed for mounting. There are two basic options for mounting – stackable and mounting to a surface such as a mounting plate or enclosure wall. The following sections provide further information.

Mounting - Stackable Design

An example stackable design is shown in Figure 3.
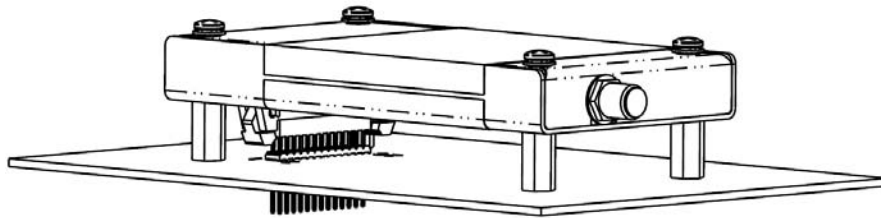
Figure 3: 9601 SBD Transceiver mounted to a unpopulated PCB.

The figures and tables below provides mechanical information design information for a suitable 'stackable' 9601 to developer PCB configuration
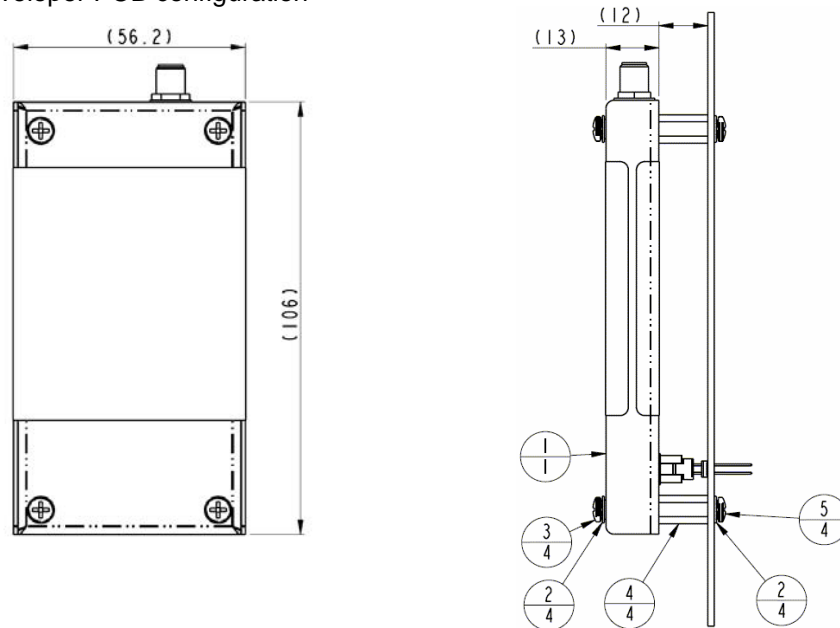
Figure 4: Assembly Item Number Identification.
[Note: Item Numbers in Figure 4 are described in Table 3.]
Not to scale. Dimensions in millimeters.

Table 3: Item Number Description for Figure 4

Item	Type	Description	Quantity
1	Assembly	9601 SBD Transceiver	1
2	Part	M3 Shake-proof washer, zinc plated steel [not supplied]	8
3	Part	M3 x 20 Pan head screw, pozidrive, zinc plated steel [not supplied]	4
4	Part	M3 Threaded standoff, 6.0 A/F HEX x 12.00 mm [not supplied]	4
5	Part	M3 x 8 Pan head screw, pozidrive, zinc plated steel [not supplied]	4
6	Assembly	Solution developer PCB fitted with Samtec connector ESQT-113-02-L-D-425. [This item is the same item as Item 1 in Figure 5.]	1
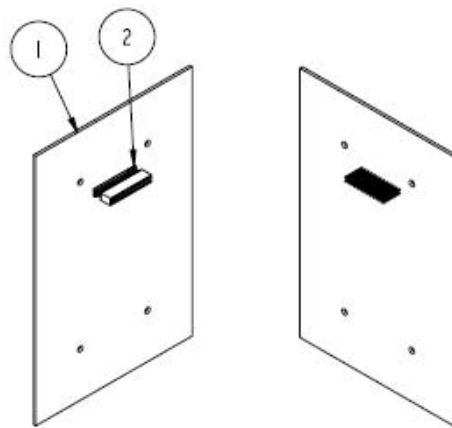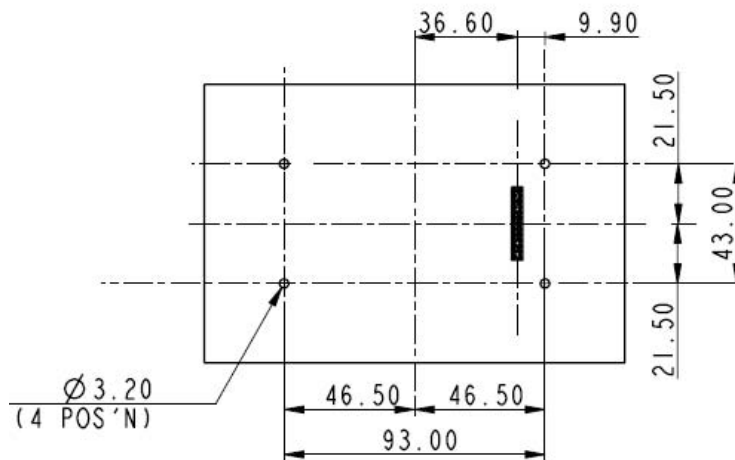
Figure 5: Mechanical mounting foot print for use when stacking the 9601 with a developer provided PCB.
(Dimensions in millimeters, not to scale)

Notes for Figure 5:

1. Item 1 is a generic, developer provided PCB design and shown for illustrative purposes. This item is the same as Item 6 in Figure 4.
2. Item 2 is available from Samtec in a variety of heights. This example shows a 0.425" version. The part number for this connector is ESQT-113-02-L-D-425
3. Compatible heights of stand-offs and variants on Item 2 are as follows:
    a. 0.425" height (shown) fits with 12mm high spacers
    b. 0.327" height is minimum that can be used. Fits with 9.50mm spacers.
    c. 0.800" height is the maximum height available fits with 21.50mm spacers.
    d. Anything else in-between should work if 'Samtec height' = 'Spacer height' minus 1.20mm.
4. Suggested examples of spacer types and compatible fasteners:
    a. M3 threaded thru' hole 6.0 A/F Hex x 12mm, use M3 x 20 screws and washers, with M3 x 8 screws and washers.
    b. Plain thru' hole diameter 3.2-3.5, diameter 6.0 x 9.50mm, use M3 x 30 screws, with M3 x 8 screws and washers.
    c. Plain thru' hole diameter 3.2-3.5, diameter 6.0 x 21.50mm, use M3 x 35 screws with M3 x 8 screws and washers.

2.2.1 Mounting to a Panel/Surface – For use with cable connections

An example of mounting to a panel or other surface design is shown in Figure 6.
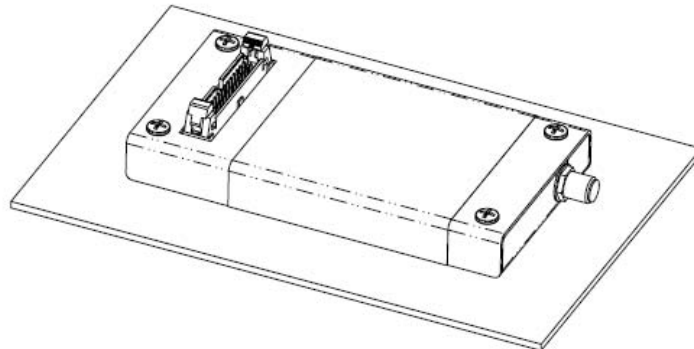
Figure 6: 9601 SBD Transceiver mounted to a plate or surface.

The figures and tables below provide mechanical information design information for a mounting a 9601 to a plate or surface configuration
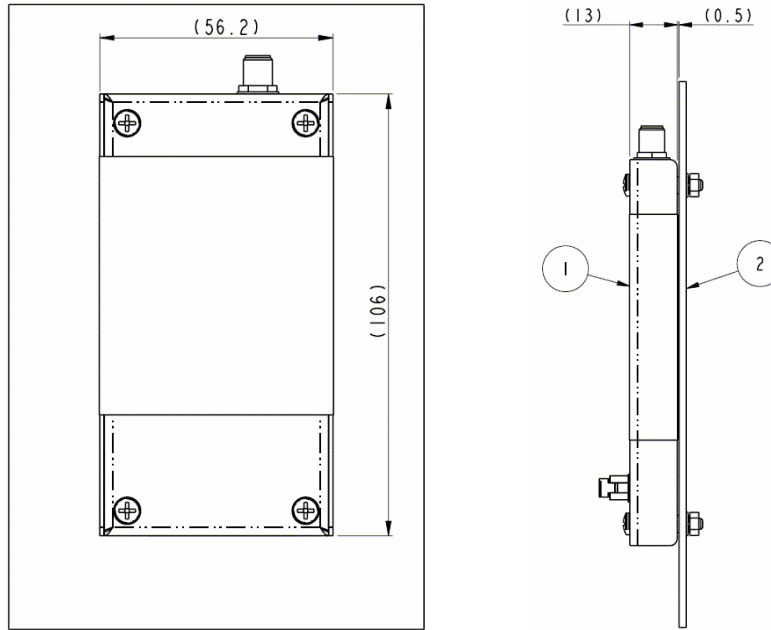
Figure 7: Assembly Item Number Identification.
[Note: Item Numbers in Figure 7 are described in Table 4.]
(Not to scale. Dimensions in millimeters.)

Notes for Figure 7:
1. Item 1 includes 4 off M3 x 20 shipping screws, shake-proof washers and nuts
2. Shipping screws can be used to attach Transceiver to panel of 2.00 mm maximum thickness
3. Panels thicker than 2.00mm require longer screws to be e.g. M3 x 25mm
4. See Figure 8 for mounting hole dimensions

Table 4: Item Number Description for Figure 7

Item	Type	Description	Quantity
1	Assembly	9601 SBD Transceiver	1
2	Part	Mounting Plate or Surface (developer provided)	1
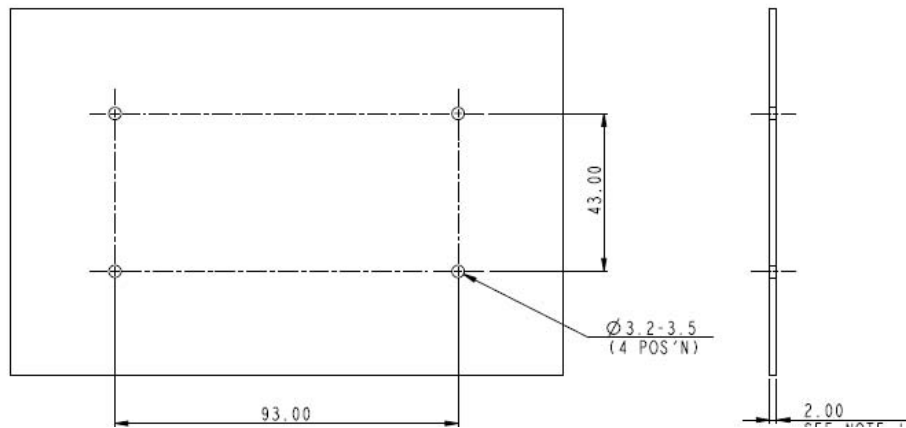
Figure 8: Mechanical mounting footprint for use when panel-mounting the 9601.
(Dimensions in millimeters, not to scale)

2.3 *Environmental*

The environmental specifications of the 9601 are summarized in Table 5 below.

