Iridium 9604
Technical Reference Guide

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1.0	May 2026	Initial Release
1.1	June 2026	Updated 5.2.4. Current consumption, Table 13 - Satellite connected mode

Documentation Feedback

To provide feedback on this document, open a ticket in the Partner Support portal (Iridium Service Desk) and under Component select Document Feedback.

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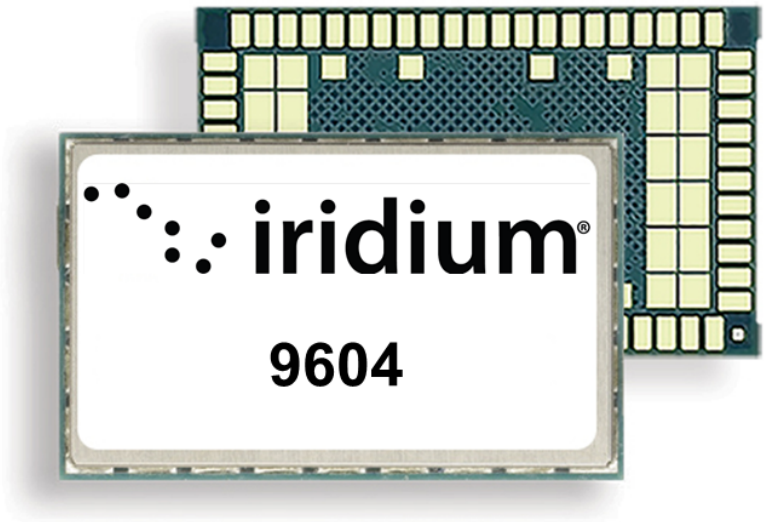
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1. Introduction

The Iridium® 9604 is a hybrid LTE-M cellular + Iridium® Short Burst Data (SBD) satellite + GNSS transceiver for IoT. It is designed for IoT applications requiring constant or on-demand network connectivity worldwide.

This document describes the Iridium 9604 hybrid satellite + cellular IoT transceiver, offering connectivity on both LTE-M cellular terrestrial networks and the Iridium® satellite Short Burst Data network based on the u-blox UBX-R52 modem SoC, as well as accurate and reliable GNSS positioning capability with the u-blox M10 GNSS receiver, in the compact SARA LGA form factor.



1.1. Intended Audience

This document is intended to be used by hardware developers building products incorporating the Iridium 9604 transceiver. This document focuses on hardware aspects relating to the integration of the Iridium 9604 transceiver into a host product.

1.2. Referenced Documents

For the latest Iridium partner documentation, log in to the Iridium for Partners (IFP) website at https://ifp.iridium.com/login and then go to the Resources section.

No.	Document	Description
1	IRDM-5220-ICD-001	*Iridium 9604 AT Command Guide*
2	IRDM-5220-UDOC-001	*Iridium 9604 Hardware Development Guide*
3	3GPP TS 27.007	AT command set for User Equipment (UE)
4	3GPP TS 27.005	Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
5	I3GPP TS 27.010	Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
6	3GPP TS 36.521-1	Evolved Universal Terrestrial Radio Access; User Equipment conformance specification; Radio transmission and reception; Part 1: Conformance Testing
7	ITU-T Recommendation V24	Use of CellTime feature
8	Universal Serial Bus Revision 2.0 specification	https://www.usb.org/
9	I2C-bus specification and user manual - UM10204	https://www.nxp.com/
10	RFC 7252	Constrained Application Protocol (CoAP)
11	IEC 60079-0	Explosive atmospheres, part 0: equipment general requirements
12	EC 60079-11	Explosive atmospheres, part 11: equipment protection by intrinsic safety 'i'
13	IEC 60079-26	Explosive atmospheres, part 26: equipment with EPL Ga

1.3. Abbreviations

See Appendix A.

2. Functional description

2.1. Overview

Iridium 9604 is an easy-to-design, economical, small form-factor, high functionality transceiver providing nearly worldwide IoT connectivity for a wide variety of use cases. The Iridium 9604 transceiver, powered by the widely used u-blox UBX-R52 modem SoC and the u-blox M10 GNSS receiver chip, offers comprehensive connectivity support, including cellular LTE-M and the Iridium® Short Burst Data, or SBD, satellite IoT protocol. All this integration comes packaged neatly in a small, widely-used SARA form-factor that consumes just over 400 mm2 of board space.

The transceiver is designed for IoT applications requiring constant or on-demand network connectivity worldwide, which is made possible by the hybrid CEL+SAT architecture and by widespread LTE-M availability and near-global coverage of the satellite constellation. SBD provides real-time, two-way messaging anywhere in the world, using a simple, efficient packet-based service for frequent short data transmissions between equipment and centralized host computer systems. Cellular LTE-M (or LTE Cat M1) is optimized for IoT applications. It boasts enhancements in power consumption, coverage, data rate, and mobility.

The transceiver also integrates the u-blox M10 GNSS receiver to deliver best-in-class location data concurrent with LTE operation, making it the ideal solution for continuous or cyclic tracking applications. Cellular LTE-M connectivity and Satellite SBD connectivity are mutually exclusive. GNSS signal reception is possible in both Cellular and Satellite modes, but is not possible during satellite transmission and reception. In other words, the 9604 transceiver cannot get a GNSS fix during an active SBD session.

Table 1 lists the main features and interfaces of the Iridium 9604 transceiver.

Table 1. Iridium 9604 Main Features Summary

Model	Region	Radio Access Technology						GNSS		u-blox Services		External Interfaces					Features														Grade		
		LTE 3GPP category	LTE bands	LTE power class [dBm]	Satellite protocol	Satellite band	Satellite Tx power [dBm]	Integrated GNSS receiver	Dedicated GNSS/Satellite antenna interface	AssistNow™	CloudLocate	UARTs	USB (for diagnostics)	I2C	USIM	GPIOs	Secure boot, updates	Antenna dynamic tuning	Ultra-low consumption in PSM / eDRX	Embedded TCP/UDP	Embedded HTTP, FTP	Embedded TLS, DTLS	Embedded MQTT, MQTT-SN	Embedded COAP and LwM2M	FW update via serial (FOAT)	Last gasp	Jamming detection	Antenna and SIM detection	CellTime	Standard	Professional (-40° to +85° C)	Automotive
IRIDIUM 9604	Global	M1	1,2,3,4,5 8,12,13 18,19,20 25,26,28 66,71,85	23	SBD	L	32.2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	

Figure 1 provides a high-level block diagram of the Iridium 9604 transceiver architecture.

2.2. Block diagram

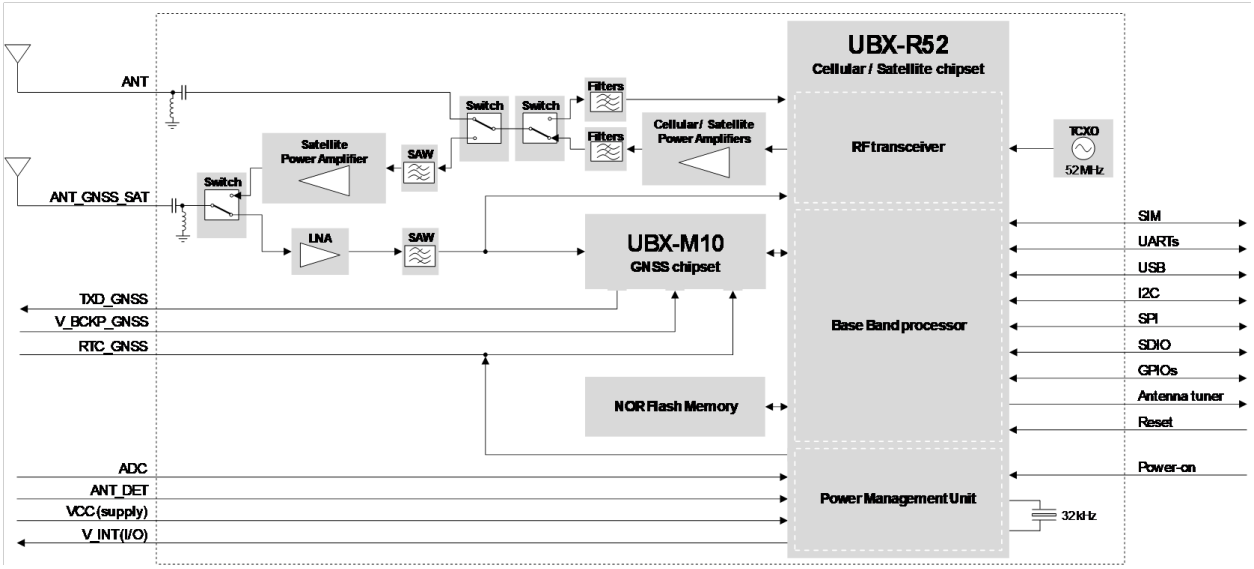


Figure 1. Iridium 9604 Simplified Block Diagram

SPI and SDIO interfaces are not supported except for diagnostic purposes.

2.3. Product description

Table 2. Iridium 9604 Cellular, Satellite and GNSS Main Characteristics

Item	Iridium 9604
Cellular protocol	Including key 3GPP Release14 features for LTE Cat M1
Cellular data rate	LTE category M1 Half-duplex: up to 1200 kbit/s UL, up to 588 kbit/s DL
Cellular power class	LTE power class 3 (23 dBm)
Cellular operating bands	LTE FDD band 1 (2100 MHz) LTE FDD band 2 (1900 MHz) LTE FDD band 3 (1800 MHz) LTE FDD band 4 (1700 MHz) LTE FDD band 5 (850 MHz) LTE FDD band 8 (900 MHz) LTE FDD band 12 (700 MHz) LTE FDD band 13 (750 MHz) LTE FDD band 18 (850 MHz) LTE FDD band 19 (850 MHz) LTE FDD band 20 (800 MHz) LTE FDD band 25 (1900 MHz) LTE FDD band 26 (850 MHz) LTE FDD band 28 (700 MHz) LTE FDD band 66 (1700 MHz) LTE FDD band 71 (600 MHz) LTE FDD band 85 (700 MHz)
Satellite protocol	Iridium Short Burst Data (SBD)
Satellite max message size	340 bytes (MT), 270 bytes (MO)
Satellite transmit power	32.2 dBm
Satellite operating bands	L-band (Tx: 1616.0 - 1626 MHz, Rx: 1616-1626.5 MHz)
GNSS receiver type	u-blox M10050 SPG 5.10 receiver supporting concurrent reception of up to four GNSS systems GPS / QZSS L1C/A, Galileo E1-B/C, GLONASS L1OF, BeiDou B1I, BeiDou B1C, SBAS (EGNOS, GAGAN, MSAS and WAAS), QZSS L1S (SLAS)

2.4. AT Command Support

Iridium 9604 supports AT commands according to 3GPP standards TS 27.007 [3], TS 27.005 [4], TS 27.010 [5], and proprietary AT commands extension.

For the complete description of supported AT commands, see the *Iridium 9604 AT Command Guide* [1].

2.5. Supported Features and Services

Table 3 lists the main features and services supported by Iridium 9604. For more details, see the *Iridium 9604 Hardware Development Guide* [2] and the *Iridium 9604 AT Command Guide* [1].

