Iridium Certus™ 9770

User Guide

PRELIMINARY DOCUMENTATION

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Revision History

Version	Date	Description
V0.3	November 21, 2019	Original Release

Approvals

CCR #	Issue	CCB	Date

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1 Introduction

The Iridium Certus™ 9770 is a transceiver designed to be used inside a Value-Added Manufacturer (VAM) product as per Figure 1-1 below. The Iridium Certus 9770 provides satellite messaging, IP data and voice connectivity using Iridium's NEXT satellite constellation. Iridium's satellite services using the Iridium Certus 9770 are provided by Iridium Certus Service Providers (SP) to end users.

This document describes hardware specifications for the Iridium Certus 9770 including

- Digital interfaces for connecting to VAM Electronics
- RF interfaces to a VAM furnished antenna
- Mechanical specifications for housing the transceiver in a VAM product
- Environmental specifications relating to VAM use cases

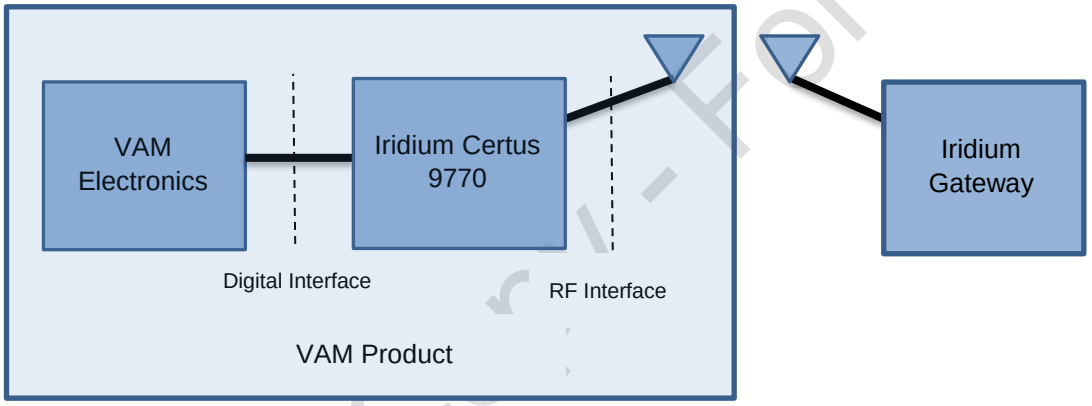

Figure 1-1 : Hardware Interface Overview

1.1 Intended Audience

This document is intended to be used by a VAM that is building products incorporating the Iridium Certus 9770. This document focuses on hardware aspects relating to the integration of the Iridium Certus 9770 into a VAM product.

1.2 Abbreviations

Name	Description
CE	Conformité Européene
DTMF	Dual Tone Multi Frequency
FCC	Federal Communications Commission
GPIO	General Purpose Input/Outputs
GND	Ground
IC	Industry Canada
RH	Relative Humidity
SD card	Secure Digital (a non-volatile memory card)
SP	Service Provider
SPI	Serial Parallel Interface
UART	Universal Asynchronous Receiver Transmitter
VAM	Value-Added Manufacturer
VSWR	Voltage Standing Wave Ratio

2 Digital Interface

The digital interface to the Iridium Certus 9770 consists of the following interfaces:

- Four UARTs
  - UART_A: Command and control functionality
  - UART_B: Transfer of user data
  - UART_C: Reserved
  - UART_D: Reserved
- I²S bus for transfer of digital audio samples used in voice calls
- SPI bus for Iridium diagnostics to assist VAM troubleshooting
- Several GPIO lines for status and control
- Power input
- Ground return
- SIM card interface

2.1 Power Supply

The Iridium Certus 9770 transceiver has a single voltage power supply input (EXT_PWR).

EXT_PWR accepts input voltages of +12 VDC +/- 2.5 V with an input ripple less than 40 mV peak-to-peak. The maximum operational input current for the Iridium Certus 9770 in stable operation is 1.5 A.

Note: For safety compliance the external power source should meet requirements of IEC 62368-1 classes ES1 & PS2.

3 RF Interface

The Iridium Certus 9770 has a dedicated RF connector that provides a connection to an external passive antenna.

3.1 RF Connector Type

The Iridium Certus 9770 has a right-angle jack, MMCX 50-ohm RF connector (Samtec part number MMCX-J-P-H-RA-TH1). The RF connector is located on the opposite end of the transceiver from the digital connector.