Table 5: Environmental Specifications

Parameter	Value
Operating Temperature Range	-35ºC to + 70ºC
Operating Humidity Range	≤ 75% RH
Storage Temperature Range	-40ºC to + 85ºC
Storage Humidity Range	≤ 93% RH

The 9601 has been tested to the specifications listed in Table 6.

Table 6: Environmental Tests

Test Name	Test Reference	Test Description
Thermal Shock	EN60068-2-14:2000	Change of Temperature, -35°C to +70°C, 5 cycles of 1 hour each
Humidity	IEC60068-2-2:1996	Damp heat steady state 40C 93% RH for 4 days
Shock	EN60068-2-27:1993 (NF c20-727)	
Shock	J1455 Society of Automotive Engineers	
Vibration	EN 60068-2-36:1996	Sinusoidal Vibration 0.96 m2/s3 from 5Hz to 20Hz
Vibration	IEC 60068-2-36:1996	Sinusoidal Vibration 21Hz to 500Hz -3dB per octave
Vibration	J1455 Society of Automotive Engineers	

2.4 *Interface Connectors*

The 9601 SBD Transceiver incorporates two connectors:

- A multi-interface connector
- An antenna connector

These interfaces are described in more detail in Sections 3 and 4 respectively.

3.0 Electrical Interfaces

The subsections to follow contain information for the electrical interfaces of the 9601 SBD Transceiver.

3.1 *Multi-Interface Connector*

The multi-interface connector includes five interfaces:

- DC power supply input
- Power on/off control
- RS-232 Serial data
- Network available output
- DC power output

3.1.1 Connector Type

The connector on the 9601 is a Samtec EHT series. This connector provides the ability for both a cable connector as well as a stackable board to board connection. For cable connected applications use the Samtec TCSD series. For PCB stacking use the Samtec ESQT series.

Data sheets on these connectors can be found at:

EHT Series: http://www.samtec.com/technical_specifications/overview.asp?series=EHT
TCSD Series: http://www.samtec.com/technical_specifications/overview.asp?series=tcsd
ESQT Series: http://www.samtec.com/technical_specifications/overview.asp?series=esqt

A suitable connector is the EHT-113-01-SM-D-SM.

3.1.2 Connector Pin Allocation

The user connector is a 2-row 26-way latching header. Individual pin assignments are shown in Table 7. Multiple supply grounds are provided and all supply and supply grounds (pins 1-6) are required to be connected to the power supply in order to limit the current on any one pin. The three Supply Returns (pins 4, 5 & 6) are tied together at the connector as well as the three Supply pins (pins 1, 2 & 3.) Note that any cable used to supply power to the transceiver can be no longer than 152mm (6 inches) from the power source to the connector. Multiple signal grounds are provided to reduce cross-talk. The signal grounds on pins 10,13, 20 & 23 are all tied together at the connector and can be joined with any of the signal wires e.g. RS232, Network Available etc. However each signal requires its own signal ground in order to limit current on any one pin.

Table 7: Multi Interface Connector Pin Allocation

Pin No.	Signal Name	Signal direction (WRT 9601)	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_PWR	Input	Supply	+5 V +/- 0.5 V
4	EXT_GND		Supply return	0 V
5	EXT_GND		Supply return	0 V
6	EXT_GND		Supply return	0 V
7	ON/OFF	Input	On/Off control input	On: 2.0V to Vsupply Off: 0V to 0.5V I = 120 µA max
8	Reserved			
9	Reserved			
10	SIG_GND		Signal ground	0V
11	DF_S_TX	Input	Data port, serial data into 9601	RS-232
12	DF_S_RX	Output	Data port, serial data from 9601	RS-232
13	SIG_GND		Signal ground	0V
14	DF_ DCD	Output	Data port, Data Carrier Detect	RS-232
15	DF_ DSR	Output	Data port, Data Set Ready	RS-232
16	DF_ CTS	Output	Data port, Clear-to-Send	RS-232
17	DF_RI	Output	Data port, Ring Indicator	RS-232
18	DF_ RTS	Input	Data port, Request-to-Send	RS-232
19	DF_ DTR	Input	Data port, Data Terminal Ready	RS-232
20	SIG_GND		Signal ground	0V
21	Reserved			
22	Reserved			
23	SIG_GND		Signal ground	0V
24	NETWORK_ AVAILABLE	Output	Set to logic 1 when network is visible	2.9 V CMOS
25	Spare			
26	+2V9	Output	Supply output	+2.9 V ± 0.15 V, 50mA maximum

Figure 9 provides a reference for the pin designation. Note that this designation is when looking into the multi-interface connector from above. It is not to scale and not representative of the actual connector mechanical layout.
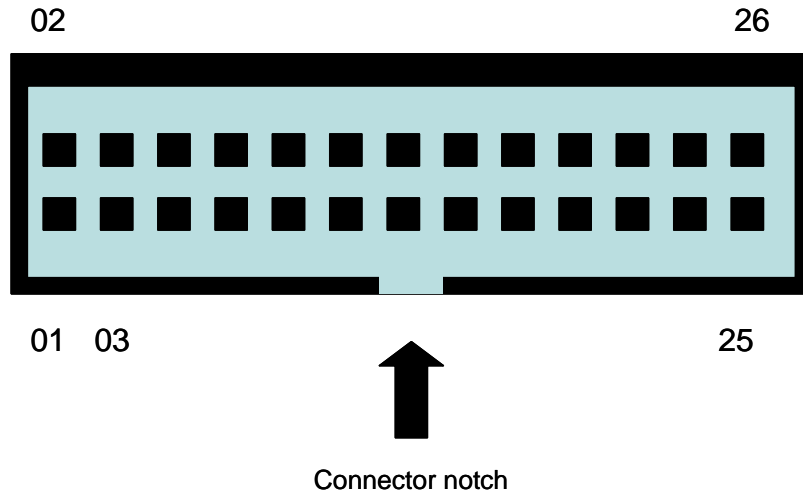
Figure 9: Multi-Interface Connector Pin Number Designation

Notes:
1. View looking into connector from above
2. Numbers indicate pin designations
3. Not to scale, for illustrative purposes only
4. Note location of connector notch
5. Connector notch faces towards opposite end to the antenna connector as shown in Figure 10
6. On the physical connector Pin 1 is indicated by an arrow mark
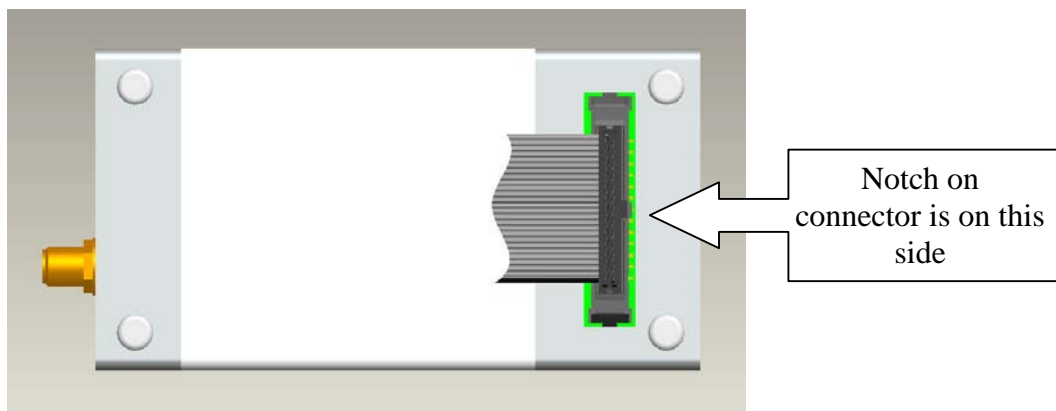
Figure 10: Multi Interface Connector Notch Location

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 three +5V Inputs and three 0V supply returns are used to supply DC power to the 9601 and ensure that enough current can be drawn across the connector without the 9601 malfunctioning during transmit due to lack of current supply. Note that all six pins should be connected.

The DC power supply requirements for the 9601 are summarized in Table 8 below. Note that these requirements apply to DC power measured at the 9601 multi-interface 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 9601.

Table 8: DC Power Input Specifications

Parameter	Value
Main Input Voltage Range	+4.5 VDC to +5.5 VDC
Main Input Voltage Nominal	5.0VDC
Main Input Voltage – Ripple	40 mV pp
Consumption at +5.0 VDC	*Value*
Input Standby Current (average)	66mA
Peak Transient Current – Transmit	1.5 A
Current Average* – when SBD message transfer in process	<= 350 mA
Average Power consumption – when SBD message transfer in process	<= 1.75 W

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

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

- The supply voltage droop over an 8.3mS burst should not be more than 0.2 Volts.
- The power supply should limit the in-rush current to 4 Amps maximum
- The supply noise should be less than that in the following profile (linear interpolation between these points):
    - 100 mV pk-pk 0Hz to 50 kHz
    - 5 mV pk-pk in 50 kHz bandwidth at 1 MHz
    - 10 mV pk-pk in 1 MHz bandwidth at 1 MHz
    - 5 mV pk-pk in 1 MHz bandwidth above 5 MHz.

Note that any cable used to supply power to the transceiver can be no longer than 152mm (6 inches) from the power source to the connector.

3.2.1 Power On/Off Control

An external on/off input is provided on a pin of the multi-interface connector. The 9601 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. The input logic high threshold is 2.0 V and the logic low threshold is 0.5 V.

Note that this on/off control is **not** the same as the 9522 or 9522A.

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21

When a transceiver has been turned off, application developers should not reapply power on a unit until more than 1.5 seconds has elapsed after power has reached 0V. Additionally if a unit does not respond to AT commands power off the unit for 2 seconds then power back on.

3.2.2 Typical Power Usage Profile

This section is designed to give the application developer some insight to the electrical power profile that the 9601 uses. It does not describe every situation and permutation possible. It should be used as a starting point for the application developer to continue their 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 VSWR the higher the current consumed
3) Application programming
4) Possible manufacturing variation from transceiver to transceiver. [I.e. the transceiver still meets specification, but over a large sample size some may operate better than average.]