Table 3. Main Features and Services Supported by Iridium 9604

Feature	Description
SBD satellite connectivity	Iridium 9604 supports access to Short Burst Data (SBD) satellite service provided by Iridium, with a dedicated satellite + GNSS antenna interface for SBD data transmission and reception, including LNA-SAW-LNA chain to optimize satellite data reception.
Integrated GNSS receiver	Iridium 9604 is pre-integrated with the u-blox UBX-M10050 concurrent GNSS receiver chipset with SPG 5.10 firmware version, comprehensive of a dedicated GNSS / Satellite antenna interface and LNA-SAW-LNA-SAW chain to optimize GNSS data reception. The GNSS system is independent from the LTE system and can run concurrently to an LTE communication.
Embedded AssistNow Software	A u-blox service based on embedded AssistNow Online and AssistNow Offline clients are available to provide better GNSS performance and faster TTFF (time to first fix). An AT command can enable / disable the clients. See https://www.u-blox.com/en/product/assistnow for more information on this service.
CellTime	Returns accurate timing retrieved from the LTE network and/or from the integrated u-blox M10 positioning chip. Can be used to provide periodic timestamps to an external application processor or to output a time indication associated to an interrupt detected on a GPIO (e.g. coming from an external sensor connected to the transceiver). The implementation of CellTime can be extended to control and maintain timing info in a network of sensors, each one integrating a Iridium 9604 transceiver.
Smart Connection Manager (SCM)	Smart Connection Manager (SCM) is an application running on the transceiver that may be enabled to let the transceiver automatically handle the connection with the network, setting up the link and reestablishing it if dropped according to some predefined and user-customizable profiles which set the transceiver basic modes of operation. The SCM feature reduces the complexity of the application code controlling the transceiver, saving developers time, reducing time to market, and optimizing transceiver behavior in typical operating modes.
Antenna dynamic tuning	Real-time control of an external antenna matching IC via two dedicated pins of the transceiver according to the LTE band used by the transceiver.

Feature	Description
Embedded TCP and UDP stack	Embedded TCP/IP and UDP/IP stack including direct link mode for TCP and UDP sockets. Sockets can be set in Direct Link mode to establish a transparent end-to-end communication with an already connected TCP or UDP socket via the serial interface.
HTTP, HTTPS (v1.0 for +UHTTP, v1.1 for LwM2M client)	Hyper-Text Transfer Protocol as well as Secure Hyper-Text Transfer Protocol (SSL encryption) functionalities are supported via AT commands.
FTP, FTPS	File Transfer Protocol and Secure File Transfer Protocol (SSL encryption of FTP control channel) functionalities are supported by AT commands.
CoAP (RFC 7252) [10]	Embedded Constrained Application Protocol (CoAP) datagram-based client/server application protocol designed to easily translate from HTTP for simplified integration with the web.
MQTT (v3.1.1) and MQTT-SN (v1.2)	Embedded Message Queuing Telemetry Transport (MQTT) and MQTT for Sensor Networks (MQTT-SN) publish-subscribe messaging protocols designed for lightweight M2M communications over TCP (MQTT) or over UDP (MQTT-SN). These allow one-to-one, one-to-many and many-to-one communications over a TCP or UDP connection.
LwM2M (v1.0)	LwM2M is a light and compact communication protocol designed for managing IoT machine-to-machine communication between a LwM2M Server and a LwM2M Client located in low power or resource-constrained LwM2M devices, with object data model.
TLS (v1.0, v1.1, v1.2, v1.3) and DTLS (v1.2)	Transport Layer Security (TLS) provides security for HTTP, FTP, MQTT and TCP communications. Embedded Datagram Transport Layer Security (DTLS) provides security for CoAP, LwM2M, MQTT-SN and UDP communications.
Device security	Hardware-based security functions of the chipset are used to provide • Secure boot: guarantees software authenticity and integrity • Secure update: supervises the secure delivery of the correct FW to the transceiver
AWS IoT Core and Microsoft Azure	AWS IoT Core qualified and Microsoft Azure certified
MQTT Anywhere, MQTT Flex	u-blox MQTT broker services based on MQTT-SN, using the integrated MQTT client. Contact u-blox for details.
Jamming detection	Detects “artificial” interference that obscures the operator’s carrier entitled to give access to the radio service and automatically reports the start and stop of such conditions to the application processor that can react accordingly.
Smart temperature supervisor	Constant monitoring of the transceiver board temperature: • Warning notification when the temperature approaches an upper or lower predefined threshold (see Section 5.2.19) • Shutdown notified and forced when the temperature value is outside the specified range (shutdown suspended in case of an emergency call in progress) The smart temperature supervisor feature can be enabled or disabled through an AT command (see the *Iridium 9604 AT Command Guide*, +USTS AT command).
Last gasp	In case of power supply outage (i.e. main supply interruption, battery removal, battery voltage below a certain threshold) the transceiver can be configured through the +ULGASP AT command to send an alarm notification to a remote entity.

Feature	Description
Network status indication	GPIO configured to indicate the network status: registered home network, registered roaming, data call enabled, no service. The feature can be enabled through the +UGPIOC AT command.
Antenna detection	The **ANT_DET** pin provides antenna presence detection capability, evaluating the resistance from the **ANT** pin to GND by means of an external antenna detection circuit implemented on the application board. The antenna supervisor (i.e. antenna detection) feature can be enabled through the +UANTR AT command.
BIP	Bearer Independent Protocol for over-the-air SIM provisioning.
Dual stack IPv4/Ipv6	Capability to move between Ipv4 and dual stack network infrastructures. IPv4 and IPv6 addresses can be used.
Firmware update Over AT commands (FOAT)	Firmware transceiver update over AT command interface.
Power Saving Mode (PSM)	The Power Saving Mode (PSM) feature, defined in 3GPP Rel.13, allows further reduction of the transceiver current consumption maximizing the amount of time a device can remain in PSM low power deep-sleep mode during periods of data inactivity.
eDRX	Extended mode DRX, based on 3GPP Rel.13, reduces the amount of signaling overhead decreasing the frequency of scheduled measurements and/or transmissions performed by the transceiver in idle mode (for eDRX sleep time shorter than 70 s) or in deep-sleep mode (for eDRX sleep time longer than 70 s). This in turn leads to a reduction in the transceiver power consumption while maintaining a perpetual connection with the base station.
Coverage Enhancement	Coverage Enhancement modes introduced in 3GPP Rel.13 are used to improve cell signal penetration.
LTE-M 3GPP release 14 features	For LTE-M: Larger max UL TBS (2984 bits instead of 1000 bits), Enhanced PUCCH repetition in CE mode B (64 and 128 repetition factor)

3. Interfaces

3.1. Power management

3.1.1. Transceiver supply input (VCC)

The Iridium 9604 transceiver must be supplied through the **VCC** pins by a proper external DC power supply providing a nominal voltage within the normal operating range (see Table 11). Voltage must be stable, because during operation the current drawn from **VCC** may vary significantly, based on the power consumption profile of the LTE Cat M1 and the Satellite radio access technologies (described in the *Iridium 9604 Hardware Development Guide* [2]).

The three **VCC** pins of Iridium 9604 are internally connected to the internal power management unit, consisting in voltage regulators generating all the internal supply voltages needed by the transceiver for the designed operations, as the supply voltage for the generic digital interfaces (**V_INT**), the one for the SIM interface (**VSIM**), the one for the internal GNSS receiver, etc.

It is important that the system power supply circuit can withstand the maximum current during a transmission at maximum power level (see Table 13).

3.1.2. Generic digital interfaces supply output (V_INT)

Iridium 9604 provides a 1.8 V supply rail output on the **V_INT** pin, which is internally generated when the transceiver is switched on, outside the ultra-low power deep-sleep mode. The same voltage domain is used internally to supply the generic digital interfaces of the transceiver. The **V_INT** supply output can be used in place of an external discrete regulator.

☞ It is recommended to provide an accessible test point directly connected to the **V_INT** pin.

3.1.3. GNSS backup supply input (V_BCKP_GNSS)

Backup domain (BBR and RTC) of the internal u-blox M10 GNSS chip can be optionally supplied through the **V_BCKP_GNSS** pin, enabling the hardware backup mode when GNSS chip is switched off and allowing better TTFF, accuracy, availability, and power consumption at the next GNSS startup.

☞ To enable the GNSS RTC in HW backup mode, a 32.768 kHz clock must also be applied (see Section 3.10).

☞ Leave **V_BCKP_GNSS** pin unconnected if the GNSS hardware backup mode is not used.

3.2. Antenna interfaces

3.2.1. Cellular antenna RF interface (ANT)

The **ANT** pin is the RF antenna I/O interface for LTE cellular RF signals transmission and reception, designed with 50 Ω characteristic impedance.

3.2.2. GNSS / Satellite antenna RF interface (ANT_GNSS_SAT)

The **ANT_GNSS_SAT** pin is the RF antenna I/O interface for GNSS RF signals reception and for Satellite RF signals transmission and reception, designed with 50 Ω characteristic impedance and with an internal DC block. The reception of both the GNSS and the Satellite RF signals is optimized due to the internal LNA-SAW chain in front of both the GNSS receiver chip and the satellite receiver integrated in the UBX-R52 satellite / cellular chip.

3.2.3. Antenna detection (ANT_DET)

The **ANT_DET** pin is an analog-to-digital converter (ADC) input with a current source provided by Iridium 9604 to sense the presence of the external antenna (as an optional feature), evaluating the DC resistance to GND by an externally implemented circuit (see the *Iridium 9604 Hardware Development Guide* [2] and the *Iridium 9604 AT Command Guide* [1]).

3.3. System functions

3.3.1. Transceiver power-on

When the Iridium 9604 is not powered, they can be switched on as follows:

- Applying a voltage at the **VCC** transceiver supply input within the operating range (see Table 11)

When Iridium 9604 is in power-off mode (i.e. switched off, but with a valid voltage present at the **VCC** transceiver supply input within the operating range reported in Table 11), they can be switched on as follows:

- Forcing a low level at the **PWR_ON** input pin, which is normally set high by an internal pull-up, for a valid time period (see section Section 5.2.10, transceiver switch-on).

When Iridium 9604 is in low power PSM / eDRX deep-sleep mode, with a valid voltage present at the **VCC** transceiver supply input within the operating range reported in Table 11, it can be woken up as follows:

- Forcing a low level at the **PWR_ON** input pin, which is normally set high by an internal pull-up, for a valid time period (see section Section 5.2.10, transceiver early wake-up from PSM / eDRX deep-sleep).

The **PWR_ON** line is intended to be driven by open drain, open collector or contact switch.

It is recommended to provide an accessible test point directly connected to the **PWR_ON** input pin.

3.3.2. Transceiver power-off

The proper graceful power-off of Iridium 9604, with storage of the current parameter settings in the transceiver's non-volatile memory and a clean network detach, can be triggered by:

- AT+CPWROFF command (see the *Iridium 9604 AT Command Guide* [1])
- Forcing a low pulse at the **PWR_ON** input pin, for a valid time period (see section Section 5.2.10, transceiver normal graceful switch-off)

A faster power-off procedure of the transceiver, with storage of the current parameter settings in the transceiver's non-volatile memory and without a clean network detach, can be triggered by:

- AT+CFUN=10 command (see the *Iridium 9604 AT Command Guide* [1])
- Toggling the GPIO input configured with the faster power-off function (see Section 3.7)

An abrupt emergency hardware shutdown of the transceiver, without saving current parameter settings in the transceiver's non-volatile memory and without clean network detach, can be executed by:

- Forcing a low pulse at the **PWR_ON** input pin, for a valid time period (see Section 5.2.10, transceiver emergency hardware shutdown)

An abrupt under-voltage shutdown occurs on Iridium 9604 when the **VCC** supply is removed. If this occurs, it is not possible to store the current parameter settings in the transceiver's non-volatile memory or to perform the proper network detach.

An over-temperature or an under-temperature shutdown occurs when the temperature measured within the transceiver reaches certain thresholds (see Section 5.2.19), if the optional "Smart temperature supervisor" feature is enabled and configured by AT+USTS command (see *Iridium 9604 AT Command Guide* [1]).

3.3.3. Transceiver reset

Iridium 9604 can be reset (re-booted), saving current parameter settings in the transceiver's non-volatile memory and performing a proper network detach, by:

- AT+CFUN=16 command (for other options and further details, see the *Iridium 9604 AT Command Guide* [1]). This causes a graceful software reset of the transceiver.

An abrupt software reset of the transceiver is executed by applying a low pulse at the **RESET_N** input pin, which is normally set high by an internal pull-up, for a valid time period (see Section 5.2.11). The current parameter settings are not saved in the transceiver's non-volatile memory and a proper network detach is not performed.

The **RESET_N** line is intended to be driven by open drain, open collector or contact switch.

It is recommended to provide an accessible test point directly connected to the **RESET_N** input pin.