3.2 General RF Specifications

The general RF interface requirements for the Iridium Certus 9770 are summarized in Table 3.2-1 below. All radiated values assume a compliant antenna and cable system (see Reference 4).

Parameter	Value
Frequency Range	1616 MHz to 1626.5 MHz
Transmit Frequency Range	1616 MHz to 1626 MHz
Receive Frequency Range	1616 MHz to 1626.5 MHz
Duplexing Method	TDMA (Time Division Multiple Access)
Input / Output Impedance	50 Ω
Modulation	QPSK, DEQPSK
Maximum Average EIRP	9 dBW
Maximum Peak EIRP	15 dBW
Transmit RF Burst Duration	8.2 ms

Table 3.2-1: General RF Parameters

3.3 Conducted RF Outputs

The Iridium Certus 9770 RF output power at its connector varies during normal operating conditions as it is subject to dynamic transmitter power control by the Iridium® network. As such, the conducted RF power average (measured at the RF connector) across the burst may range between +24 dBm and +40 dBm, depending on the signal type, link conditions and dynamic power

control level. Conducted RF peak power may be up to 6 dB higher than the average RF power measured over a transmit burst.

3.4 Conductive RF Inputs

The absolute maximum RF input into the Iridium Certus 9770 should not exceed +5 dBm; otherwise, damage to the Iridium Certus 9770 is possible.

3.5 RF Cable Considerations

For safety reasons, the RF connector on the Iridium Certus 9770 should not be directly connected to an external antenna cable or cable distribution system.

EN60950-1:2006 safety standard requires that users are protected against high voltages that might appear on these cables. This can be achieved either by inserting a high voltage isolating capacitor in series with the signal or by grounding the shield of the coaxial cable. The Iridium Certus 9770's RF connector has limited voltage capacity; therefore, protection needs to be provided by a VAM product. Developers are encouraged to review the EN60950-1:2006 standard for additional details.

3.6 Antenna Specifications

The Iridium Certus 9770 requires the VAM to provide a matched RF load consisting of an antenna and RF cable. The RF path specifications including in and out of band VSWR requirements for the combined supplied RF cable and antenna are specified in Reference 4. The Certus 9770 should be used with an Iridium compliant antenna with a gain that does not exceed +3.0dBi.

4 Mechanical Specifications

The following section describes the mechanical specification for the Iridium Certus 9770.

Figure 4-1: Iridium Certus 9770 Front and Back Views

4.1 Size and Mass

The Iridium Certus 9770 overall dimensions are 140.2 mm X 60.0 mm X 16.3 mm and its mass is 185 g.

4.2 Enclosure Material

The enclosure material is an Aluminum Alloy ADC10 with a RoHs Compliant Chromate Conversion coating.

4.3 Mechanical Drawing

Figure *4.3-1* below shows the mechanical dimensions of the Iridium Certus 9770. CAD files for the Iridium Certus 9770 are also available in STEP and Parasolid files as per References 2 and 3 respectively.