The application designer should be sure not to use best case numbers for average, expected or worse case scenarios. Figure 11 provides a graphical representation of the typical supply current profile of a 9601 SBD Transceiver sending and receiving SBD messages.
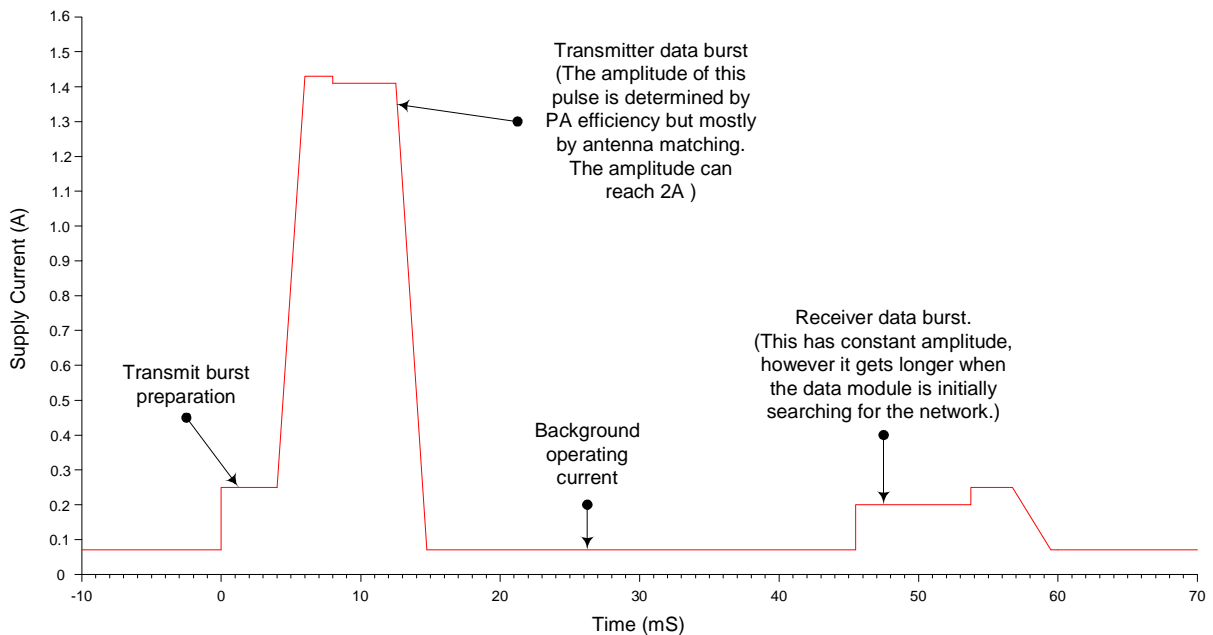
Figure 11 – Typical Supply Current Profile

Description:

(A) Transmit burst preparation: As the 9601 gets ready to send the data burst, it turns on various parts of the transmitter chain and transfers the message into the DSP to be formatted for transmission. This first part of the pulse is nominally 170mA and lasts for 4mS.

(B) Transmitter data burst: The final part of the preparation stage is to power up the power amplifier (PA). Once power is available, and synchronized to the system framing, the formatted burst is clocked into the DAC, which causes the PA to draw the high current pulse. This pulse is 9mS long, but the amplitude is variable upon the RF matching into the antenna. Generally a high VSWR will use more current. For example, into an open circuit antenna port, the 9601 can use between 1.4A and 2A, dependant upon the phase of the mismatch. For power critical applications a good antenna and cable will be required.

(C) Background operating current: Whenever the 9601 is turned on the nominal supply current will be 70mA.

(D) Receiver data burst: The receive data burst current pulse is 14mS long, and is initially 200mA, rising to 247mA for the last 5mS, as the 9601 turns on various parts of the receiver, to capture the data burst from the satellite.

Figure 12 shows an oscilloscope plot of a single frame:
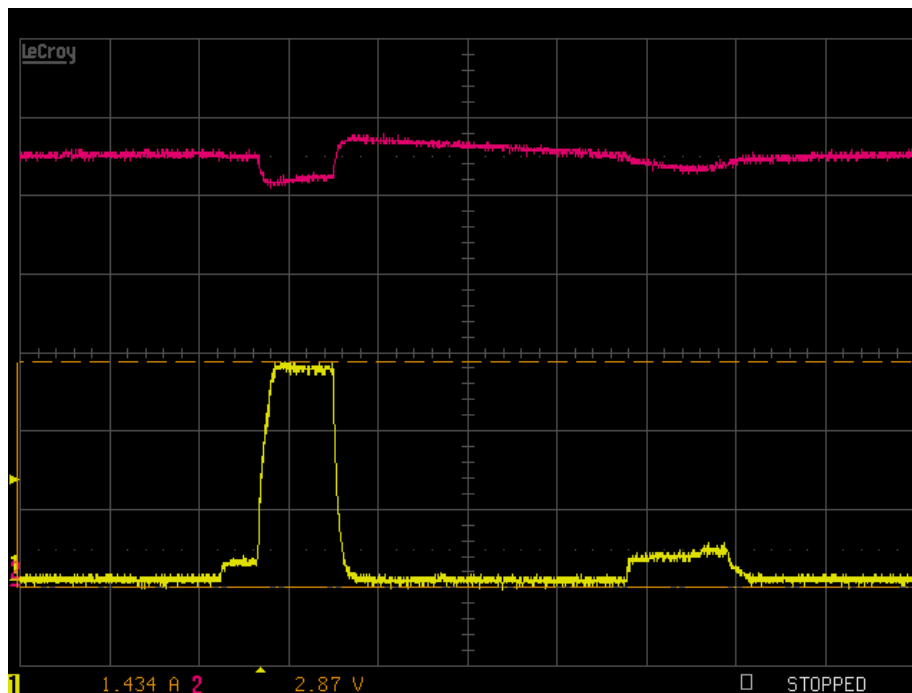
Figure 12 Single Frame Current Profile for the 9601

The scales for the above plot are:

Time base	10mS / cm
Current (Yellow trace)	0.5A / cm
Voltage (Red trace)	1V / cm

Both traces are zero referenced on the first graticule line from the bottom of the plot. The upper trace is the 5V supply rail measured at the Test Interface Connector (TIC) box. The power supply was set for 5.5V and configured for remote sensing, which gives rise to the voltage overshoot at the end of the transmit burst.

Figure 13 shows an oscilloscope plot of five transmit and receive frames:
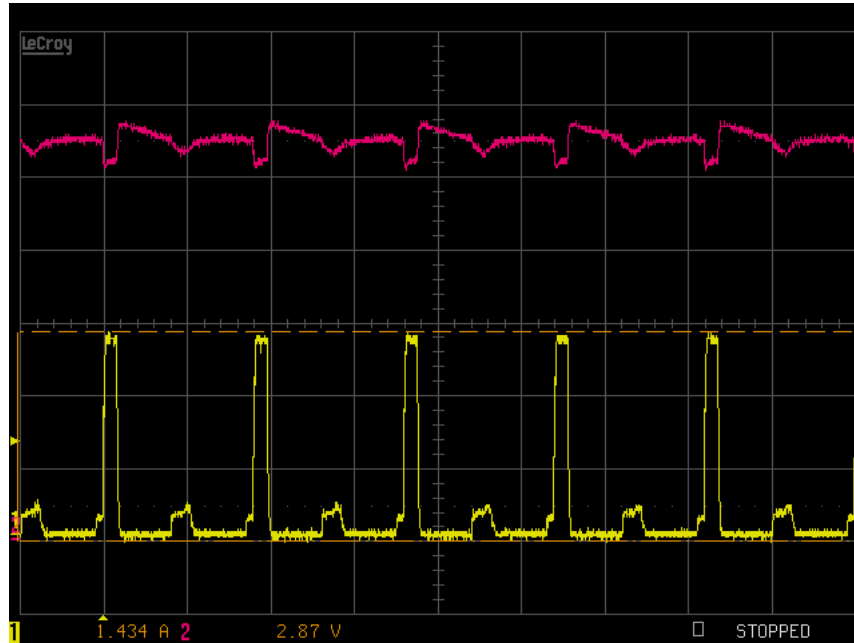
Figure 13 Current Profile for Five Frames for the 9601

The scales for the above plot are:

Time base	50mS / cm
Current (Yellow trace)	0.5A / cm
Voltage (Red trace)	1V / cm

Both traces are 0 referenced on the first graticule line from the bottom of the plot. The upper trace is the 5V supply rail measured at the tick box. The power supply was set for 5.5V and configured for remote sensing, which gives rise to the voltage overshoot at the end of the transmit burst.

3.3 *Serial Data Interface*

The Serial data interface is used to both command the 9601 and transfer user data to and from the Transceiver. The 9601 presents a 9-wire data port to the FA (Field Application), where the interface is at RS232 levels. With respect to this interface, the 9601 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 "9601" and "DCE".

Autobaud is not supported in 9601 SBD Transceiver. The baud rate can be set via the AT+IPR command. The default rate is 19200 bps.

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24

3.3.1 9-Wire and 3-Wire Operation

By default, the serial interface operates as a 9-wire connection. Table 9 describes each of the signals, where "input" means an input to the 9601, and "output" means an output from the 9601 SBD Transceiver.

Table 9 – Serial Interface Signals

Signal	Description
RX	Active high data output [The DTE receives the data from the 9601]
TX	Active high data input [Data is transmitted from the DTE to the 9601]
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 9601 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 9601 will stop responding to AT commands until the data port is returned to DCE mode.
DSR	Active low handshaking output The 9601 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 9601 is powered up and ready to receive AT commands.
RI	Active low ring indicator output The 9601 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 9601 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. 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)

Note: 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).

3.3.2 Configuration Settings

The 9601 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 9601 power-up through use of the AT&Yn command. The 9601 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.

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26

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 9601. 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 9601 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 9601 suspends transfer of data to the DTE; when CTS is OFF (high), the 9601 expects the DTE to suspend transfer of data to the 9601.

When in SBD session mode, the 9601 is attempting to conduct an SBD session with the network. In SBD session mode:
- The DTE must wait for the +SBDI 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 9601 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 9601 serial port (RTS, DTR and TXD) will operate correctly at TTL signal levels (logic low 0.4 V max, logic high 2.4V min) or RS-232 levels up to +/- 25 Volts. Because the circuit for the data port is an RS-232 receiver the lowest logic low and highest logic high are rated to +/- 25 Volts. The transition voltage point (transition from a Low to a High is at about 1V (Above 1V = a high; below 1V = Low).

RS-232 transmitters and receivers always invert. Thus if you use these inputs at logic level you would need to invert these signals using logic-level inverters.

3.3.4.2 Data Port Outputs

The five outputs from the 9601 serial port (DCD, DSR, CTS, RI and RXD) are all at RS-232 levels of approximately +/- 7 Volts no load (manufacturing test limits are 6 to 8 Volts). With a 3 kOhm load the output is +/- 6.4 Volts.

3.4 *Hardware Failure Reporting*

If the 9601 detects a hardware problem during initialisation, the 9601 may be unable to function correctly. The 9601 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 application 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 9601 can successfully receive the Ring Channel, or, put more simply, it can see a 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 9601 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 by 96 frames up to a maximum of 1344 frames, or 121 seconds.

If Network Available is currently off, the Field Application may still attempt an SBDI session. This will force the 9601 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 9601 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 Power Output*

A limited power output can be provided by the 9601 which could be used for driving an LED to provide a visible indication that the transceiver is on, or the output could be used in application logic to determine if the transceiver is on.

4.0   RF Interface

This section describes the physical connector and RF specifications of the RF Interface.

4.1 *Antenna Connector*

The 9601 will have the following antenna connector characteristics as described in Table 10.