3.4. SIM

3.4.1. SIM interface

Iridium 9604 provides an interface on the **VSIM**, **SIM_IO**, **SIM_CLK**, **SIM_RST** pins to connect an external SIM card/chip. Both 1.8 V and 3.0 V SIM types are supported. Activation and deactivation with an automatic voltage switch from 1.8 V to 3.0 V is implemented according to the ISO-IEC 7816-3 specifications.

3.4.2. SIM detection

The **GPIO5** pin of Iridium 9604 is a 1.8 V digital input which can be configured as an external interrupt to detect the SIM card presence (as a feature which can be optionally used), as intended to be properly connected to the mechanical switch of an external SIM card holder. For more details, see the *Iridium 9604 Hardware Development Guide* [2] and the *Iridium 9604 AT Command Guide* [1].

3.5. Serial communication

The Iridium 9604 provides the following serial communication interfaces:

- UART interfaces, available for communications with host application processor (Section 3.5.1)
- USB 2.0 compliant interface, available for diagnostics only (Section 3.5.2)
- SPI interfaces, available for diagnostic (Section 3.5.3)
- SDIO interface, available for diagnostic (Section 3.5.4)
- I2C bus compatible interface, available for communications with external I2C devices (Section 3.5.5)

3.5.1. UART interfaces

Iridium 9604 includes 1.8V unbalanced asynchronous serial interfaces for communication with external application host processor(s). UART interfaces can be configured by dedicated AT command in the following variants:

- **Variant 0** (default configuration), consists of a single UART interface that supports AT commands, data communication, multiplexer protocol functionality, FW update by FOAT or by the EasyFlash tool, and provides the following lines:
  - Data lines (**RXD** as output, **TXD** as input),
  - Hardware flow control lines (**CTS** as output, **RTS** as input),
  - Modem status and control lines (**DTR** as input, **RI** as output)
- **Variant 1**, consists of a single UART interface that supports AT commands, data communication, multiplexer protocol functionality, FW update by FOAT or by the EasyFlash tool, and provides the following lines:
  - Data lines (**RXD** as output, **TXD** as input),
  - Hardware flow control lines (**CTS** as output, **RTS** as input),
  - Modem status and control lines (**DTR** as input, **DSR** as output, **DCD** as output, **RI** as output)
- **Variants 2, 3 and 4**, consists of two UART interfaces plus ring indicator function:
  - First primary UART interface supports AT commands, data communication, multiplexer protocol functionality, FW update by FOAT or by the EasyFlash tool, and provides the following lines:
    - Data lines (**RXD** as output, **TXD** as input),
    - Hardware flow control lines (**CTS** as output, **RTS** as input),
  - Second auxiliary UART interface supports AT commands (variant 2 only), data communication (variant 2 only), FW update by FOAT (variant 2 only), diagnostic trace logging (variant 3 only), and GNSS tunneling (variant 4 only), and provides the following lines:
    - Data lines (**DCD** as data output, **DTR** as data input),
    - Hardware flow control lines (**RI** as flow control output, **DSR** as flow control input),
  - Ring indicator function over the GPIO pin configured with RI function (see section Section 3.7)

UART general features, valid for all variants, are:

- Serial port with RS-232 functionality conforming to the ITU-T V.24 recommendation [7], with CMOS compatible levels (0 V for low data bit or ON state, and 1.8 V for high data bit or OFF state)
- Hardware flow control (default value) or none flow control are supported.
- UART power saving indication available on the hardware flow control output, if hardware flow control is enabled: the line is driven to the OFF state when the transceiver is not prepared to accept data by the UART interface.
- One-shot autobauding is supported and it is enabled by default: automatic baud rate detection is performed only once, at transceiver start up. After the detection, the transceiver works at the fixed baud rate (the detected one) and the baud rate can only be changed via AT command (see the *Iridium 9604 AT Command Guide* [1])
- Following baud rates are supported and can be auto detected: 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s, 230400 bit/s, 460800 bit/s, 921600 bit/s
- Following baud rates are supported but cannot be auto detected: 3000000 bit/s, 3250000 bit/s
- The default frame format is 8N1 (8 data bits, no parity, 1 stop bit)
- Following frame formats are supported: 8N1 (8 data bits, no parity, 1 stop bit), 8N2 (8 data bits, no parity, 2 stop bit), 8E1 (8 data bits, even parity, 1 stop bit), 8O1 (8 data bits, odd parity, 1 stop bit), 7N1 (7 data bits, no parity, 1 stop bit), 7E1 (7 data bits, even parity, 1 stop bit), 7O1 (7 data bits, odd parity, 1 stop bit)

The UART interfaces can be conveniently configured through AT commands. For more details, see the *Iridium 9604 AT Command Guide* [1] and the *Iridium 9604 Hardware Development Guide* [2].

It is highly recommended to provide accessible test points directly connected to the **TXD** and **RXD** pins for FW upgrade purpose.

Accessible test points directly connected to the **DCD** and **DTR** pins may be provided for diagnostic purposes, alternatively to the highly recommended accessible test points provided on the USB interface pins.

Multiplexer protocol

The transceiver includes multiplexer functionality as per 3GPP TS 27.010 [6] on the primary UART. This is a data link protocol which uses HDLC-like framing and operates between the transceiver (DCE) and the application processor (DTE), allowing a number of simultaneous sessions over the physical link.

When USIO variant 0 or 1 is set, the following virtual channels are defined:

- Channel 0: control channel
- Channel 1 - 3: AT commands / data communication
- Channel 4: GNSS tunneling

When USIO variant 2 is set, AT commands and data communication are available on the second auxiliary UART, and the following virtual channels are defined on the primary UART:

- Channel 0: control channel
- Channel 1 - 2: AT commands / data communication
- Channel 3: GNSS tunneling

When USIO variant 3 is set, diagnostic trace log is available on the second auxiliary UART, and the following virtual channels are defined on the primary UART:

- Channel 0: control channel
- Channel 1 - 3: AT commands / data communication
- Channel 4: GNSS tunneling

When USIO variant 4 is set, GNSS tunneling is available on the second auxiliary UART, and the following virtual channels are defined on the primary UART:

- Channel 0: control channel
- Channel 1 - 3: AT commands / data communication

3.5.2. USB interface

Iridium 9604 includes a high-speed USB 2.0 compliant interface with a maximum 480 Mbit/s data rate according to the USB 2.0 specification [8]. The transceiver itself acts as a USB device and can be connected to any USB host equipped with compatible drivers.

The USB interface is available for diagnostic purposes only.

The **USB_D+** / **USB_D-** lines carry the USB data and signaling, while the **VUSB_DET** pin represents the input to enable the USB interface by applying an external valid USB VBUS voltage (5.0 V typical).

It is highly recommended to provide accessible test points directly connected to the USB interface pins (**VUSB_DET, USB_D+, USB_D-**) for diagnostic purposes.

3.5.3. SPI interfaces

The SPI interfaces are not supported in Iridium 9604, except for diagnostic purposes.

Iridium 9604 includes 1.8V Serial Peripheral Interfaces available for communications with external SPI target devices, or with the transceiver acting as SPI host, for diagnostic purposes.

3.5.4. SDIO interface

- The SDIO interface is not supported in Iridium 9604, except for diagnostic purposes.

Iridium 9604 transceiver includes a 1.8V 4-bit Secure Digital Input Output interface over the **SDIO_D0**, **SDIO_D1**, **SDIO_D2**, **SDIO_D3**, **SDIO_CLK** and **SDIO_CMD** pins, with the transceiver acting as SDIO host, available for communications with compatible external SDIO devices, and for diagnostic.

Accessible test points directly connected to the **SDIO_D0, SDIO_D1, SDIO_D2** and **SDIO_D3** pins may be provided for diagnostic purposes, alternatively to the highly recommended accessible test points provided on the USB interface pins.

3.5.5. I2C interface

Iridium 9604 includes a 1.8V I2C-bus compatible interface over the **SDA** and **SCL** pins, available to communicate with external I2C devices: the transceiver acts as an I2C host that can communicate with I2C devices in accordance with the I2C bus specifications [9].

3.6. ADC

Iridium 9604 transceiver includes an analog-to-digital converter input pin, **ADC**, configurable via a dedicated AT command (for further details, see the *Iridium 9604 AT Command Guide* [1]).

3.7. GPIOs

Iridium 9604 includes pins that can be configured as general-purpose input/output or to provide custom functions as summarized in Table 4. For further details, see the *Iridium 9604 Hardware Development Guide* [2] and the *Iridium 9604 AT Command Guide* [1], +UGPIOC, +UGPIOR, +UGPIOW AT commands.

Table 4. GPIO Custom Functions Configuration

Function	Description	Default GPIO	Configurable GPIOs
General purpose output	Output to set high or low digital level	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, GPIO7
General purpose input	Input to sense high or low digital level	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, GPIO7
Network status indication	Output indicating cellular network status: registered, data transmission, no service	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6
SIM card detection	Input for SIM card physical presence detection, to optionally enable / disable SIM interface upon detection of external SIM card physical insertion / removal	-	GPIO5
transceiver status indication	Output indicating transceiver status: power-off or deep-sleep mode versus idle, active or connected mode	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6
transceiver operating mode indication	Output indicating transceiver operating mode: power-off, deep-sleep or idle mode versus active or connected mode	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6
Ring indicator	Output providing events indicator	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6
Last gasp	Input to trigger last gasp notification	-	GPIO1, GPIO2, GPIO4, GPIO6
Time pulse output	Output providing accurate time reference, as a sequence with configurable PPS or as single time pulse, based on the GNSS system or the LTE system (CellTime)	-	GPIO6
Faster power-off	Input with internal pull-down to trigger a faster shutdown (as AT+CFUN=10 command) by applying a rising edge	-	GPIO1, GPIO2, GPIO4, GPIO6
Satellite / GNSS Rx indication	Output indicating Satellite RF receiving and/or GNSS RF receiving operation in progress: • High with Satellite Rx, or GNSS Rx in progress, • Low otherwise	-	GPIO2

Function	Description	Default GPIO	Configurable GPIOs
Satellite / GNSS Tx/Rx indication	Output indicating Satellite RF transmitting / receiving and/or GNSS RF receiving operation in progress: • High with Satellite Tx, Satellite Rx, or GNSS Rx in progress, • Low otherwise	-	GPIO7
Pin disabled	Tri-state with an internal active pull-down enabled	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, GPIO7	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, GPIO7

3.8. Cellular antenna dynamic tuner interface

Iridium 9604 includes two output pins, **RFCTRL1** and **RFCTRL2**, that can optionally be used to control in real time an external antenna tuning IC, as the two pins change their output value dynamically according to the specific current LTE band in use by the transceiver. Table 5 illustrates the default factory-programmed configuration, which can be changed by dedicated AT command.

Table 5. Iridium 9604 Antenna Dynamic Tuning Truth Table (default factory-programmed configuration)

RFCTRL1	RFCTRL2	LTE frequency band in use
0	0	B71 (< 700 MHz)
0	1	B12, B13, B28, B85 (700..800 MHz)
1	0	B5, B8, B18, B19, B20, B26 (800..900 MHz)
1	1	B1, B2, B3, B4, B25, B66 (> 1000 MHz)

For dedicated design-in guidelines and details about how to enable and use the feature, see the *Iridium 9604 Hardware Development Guide* [2] and the *Iridium 9604 AT Command Guide* [1].

3.9. GNSS peripheral outputs

Iridium 9604 provides the following 1.8 V peripheral output pins directly connected to the internal M10 GNSS chipset (as illustrated in Figure 1):

- The **TXD_GNSS** pin provides the UART data output of the internal GNSS chipset.

3.10. GNSS real-time clock

Real-time clock of the internal M10 GNSS chip can be optionally fed with a 32.768 kHz clock, enabling hot starts and warm starts, allowing in most cases better TTFF, accuracy, availability, and power consumption at the next GNSS startup.

This clock can be applied externally through the **RTC_GNSS** pin; alternatively, it can be enabled with a dedicated AT command and internally generated as long as the transceiver does not enter deep-sleep mode or does not switch off.

☞ To enable the GNSS RTC in hardware backup mode, the GNSS backup domain must also be supplied (see Section 3.1.3).

☞ Leave **RTC_GNSS** pin unconnected if it is not used.

