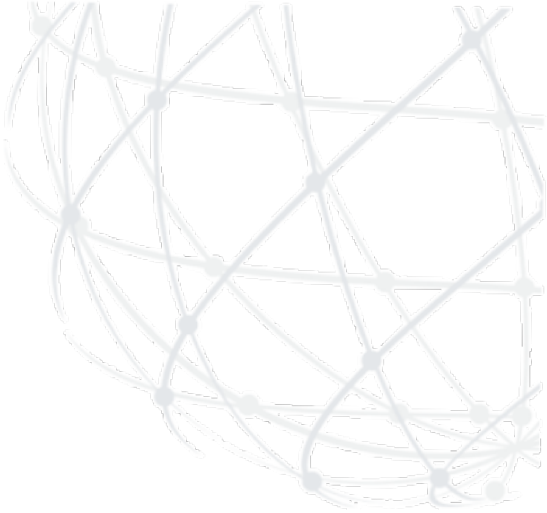

Iridium 9704
User Guide

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Revision History

Version	Date	Description
1.0	October 2024	Initial Release
2.0	November 2024	Updated design guidelines for RF routing

Table of Contents

1. Introduction

The Iridium 9704 is a transceiver designed to be used inside an integrator's product, providing satellite messaging using the Iridium® satellite constellation. Iridium's satellite services using the Iridium 9704 typically are provided by Iridium Service Providers and Value Added Resellers to end users.

This document describes hardware specifications and integration information for the Iridium 9704 transceiver including:

- Digital interfaces for communication between the transceiver and the host product
- RF interfaces to:
  - provide the transceiver with access to the Iridium network via the host PCB and antenna
  - provide GNSS passthrough to an integrator's GNSS receiver
- Mechanical specifications for integrating the transceiver into a host product
- Environmental specifications for transceiver storage and operation

1.1. Intended Audience

This document is intended to be used by hardware developers building products incorporating the Iridium 9704 transceiver. This document focuses on hardware aspects relating to the integration of the Iridium 9704 transceiver into a host product.

1.2. Abbreviations

Term	Description
DEQPSK	Differentially Encoded Quadrature Phase Shift Key
EIRP	Equivalent Isotropic Radiated Power
EMC	Electromagnetic Compatibility
ETSI	European Telecommunications Standards Institute
EU	European Union
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple-Access
GNSS	Global Navigation Satellite System
IC	Industry Canada
IEC	International Electrotechnical Commission
IFP	Iridium for Partners
ISEDC	Innovation, Science and Economic Development Canada
LGA	Land Grid Array
MSL	Moisture Sensitivity Level
PCB	Printed Circuit Board
QPSK	Quadrature Phase Shift Key
RED	Radio Equipment Directive
RF	Radio Frequency
RH	Relative Humidity
RSS	Radio Standard Specification
SP	Service Provider
TDD	Time-Division Duplexing
TDMA	Time-Division Multiple-Access

2. Electrical Specification

2.1. Absolute Maximum Ratings

Parameter	MIN	MAX	UNIT
RF			
XCVR_RF Average Output Power		32.0	dBm
XCVR_RF Peak Output Power		37.0	dBm
XCVR_RF Peak input Power		0.0	dBm

2.2. Recommended Operating Conditions

2.2.1. Transceiver Power Supplies

Parameter		Conditions	MIN	TYP	MAX	UNIT
Supply Voltages						
V_BAT_MAIN	$V_{BAT,\ MAIN}$		3.5	3.7	4.5	V
V_BAT_PA	$V_{BAT,\ PA}$					
V_IO	V_{IO}		1.62	1.8, 3.3	3.6	

2.2.2. Antenna RF Connection - XCVR_RF

Parameter	Conditions	MIN	TYP	MAX	UNIT
Iridium Transmit Frequency Range		1616.0		1626.0	MHz
Iridium Receive Frequency Range		1616.0		1626.5	MHz
Average RF Transmit Power (conducted)		26		32	dBm
Input/Output Impedance			50		Ω
Iridium RF Burst Duration			8.27		ms
Iridium RF Burst Interval			90.0		ms
Duplexing Method		TDD			
Multiplexing Method		TDMA / FDMA			
Modulation		QPSK, DEQPSK			

3. RF

3.1. RF Routing

Both the transceiver connection to the antenna (XCVR_RF) and the GNSS passthrough connection to the GNSS receiver (GNSS_RF_OUT) need to be routed on the host PCB as an impedance controlled $50\ \Omega$ track. For the XCVR_RF signal it is recommended to use a microstrip track topology on the host PCB routing to a through-hole SMA connector, following the design guidelines and layout requirements below.