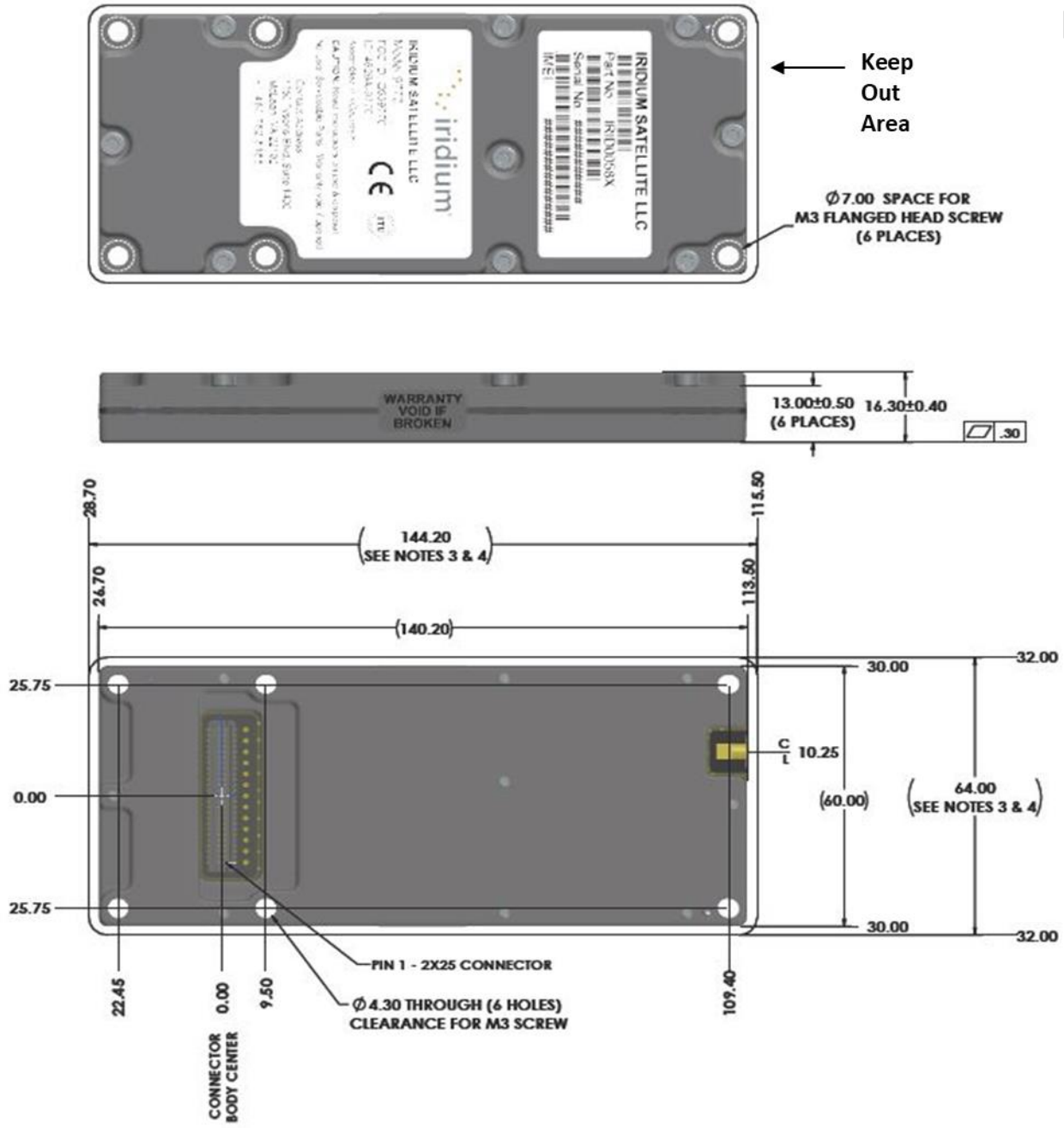

Figure 4.3-1: Iridium Certus 9770 Mechanical Drawing

4.4 Mounting Considerations

The Iridium Certus 9770 has six mounting holes with clearance for M3 screws that can be used to secure the transceiver to a VAM product. The Iridium Certus 9770 should be assembled into a VAM product by pushing the transceiver straight down onto a VAM product's mating connector, ensuring not to rotate or twist the transceiver.

The mechanical drawings in section 4.3 define a keep-out region. VAM product components should not be placed inside this keep out area which has allowances for reasonable manufacturing and assembly variations.

4.5 Grounding

Ground pins on the Iridium Certus 9770 digital connector are the intended return path for all return currents. As such, although the Iridium Certus 9770's metal enclosure is also electrically connected to a ground, it is recommended that all high current ground returns only flow through the ground pins on the digital connector.

4.6 Thermal Management

The Iridium Certus 9770 has an aluminum die cast enclosure which provides a passive thermal heat sink path that is designed to conduct, connect and/or radiate heat from its bottom surface to a VAM product. Figure 4.6-1 illustrates the location on the Iridium Certus 9770's power amplifier where the dominate heat is generated. At a minimum, it is recommended that heat sinks on a VAM product contact the Iridium Certus 9770 at this location. Depending on a VAM product design and use case scenarios, larger heat sink contact zones may be required.