Table 10: 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 9522 and 9522A)
- Existing antennas will require different RF connector types to those for the 9522 and 9522A

4.1.1 Antenna Connector Type

The antenna connector on the 9601 is a female SMA type. SMA nut is tightened at the factory to 3lbf.in. The connector is manufactured by Johnson Components and has a part number: 142-0701-871. Additional information can be found at:

http://www.johnsoncomponents.com/webapp/wcs/stores/servlet/ENPProductDetailView?itemid=20525&storeId=10010&catalogId=10010&langId=-1

A data sheet may be downloaded from:

http://www.johnsoncomponents.com/webapp/wcs/stores/Johnson/pdfs/1420701871.pdf

4.2 *RF Interface Specifications*

The RF interface requirements for the 9601 are summarized in Table 11 below.

Table 11: General RF Parameters

Parameter	Value
Frequency Range	1616 MHz to 1626.5 MHz
Duplexing Method	TDD (Time Domain Duplex)
Oscillator Stability	± 1.5 ppm
Input/Output Impedance	50Ω
Multiplexing Method	TDMA/FDMA

4.3 *Radio Characteristics*

The tables within this section contain radio characteristics of the 9601 SBD Transceiver.

Table 12: Radio Characteristics

Parameter	Value
Average Power during a transmit slot (max)	1.6 W
Receiver sensitivity	-118dBm
Max Cable loss permitted (Note 2)	2dB
Link Margin – Downlink (Note 3)	13dB
Link Margin – Uplink (Note 3)	7dB

Note 1: This Transceiver has a different antenna connector to other Iridium transceivers

Note 2: Cable losses should be minimized. **Note that the total implementation loss for an antenna, connectors, cable, lightening arrestor and any other RF component between the transceiver and the antenna shall not exceed 3dB. Implementation loss higher than this will affect link performance and quality of service. Solutions with a loss higher than 3dB will not meet the requirements of Iridium Solution Certification.**

Note 3: Link Margin given for free space.

5.0   AT Command Set Description

This document specifies the AT Commands supported by the 9601 Transceiver. Informative examples are presented in Section 8.0.

The 9601 is configured and operated through the use of AT commands. Only AT Commands that are relevant to the 9601 are included. AT Commands related to functionality of the 9522 and 9522A LBTs are not included. Note that Commands may be modified, removed or added and that you should not rely on this document as a definitive statement of the functionality of the commercial 9601 Transceiver. This document will be periodically updated to reflect the addition, deletion or modification of AT Commands. Developers should also consult the software release notes for the version of software that is physically loaded on the 9601 used in applications under development. Such release notes are made available to authorized Iridium VARs and VAMs on the Iridium Developer Extranet. It is the responsibility of applications developers to check compatibility of applications software with the AT Commands on all 9601s used for both development and commercial deployments.

Applications developers should also consult the "Iridium Short Burst Data Service Developers Guide" in addition to the Commands stated herein. That guide provides significant additional information that will aide in developers understanding of the Iridium system.

5.1 *AT – ATtention Code*

This is the prefix for all commands except $A/$. When entered on its own, the 9601 will respond OK.

5.2 *A/ - Repeat Last Command*

Repeat the last command issued to the 9601 unless the power was interrupted or the unit is reset. A/ is not followed by <CR>.

5.3 *En – Echo*

Echo command characters.

      0 Characters are not echoed to the DTE.

      1 Characters are echoed to the DTE (default).

5.4 *In – Identification*

Requests the 9601 to display information about itself.

0	"2400" (for compatibility only)
1	"0000" (for compatibility only)
2	"OK" (for compatibility only)
3	"XXXXXXX" (Software revision level)
4	"IRIDIUM 9600 Family" (Product description)
5	"8816" (for compatibility only)
6	"XXX" (Factory identity)
7	"XXXXXXXX" (Hardware specification)

5.5 *Qn – Quiet Mode*

Control 9601 responses.

0	9601 responses are sent to the DTE (default).
1	9601 responses are NOT sent to the DTE.

5.6 *Vn – Verbose Mode*

Set the response format of the 9601, which may be either numeric or textual.

0	Numeric responses.
1	Textual responses (default).

5.7 *Zn – Soft Reset*

Reset the 9601's data port to a user-stored configuration that has been previously stored using $\&Wn$.

0	Restores user configuration 0.
1	Restores user configuration 1.

5.8 *&Dn – DTR Option*

Set the 9601 reaction to the DTR signal.

0	DTR is ignored. A DTR signal input is not needed when set to &D0.
1-3	DTR must be ON. If DTR transitions from ON to OFF, the data port will be locked after approximately 10 seconds to enter the UART test mode. The data port will resume when DTR is restored to ON.
	There is no distinction between settings 1-3. (Default is 2)

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32

5.9 *&Fn – Restore Factory Settings*

Recall factory default configuration without resetting the data port.

> 0   Recall factory default 0.

5.10 *&Kn – Flow Control*

Select the flow control method between the 9601 and DTE. Flow control is only applied to the transfer of SBD message data; it does not apply to AT commands and their responses.

> 0   Disables flow control.
>
> 3   Enables RTS/CTS flow control (default).

5.11 *&V – View Active and Stored Configuration*

View the current active configuration and stored profiles.

5.12 *&Wn – Store Active Configuration*

Store the active profile in non-volatile memory. This is used to store user configurations for later use.

> 0   Store current (active) configuration as profile 0.
>
> 1   Store current (active) configuration as profile 1.

5.13 *&Yn – Designate Default Reset Profile*

Select profile for use after power-up.

> 0   Select profile 0 (default).
>
> 1   Select profile 1.

5.14 *%R – Display Registers*

Display all the S-registers in the system.

5.15 **F – Flush to Eeprom*

Flush all pending writes to Eeprom, shut down the radio, and prepare the 9601 to be powered down. The command returns OK upon completion, at which point it is safe to remove the power without losing non-volatile data.

Note: This command stops the 9601 from responding to any more commands, but does not actually power it down. The only way to power down the 9601 is for the FA to remove the power or to de-assert the on/off control line.

Note: After an SBD session, the new SBD MOMSN is always flushed to Eeprom before the +SBDI result is issued.

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33

5.16 *Rn – Radio Activity

Control radio activity.

> 0   Disable radio activity.

> 1   Enable radio activity (default).

While the radio is disabled:

- SBD sessions can not be initiated; they will fail immediately.

- No SBD Automatic Notifications will be issued for automatic-MT messages.

- No registration, i.e. location updates will be performed.

- The baseband circuitry is still active and the 9601 still accepts AT commands.

This command allows the FA to reduce detectable emissions from the RF circuitry during the idle periods between SBD sessions, and also provides some, limited, power saving in cases where it may be inconvenient for the FA to power down the 9601.

5.17 +CGMI – Manufacturer Identification

Exec Command: **+CGMI**

Query the 9601 manufacturer.

5.18 +CGMM – Model Identification

Exec Command: **+CGMM**

Query the 9601 model.

5.19 +CGMR – Revision

Exec Command: **+CGMR**

Query the 9601 revision.

5.20 +CGSN – Serial Number

Exec Command: **+CGSN**

Query the 9601 IMEI.

5.21 +CIER – Indicator Event Reporting

Set Command: +CIER=[<mode>[,<sigind>[,<svcind>]]]

The set command enables or disables sending of the +CIEV unsolicited result code from the 9601 to the DTE in case of indicator state changes. <mode> controls the processing of the +CIEV unsolicited result codes.

<mode>:

    0   Disable indicator event reporting; do not send +CIEV unsolicited result codes to the DTE; buffer the most recent indicator event for each indicator in the 9601 (default).

    1   Enable indicator event reporting; buffer the most recent +CIEV unsolicited result code for each indicator when the data port is reserved (e.g. in SBD data mode) and flush them to the DTE after reservation; otherwise forward them directly to the DTE.

<sigind>:

Control reporting of "signal quality" indicator changes:

    0   No "signal quality" indicator reporting.

    1   Enable "signal quality" indicator reporting using result code

        +CIEV:0,<rssi>

        where <rssi> is:

        0   Equivalent to 0 bars on the signal strength indicator
        1   Equivalent to 1 bars on the signal strength indicator
        2   Equivalent to 2 bars on the signal strength indicator
        3   Equivalent to 3 bars on the signal strength indicator
        4   Equivalent to 4 bars on the signal strength indicator
        5   Equivalent to 5 bars on the signal strength indicator

The reported signal strength is the same value that would be returned by the +CSQ command.

When enabled, the signal quality indicator is reported only when the signal strength changes.

<svcind>:

Control reporting of "service availability" indicator changes:

    0   No "service availability" indicator reporting.

    1   Enable "service availability" indicator reporting using result code

        +CIEV:1,<value>

        where <value> is:

        0   Network service is currently unavailable.
        1   Network service is available.

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35

Network service availability is equivalent to a signal strength greater than 0.   The service availability indicator provides a way for the FA to wait until the 9601 can start an SBD session without receiving continual notifications of changes in signal strength.

Read Command: +CIER?

Query the current indicator event reporting settings. The response is of the form:

> +CIER:<mode>,<sigind>,<svcind>,<antind>

Where <antind> is not used.

Test Command: +CIER=?

List the supported settings. The response is in the form:

> +CIER:(supported <mode>s),(supported <sigind>s),(supported <svcind>s) ,(supported
> <antind>s)

Note: In <mode> 1, the DTE may miss some indicator state changes if they occur while the data port is reserved.   However, the buffering mechanism ensures that the *most recent* change for each indicator during reservation will be flushed to the DTE after reservation; thus the DTE is always made aware of the latest state of each indicator.

Note: The DTE may initiate an SBD session even if service is unavailable; in this case, the 9601 makes an immediate search for the network and, if successful, starts the SBD session, otherwise the SBD session fails.

5.22 +CRIS – Ring Indication Status

Exec Command: +CRIS

Query the ring indication status, returning the reason for the most recent assertion of the Ring Indicator. The response contains separate indications for telephony and SBD ring indications.

The response is in the form:

+CRIS:<tri>,<sri>

where <tri> indicates the telephony ring indication status (for compatibility):

> 0   No telephony ring alert received.

and <sri> indicates the SBD ring indication status:

> 0   No SBD Ring Alert received.

> 1   SBD Ring Alert received.

Note: The <tri> response is included for compatibility with 9522A applications. The results in the <tri> response should be ignored for 9601 applications. For the 9601 only the <sri> response should be evaluated.

5.23 +CSQ – Signal Quality

Exec Command: +CSQ[F]

Execution command returns the received signal strength indication <rssi> from the 9601. Response is in the form:

+CSQ:<rssi>

where:

<rssi>:

0	Equivalent to 0 bars displayed on the signal strength indicator.
1	Equivalent to 1 bar displayed on the signal strength indicator.
2	Equivalent to 2 bars displayed on the signal strength indicator.
3	Equivalent to 3 bars displayed on the signal strength indicator.
4	Equivalent to 4 bars displayed on the signal strength indicator.
5	Equivalent to 5 bars displayed on the signal strength indicator.

Test Command: +CSQ=?

List the supported signal strength indications. The response is in the form:

+CSQ:(supported <rssi>s)

Note: A signal strength response may not be immediately available, but will usually be received within two seconds of issuing the command. If the 9601 is in the process of acquiring the system, a delay in response of up to 50 seconds may be experienced.

Note: The +CSQF form of the command returns immediately, reporting the last known calculated signal strength. Note that the signal strength returned by this command could be different from the current actual signal strength if the +CSQ form is used. This form is included for developer application compatibility as it provides a <u>F</u>ast response.