Consult Iridium before adopting a different track topology or antenna connector from microstrip and through-hole SMA. This will confirm current design guidelines, layout requirements and regulatory advice.

The reference plane for the RF routing on the host PCB should connect to the GND signal on the Iridium 9704 transceiver using the LGA pads adjacent to the RF pad. The RF signals from the transceiver are referenced to this common GND ground plane within the transceiver.

To achieve a $50\ \Omega$ microstrip track the copper and substrate dimensions shown in Figure 1 should be considered, along with the dielectric constant, ϵ_r, of the substrate used. An online calculator tool can be used to find the exact dimensions appropriate for the host board's stackup, with the table below giving some example values. The impedance control requirements should also be explicitly stated in the design documents provided to the bare PCB fabricator to ensure the dimensions are adjusted to align with the final fabrication processes.

Track Impedance [Ω]	T	W [mm]	H [mm]	S [mm]	ϵ_r
50	1.0 oz/sq-ft Foil + Plating	0.11	0.076	≥ 0.22	4.2
		0.34	0.2	≥ 0.68	
		0.5	0.3	≥ 1.0	
		0.9	0.5	≥ 1.8	
		2.0	1.0	≥ 4.0	

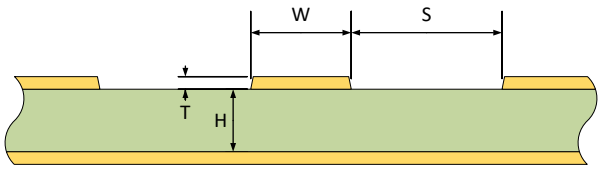

Figure 1. Microstrip Track Dimensions

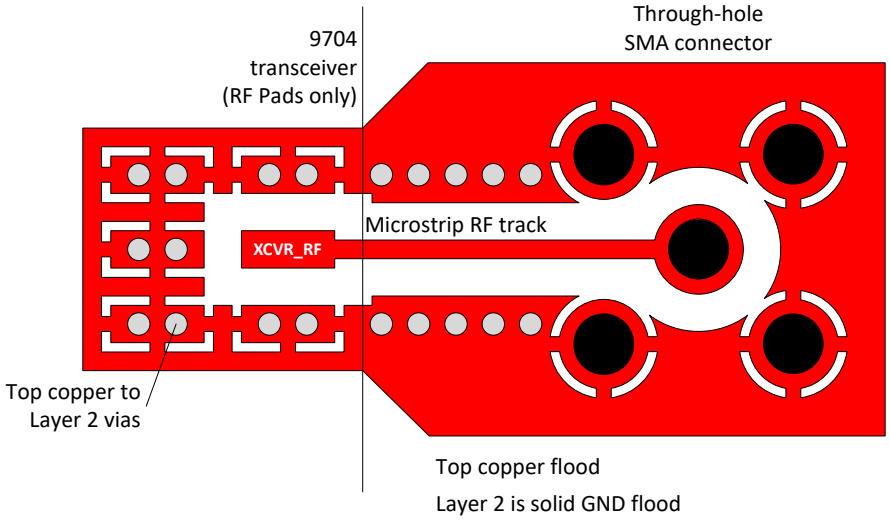

Figure 2. Example Layout For RF Routing Showing Microstrip From XCVR_RF LGA Pad to SMA Connector

The examples given show a simplified PCB with ony two copper layers. If a PCB with a higher layer count is to be used, either:

- The reference plane for the RF should be on the adjacent layer to the signal. With H being the substrate thickness between the two layers.
- If the reference plane is not on the adjacent layer, then all the copper on the intermediary layers must be removed (including all tracks, vias and planes) out to beyond the separation distance S. The distance H is then the separation distance between the bottom of the copper track and the top of the reference plane, accounting for all substrate and copper thickness on the intermediary layers.