4. Pin definition

4.1. Pin assignment

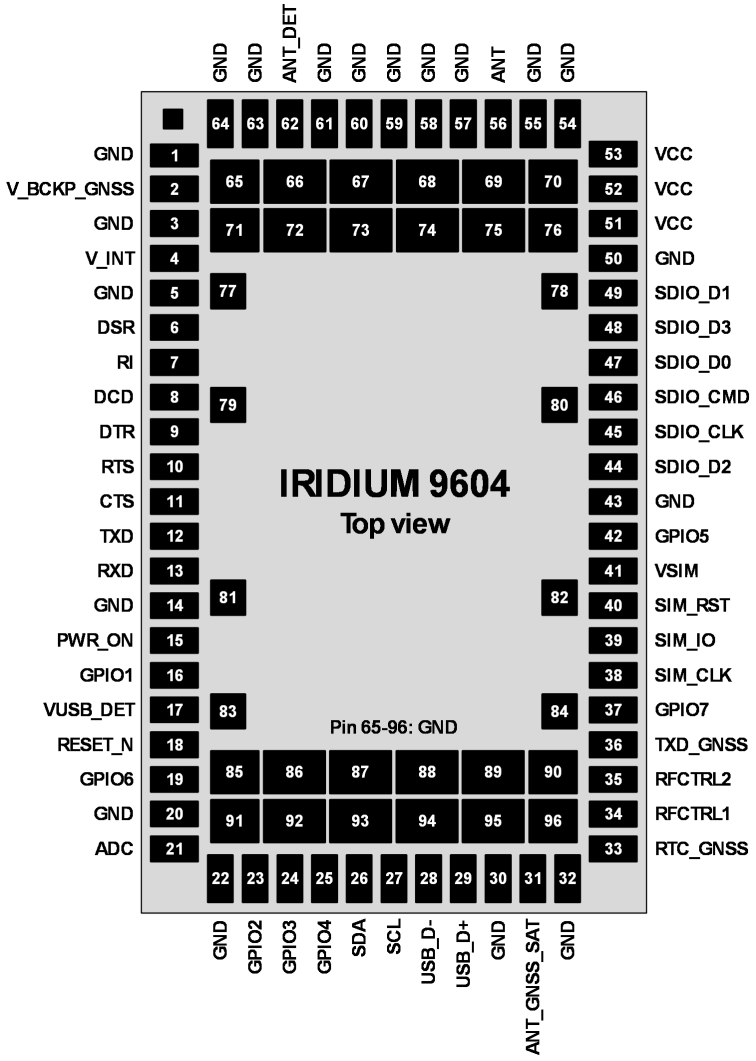


Figure 2. Iridium 9604 Transceiver Pin Assignment (top view)

Table 6. Iridium 9604 Pin-out

No.	Name	Power domain	I/O	Description	Remarks
1	GND	-	N/A	Ground	All the GND pins must be connected to ground.
2	V_BCKP_GNSS	-	I	GNSS backup voltage supply	Supply to enable GNSS hardware backup mode. See Section 3.1.3 for functional description. See Section 5.2.3 for detailed electrical specs. Leave unconnected if not used.

No.	Name	Power domain	I/O	Description	Remarks
3	GND	-	N/A	Ground	All the GND pins must be connected to ground.
4	V_INT	-	O	Generic Digital Interfaces supply output	V_INT generated by the transceiver when is switched on. See Section 3.1.2 for functional description. See Section 5.2.3 for detailed electrical specs. Provide test point for diagnostic purposes.
5	GND	-	N/A	Ground	All the GND pins must be connected to ground.
6	DSR	GDI	O / I	UART data set ready / AUX UART request to send	Circuit 107 in ITU-T V.24 (DSR output, push-pull, idle high, active low), alternatively configurable as Second Auxiliary UART RTS (HW flow control input, idle high, active low, with internal active pull-up). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs.
7	RI	GDI	O / O	UART ring indicator / AUX UART clear to send	Circuit 125 in ITU-T V.24 (RI output, push-pull, idle high, active low), alternatively configurable as Second Auxiliary UART CTS (HW flow control output, push-pull, idle high, active low). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs.
8	DCD	GDI	O / O	UART data carrier detect / AUX UART data output	Circuit 109 in ITU-T V.24 (DCD output, push-pull, idle high, active low), alternatively settable as Second Auxiliary UART RXD (data output, push-pull, idle high, active low). Fixed push-pull. See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs. Provide test point for diagnostic purposes.
9	DTR	GDI	I / I	UART data terminal ready / AUX UART data input	Circuit 108/2 in ITU-T V. 24 (DTR input, idle high, active low, with internal active pull-up), alternatively settable as Second Auxiliary UART TXD (data input, idle high, active low, with internal active pull-up). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs. Provide test point for diagnostic purposes.

No.	Name	Power domain	I/O	Description	Remarks
10	RTS	GDI	I	UART request to send	Circuit 105 in ITU-T V.24 (RTS flow control input, idle high, active low, with internal active pull-up). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs.
11	CTS	GDI	O	UART clear to send	Circuit 106 in ITU-T V.24 (CTS hardware flow control output, push-pull, idle high, active low). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs.
12	TXD	GDI	I	UART data input	Circuit 103 in ITU-T V.24 (TxD data input, idle high, active low, with internal active pull-up). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs. Provide test point for FW update purposes.
13	RXD	GDI	O	UART data output	Circuit 104 in ITU-T V.24 (RxD data output, push-pull, idle high, active low). See Section 3.5.1 for functional description. See Section 5.2.13 for detailed electrical specs. Provide test point for FW update purposes.
14	GND	-	N/A	Ground	All the GND pins must be connected to ground.
15	PWR_ON	POS	I	Power-on/off input	Internal active pull-up. Active low. See Section 3.3.1 / Section 3.3.2 for functional description. See Section 5.2.10 for detailed electrical specs. Provide test point for diagnostic purposes.
16	GPIO1	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.

No.	Name	Power domain	I/O	Description	Remarks
17	VUSB_DET	USB	I	USB detect input	Input for VBUS (5 V typical) USB supply sense. USB interface supported for diagnostic purposes only See Section 3.5.2 for functional description. See Section 5.2.17 for detailed electrical specs. Provide test point for diagnostic purposes.
18	RESET_N	GDI	I	External reset input	Internal active pull-up. Active low. See Section 3.3.3 2.3.3 for functional description. See Section 5.2.11 for detailed electrical specs. Provide test point for diagnostic purposes.
19	GPIO6	GDI	I/O / O	GPIO / Time pulse output	Configurable GPIO as accurate time reference output. Push-pull output type. See Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.
20	GND	-	N/A	Ground	All the GND pins must be connected to ground.
21	ADC	ADC	I	ADC input	12-bit Analog to Digital Converter input. See Section 3.6 for functional description. See Section 5.2.18 for detailed electrical specs. This pin can be externally connected to GND, if the ADC function is not needed.
22	GND	-	N/A	Ground	All the GND pins must be connected to ground.
23	GPIO2	GDI	I/O	GPIO	Configurable GPIO, alternatively settable to indicate Satellite / GNSS Rx operation. Push-pull output type. See Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.
24	GPIO3	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.
25	GPIO4	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.

No.	Name	Power domain	I/O	Description	Remarks
26	SDA	I2C	I/O	I2C bus data line	Open drain output type. Internal active pull-up. Idle high, active low. See Section 3.5.5 for functional description. See Section 5.2.16 for detailed electrical specs.
27	SCL	I2C	O	I2C bus clock line	Open drain output type. Internal active pull-up. Idle high, active low. See Section 3.5.5 for functional description. See Section 5.2.16 for detailed electrical specs.
28	USB_D-	USB	I/O	USB Data Line D-	90 Ω nominal differential impedance. Pull-up, pull-down and series resistors, as required by the USB 2.0 specifications [8], are part of the USB pin driver and shall not be provided externally. USB interface supported for diagnostic purposes only See Section 3.5.2 for functional description. See Section 5.2.17 for detailed electrical specs. Provide test point for diagnostic purposes.
29	USB_D+	USB	I/O	USB Data Line D+	90 Ω nominal differential impedance. Pull-up, pull-down and series resistors, as required by USB 2.0 specifications [8], are part of the USB pin driver and shall not be provided externally. USB interface supported for diagnostic purpose only See Section 3.5.2 for functional description. See Section 5.2.17 for detailed electrical specs. Provide test point for diagnostic purposes.
30	GND	-	N/A	Ground	All the GND pins must be connected to ground.
31	ANT_GNSS_SAT	-	I/O	GNSS / Satellite antenna	RF input/output for external GNSS Rx antenna and Satellite Rx/Tx antenna. 50 Ω nominal impedance. See Section 3.2.2 , Table 15, Table 19 for functional description.

No.	Name	Power domain	I/O	Description	Remarks
32	GND	-	N/A	Ground	All the GND pins must be connected to ground.
33	RTC_GNSS	-	I	GNSS RTC input	GNSS RTC oscillator input for external 32.768 kHz clock. See Section 3.10 for functional description. See Section 5.2.15 for detailed electrical specs. Leave unconnected if not used.
34	RFCTRL1	GDI	O	RF GPIO for cellular antenna tuning	Digital output to optionally control an antenna tuning IC. Push-pull output type. See Section 3.8 for functional description. See Section 5.2.13 for detailed electrical specs.
35	RFCTRL2	GDI	O	RF GPIO for cellular antenna tuning	Digital output to optionally control an antenna tuning IC. Push-pull output type. See Section 3.8 for functional description. See Section 5.2.13 for detailed electrical specs.
36	TXD_GNSS	GNSS	O	GNSS data output	GNSS UART data output from internal GNSS chip. See Section 3.9 for functional description. See Section 5.2.14 for detailed electrical specs.
37	GPIO7	GDI	I/O	GPIO	Configurable GPIO, alternatively settable to indicate Satellite Tx/Rx and/or GNSS Rx operation. Push-pull output type. See Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.
38	SIM_CLK	SIM	O	SIM clock	See Section 3.4.1 for functional description. See Section 5.2.12 for detailed electrical specs.
39	SIM_IO	SIM	I/O	SIM data	See Section 3.4.1 for functional description. See Section 5.2.12 for detailed electrical specs.
40	SIM_RST	SIM	O	SIM reset	See Section 3.4.1 for functional description. See Section 5.2.12 for detailed electrical specs.
41	VSIM	-	O	SIM supply output	See Section 3.4.1 for functional description. See Section 5.2.12 for detailed electrical specs.

No.	Name	Power domain	I/O	Description	Remarks
42	GPIO5	GDI	I/O / I	GPIO / SIM card detection	Configurable GPIO, alternatively settable as input pin for SIM card detection. Push-pull output type. See Section 3.4.2 / Section 3.7 for functional description. See Section 5.2.13 for detailed electrical specs.
43	GND	-	N/A	Ground	All the GND pins must be connected to ground.
44	SDIO_D2	GDI	I/O / O	SDIO data [2] / SPI_CLK	SDIO supported for diagnostic purposes only. The pin is alternatively configurable as SPI_CLK, for diagnostic purposes only. Push-pull output type.
45	SDIO_CLK	GDI	O	SDIO serial clock	SDIO supported for diagnostic purposes only.
46	SDIO_CMD	GDI	I/O	SDIO command	SDIO supported for diagnostic purposes only.
47	SDIO_D0	GDI	I/O / O	SDIO data [0] / SPI_MOSI	SDIO supported for diagnostic purposes only. The pin is alternatively configurable as SPI_MOSI, for diagnostic purposes only. Push-pull output type.
48	SDIO_D3	GDI	I/O / O	SDIO data [3] / SPI_CS	SDIO supported for diagnostic purposes only. The pin is alternatively configurable as SPI_CS, for diagnostic purposes only. Push-pull output type.
49	SDIO_D1	GDI	I/O / I	SDIO data [1] / SPI_MISO	SDIO supported for diagnostic purposes only. The pin is alternatively configurable as SPI_MISO, for diagnostic purposes only.
50	GND	-	N/A	Ground	All the GND pins must be connected to ground.
51	VCC	-	I	Transceiver supply input	All VCC pins must be connected to external supply. See Section 3.1.1 for functional description. See Section 5.2.3 for detailed electrical specs.
52	VCC	-	I	Transceiver supply input	All VCC pins must be connected to external supply. See Section 3.1.1 for functional description. See Section 5.2.3 for detailed electrical specs.
53	VCC	-	I	Transceiver supply input	All VCC pins must be connected to external supply. See Section 3.1.1 for functional description. See Section 5.2.3 for detailed electrical specs.
54	GND	-	N/A	Ground	All the GND pins must be connected to ground.
55	GND	-	N/A	Ground	All the GND pins must be connected to ground.