5.24 +CULK – Unlock

Exec Command: +CULK=<unlock key>

Unlock the Transceiver after it has been locked by the Gateway. The unlock key must be obtained by contacting Iridium's customer support.

<unlock key>:

> 0000000000000000 .. FFFFFFFFFFFFFFFF
> A string of 16 hexadecimal digits.

While the Transceiver is locked, it is unable to perform any SBD sessions. Any attempts to start a session will return an error code indicating that the Transceiver is locked.

Command Response:

> +CULK:<status>

where:

<status> indicates the lock status of the Transceiver following the unlock attempt:

> 0 Unlocked – Transceiver is not locked and is permitted to perform SBD sessions.
>
> 1 Locked – Transceiver is locked and unable to perform SBD sessions. It must be unlocked by supplying the correct unlock key to the +CULK command.
>
> 2 Permanently locked – Transceiver is locked and unable to perform SBD sessions. It cannot be unlocked and must be returned to the supplier.

Read Command: +CULK?

Query the current lock status of the Transceiver. The response is of the form:

> +CULK:<status>

<status>:

> 0 Unlocked
>
> 1 Locked
>
> 2 Permanently locked

5.25 +GMI – Manufacturer Identification

Exec Command: +CGMI

Query the 9601 manufacturer.

5.26 +GMM – Model Identification

Exec Command: +CGMM

Query the 9601 model.

5.27 +GMR – Revision

Exec Command: +CGMR

Query the 9601 revision.

5.28 +GSN – Serial Number

***Exec Command:* +CGSN**

Query the 9601 IMEI.

5.29 +IPR – Fixed DTE Rate

***Set Command:* +IPR=<rate>**

Set the data rate at which the 9601 will accept commands. The change in data rate takes into effect after the result code (e.g., OK) is received by the DTE.

where:

<rate>:

1	600 bps
2	1200 bps
3	2400 bps
4	4800 bps
5	9600 bps
6	19200 bps (default)
7	38400 bps
8	57600 bps
9	115200 bps

***Read Command:* +IPR?**

Query the current data rate. The response is in the form:

+IPR:<rate>

***Test Command:* +IPR=?**

List the supported data rates. The response is in the form:

+IPR:(supported <rate> settings)

5.30 +*SBDWB – Short Burst Data: Write Binary Data to the ISU*

Exec Command: **+SBDWB=<SBD message length>**

This command is used to transfer a binary SBD message from the DTE to the single mobile originated buffer in the 9601. The mobile originated buffer can contain only one message at any one time.

- Once the command is entered, and the message length is acceptable, the 9601 will indicate to the DTE that it is prepared to receive the message by sending the ASCII encoded string "READY<CR><LF>" (hex 52 45 41 44 59 0D 0A) to the DTE.

- The <SBD message length> parameter represents the length, in bytes, of the SBD message <u>not</u> including the mandatory two-byte checksum.

- The maximum mobile originated SBD message length is specified at 340 bytes. The minimum mobile originated SBD message length is 1 byte. If the <SBD message length> parameter is out of range, the 9601 issues response 3 (see below).

- Once the DTE receives the READY indication from the 9601, the SBD message must be sent from the DTE formatted as follows:
  {binary SBD message} + {2-byte checksum}

  - The checksum is the least significant 2-bytes of the summation of the entire SBD message. The high order byte must be sent first. For example if the DTE were to send the word "hello" encoded in ASCII to the 9601 the binary stream would be hex 68 65 6c 6c 6f 02 14.

- The mobile originated buffer will be empty upon power-up.

- If any data is currently in the mobile originated buffer, it will be overwritten.

Command Response:

0	SBD message successfully written to the 9601.
1	SBD message write timeout. An insufficient number of bytes were transferred to 9601 during the transfer period of 60 seconds.
2	SBD message checksum sent from DTE does not match the checksum calculated by the 9601.
3	SBD message size is not correct. The maximum mobile originated SBD message length is 340 bytes. The minimum mobile originated SBD message length is 1 byte.

5.31 +*SBDRB – Short Burst Data: Read Binary Data from the Module*

Exec Command: **+SBDRB**

This command is used to transfer a binary SBD message from the single mobile terminated buffer in the 9601 to the DTE. The mobile terminated buffer can contain only one message at any one time.

- The SBD message is transferred formatted as follows: *{2-byte message length} + {binary SBD message} + {2-byte checksum}*

  - The {2-byte message length} field represents the length, in bytes, of the SBD message not including the length field or the mandatory two-byte checksum. The high order byte will be sent first.

  - The maximum mobile terminated SBD message length is length is specified at 270 bytes (and may be increased following actual performance testing).

  - The checksum is the least significant 2-bytes of the summation of the entire SBD message. The high order byte will be sent first. For example if the 9601 were to send the word "hello" encoded in ASCII to the DTE the binary stream would be hex 00 05 68 65 6c 6c 6f 02 14.

  - If there is no mobile terminated SBD message waiting to be retrieved from the 9601, the message length and checksum fields will be zero.

- The mobile terminated message buffer will be empty upon power-up.

Command Response:

There are no response codes generated by the 9601 for this command.

5.32 +*SBDWT – Short Burst Data: Write a Text Message to the Module*

Exec Command: **+SBDWT[=<text message>]**

This command is used to transfer a text SBD message from the DTE to the single mobile originated buffer in the 9601.

The text message may be entered on the command line:

- For example, "AT+SBDWT=hello".

- The length of <text message> is limited to 120 characters. This is due to the length limit on the AT command line interface.

- The message is terminated when a carriage return is entered.

Alternatively, the text message may be entered separately:

- Upon entering the command "AT+SBDWT", the 9601 will indicate to the DTE that it is prepared to receive the message by sending the string "READY<CR><LF>" (hex 52 45 41 44 59 0D 0A) to the DTE.

- Once the DTE receives the READY indication, the text message must be sent, terminated by a carriage return.

- The length of the text message entered in this way is limited only by maximum mobile-originated SBD message length of 340 bytes.

- The mobile originated buffer will be empty upon power-up.

- If any data is currently in the mobile originated buffer, it will be overwritten.

Command Response:

For the "AT+SBDWT" form:

       0   SBD message successfully written to the 9601.

       1   SBD message write timeout. An insufficient number of bytes were transferred to 9601 during the transfer period of 60 seconds.

For the "AT+SBDWT=<text message>" form:

       OK: SBD message successfully stored in mobile originated buffer.

       ERROR: An error occurred storing SBD message in mobile originated buffer.

5.33 *+SBDRT – Short Burst Data: Read a Text Message from the Module*

***Exec Command:* +SBDRT**

This command is used to transfer a text SBD message from the single mobile terminated buffer in the 9601 to the DTE. This command is similar to +SBDRB but does not provide a length indicator or checksum. The intent of this command is to provide a human friendly interface to SBD for demonstrations and application development. It is expected that most usage of SBD will be with binary messages.

- Once the command is entered, the SBD message in the mobile terminated buffer is sent out of the port.

- This command is similar to +SBDRB except no length or checksum will be provided.

- The maximum mobile terminated SBD message length is 270 bytes.

- The mobile terminated message buffer will be empty upon power-up.

Command Response:

+SBDRT:<CR> {mobile terminated buffer}

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43

5.34 +SBDI – Short Burst Data: Initiate an SBD Session

Note: The +SBDI command is provided for backwards compatibility with existing FAs which do not use SBD Automatic Notification functionality. For SBD calls invoked with this command:

- The SBD Session Type is fixed at type 0 – MO call.

- The SBD Delivery Short Code will be the value specified by the +SBDDSC command.

- The Detach/Attach flag is fixed at the Detach setting.

- The Location Update flag is fixed at the No Update setting.

FAs requiring SBD Automatic Notification functionality should use the extended +SBDIX command.

Exec Command: **+SBDI**

This command initiates an SBD session between the 9601 and the GSS. If there is a message in the mobile originated buffer it will be transferred to the GSS. Similarly if there is one or more messages queued at the GSS the oldest will be transferred to the 9601 and placed into the mobile terminated buffer.

- The message, if any, in the mobile originated buffer will be sent from the 9601 to the GSS.

- If there is a MT-SBD message queued at the GSS it will be transferred to the 9601 and placed into the mobile terminated buffer.

Command Response:

> +SBDI:<MO status>,<MOMSN>,<MT status>,<MTMSN>,<MT length>,<MT queued>

where:

<MO status>:

MO session status provides an indication of the disposition of the mobile originated transaction. The field can take on the following values:

> 0   No SBD message to send from the 9601.
>
> 1   SBD message successfully sent from the 9601 to the GSS.
>
> 2   An error occurred while attempting to send SBD message from 9601 to GSS.

<MOMSN>:

The Mobile Originated Message Sequence Number (MOMSN) is a value assigned by the 9601 when sending a mobile-originated message to the GSS. This value is incremented each time an SBD session is successfully completed between the 9601 to the GSS. This wrap around counter can range from 0 to 65535.

<MT status>:

The MT status provides an indication of the disposition of the mobile terminated transaction. The field can take on the following values:

> 0   No SBD message to receive from the GSS.
>
> 1   SBD message successfully received from the GSS.
>
> 2   An error occurred while attempting to perform a mailbox check or receive a message from the GSS.

<MTMSN>:

The Mobile Terminated Message Sequence Number (MTMSN) is assigned by the GSS when sending a message to the 9601. This value is indeterminate if the field <MT status> is zero. This wrap around counter can range from 0 to 65535.

<MT length>:

The MT length is the length in bytes of the mobile terminated SBD message received from the GSS. If no message was received, this field will be zero.

<MT queued>:

MT queued is a count of mobile terminated SBD messages waiting at the GSS to be transferred to the 9601.

5.35 +SBDDET – Short Burst Data: Detach

Exec Command: +SBDDET

Initiates an SBD session to stop sending SBD Ring Alerts to the Transceiver from the Gateway (detach).

Command Response:

> +SBDDET:<status>,<error>

where:

<status>:

0	Detach successfully performed
1	An error occurred while attempting the detach

<error>:

Gateway-reported values

0	No error.
1..4	Reserved, but indicate success if used.
5..14	Reserved, but indicate failure if used.
15	Access is denied.

Transceiver-reported values

16	Transceiver has been locked and may not make SBD calls (see +CULK command).
17	Gateway not responding (local session timeout).
18	Connection lost (RF drop).
19..31	Reserved, but indicate failure if used.
32	No network service, unable to initiate call.
33	Antenna fault, unable to initiate call.
34	Radio is disabled, unable to initiate call (see *Rn command).
35	Transceiver is busy, unable to initiate call (typically performing auto-registration).
36..	Reserved, but indicate failure if used.

This command instructs the GSS to stop sending SBD Ring Alerts (detach) for the calling Transceiver. Successful completion of the detach command implies that the GSS has performed the requested detach action and the Transceiver will no longer receive any notifications of queued MT Messages from the GSS. This session does not transfer any MO or MT messages.

Note: A user can send an MO-SBD message and request a detach at the same time by using the +SBDI command. The +SBDI command always requests a detach.