As well as the microstrip dimensional requirements, the following should also be met:

- The RF track should be routed directly from the 9704 transceiver to the antenna connection
- The RF track length should be kept as short as possible to minimize transmission line loss
- No discrete components should be placed in the RF route (series or shunt)
- Avoid the use of any right-angle bends in the RF track. If a large direction change is required, this should be achieved using multiple smaller-angled transitions.

3.2. FCC and ISEDC Modular Grant Re-use

For operation in the US and Canada, the 9704 transceiver has obtained regulatory certification against the technical radio requirements standards in Table 1 in the form of Modular Grants. It is possible for the integrator to use the Modular Grants as evidence of the host product's compliance with these technical requirements without the need for formal testing or application to the FCC and ISEDC via a TCB or FCB. This is contingent on the adherence to the routing and layout guidelines detailed in Section 3.1, "RF Routing".

Table 1. US and Canada Technical Radio Requirements

Governing Standard	Technical Radio Requirements
FCC	FCC CFR 47 Part 2: 2021 FCC CFR 47 Part 25: 2025
ISEDC	RSS-170 Issue 4 (2022-09) ISEDC RSS-GEN Issue 5 + A2 (2021-02)

It is strongly recommended, by both the FCC and ISEDC, that *investigative* testing against the technical requirements in Table 2 is performed by the integrator. This is to confirm the 9704 transceiver is still compliant to the requirements when integrated into the host product.

It is the responsibility of the integrator to ensure that the Modular Grant is still applicable, this includes the identification and resolution of any test failures of the host product.

Table 2. Advised Technical Radio Requirement Retest By Integrator

Test Description	Governing Standard	Technical Radio Requirements	Specification Clause
Radiated Spurious Emissions	FCC	FCC CFR 47 Part 2: 2021	2.1053
		FCC CFR 47 Part 25: 2025	25.202(f)
	ISEDC	RSS-170 Issue 4 (2022-09)	5.8
		ISEDC RSS-GEN Issue 5 + A2 (2021-02)	6.13
Equivalent Isotropic Radiated Power	FCC	FCC CFR 47 Part 2: 2021	2.1046
		FCC CFR 47 Part 25: 2025	25.204
	ISEDC	RSS-170 Issue 4 (2022-09)	5.5
		ISEDC RSS-GEN Issue 5 + A2 (2021-02)	6.12

For the testing outlined in Table 2, a maximum power C2 burst at top, middle and bottom of the Iridium band should be used. For details of the required test commands see [IR5187-AN-009].

3.3. Antenna Compatibility

The Iridium 9704 transceiver requires the integrator to provide a matched antenna capable of supporting the RF frequency range and RF powers specified in this document and further detailed in [IR5187-TRD-005].

The Iridium 9704 transceiver must be used with an Iridium compliant antenna with a gain that does not exceed +5.0 dBi.

4. Mechanical

4.1. Transceiver Dimensions

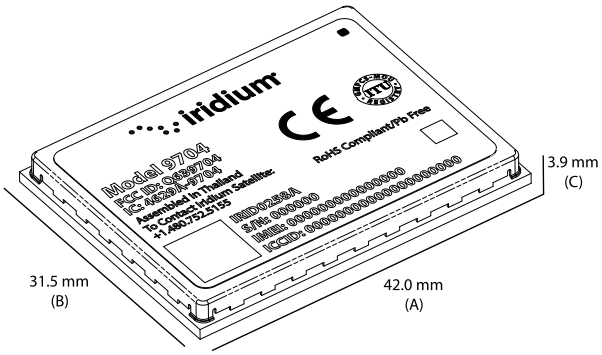

Figure 3. Dimensions of 9704 Transceiver

Description	VALUE	UNIT
Transceiver Length	42.0	mm
Transceiver Width	31.5	mm
Transceiver Thickness	3.9	mm
Transceiver Weight	9.7	g
Transceiver Flatness *(LGA Pad Surface)*	better than 0.1	mm