No.	Name	Power domain	I/O	Description	Remarks
56	ANT	-	I/O	Cellular antenna	RF input/output for Cellular Rx/Tx antenna. 50 Ω nominal impedance. See Section 3.2.1 and Section 5.2.6 for details.
57	GND	-	N/A	Ground	All the GND pins must be connected to ground.
58	GND	-	N/A	Ground	All the GND pins must be connected to ground.
59	GND	-	N/A	Ground	All the GND pins must be connected to ground.
60	GND	-	N/A	Ground	All the GND pins must be connected to ground.
61	GND	-	N/A	Ground	All the GND pins must be connected to ground.
62	ANT_DET	ADC	I	Antenna detection	Antenna presence detection function. See Section 3.2.3 for details. See Section 5.2.8 for detailed electrical specs.
63	GND	-	N/A	Ground	All the GND pins must be connected to ground.
64	GND	-	N/A	Ground	All the GND pins must be connected to ground.
65	GND	-	N/A	Ground	All the GND pins must be connected to ground.
...					
96					

For more information about pin-out, see the *Iridium 9604 Hardware Development Guide* [2].

See Appendix A for an explanation of the abbreviations and terms used.

5. Electrical specifications

Stressing the device above one or more of the ratings listed in Section 5.1 , may cause permanent damage. These are stress ratings only. Operating the transceiver at these or at any conditions other than those specified in Section 5.2 , must be avoided. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical characteristics are defined according to the verification on a representative number of samples or according to the simulation.

Where application information is given, it is advisory only and does not form part of the specification.

5.1. Absolute maximum rating

Limiting values given below are in accordance with Absolute Maximum Rating System (IEC 134).

Table 7. Absolute Maximum Ratings

Symbol	Description	Condition	Min.	Max.	Unit
VCC	Transceiver supply voltage	Input voltage at VCC pins	-0.3	4.6	V
		Input voltage ramp at VCC pins		130	mV/µs
VUSB_DET	USB detection pin	Input voltage at VUSB_DET pin	-0.3	5.5	V
		Input voltage ramp at VUSB_DET pin		650	mV/µs
USB	USB D+/D- pins	Input voltage at USB interface pins	-0.3	3.6	V
GDI	Generic digital interfaces	Input voltage at Generic digital interfaces pins	-0.3	2.3	V
I2C	I2C interface	Input voltage at I2C interface pins	-0.3	2.3	V
GNSS	GNSS digital interfaces	Input voltage at GNSS digital interfaces pins	-0.3	2.3	V
V_BCKP_GNSS	GNSS backup supply	Input voltage at GNSS backup supply pin	-0.3	3.6	V
RTC_GNSS	GNSS RTC input	Input voltage at GNSS RTC input pin	-0.3	1.15	V
SIM	SIM interface	Input voltage at SIM interface pins	-0.3	3.5	V
POS	Power-on input	Input voltage at PWR_ON pin	-0.3	1.65	V
ADC	ADC signal	Input voltage at ANT_DET and ADC pins	-0.3	1.65	V
P_RF	RF power	Input RF power at ANT pin		3	dBm
		Input RF power at ANT_GNSS_SAT pin		0	dBm
Rho_ANT	Antenna ruggedness	Output RF load mismatch ruggedness at RF pins		10:1	VSWR
Tstg	Storage temperature		-40	+85	°C

The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the voltage specifications given in Table 7 above must be limited to values within the specified boundaries by using appropriate protection devices.

5.1.1. Maximum ESD

Table 8. Maximum ESD Ratings

Parameter	Min	Max	Unit	Remarks
ESD sensitivity for all pins		1000	V	Human Body Model according to JS-001-2017
		500	V	Charged Device Model according to JS-002-2018

This transceiver is an electrostatic sensitive device and requires special precautions when handling. See Section 8.4 for ESD handling instructions.

5.2. Operating conditions

Unless otherwise indicated, all operating condition specifications are at an ambient temperature of +25 °C.

Operation beyond the operating conditions is not recommended and extended exposure beyond them may affect device reliability.

5.2.1. Operating temperature range

Table 9. Environmental Conditions

Parameter	Min.	Typ.	Max.	Unit	Remarks
Normal operating temperature	-20	+25	+65	°C	Operating within 3GPP LTE specifications
Extended operating temperature	-40		+85	°C	Operating within Iridium Satellite specifications. Operating with possible slight deviation in LTE RF performance outside normal operating range

5.2.2. Thermal parameters

Table 10. Thermal Characterization Parameters of the Transceiver

Symbol	Parameter	Min	Typ	Max	Unit	Remarks
Ψ_{M-A}	Transceiver-to-Ambient thermal parameter		10		°C/W	Thermal characterization parameter $\Psi_{M-A} = (T_M - T_A) / P_H$ proportional to the delta between internal transceiver temperature (T_M) and ambient temperature (T_A), due to heat power dissipation (P_H), with the transceiver mounted on a 79 x 62 x 1.41 mm 4-Layer PCB with a high coverage of copper, in still air conditions

Symbol	Parameter	Min	Typ	Max	Unit	Remarks
Ψ_{M-C}	Transceiver-to-Case thermal parameter		2		°C/W	Thermal characterization parameter $\Psi_{M-C} = (T_M - T_C) / P_H$ proportional to the delta between internal transceiver temperature (T_M) and ambient temperature (T_C), due to heat power dissipation (P_H), with the transceiver mounted on a 79 x 62 x 1.41 mm 4-Layer PCB with a high coverage of copper, with a robust aluminum heat-sink and with forced air ventilation, i.e. reducing to a value close to 0 °C/W the thermal resistance from the case of the transceiver to the ambient

5.2.3. Supply/power pins

Table 11. Input Characteristics of the Supply/Power Pins

Symbol	Parameter	Min.	Typical	Max.	Unit
VCC	Transceiver supply normal operating input voltage [1]	3.3	3.8	4.4	V
	Transceiver supply extended operating input voltage [2]	3.0		4.5	V
V_BCKP_GNSS	GNSS backup domain, supply voltage	1.65		3.6	V
I_BCKP_GNSS[3]	Backup current in GNSS hardware backup mode, at V_BCKP_GNSS = 3.3 V		32		µA

Table 12. Output Characteristics of the Supply/Power Pins

Symbol	Parameter	Min.	Typical	Max.	Unit
VSIM	SIM supply output voltage with 1.8 V external SIM		1.8		V
	SIM supply output voltage with 3.0 V external SIM		3.0		V
V_INT	Generic Digital Interfaces supply output voltage		1.8		V
	Generic Digital Interfaces supply output current capability			70	mA

5.2.4. Current consumption

Table 13. VCC Current Consumption of Iridium 9604 with GNSS Off

Mode	Condition	Tx power	Min	Typ[4]	Max	Unit
Power-off mode	Average current value (power-off mode)	—		0.5		µA
LTE PSM deep-sleep mode	Average current value (PSM deep-sleep mode)	—		0.5		µA
LTE cyclic deep-sleep / active mode (+UPSV: 1)	Average current value (eDRX deep-sleep mode[5] rock bottom floor current)	—		0.5		µA
	Average current value (DRX = 2.56 s, PTW = 20.48 s, eDRX = 655.36 s, +UPSMVER: 8)	—		200		µA
LTE cyclic idle / active mode (+UPSV: 1)	Average current value (low power idle mode rock bottom floor current)	—		1.4		mA
	Average current value (DRX = 2.56 s, PTW = 20.48 s, eDRX = 655.36 s, +UPSMVER: 0)	—		1.4		mA
	Average current value (DRX = 2.56 s, no eDRX)	—		1.9		mA
	Average current value (DRX = 1.28 s, no eDRX)	—		2.2		mA
Satellite cyclic idle / active mode (+UPSV: 1)	Average current value (low power idle mode rock bottom floor current)	—		1.8		mA
	Average current value (DRX = 4.316s)	—		9.8		mA
Idle mode (+UPSV: 1)	Average current value (airplane mode, +CFUN: 0)	—		1.4		mA
LTE active mode (+UPSV: 0)	Average current value (DRX = 1.28 s)	—		15		mA
Satellite active mode (+UPSV: 0)	Average current value (DRX = 4.316s)	—		17		mA
LTE Cat M1 connected mode	Average current value (Tx/ Rx data transfer)	Min. (-50 dBm)		95		mA
		0 dBm		100		mA
		8 dBm		115		mA
		14 dBm		140		mA
		20 dBm		170		mA

Mode	Condition	Tx power	Min	Typ[4]	Max	Unit
		Max. (23 dBm)		195		mA
	Average current value (during Tx only)	Max. (23 dBm)		395		mA
Satellite connected mode	Average current value (during Rx only)	—		118		mA
	Average current value (during Tx only)	Max. (32.2 dBm)		2.5	2.8	A

NOTE: When transmitting in satellite connected mode, instantaneous peak current can be as much as 1 A higher than the average value.

Table 14. Indicative VCC Current Consumption of the Iridium 9604 with GNSS On

GNSS condition	Modem condition	GPS	GPS + GLO	GPS + GLO + GAL + BDS B1C	Unit
1s cyclic tracking	LTE PSM, +UPSV: 1	11.5	12	N/A	mA
	LTE DRX = 1.28 s, +UPSV: 1	12.5	13	N/A	mA
Continuous tracking	LTE PSM, +UPSV: 1	15	17	19	mA
	LTE DRX = 1.28 s, +UPSV: 1	16	18	20	mA
	LTE DRX = 1.28 s, +UPSV: 0	28	30	31	mA
Acquisition	LTE DRX = 1.28 s, +UPSV: 0	30.5	32.5	37.5	mA
Startup	LTE DRX = 1.28 s, +UPSV: 0	≤ 120	≤ 120	≤ 120	mA

5.2.5. GNSS characteristics

Table 15. GNSS Characteristics of Iridium 9604

Parameter	Specification	
Receiver type	u-blox UBX-M10050 SPG 5.10, supporting concurrent reception of up to 4 GNSS systems	
GNSS signals	GPS / QZSS Galileo GLONASS BeiDou[6]	L1C/A (1575.42 MHz) E1-B/C (1575.42 MHz) L1OF (1602 MHz + k*562.5 kHz, k = -7,..., 5, 6) B1I (1561.098 MHz), B1C (1575.42 MHz)
Operational limits[7]	Dynamics Altitude Velocity	≤ 4 g 80'000 m 500 m/s
Velocity accuracy[8]		0.05 m/s
Heading accuracy[8]		0.3 degrees
Time pulse signal	Accuracy	30 ns (RMS) 60 ns (99%)
	Frequency	Default 1 PPS (0.25 Hz to 10 MHz configurable)

Table 16. GNSS Performance of Iridium 9604

Parameter		GPS+Galileo	GPS+Galileo +GLONASS	GPS+Galileo +BeiDou B1I	GPS+Galileo +BeiDou B1C	GPS+Galileo +BeiDou B1C +GLONASS
Time-To-First-Fix (TTFF)[9]	Cold start	28 s	23 s	27 s	28 s	23 s
	Hot start	1 s	1 s	1 s	1 s	1 s
	Aided starts[10]	1 s	1 s	1 s	1 s	1 s
Max navigation update rate	Default	10 Hz	6 Hz	3 Hz	8 Hz	4 Hz
	High performance[11]	20 Hz	16 Hz	12 Hz	16 Hz	10 Hz
	Reacquisition	-160 dBm	-160 dBm	-160 dBm	-160 dBm	-160 dBm
	Cold start	-148 dBm	-148 dBm	-148 dBm	-148 dBm	-148 dBm
	Hot start[12]	-159 dBm	-159 dBm	-159 dBm	-159 dBm	-159 dBm
Position accuracy[13]		1.5 m	1.5 m	1.5 m	1.5 m	1.5 m
Parameter		**GPS**	**GLONASS**	**BeiDou B1I**	**Galileo**	**BeiDou B1C**
Time-To-First-Fix (TTFF)[9]	Cold start	29 s	27 s	30 s	41 s	56 s
	Hot start	1 s	1 s	1 s	1 s	1 s
	Aided starts[10]	1 s	1 s	1 s	5 s	N/A
Max navigation update rate	Default	18 Hz	18 Hz	18 Hz	18 Hz	18 Hz
	High performance[11]	25 Hz	25 Hz	25 Hz	25 Hz	25 Hz
Sensitivity[12]	Tracking and nav.	-167 dBm	-166 dBm	-160 dBm	-161 dBm	-163 dBm
	Reacquisition	-160 dBm	-158 dBm	-158 dBm	-154 dBm	-156 dBm
	Cold start	-148 dBm	-147 dBm	-146 dBm	-141 dBm	-136 dBm
	Hot start[13]	-159 dBm	-159 dBm	-159 dBm	-155 dBm	-157 dBm
Position accuracy[14]		1.5 m	4 m	2 m	3 m	2 m

5.2.6. Cellular RF characteristics

The cellular LTE Cat M1 bands supported by Iridium 9604 are defined in Table 2, while Table 17 describes the frequency ranges for each LTE band as per 3GPP TS 36.521-1 [6].