5.36 +*SBDDSC – Short Burst Data: Delivery Short Code*

Set Command: **+SBDDSC=<dsc>**

Set the Delivery Short Code (DSC), which provides some additional options for control of MT messages. This is an 8-bit value providing the ability to set individual fields. Value 0x80 (hexadecimal) sets the most significant bit. Value 0x01 sets the least significant bit. Flag values can be added together to achieve a combination of settings. Some fields may be "locked" when the Transceiver is in a special mode (e.g. Autoregistration locks the flag values 0x80 and 0x40).

<dsc>:

0..255	DSC to be used for subsequent uploaded messages (0 default)
128	Hold MT message delivery
64	Leave MT message in queue after delivery

Read Command: **+SBDDSC?**

Query the current Delivery Short Code. The response is of the form:

+SBDDSC:<dsc>

5.37 *+SBDIX – Short Burst Data: Initiate an SBD Session Extended*

Note: The +SBDIX command must be used in place of the +SBDI command for FAs wishing to make use of SBD Automatic Notification functionality.

Exec Command: **+SBDIX[A][=<location>]**

This command initiates an SBD session between the 9601 and the GSS, setting the SBD Session Type according to the type of command +SBDIX or +SBDIXA, Delivery Short Code according to the value specified by the +SBDDSC command, and the type of location according to whether the optional location value is provided. If there is a message in the mobile originated buffer it will be transferred to the GSS. Similarly if there is one or more MT messages queued at the GSS the oldest will be transferred to the 9601 and placed into the mobile terminated buffer.

- The message, if any, in the mobile originated buffer will be sent from the 9601 to the GSS.

- If there is a MT message queued at the GSS it will be transferred to the 9601 and placed into the mobile terminated buffer.

- This command will always attempt an SBD Network Registration, consisting of attach and location update, during the SBD session in order to support SBD Automatic Notification. If this is not desired, the +SBDI command should be used.

- The FA should append an 'A' to the command, i.e. +SBDIXA, when the SBD session is in response to SBD Ring Alert. If this option is not used, more than one SBD Ring Alert may be received.

<location> has format:

   [+|-]DDMM.MMM,[+|-]dddmm.mmm

where:

DD	Degrees latitude (00-89)
MM	Minutes latitude (00-59)
MMM	Thousandths of minutes latitude (000-999)
ddd	Degrees longitude (000-179)
mm	Minutes longitude (00-59)
mmm	Thousandths of minutes longitude (000-999)

The optional sign indicators specify latitude North (+) or South (-), and longitude East (+) or West (-). If omitted, the default is +.

For example,

   AT+SBDIX=5212.483,-00007.350

corresponds to 52 degrees 12.483 minutes North, 0 degrees 7.35 minutes West.

Command Response:

   +SBDIX:<MO status>,<MOMSN>,<MT status>,<MTMSN>,<MT length>,<MT queued>

where:

<MO status>:

MO session status provides an indication of the disposition of the mobile originated transaction. The field can take on the following values:

   Gateway-reported values

   0   MO message, if any, transferred successfully.

1	MO message, if any, transferred successfully, but the MT message in the queue was too big to be transferred.
2	MO message, if any, transferred successfully, but the requested Location Update was not accepted.
3..4	Reserved, but indicate MO session success if used.
5..8	Reserved, but indicate MO session failure if used.
10	Gateway reported that the call did not complete in the allowed time.
11	MO message queue at the Gateway is full.
12	MO message has too many segments.
13	Gateway reported that the session did not complete.
14	Invalid segment size.
15	Access is denied.

Transceiver-reported values

16	Transceiver has been locked and may not make SBD calls (see +CULK command).
17	Gateway not responding (local session timeout).
18	Connection lost (RF drop).
19..31	Reserved, but indicate MO session failure if used.
32	No network service, unable to initiate call.
33	Antenna fault, unable to initiate call.
34	Radio is disabled, unable to initiate call (see *Rn command).
35	Transceiver is busy, unable to initiate call (typically performing auto-registration).
36..	Reserved, but indicate failure if used.

<MOMSN>:

The Mobile Originated Message Sequence Number (MOMSN) is a value assigned by the 9601 when sending a mobile-originated message to the GSS. This value is incremented each time an SBD session is successfully completed between the 9601 to the GSS. This wrap around counter can range from 0 to 65535.

<MT status>:

The MT status provides an indication of the disposition of the mobile terminated transaction. The field can take on the following values:

0	No MT SBD message to receive from the Gateway.
1	MT SBD message successfully received from the Gateway.
2	An error occurred while attempting to perform a mailbox check or receive a message from the Gateway.

<MTMSN>:

The Mobile Terminated Message Sequence Number (MTMSN) is assigned by the GSS when forwarding a message to the 9601. This value is indeterminate if the field <MT status> is zero. This wrap around counter can range from 0 to 65535.

<MT length>:

The MT length is the length in bytes of the mobile terminated SBD message received from the GSS. If no message was received, this field will be zero.

<MT queued>:

MT queued is a count of mobile terminated SBD messages waiting at the GSS to be transferred to the 9601.

5.38 +SBDMTA – Short Burst Data: Mobile-Terminated Alert

***Set Command:* +SBDMTA=<mode>**

Enable or disable the ISU to listen for SBD Ring Alerts.

<mode>:

      0   Disable SBD Ring Alert indication

      1   Enable SBD Ring Alert ring indication (default)

When SBD Ring Alert indication is enabled, the 9601 asserts the RI line and issues the unsolicited result code SBDRING when an SBD Ring Alert is received.

***Read Command:* +SBDMTA?**

Query the current ring indication mode. The response is of the form:

      +SBDMTA:<mode>

***Test Command:* +SBDMTA=?**

List the supported mode settings. The response is of the form:

      +SBDMTA:(supported <mode> settings)

Note: There are a number of required steps in both the ISU and the GSS in order to successfully enable SBD Automatic Notifications. Consult the SBD Developers Guide section on Automatic Notifications for Mobile Terminated Messages.

5.39 +SBDREG – Short Burst Data: Network Registration

***Exec Command:* +SBDREG[=<location>]**

Triggers an SBD session to perform a manual SBD Network Registration.

This command initiates an SBD session to perform a manual SBD Network Registration, consisting of an attach and location update.   The session type will be set to 2 – registration. This session does not transfer any MO or MT message(s).

Note: The Transceiver restricts the number of manual and automatic registrations to one every 3 minutes.   Successive attempts within 3 minutes will return an error code indicating that the FA should try later (see error 36 below).

Note: A user can send an MO SBD message and perform a SBD Network Registration at the same time by using the +SBDIX command.   The +SBDIX command always performs a SBD Network Registration attempt and should be used for an application requiring SBD Automatic Notification. The +SBDI command never includes an SBD Network registration and should be used for an application that does not require SBD Automatic Notification.

Note: If you are not using MT-SBD messages there is no requirement or benefit to using this command.

<location> has format:

      [+|-]DDMM.MMM,[+|-]dddmm.mmm

where:

DD   Degrees latitude (00-89)

MM   Minutes latitude (00-59)

MMM   Thousandths of minutes latitude (000-999)

ddd   Degrees longitude (000-179)

mm   Minutes longitude (00-59)

mmm   Thousandths of minutes longitude (000-999)

The optional sign indicators specify latitude North (+) or South (-), and longitude East (+) or West (-). If omitted, the default is +.

For example,

AT+SBDIX=5212.483,-00007.350

corresponds to 52 degrees 12.483 minutes North, 0 degrees 7.35 minutes West.

Command Response:

+SBDREG:<status>,<reg err>

where:

<status> indicates the resulting registration status of the Transceiver:

0   Detached – Transceiver is detached as a result of a successful +SBDDET or +SBDI command.

1   Not registered – Transceiver is attached but has not provided a good location since it was last detached.

2   Registered – Transceiver is attached with a good location. Note that this may be the case even when the most recent attempt did not provide a good location.

3   Registration denied – The gateway is denying service to the Transceiver.

<reg err>:

Gateway-reported values

0   No error.

2   Session completed but the requested Location Update was not accepted.

3..14   Reserved, but indicate Location Update failure if used.

15   Access is denied.

Transceiver-reported values

16   Transceiver has been locked and may not make SBD calls (see +CULK command).

17   Gateway not responding (local session timeout).

18   Connection lost (RF drop).

19..31 Reserved, but indicate failure if used.

32   No network service, unable to initiate call.

33   Antenna fault, unable to initiate call.

34   Radio is disabled, unable to initiate call (see *Rn command).

35   Transceiver is busy, unable to initiate call (typically performing auto-registration).

36   Try later, must wait 3 minutes since last registration.

37..   Reserved, but indicate failure if used.

Read Command: +SBDREG?

Query the current SBD registration status of the Transceiver. The response is of the form:

+SBDREG:<status>

<status>:

0   Detached

1   Not registered

2   Registered

3   Registration denied

4   Unknown

The SBD Network Registration status is stored in Transceiver non-volatile memory, and can therefore be queried by the FA after powering up. Note that if the transceiver is powered off and then moved any significant distance (> 150Kilometers) that the location information will be incorrect when the transceiver is subsequently powered on. It is recommended that Developers initiate a SBD Network Registration following power on if the application is using Mobile Terminated Messages in conjunction with SBD Ring Alerts.

Note: There are a number of required steps in both the ISU and the GSS in order to successfully enable SBD Automatic Notifications. Consult the SBD Developers Guide section on Automatic Notifications for Mobile Terminated Messages.

5.40 +*SBDAREG* – *Short Burst Data: Automatic Registration*

Set Command: **+SBDAREG=<mode>**

Set the Transceiver's automatic SBD Network Registration mode.

<mode>:

0	Disable Automatic SBD Network Registration (default)
1	Set the Automatic SBD Network Registration mode to "Automatic"
2	Set the Automatic SBD Network Registration mode to "Ask"

When Automatic SBD Network Registration is enabled, mode 1 or 2, the Transceiver monitors its current location and triggers an Automatic SBD Network Registration when it determines that the Transceiver has moved sufficiently far away from its last registered location. Note that Automatic SBD Network Registration runs only while the Transceiver is attached to the gateway, i.e. the registration status is "Not registered" or "Registered".

Automatic SBD Network Registration may only be used with system-provided location. If the FA is providing its own location (e.g. GPS), the FA should use the manual SBD Network Registration command, +SBDREG.

Upon triggering in mode 1, "Automatic", the Transceiver autonomously initiates an SBD session in order to perform a SBD Network Registration with the updated location of the Transceiver, with the session type set to 3 – auto-registration. This session does not transfer any MO or MT messages.

Upon triggering in mode 2, "Ask", the Transceiver reports to the FA that it should register with the system because the Transceiver location has changed (see <event> below); it is then the responsibility of the FA to register via +SBDREG or +SBDIX. +SBDIX allows the FA to register while including an MO message and/or retrieving an MT message that is pending at the Gateway.

When auto-registration is enabled, mode 1 or 2, the Transceiver reports relevant events to the FA by issuing an unsolicited result code +AREG:<event>,<reg error>.

<event>:

0	Suggest FA makes a registration attempt (mode 2 only)
1	Auto-registration has been performed successfully (mode 1 only)
2	Auto-registration has failed and will be retried after a delay (mode 1 only)

<reg error>:

Gateway-reported values

0	No error.
2	Session completed but the requested Location Update was not accepted.
3..14	Reserved, but indicate Location Update failure if used.
15	Access is denied.