5. Environmental

5.1. Operating Conditions

Parameter	MIN	MAX	UNIT
Environmental			
Storage Temperature	-40	125	$^{\circ}C$
Storage Humidity		93	$\%RH$
MSL	Level 3		
Operational Temperature	-40	85	$^{\circ}C$
Operating Humidity		95	$\%RH$
Maximum Operational Vibration	$0.02\ g^2$ / Hz from $10\ Hz$ to $40\ Hz$, $40\ Hz$ to $500\ Hz$ dropping $6\ dB$ per octave $0.96\ m^2$ / s^3 from $5\ Hz$ to $20\ Hz$, $21\ Hz$ to $500\ Hz$ dropping $3\ dB$ per octave		
Maximum Operational Shock	$10\ G$ peak shock over a period of $11\ ms$, 3 shocks in 3 perpendicular orientations		

The operating temperature is defined as the temperature as measured at the transceiver electronics within any host enclosure.

Prolonged storage at high temperature prior to reflow can result in poor solderability of parts due to effects such as oxidation. Consult standard JEDEC practices for storage and handling of SMT parts prior to host product assembly.

5.2. Thermal Management

5.2.1. Transceiver Self-Heating and Thermal Integration

When operating, the Iridium 9704 transceiver will dissipate power internally as heat. It is the responsibility of the host product to conduct this heat away from the transceiver to maintain the transceiver within its operating temperature range.

The primary thermal path for conducting this heat from the transceiver is through the LGA GND pads on the underside of the transceiver - i.e. directly into the host PCB. The screening can of the Iridium 9704 transceiver is only weakly thermally coupled to the internal circuitry, and is not recommended as a thermal path.

The extent of self-heating of the transceiver will depend on the dissipative design of the host product.

When transmitting or in high ambient temperatures, the Iridium 9704 can be hot to the touch. Avoid direct contact with the transceiver in order to avoid burns.

6. Regulatory Approvals

The Iridium 9704 transceiver is a regulatory approved component that can be fitted within an integrator's product or host device. The integrator is responsible for providing the appropriate external connections to ensure that the host device meets all pertinent regulatory requirements such as CE, FCC, and IC. It is the responsibility of the integrator to ensure that the host product meets all regulatory requirements.

The Iridium 9704 has been tested to the regulatory and technical certifications shown below.

Regulatory Approvals	Tests	Regulatory and Technical Certifications
FCC	Radio Tests	FCC 47 CFR Part 2: 2021
		FCC 47 CFR Part 25: 2023
Industry Canada	Radio Tests	RSS170 Issue 4 (2022-09)
		ISEDC RSS-GEN Issue 5 + A2 (2021-02)
EU (RED)	Radio Tests	ETSI EN 301 441 V2.1.1 (2016-06)
	Electrical / Mechanical / Operational Safety Tests	IEC 62368-1:2024 + A11:2024
		EN 50665: 2017
	EMC Tests	ETSI EN 301 489-1 V2.2.3 (2019-11)
		ETSI EN 301 489-20 V2.1.1 (2019-04)

6.1. Unauthorized Changes

Iridium has not approved any changes or modifications to the Iridium 9704 transceiver by the user. Any changes or modifications could void the user's authority to operate the equipment.

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

6.2. Radio Interference

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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

L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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

6.3. RF Exposure

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 30 cm between the radiator and your body. Antenna gain must be below: +5.0 dBi. This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la IC pour un environnement non contrôlé. L'antenne doit être installé de façon à garder une distance minimale de 30 centimètres entre la source de rayonnements et votre corps. Gain de l'antenne doit être ci-dessous: +5.0 dBi. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

6.4. Labeling Requirements for Host Device

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

Contains FCC ID: Q639704 Contains IC: 4629A-9704	or	Contains transmitter module FCC ID: Q639704 Contains transmitter module IC: 4629A-9704

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

Contains FCC ID: Q639704 Contains IC: 4629A-9704	or	Contains transmitter module FCC ID: Q639704 Contains transmitter module IC: 4629A-9704

6.5. EU Declaration of Conformity

The EU Declaration of Conformity is available on the Iridium for Partners website, https://www.iridium.com/ifp.