Table 17. LTE Operating RF Frequency Bands

Parameter		Min.	Max.	Unit	Remarks
Frequency range FDD band 71 (600 MHz)	Uplink	663	698	MHz	Transceiver transmits
	Downlink	617	652	MHz	Transceiver receives
Frequency range FDD band 12 (700 MHz)	Uplink	699	716	MHz	Transceiver transmits
	Downlink	729	746	MHz	Transceiver receives
Frequency range FDD band 28 (700 MHz)	Uplink	703	748	MHz	Transceiver transmits
	Downlink	758	803	MHz	Transceiver receives
Frequency range FDD band 85 (700 MHz)	Uplink	698	716	MHz	Transceiver transmits
	Downlink	728	746	MHz	Transceiver receives
Frequency range FDD band 13 (750 MHz)	Uplink	777	787	MHz	Transceiver transmits
	Downlink	746	756	MHz	Transceiver receives
Frequency range FDD band 20 (800 MHz)	Uplink	832	862	MHz	Transceiver transmits
	Downlink	791	821	MHz	Transceiver receives
Frequency range FDD band 26 (850 MHz)	Uplink	814	849	MHz	Transceiver transmits
	Downlink	859	894	MHz	Transceiver receives
Frequency range FDD band 18 (850 MHz)	Uplink	815	830	MHz	Transceiver transmits
	Downlink	860	875	MHz	Transceiver receives
Frequency range FDD band 5 (850 MHz)	Uplink	824	849	MHz	Transceiver transmits
	Downlink	869	894	MHz	Transceiver receives
Frequency range FDD band 19 (850 MHz)	Uplink	830	845	MHz	Transceiver transmits
	Downlink	875	890	MHz	Transceiver receives
Frequency range FDD band 8 (900 MHz)	Uplink	880	915	MHz	Transceiver transmits
	Downlink	925	960	MHz	Transceiver receives

Parameter		Min.	Max.	Unit	Remarks
Frequency range FDD band 4 (1700 MHz)	Uplink	1710	1755	MHz	Transceiver transmits
	Downlink	2110	2155	MHz	Transceiver receives
Frequency range FDD band 66 (1700 MHz)	Uplink	1710	1780	MHz	Transceiver transmits
	Downlink	2110	2200	MHz	Transceiver receives
Frequency range FDD band 3 (1800 MHz)	Uplink	1710	1785	MHz	Transceiver transmits
	Downlink	1805	1880	MHz	Transceiver receives
Frequency range FDD band 2 (1900 MHz)	Uplink	1850	1910	MHz	Transceiver transmits
	Downlink	1930	1990	MHz	Transceiver receives
Frequency range FDD band 25 (1900 MHz)	Uplink	1850	1915	MHz	Transceiver transmits
	Downlink	1930	1995	MHz	Transceiver receives
Frequency range FDD band 1 (2100 MHz)	Uplink	1920	1980	MHz	Transceiver transmits
	Downlink	2110	2170	MHz	Transceiver receives

Iridium 9604 includes a UE Power Class 3 LTE Category M1 transmitter (see Table 2) compliant to 3GPP TS 36.521-1 [6], and an LTE receiver compliant to 3GPP TS 36.521-1 [6] with LTE conducted receiver sensitivity performance described in Table 18.

Table 18. LTE Cat M1 Receiver Sensitivity Performance

Parameter	Min.	Typical	Max.	Unit	Remarks
Receiver input sensitivity Band 71 (600 MHz)		-108		dBm	Without repetitions
Receiver input sensitivity Band 12 / 28 / 85 (700 MHz)		-108		dBm	Without repetitions
Receiver input sensitivity Band 13 (750 MHz)		-108		dBm	Without repetitions
Receiver input sensitivity Band 20 (800 MHz)		-108		dBm	Without repetitions
Receiver input sensitivity Band 5 / 18 / 19 / 26 (850 MHz)		-107		dBm	Without repetitions
Receiver input sensitivity Band 8 (900 MHz)		-107		dBm	Without repetitions
Receiver input sensitivity Band 3 (1800 MHz)		-107		dBm	Without repetitions
Receiver input sensitivity Band 2 / 25 (1900 MHz)		-107		dBm	Without repetitions
Receiver input sensitivity Band 1 / 4 / 66 (2100 MHz)		-107		dBm	Without repetitions
Condition: 50 Ω, throughput > 95%, QPSK modulation, other settings as per clause 7.3EA of 3GPP TS 36.521-1 [6]					

5.2.7. Satellite RF characteristics

Connectivity over Iridium SBD satellite service is supported in the RF band indicated in Table 19.

Table 19. Satellite Operating RF Frequency Bands

Parameter	Min.	Max.	Unit	Remarks
Frequency range, L-band transmit	1616.0	1625.0	MHz	
Frequency range, L-band receive	1616.0	1625.5	MHz	

Table 20. Satellite Receiver Sensitivity Performance

Parameter	Min.	Typical	Max.	Unit	Remarks
Receiver input sensitivity, L-band at T_{NOM}		-116		dBm	<2% BER
Receiver input sensitivity, L-band at T_{LO} and T_{HI}		-113		dBm	<2% BER

5.2.8. ANT_DET pin

Table 21. ANT_DET pin characteristics

Pin Name	Parameter	Min.	Typ.	Max.	Unit	Remarks
ANT_DET	Output DC current pulse value		30		µA	
	Output DC current pulse time length		2		ms	

5.2.9. Time pulse

Table 22. Time Pulse / Time Stamp Characteristics

Parameter		Specification		Unit
Accuracy of time pulse / time stamp	GNSS source [14]	RMS	50	ns
		99%	100	ns
	LTE source	RMS	500	ns
		99%	1	µs
Configurable period of time pulse		0.5, 1.0, 2.0, 3.0 or 4.0		s

5.2.10. PWR_ON pin

Table 23. PWR_ON Pin Characteristics

Parameter	Min.	Typical	Max.	Unit	Remarks
Low-level input	-0.3		0.2	V	
Pull-up resistance		100		kΩ	Integrated pull-up to internal rail (1.2 V typical)
Low-level input current		-15		µA	
PWR_ON low time	0.1		0.9	s	Low time to trigger transceiver switch-on from power-off mode
	0.1		0.9	s	Low time to trigger transceiver early wake-up from deep-sleep
	1.5			s	Low time to trigger transceiver normal graceful switch off
	17			s	Low time to trigger transceiver emergency hardware shutdown

5.2.11. RESET_N pin

Table 24. RESET_N Pin Characteristics

Parameter	Min.	Typical	Max.	Unit	Remarks
Internal supply		1.8			Digital I/O Interfaces supply (V_INT)
Low-level input	-0.3		0.5	V	
Low-level input current	-18	-32	-56	µA	
RESET_N low time	100			ms	Low time to trigger transceiver reset / reboot

5.2.12. SIM pins

The SIM pins are a dedicated interface to the external SIM card/chip. The electrical characteristics fulfill the regulatory specification requirements. The values in Table 25 are for information only.

Table 25. SIM Pin Characteristics

Parameter	Min.	Typ.	Max.	Unit	Remarks
Internal supply domain for SIM interface		1.8		V	VSIM, with external 1.8 V SIM type
		3.0		V	VSIM, with external 3.0 V SIM type
Low-level input	-0.3		0.2*VSIM	V	
High-level input	0.6*VSIM		VSIM+0.3	V	
Low-level output		0.0		V	
High-level output		VSIM		V	
Internal pull-up resistor on SIM_IO		4.7		kΩ	Internal pull-up to VSIM supply
Clock frequency on SIM_CLK		3.13		MHz	

5.2.13. Generic Digital Interfaces pins

Table 26. GDI Pin Characteristics

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for GDI domain		1.8		V	Digital I/O Interfaces supply (V_INT)
Low-level input	-0.3		0.5	V	
High-level input	1.3		2.1	V	
Low-level output		0.0	0.4	V	
High-level output	1.4	1.8		V	
Input leakage current			1	µA	0 V < V_{IN} < 1.8 V
Output high driver strength	3.28	5.22	7.92	mA	V_{OUT} = 1.4
Output low driver strength	3.02	5.41	8.63	mA	V_{OUT} = 0.4
Pull-up input current	-18	-32	-56	µA	
Pull-down input current	15	30	56	µA	

5.2.14. GNSS digital interfaces pins

Table 27. GNSS Pins Characteristics

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for GNSS domain		1.80		V	
Low-level output		0.00	0.40	V	
High-level output	1.40	1.80		V	

5.2.15. RTC_GNSS pin

Table 28. RTC_GNSS Pin Characteristics

Parameter	Min	Typical	Max	Unit	Remarks
RTC_GNSS input capacitance	7	10	14	pF	With respect to GND
RTC_GNSS input resistance	47.5	50	52.5	kΩ	With respect to GND
Low-level input	0		0.22	V	
High-level input	0.71		1.1	V	

5.2.16. I2C pins

I2C lines (**SCL** and **SDA**) are compliant to the I2C-bus standard mode specification. See the I2C-bus specification [9] for detailed electrical characteristics.

Table 29. I2C Pin Characteristics

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for I2C domain		1.8		V	Digital I/O Interfaces supply (V_INT)
Low-level input	-0.3		0.5	V	
High-level input	1.3		2.1	V	
Low-level output		0.0		V	
Pull-up input current		-450		µA	

5.2.17. USB pins

USB data lines (**USB_D+** / **USB_D-**) are compliant with the USB 2.0 high-speed specification. See the Universal Serial Bus specification revision 2.0 [8] for detailed electrical characteristics. The values in Table 30 related to USB 2.0 high-speed physical layer specifications are for information only.