Transceiver-reported values

16	Transceiver has been locked and may not make SBD calls (see +CULK command).
17	Gateway not responding (local session timeout).
18	Connection lost (RF drop).
19..31	Reserved, but indicate failure if used.
32	No network service, unable to initiate call.

33   Antenna fault, unable to initiate call.

34   Radio is disabled, unable to initiate call (see *Rn command).

35   Transceiver is busy, unable to initiate call (typically performing auto-registration).

36   Try later, must wait 3 minutes since last registration.

37..   Reserved, but indicate failure if used.

Read Command: +SBDAREG?

Query the current automatic MT registration mode. The response is of the form:

    +SBDAREG:<mode>

Test Command: +SBDAREG=?

List the supported mode settings. The response is of the form:

    +SBDAREG:(supported <mode> settings)

Note: There are a number of required steps in both the ISU and the GSS in order to successfully enable SBD Automatic Notifications. Consult the SBD Developers Guide section on Automatic Notifications for Mobile Terminated Messages.

5.41 +SBDD – Short Burst Data: Clear SBD Message Buffer(s)

Exec Command: +SBDD<Delete type>

This command is used to clear the mobile originated buffer, mobile terminated buffer or both.

- The <Delete type> parameter identifies which buffers are cleared.

    0   Clear the mobile originated buffer.

    1   Clear the mobile terminated buffer.

    2   Clear both the mobile originated and mobile terminated buffers.

- Using this command or power cycling the 9601 are the only means by which both buffers are cleared.

- The mobile terminated buffer will be cleared when an SBD session is initiated.

- Sending a message from the 9601 to the ESS does not clear the mobile originated buffer.

- Reading a message from the 9601 does not clear the mobile terminated buffer.

Command Response:

    0   Buffer(s) cleared successfully.

    1   An error occurred while clearing the buffer(s).

5.42 +SBDC – Short Burst Data: Clear SBD MOMSN

Exec Command: +SBDC

This command will clear (set to 0) the mobile originated message sequence number (MOMSN) stored in the 9601.

- The MOMSN is maintained even after power cycle.

Command Response:

0   The MOMSN was cleared successfully.

1   An error occurred while clearing the MOMSN.

5.43 +SBDS – Short Burst Data: Status

Exec Command: +SBDS

This command returns current state of the mobile originated and mobile terminated buffers.

Command Response:

+SBDS:<MO flag>,<MOMSN>,<MT flag>,<MTMSN>

where:

<MO flag>:

The MO flag indicates the existence of a message in the mobile originated buffer. The response from the 9601 is one of the following numeric codes:

0   No message in mobile originated buffer

1   Message in mobile originated buffer

<MOMSN>:

The MOMSN identifies the sequence number that will be used during the next mobile originated SBD session.

<MT Flag>:

The MT flag indicates the existence of a message in the mobile terminated buffer. The response from the 9601 is one of the following numeric codes:

0   No message in mobile terminated buffer

1   Message in mobile terminated buffer

<MTMSN>:

The MTMSN identifies the sequence number that was used in the most recent mobile terminated SBD session. This value will be –1 if there is nothing in the mobile terminated buffer.

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54

5.44 +SBDSX - Short Burst Data: Status Extended

Exec Command: +SBDSX

This command returns current state of the mobile originated and mobile terminated buffers, and the SBD ring alert status.

Command Response:

+SBDSX: <MO flag>, <MOMSN>, <MT flag>, <MTMSN>, <RA flag>, <msg waiting>

where:

<MO flag>:

The MO flag indicates the existence of a message in the mobile originated buffer. The response from the ISU is one of the following numeric codes:

0	No message in mobile originated buffer.
1	Message in mobile originated buffer.

<MOMSN>:

The MOMSN identifies the sequence number that will be used during the next mobile originated SBD session.

<MT Flag>:

The MT flag indicates the existence of a message in the mobile terminated buffer. The response from the ISU is one of the following numeric codes:

0	No message in mobile terminated buffer.
1	Message in mobile terminated buffer.

<MTMSN>:

The MTMSN identifies the sequence number that was used in the most recent mobile terminated SBD session. This value will be –1 if there is nothing in the mobile terminated buffer.

<RA flag>:

The RA flag indicates whether an SBD Ring Alert has been received and still needs to be answered.

0	No SBD ring alert.
1	SBD ring alert has been received and needs to be answered.

Note: The RA flag is set whenever the ISU receives an SBD Ring Alert; this happens even if the +SBDMTA setting specifies that SBD ring indications are disabled.

The RA flag is cleared only on successful completion of an SBD mailbox check, i.e. an SBD session invoked with +SBDI[X[A]] in which the returned MT status indicates that no error occurred.

The value of the RA flag is stored in non-volatile memory so it is preserved across power cycling of the ISU.

<msg waiting>:

The message waiting flag indicates how many SBD Mobile Terminated messages are currently queued at the gateway awaiting collection by the ISU. This flag is updated after every SBD session, including +SBDI, +SBDIX, +SBDIXA, +SBDREG and +SBDDET.

5.45 *+SBDTC – Short Burst Data: Transfer MO Buffer to MT Buffer*

Exec Command: +SBDTC

This command will transfer the contents of the mobile originated buffer to the mobile terminated buffer. Developers of DTE can use this command to test reading and writing to the 9601 without actually initiating SBD sessions with the ESS.

Command Response:

The command produces a response of the form "SBDTC: Outbound SBD copied to Inbound SBD: size = <size>" followed by "OK", where:

<size>: The length of the message in bytes.

5.46 *-MSSTM – Request System Time*

Exec Command: -MSSTM

Query the latest system time received from the network. The response is the form:

-MSSTM:<system_time>

<system_time> can take one of the following forms:

no network service	The 9601 has not yet received system time from the network.
XXXXXXX	Where XXXXXXXX is the current Iridium system time available from the network. The system time as received through the Iridium Air Interface, is a 32 bit integer count of the number of 90 millisecond intervals that have elapsed since the epoch. The return value is formatted as an ASCII hexadecimal number. The counter will rollover approximately every 12 years.

Iridium system time epoch: June 1, 1996, 00:00:13 (GMT):

Iridium system time source: The system time is available and valid only after the 9601 has registered with the network and has received the Iridium system time from the network. Once the time is received, the 9601 uses its internal clock to increment the counter. In addition, at least every 8 hours, or on location update or other event that requires re-registration, the 9601 will obtain a new system time from the network.

Time localization: None. The system time value is always expressed in GMT time.

Resolution and accuracy: The resolution of the system time is one Iridium frame tick, or 90 ms. Accuracy as measured by the difference between the time reported and the actual time it is sent out the 9601 serial port should not exceed 4 frame ticks (.36 seconds) and in most cases will be one frame tick (.09 seconds) or less.

6.0   S-Register Definitions

S-registers allow control over specific 9601 operations. Some S-registers contain a single numeric value, other S-registers are bit-mapped where individual bits, or set of bits, control specific functions.

Table 6-1 defines the S-registers used for 9601 Transceiver. Many of the 9522A Transceiver S-registers are obsolete for 9601 Transceiver, and 9601 Transceiver requires some new S-registers. To prevent reallocation of obsolete S-registers, they are reserved and shaded out in the table, and the new S-registers are registers that are unused in 9522A Transceiver and are marked as "*new for 9601 Transceiver.*"

All S-registers, from S0 to S127, are readable. All write permissions remain unchanged from 9522A Transceiver, even where a writable register is not used in 9601 Transceiver. Writable registers are highlighted in the "Sr=n writable?" column. An FA *could* use the unused writable S-registers to store application-specific data.

The final column in the table indicates which S-registers are stored in non-volatile memory as part of a user profile; the 9601 can be reset to a stored profile using the Zn command.

6.1 *S-Register Commands*

Commands allow S-registers to be read, written, or simply referenced (i.e. set a pointer to designate the current, referenced S-register). S-register commands are described in the following subsections.

6.1.1 Sr – Direct S-Register Reference

Set a pointer to reference S-register r.

6.1.2 Sr? – Direct S-Register Read

Read the value of S-register r.

6.1.3 Sr=n – Direct S-Register Write

Set the value of S-register r to n, where n is a decimal value in the range 0 to 255.

6.1.4 ? – Referenced S-Register Read

Read the value of the current referenced S-register. The current referenced S-register is that which was last acted upon by a direct reference (ATSr), read (ATSr?), or write (ATSr=n) command.

6.1.5 =n – Referenced S-Register Write

Set the value of the current referenced S-register to n. The current referenced S-register is that which was last acted upon by a direct reference (ATSr), read (ATSr?), or write (ATSr=n) command.

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57

6.2 S-Registers

Table 6-1: 9601 Transceiver S-Registers

[*Note: To prevent reallocation of obsolete S-registers, they are reserved and shaded out in the table, and the new S-registers are registers that are unused in 9522A Transceiver and are marked as "new for 9601 Transceiver."*]

Register	Range	Default	Description	Sr=n writable?	Profile Setting?
S0			Not applicable to 9601		
S1			Not applicable to 9601		
S2	0-255	43	Not applicable to 9601 Escape code character	✓	✓
S3	0-127	13	Carriage return character	✓	
S4	0-127	10	Line feed character	✓	
S5	0-32	8	Backspace character	✓	
S6			Not applicable to 9601		
S7			Not applicable to 9601		
S8			Not applicable to 9601		
S9			Not applicable to 9601		
S10			Not applicable to 9601		
S11			Not applicable to 9601		
S12			Not applicable to 9601		
S13	0-255	49	Bitmap register: bits 0-1: DCE data bits bits 2-3: DCE stop bits bits 4-6: DCE parity setting		✓
S14	0-255	170	Bitmap register: bit 1: En setting (echo) bit 2: Qn setting (quiet) bit 3: Vn setting (verbose) bit 5: Not applicable to 9601	✓	✓
S21	0-255	48	Bitmap register: bit 0: Not applicable to 9601 bit 2: Not applicable to 9601 bits 3-4: &Dn setting (DTR operation) bit 5: Not applicable to 9601 bit 6: Not applicable to 9601		✓
S22			Not applicable to 9601		

Register	Range	Default	Description	Sr=n writable?	Profile Setting?
S23	0-255	61	Bitmap register: bits 1-4: +IPR setting (DTE baud rate) bits 6-7: Not applicable to 9601		✓
S25			Not applicable to 9601		
S27			Not applicable to 9601		
S28			Not applicable to 9601		
S30			Not applicable to 9601		
S31			Not applicable to 9601		
S34			Not applicable to 9601		
S35			Not applicable to 9601		
S36			Not applicable to 9601		
S37			Not applicable to 9601		
S39	0-255	3	Bitmap register: bits 0-2: &Kn setting (flow control)		✓
S40			Not applicable to 9601		
S41			Not applicable to 9601		
S42			Not applicable to 9601		
S43			Not applicable to 9601		
S44			Not applicable to 9601		
S45			Not applicable to 9601		
S47			Not applicable to 9601		
S49			Not applicable to 9601		
S51			Not applicable to 9601		
S52			Not applicable to 9601		
S54			Not applicable to 9601		
S58			Not applicable to 9601		
S95			Not applicable to 9601		
S96			Not applicable to 9601		
S98			Not applicable to 9601		
S99			Not applicable to 9601		
S100			Not applicable to 9601		
S102			Not applicable to 9601		
S103			Not applicable to 9601		