Table 30. USB Pins Characteristics

Parameter	Min.	Typical	Max.	Unit	Remarks
VUSB_DET pin, High-level input	4.40	5.00	5.25	V	
High-speed squelch detection threshold (input differential signal amplitude)	100		150	mV	
High speed disconnect detection threshold (input differential signal amplitude)	525		625	mV	
High-speed data signaling input common mode voltage range	-50		500	mV	
High-speed idle output level	-10		10	mV	
High-speed data signaling output high level	360		440	mV	
High-speed data signaling output low level	-10		10	mV	
Chirp J level (output differential voltage)	700		1100	mV	
Chirp K level (output differential voltage)	-900		-500	mV	

5.2.18. ADC pin

Table 31. Analog to Digital Converter Input Pin (ADC) Characteristics

Parameter	Min.	Typical	Max.	Unit	Remarks
Resolution		12		Bits	
Input voltage range	0.25		1.15	V	
Input resistance	1			MΩ	With respect to GND

5.2.19. Smart temperature supervisor

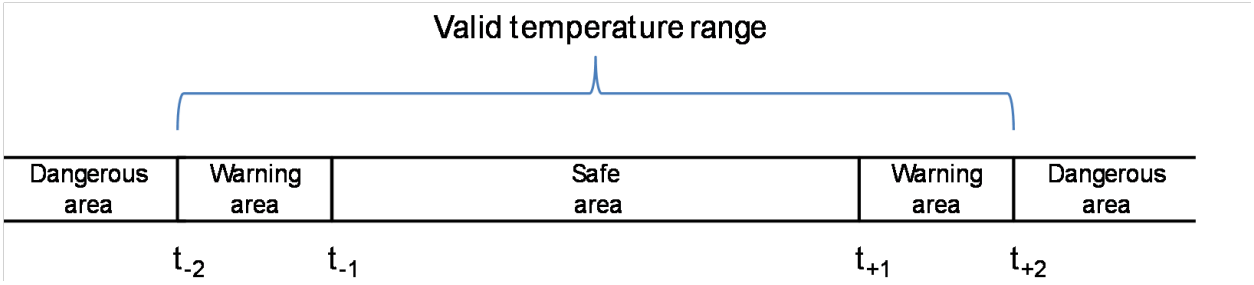


Figure 3. Temperature Range and Limits

Table 32. Thresholds Definition for the "Smart Temperature Supervisor" Feature of Iridium 9604

Symbol	Parameter	Temperature
t_{-2}	Low temperature shutdown	-40 °C
t_{-1}	Low temperature warning	-30 °C
t_{+1}	High temperature warning	+77 °C
t_{+2}	High temperature shutdown	+97 °C

The sensor measures the temperature inside the shield of the Iridium 9604 transceiver, which can differ from external ambient temperature.

5.3. Parameters for ATEX applications

This section provides useful parameters and information to integrate Iridium 9604 transceivers in applications intended for use in areas with potentially explosive atmospheres (ATEX), including:

- Total internal capacitance and inductance of the transceivers (see Table 33)
- Maximum RF output power at the antenna (**ANT**) pin of the transceivers (see Table 34)

For any device integrating the Iridium 9604 transceivers and intended for use in potentially explosive atmospheres, check the detailed requisites on the pertinent normative for the application, as for example the IEC 60079-0 [11], IEC 60079-11 [12], and IEC 60079-26 [13] standards. The requirements must be fulfilled according to the exact applicable standards.

The certification of the application device that integrates a Iridium 9604 transceiver and the compliance of the application device with all the applicable certification schemes, directives and standards required for use in potentially explosive atmospheres are the sole responsibility of the application device manufacturer.

Table 33 describes the maximum total internal capacitance and the maximum total internal inductance, considering internal parts tolerance, of the Iridium 9604 transceivers.

Table 33. Iridium 9604 Maximum Total Internal Capacitance and Maximum Total Internal Inductance

Transceiver	Parameter	Description	Value	Unit
Iridium 9604	Ci	Maximum total internal capacitance	385	µF
	Li	Maximum total internal inductance	10.7	µH

Table 34 describes the maximum RF output power transmitted from the LTE antenna (**ANT**) pin as Power Class 3 User Equipment for the LTE bands, and the maximum RF output power transmitted from the Satellite antenna (**ANT_GNSS_SAT**) pin as modem design for operation on the Iridium® SBD network.

Table 34. Iridium 9604 Maximum RF Output Power

Transceiver	Parameter	Description	Value	Unit
Iridium 9604	ANT Pout	Maximum RF output power from ANT pin	25	dBm
	ANT_GNSS_SAT Pout	Maximum RF output power from ANT_GNSS_SAT pin	32.2	dBm

Iridium 9604 transceivers do not contain internal blocks that increase the input voltage (such as step-up, duplicators, or boosters) except for the RF output **ANT** and **ANT_GNSS_SAT** pins, for which the maximum RF output power is shown in Table 34.

[1] Operating within 3GPP / ETSI specifications.

[2] Operating with possible slight deviation in RF performance outside normal operating range. The input voltage has to be above the extended operating range minimum limit to switch-on the transceiver and to avoid possible switch-off of the transceiver.

[3] [3] I_BCKP_GNSS current during GNSS normal operation is ~3 µA

[4] Typical values with matched antenna, VCC = 3.8 V

[5] Supported for eDRX sleep time longer than 70 s

[6] BeiDou B1I cannot be enabled simultaneously with BeiDou B1C or GLONASS L1OF

[7] Assuming Airborne 4 g platform

[8] 50% at 30 m/s for dynamic operation

[9] Commanded starts; all satellites at -130 dBm; GPS always in combination with QZSS and SBAS

[10] Dependent on the speed and latency of the aiding data connection

[11] Configuration required

[12] Commanded starts

[13] CEP, 50%, 24 hours static, -130 dBm, > 6 SVs for each GNSS system; GPS is always in combination with SBAS and QZSS

[14] Time pulse / time stamp is always generated by the UBX-R52 chipset after the process of the GNSS time pulse signal.

6. Mechanical specifications

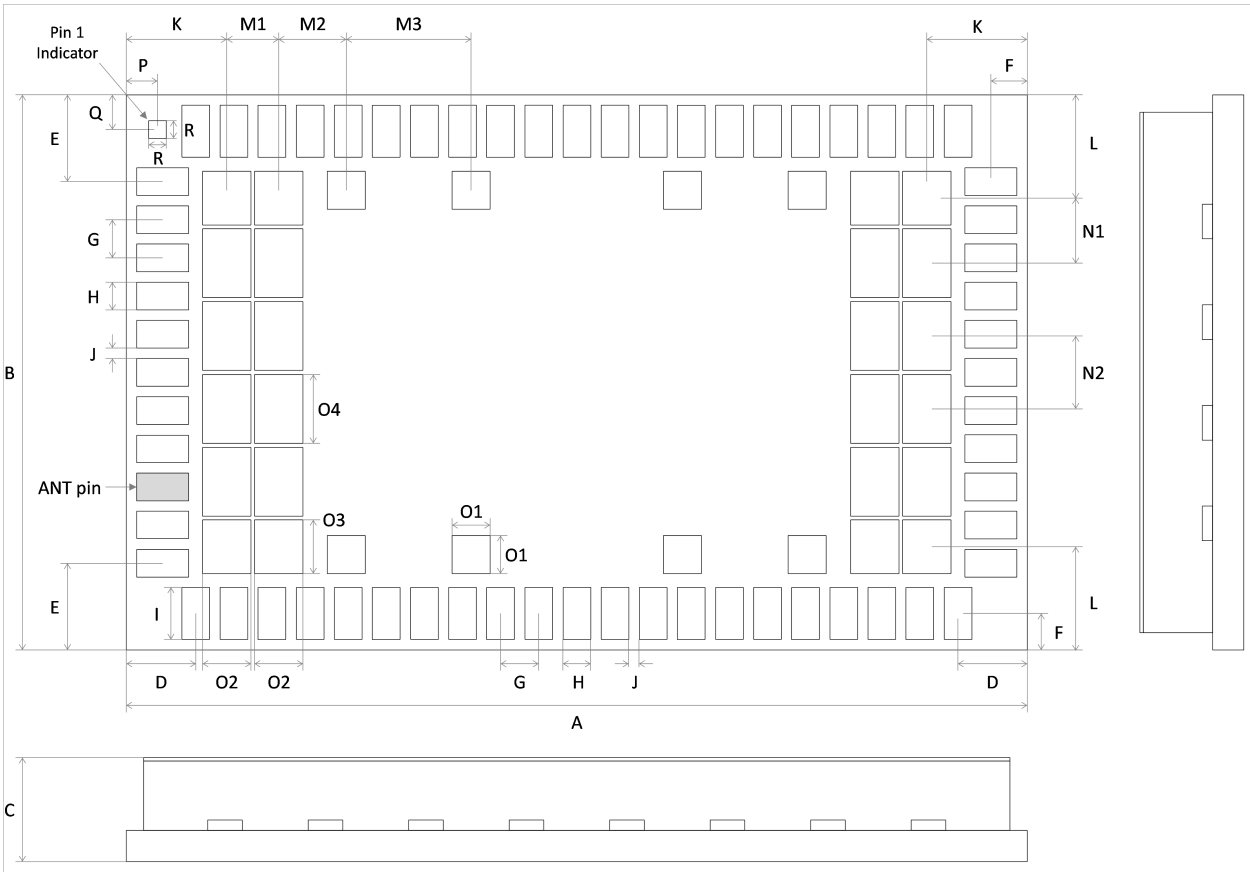


Figure 4. Iridium 9604 Dimensions (Bottom and Side Views)

Table 35. Iridium 9604 Dimensions

Parameter	Description	Typical	Tolerance	Unit
A	Transceiver height	26.0	+0.20/-0.20	mm
B	Transceiver width	16.0	+0.20/-0.20	mm
C	Transceiver thickness	2.4	+0.25/-0.15	mm
D	Horizontal edge to lateral pin pitch	2.0	+0.20/-0.20	mm
E	Vertical edge to lateral pin pitch	2.5	+0.20/-0.20	mm
F	Edge to lateral pin pitch	1.05	+0.20/-0.20	mm
G	Lateral pin to pin pitch	1.1	+0.05/-0.05	mm
H	Lateral pin height	0.8	+0.05/-0.05	mm
I	Lateral pin width	1.5	+0.05/-0.05	mm
J	Lateral pin to pin distance	0.3	+0.05/-0.05	mm
K	Horizontal edge to central pin pitch	2.9	+0.20/-0.20	mm
L	Vertical edge to central pin pitch	2.975	+0.20/-0.20	mm

Parameter	Description	Typical	Tolerance	Unit
M1	Central pin to pin horizontal pitch	1.5	+0.05/-0.05	mm
M2	Central pin to pin horizontal pitch	1.95	+0.05/-0.05	mm
M3	Central pin to pin horizontal pitch	3.6	+0.05/-0.05	mm
N1	Central pin to pin vertical pitch	1.875	+0.05/-0.05	mm
N2	Central pin to pin vertical pitch	2.1	+0.05/-0.05	mm
O1	Central pin height and width	1.1	+0.05/-0.05	mm
O2	Central pin width	1.4	+0.05/-0.05	mm
O3	Central pin height	1.55	+0.05/-0.05	mm
O4	Central pin height	2.0	+0.05/-0.05	mm
P	Horizontal edge to pin 1 indicator pitch	0.9	+0.20/-0.20	mm
Q	Vertical edge to pin 1 indicator pitch	1.0	+0.20/-0.20	mm
R	Pin 1 indicator height and width	0.5	+0.05/-0.05	mm
Weight	Transceiver weight	2		g

Transceiver height tolerance +/-0.20 mm may be exceeded close to the corners of the PCB due to the cutting process: in the worst cases, the height could be +0.40 mm longer than the typical value.

For information regarding footprint and paste mask recommended for the application board integrating the transceiver, see the *Iridium 9604 Hardware Development Guide* [2].

7. Qualifications and approvals

7.1. Reliability tests

Reliability tests for Iridium 9604 are executed according to a qualification policy based on AEC-Q104 standard.

7.2. Approvals

Iridium 9604 complies with the Directive 2011/65/EU of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment (EU RoHS 2) and its amendment Directive (EU) 2015/863 (EU RoHS 3).

Iridium 9604 is RoHS 3 compliant.

No natural rubbers, hygroscopic materials, or materials containing asbestos are employed. Table 36 summarizes the main approvals achieved or planned for Iridium 9604.

Table 36. Iridium 9604 Certification Approvals Summary

Certification	Iridium 9604
Iridium	●
GCF	●
PTCRB	●
ITU GMPCS-MOU	●
CE Europe / RED*	●
FCC United States	●
FCC ID	Q639604
ISED Canada	●
ISED Certification Number	4629A-9604
UKCA	●
AT&T with FirstNet (LTE-M)	●

* Includes compliance with RED Directive 2014/53/EU, article 3.3 d/e/f regarding cybersecurity, using ETSI EN 303 645 standard.

For guidelines and notices about compliance with certification approvals requirements integrating Iridium 9604 in the host end-device, see the *Iridium 9604 Hardware Development Guide* [2].