Register	Range	Default	Description	Sr=n writable?	Profile Setting?
S104			Not applicable to 9601		
S106			Not applicable to 9601		
S107			Not applicable to 9601		
S110			Not applicable to 9601		
S111			Not applicable to 9601		
S112	0-255	0	SBD upload message sequence number (high byte)		
S113	0-255	0	SBD upload message sequence number (low byte)		
S121	0-15	1	New for 9601 Transceiver Bitmap register: bit 0: +SBDMTA setting (ring indication) bit 1-2: +SBDAREG setting (automatic registration)		✓
S122	0-31	1	New for 9601 Transceiver Bitmap register: bit 0: *R setting (radio activity) bits 1-4: +CIER setting (indicator event reporting)		✓
S123			Not applicable to 9601		
S124			Not applicable to 9601		
S125			Not applicable to 9601		
S126			Not applicable to 9601		
S127			Not applicable to 9601		

7.0 Summary of Result Codes

Table 7- 2: Result codes

Numeric (V0)	Verbose (V1)	Description
0	'OK'	Acknowledges execution of command
126	'SBDRING'	MT-SBD message(s) present at gateway (unsolicited if enabled). See section 5.38
4	'ERROR'	Command not accepted
127	'HARDWARE FAILURE: <subsys>,<error>'	Issued at initialization in case of a hardware failure.
as verbose	'READY'	Ready to receive binary message data from DTE
as verbose	'+AREG:<event>,<reg error>'	Auto-registration event report. See section 0
as verbose	'+CIEV: <sig>,<value>'	Indicator event report (unsolicited if enabled). See section 5.21

8.0 Informative Examples

8.1 *Setting the Default Configuration*

The FA sets the Transceiver's default configuration to no handshaking, no flow control, radio enabled, SBD automatic notifications enabled.

To Transceiver (from FA)	To FA (from Transceiver)	Description
AT&K0		Disable RTS/CTS flow control
	OK	
AT*R1		Enable the radio
	OK	
AT+SBDMTA=1		Enable SBD ring indications
	OK	
AT&W0		Store the configuration as profile 0
	OK	
AT&Y0		Select profile 0 as the power-up default
	OK	

8.2 *Power-on to Sending a Message*

The FA will power up the Transceiver, wait for the Transceiver to acquire the network, and send a 70-byte message.

To Transceiver (from FA)	To FA (from Transceiver)	Description
		Apply power to the 9601
		Wait for DSR to become asserted
AT+CIER=1,0,1,0		Enable service indication reporting (note that this can be stored in the default configuration)
	OK	
	+CIEV: 1,1	Wait for the 9601 to acquire the network
AT+SBDWB=70		Transfer message to 9601
	READY	
<binary transfer>		
	0	
AT+SBDIX		Perform SBD session
	+SBDIX: 0,23,0,-1,0,0	
AT+SBDD0		Clear the MO message buffer
	OK	

8.3 *Automatic Notification Registration*

The FA verifies its registration state, performs a registration in order to be able to receive automatic notifications, and enables automatic notification indications.

To Transceiver (from FA)	To FA (from Transceiver)	Description
AT+SBDREG?		Query the Transceiver registration status
	+SBDREG:0	Transceiver is detached, i.e. un-registered
AT+SBDREG		Tell the Transceiver to register for automatic notifications
	+SBDREG:2,0	Transceiver is now registered
AT+SBDREG?		Query the Transceiver registration status
	+SBDREG:2	Transceiver is registered
AT+SBDMTA=1		Enable SBD ring indications from Transceiver to FA
	OK	

8.4 *Automatic Notification Message Reception*

The FA verifies its registration state. Upon receiving a automatic notification the FA initiates an SBD session to receive an MT message.

To Transceiver (from FA)	To FA (from Transceiver)	Description
AT+SBDREG?		Query the Transceiver registration status
	+SBDREG:2	Transceiver is registered
	…	Vendor application sends an MT message to the GSS
	+SBDRING	Transceiver indicates an incoming message. The RI line also toggles.
AT+SBDIXA		FA initiates an SBD session in answer to the automatic notification
	+SBDIXA:0,23,1,237,90,2	Transceiver informs FA that a 90-byte message was successfully received with MTMSN 237, and that two further MT messages are queued at the GSS
AT+SBDRB		FA retrieves the received message from the Transceiver
	<binary transfer>	

8.5 *Automatic Notification Automatic Registration*

The FA verifies its registration state and enables automatic registration using the "Ask" mode.

To Transceiver (from FA)	To FA (from Transceiver)	Description
AT+SBDREG?		Query the Transceiver registration status
	+SBDREG:2	Transceiver is registered
AT+SBDAREG=2		FA sets the automatic registration to "Ask" mode
	OK	
	…	Transceiver is moved
	+AREG:0,0	Transceiver notifies FA that it needs to register
AT+SBDREG		FA instructs the Transceiver to register
	+SBDREG:2,0	Registration is successful

8.6 *Sending a Message with Minimal Radio Activity*

Assuming that service indication events have been turned on with AT+CIER=1,0,1, and the radio has been disabled with AT*R0.

To Transceiver (from FA)	To FA (from Transceiver)	Description
AT+SBDWB=70		Transfer message to 9601
	READY	
<binary transfer>		
	0	
AT*R1		Activate the radio and wait for the Transceiver to acquire the network
	OK	
	+CIEV:1,1	Transceiver has acquired the network
AT+SBDI		Perform SBD session
	+SBDI: 0,23,0,-1,0,0	
AT*R0		Deactivate the radio
	OK	
AT+SBDD0		Clear the MO message buffer
	OK	

8.7 *Powering Down*

The FA flushes any pending Eeprom writes before powering down the Transceiver.

To Transceiver (from FA)	To FA (from Transceiver)	Description
AT*F		FA tells Transceiver to flush pending writes to Eeprom and waits for completion
	OK	
<binary transfer>		FA may now safely disconnect the Transceiver power supply.

9.0   Table of AT Command Changes

Table 9-3: Changes to AT commands shows which 9522A Transceiver AT commands are modified or removed, and which AT commands are new for 9601 Transceiver. Removed commands are shaded.

Table 9-3: Changes to AT commands
Note: Removed commands are shaded.

Command	Description	Modified	New
AT	Attention code		
A/	Repeat last command		
+++	Escape sequence		
A	Answer		
Bn	Communication standards		
Cn	Carrier control		
D	Dial		
En	Echo		
Fn	Line modulation		
Hn	Hangup		
In	Identification		
Ln	Loudspeaker volume		
Mn	Speaker control		
Nn	Automode enable		
On	Online		
P	Pulse dial		
Qn	Quiet mode		
T	Tone dial		
Vn	Verbose mode		
Wn	Error correction message control		
Xn	Extended result codes		
Yn	Long space disconnect		
Zn	Soft reset		
&Cn	DCD option		
&Dn	DTR option	✓	
&Fn	Restore factory settings		
&Gn	Guard tone		
&Jn	Jack control		
&Kn	Flow control	✓	
&Ln	Leased line operation		
&Mn	Asynchronous/synchronous mode		
&Pn	Pulse dial make/break ratio		
&Qn	Sync/async mode		
&Rn	RTS/CTS option		
&Sn	DSR override		
&V	View active and stored configuration		
&Wn	Store active configuration		
&Xn	Select asynchronous clock		
&Yn	Designate default reset profile		
\An	MNP block size		

Command	Description	Modified	New
\Bn	Transmit break		
\Gn	XON/XOFF flow control		
\Jn	DTE auto rate		
\Kn	Control break		
\Nn	Link type		
%Cn	Compression control		
%En	Auto retrain		
%R	Display registers		
*F	Flush to eeprom		✓
*Pn	Power phone		
*Rn	Radio activity		✓
+CBC	Battery charge		
+CBST	Select bearer service type		
+CCFC	Call forward service		
+CCLK	Real-time clock		
+CEER	Extended error report		
+CGMI	Manufacturer identification		
+CGMM	Model identification		
+CGMR	Revision		
+CGSN	Serial number		
+CHUP	Hang-up call		
+CIER	Indicator event reporting		✓
+CLCC	Request current call status		
+CLCK	Facility lock		
+CLVL	Loudspeaker volume level control		
+CMEE	Report mobile equipment error		
+CMGD	Delete SMS message		
+CMGF	SMS message format		
+CMGL	List SMS messages		
+CMGR	Read SMS message		
+CMGS	Send SMS message		
+CMGW	Write SMS message to memory		
+CMOD	Call mode		
+CMUT	Mute control		
+CNMI	New SMS message indications to DTE		
+CNUM	Read MSISDN numbers		
+COPS	Operator select		
+CPAS	Phone activity status		
+CPBF	Find phonebook entries		
+CPBR	Read phonebook entries		
+CPBS	Select phonebook storage		
+CPBW	Write phonebook entry		
+CPIN	Enter PIN		
+CPMS	Select preferred SMS message storage		
+CPWD	Change password		
+CR	Service reporting control		
+CRC	Cellular result codes		
+CREG	Network registration		

Command	Description	Modified	New
+CRIS	Ring Indicator Status		✓
+CSCA	SMS service center address		
+CSCB	Select cell broadcast message types		
+CSCS	Select TE character set		
+CSMS	Select SMS message service		
+CSQ	Signal quality		
+CSTA	Select type of address		
+CULK	Unlock		✓
+CVHU	Voice hang-up control		
+DR	Data compression report level		
+DS	Set data compression function		
+GCAP	General capabilities		
+GMI	Manufacturer identification		
+GMM	Model identification		
+GMR	Revision		
+GSN	Serial number		
+IPR	Fixed DTE rate		
+R	Radio Activity		✓
+SBDAREG	Short burst data: Automatic registration		✓
+SBDC	Short burst data: Clear SBD MOMSN		
+SBDD	Short burst data: Clear SBD message buffers		
+SBDDET	Short burst data: Detach		✓
+SBDDSC	Short burst data: Delivery short code		
+SBDI	Short burst data: Initiate an SBD session		
+SBDIX	Short burst data: Initiate an SBD session extended		✓
+SBDIXA	Short burst data: Initiate an SBD session extended		✓
+SBDMTA	Short burst data: Mobile-terminated alert		✓
+SBDRB	Short burst data: Read binary data from ISU		
+SBDREG	Short burst data: Automatic registration		✓
+SBDRT	Short burst data: Read a text message from the ISU		
+SBDS	Short burst data: Status		
+SBDSX	Short Burst data Status Extended		✓
+SBDTC	Short burst data: Transfer MO buffer to MT buffer		
+SBDWB	Short burst data: Write binary data to the ISU		
+SBDWT	Short burst data: Write a text message to the ISU		
+SBDZ	Short burst data: Segment size		
+WDAV	Register or deregister an RS232 DAV data peripheral		
+WDLDM	IRLP dynamic link delay measurement		
+WFRNG	Force IRLP renegotiation		
+WIRLP	Iridium radio link protocol		
+WTM	IRLP test mode		
-MSGEO	Request geo-location		
-MSSTM	Request system time		
-MSVLS	Local DTMF feedback selection		
-MSVTR	DTMF received in voice call		
-MSVTS	DTMF generation in voice call		