For the complete list of approvals and for specific details on all country, conformance, and network operator certifications available or planned for Iridium 9604, including related certificates of compliance, please contact Iridium.

7.3. Antennas

See the *Iridium 9604 Hardware Developer Guide* [2] for information on approved satellite antennas.

8. Product handling and soldering

8.1. Packaging

Iridium 9604 transceivers are delivered in hermetically sealed, reeled tapes to enable efficient production, production lot set-up and tear-down. For more information about packaging, see the package information user guide.

8.1.1. Reels

Iridium 9604 transceivers are delivered in quantities of 250 pieces on a reel. The transceivers are delivered using reel type B2 described in the package information user guide.

8.1.2. Tapes

Figure 5 shows the position and the orientation of Iridium 9604 transceivers as they are delivered on the tape, while Figure 6 and Table 37 specify the dimensions of the tape.

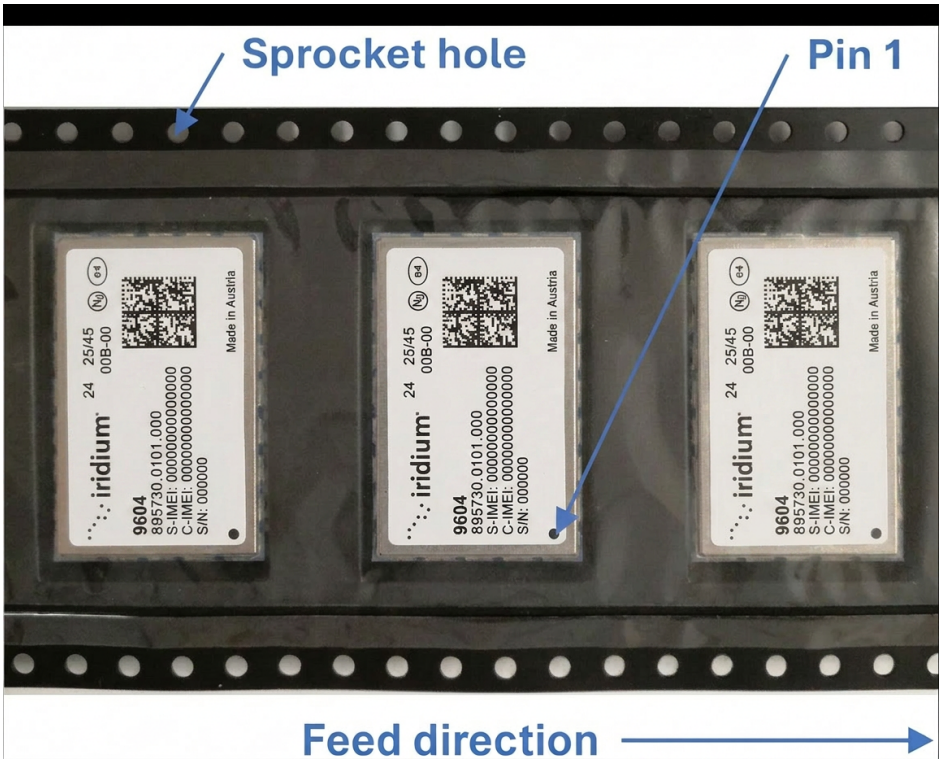


Figure 5. Orientation of Iridium 9604 Transceivers on Tape

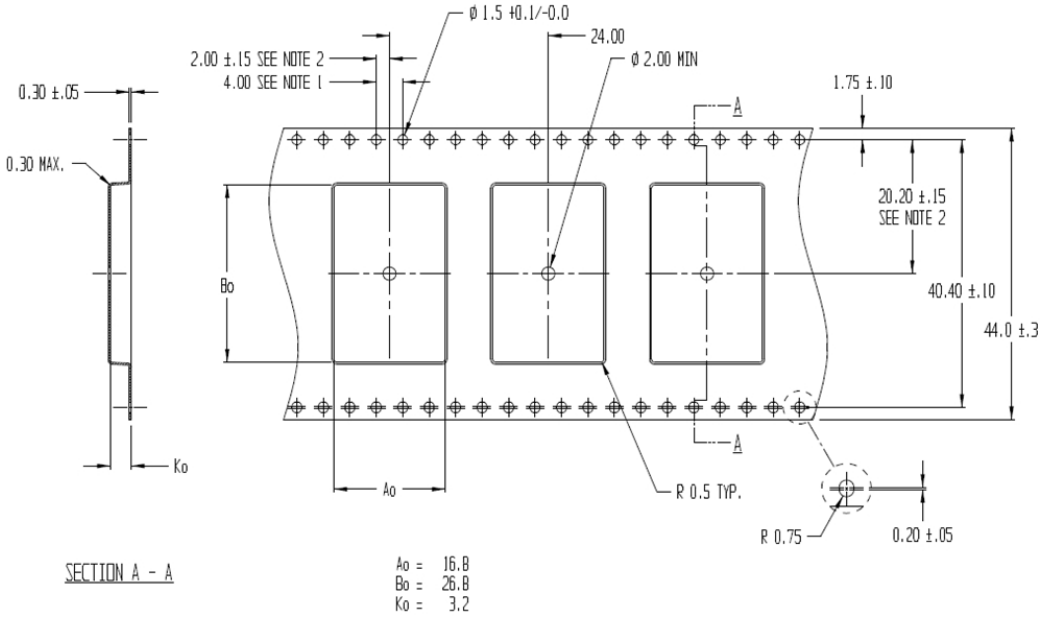


Figure 6. Iridium 9604 Tape

Table 37. Iridium 9604 Tape Dimensions (mm)

Parameter	Typical value	Tolerance	Unit
A_0	16.8	0.2	mm
B_0	26.8	0.2	mm
K_0	3.2	0.2	mm

10 sprocket hole pitch cumulative tolerance ± 0.2 mm.

Pocket position relative to sprocket hole is measured as true position of pocket, not pocket hole.

A_0 and B_0 are calculated on a plane at a distance “R” above the bottom of the pocket.

8.2. Moisture sensitivity levels

Iridium 9604 transceivers are moisture sensitive devices (MSD) in accordance with the IPC/JEDEC specification.

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. Iridium 9604 transceivers are rated at MSL level 4. For more information regarding moisture sensitivity levels, labeling, storage and drying, see the package information user guide.

- For the MSL standard, see IPC/JEDEC J-STD-020 (can be downloaded from www.jedec.org).

8.3. Reflow soldering

Reflow profiles must be selected according to recommendations (see the *Iridium 9604 Hardware Development Guide* [2]).



Failure to observe these recommendations can result in severe damage to the device!

8.4. ESD precautions



Iridium 9604 contains highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling Iridium 9604 transceivers without proper ESD protection may destroy or damage them permanently.

Iridium 9604 transceivers are Electrostatic Sensitive Devices (ESD) and require special ESD precautions typically applied to ESD sensitive components.

Table 8 details the maximum ESD ratings of Iridium 9604 transceivers.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates Iridium 9604 transceivers.

ESD precautions shall be appropriately implemented on the application board where the transceiver is mounted, as described in the *Iridium 9604 Hardware Development Guide* [2].



Failure to observe these precautions can result in severe damage to the device!

Appendix A: Abbreviations

Term	Description
3GPP	3rd Generation Partnership Project
ACMA	Australian Communications and Media Authority
ADC	Analog to Digital Converter
AEC	Automotive Electronics Council
AT	AT Command Interpreter Software Subsystem, or attention
BB	Baseband
BBR	Battery-Backed RAM
BeiDou	Chinese satellite navigation system
Cat	Category
CBS	Cell Broadcast Service
CE	Coverage Enhancement
CE	European Conformity
CEP	Circular Error Probable
CLK	Clock
CIoT	Cellular Internet of Things
CMOS	Complementary Metal-Oxide-Semiconductor
CoAP	Constrained Application Protocol
CS	Chip Select
CTS	Clear To Send
DC	Direct Current
DCD	Data Carrier Detect
DDC	Display Data Channel
DL	Down Link (Reception)
DRX	Discontinuous Reception
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTLS	Datagram Transport Layer Security
DTR	Data Terminal Ready
DUN	Dial-Up Networking
E-CID	Enhanced Cell Identity
eDRX	Extended Discontinuous Reception

Term	Description
EGNOS	European Geostationary Navigation Overlay Service
EPS	Evolved Packet System
ESD	Electrostatic Discharge
E-UTRA	Evolved Universal Terrestrial Radio Access
FCC	Federal Communications Commission (United States)
FDD	Frequency Division Duplex
FOAT	Firmware (update) Over AT commands
FTP	File Transfer Protocol
FW	Firmware
GAGAN	GPS-aided GEO augmented navigation
Galileo	European satellite navigation system
GCF	Global Certification Forum
GDI	Generic Digital Interface
GEO	Geosynchronous Equatorial Orbit
GITEKI	Gijutsu kijun tekigō shōmei - Technical standard conformity certification (Japan)
GLONASS	Russian satellite navigation system
GND	Ground
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input/Output
GPS	Global Positioning System
HARQ	Hybrid Automatic Repeat Request
HDLC	High-level Data Link Control
HTTP	HyperText Transfer Protocol
HW	Hardware
SBD	Short Burst Data
IEC	International Electrotechnical Commission
I2C	Inter-Integrated Circuit
I2S	Inter-IC Sound
I/O	Input/Output
IMEI	International Mobile Equipment Identity
IP	Internet Protocol
ISED	Innovation, Science and Economic Development (Canada)
ISO	International Organization for Standardization

Term	Description
ITU	International Telecommunications Union
LEO	Low Earth Orbit
LGA	Land Grid Array
LNA	Low Noise Amplifier
LPWA	Low Power Wide Area
LTE	Long-Term Evolution
LTE-M	Long-Term Evolution - enhanced Machine Type Communication
LwM2M	Lightweight Machine-to-Machine protocol
M2M	Machine to Machine
MEO	Medium Earth Orbit
MQTT	Message Queuing Telemetry Transport
MQTT-SN	Message Queuing Telemetry Transport for Sensor Networks
MSAS	Multi-functional Satellite Augmentation System
MSD	Moisture Sensitive Device
MSL	Moisture Sensitivity Level
MUX	Multiplexer
N/A	Not Applicable
NB-IoT	Narrowband Internet of Things
NCC	National Communications Commission (Taiwan)
NTN	Non-Terrestrial Networks
PA	Power Amplifier
PCB	Printed Circuit Board
PCN	Product Change Notification / Sample Delivery Note / Information Note
PMU	Power Management Unit
POS	Power On Signal
PPS	Pulse Per Second
PSM	Power Saving Mode
PTCRB	PCS Type Certification Review Board
PUCCH	Physical Uplink Control Channel
QPSK	Quadrature Phase Shift Keying modulation
QZSS	Quasi-Zenith Satellite System
RACH	Random Access Channel
RAM	Random Access Memory

Term	Description
RAT	Radio Access Technology
RF	Radio Frequency
RI	Ring Indicator
RIL	Radio Interface Layer
RRC	Radio Resource Control
RTC	Real Time Clock
RTS	Request To Send
Rx	Reception
SAW	Surface Acoustic Wave
SBAS	Satellite-Based Augmentation System
SBD	Short Burst Data
SCL	Serial Clock
SDA	Serial Data
SDIO	Secure Digital Input Output
SIM	Subscriber Identity Module
SLAS	Sub-meter Level Augmentation Service
SMS	Short Message Service
SPG	Standard Precision GNSS
SPI	Serial Peripheral Interface
SSL	Secure Socket Layer
TBS	Transport Block Size
TCP	Transmission Control Protocol
TCXO	Temperature-Controlled Crystal Oscillator
TDD	Time Division Duplex
TLS	Transport Layer Security
TS	Technical Specification
TTFF	Time To First Fix
Tx	Transmission
TXD	Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
UDP	User Datagram Protocol
UE	User Equipment
UL	Uplink (Transmission)

Term	Description
URC	Unsolicited Result Code
USB	Universal Serial Bus
VSWR	Voltage Standing Wave Ratio
WA	Word Alignment
WAAS	Wide Area Augmentation System