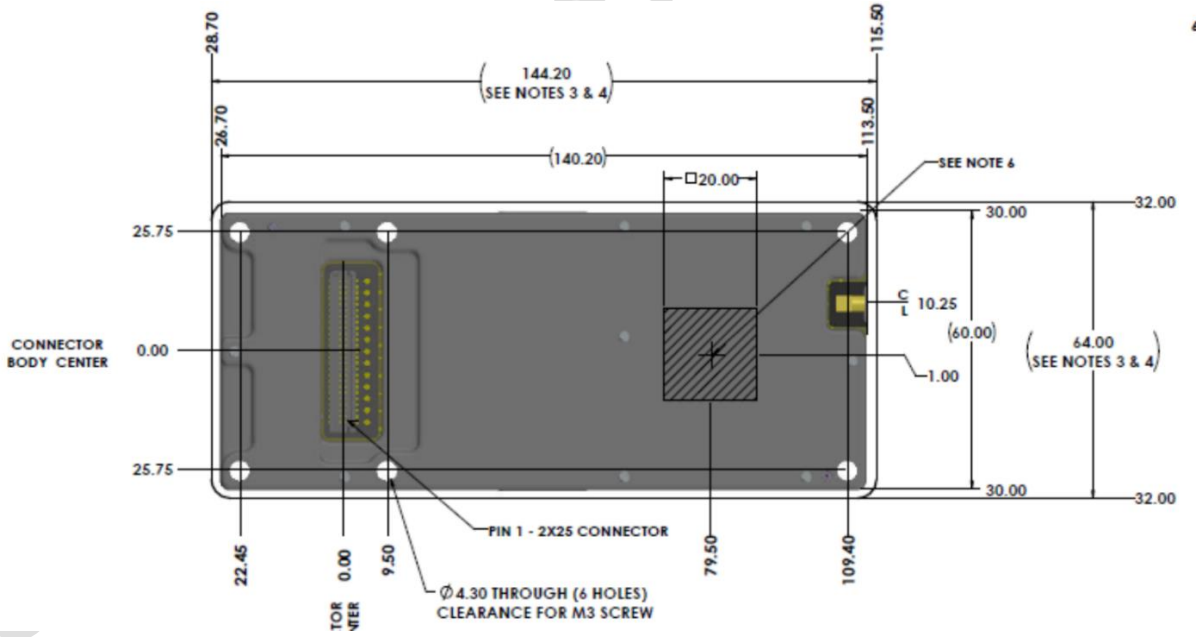

Figure 4.6-1: Primary Heat Source location

A VAM product is responsible for dissipating enough heat from the Iridium Certus 9770 into the

ambient environment to ensure that both the Iridium Certus 9770's ambient and case temperature does not exceed the temperatures in Table 4.6-1. If the Iridium Certus 9770 gets too hot, its thermal protection circuitry can shut the transceiver off and put it into a fault mode. Once the Iridium Certus 9770 enters a fault mode, a reset or power up is required to recover. Reference 1 describes how to read the status of internal temperature sensors and the notifications that are generated if the Iridium Certus 9770 goes into fault mode.

Parameter	Value
Maximum Case Temperature	75 ºC
Maximum Ambient Temperature	70 ºC

Table 4.6-1: Thermal Management Temperature Specifications

When transmitting or when ambient temperatures exceed 60 degrees C, the Iridium Certus 9770's caseworks can be hot to the touch. Avoid direct contact with the transceiver in order to avoid burns.

5 Environmental

The environmental specifications for the Iridium Certus 9770 are summarized in Table 5-1 below.

Parameter	Value
Operating Temperature Range	-40 ºC to + 70 ºC
Operating Humidity Range	≤ 95% RH
Storage Temperature Range	-40 ºC to + 85 ºC
Storage Humidity Range	≤ 93% RH
Operational Vibration	0.02 g^2/Hz from 10 Hz to 40 Hz, 40 Hz to 500 Hz dropping 6dB per octave
	0.96 m^2/s^3 from 5 Hz to 20 Hz, 21 Hz to 500 Hz dropping 3 dB per octave
Shock	10 G peak shock over a period of 11 ms, 3 shocks in 3 perpendicular orientations

Table 5-1: Environmental Specifications

6 Regulatory Approvals

The Iridium Certus™ 9770 Transceiver is a regulatory approved module that can be fitted within an enclosed host system. With appropriate external connections, the host system can be designed to meet full transceiver regulatory tests and sold as a Regulatory Certified product that meets CE, FCC and IC requirements.

The Iridium Certus™ 9770 is tested to the regulatory and technical certifications shown in Table 2 (See Note below).

The Iridium Certus™ 9770 is certified as a module for non-portable applications – i.e. those that do not combine the Iridium Certus™ 9770 with another radio element and have an intended separation distance of over 30 cm from a person. The OEM integrator is responsible for ensuring that their end-product complies with additional compliance requirements required with this module installed, such as digital device/unintentional emissions requirements and any additional potential RF exposure requirements, such as portable use or co-location requirements.

Table 2: 9770 Regulatory and Technical Certifications.

Regulatory Approvals	Radio Tests	EMC Tests	Electrical / Mechanical / Operational Safety Tests
EU (RED)	ETSI EN 301 441 V2.1.1 (2016-06)	ETSI EN 301 489-1 V2.2.1 (2019-03) ETSI EN 301 489-20 V2.1.1 (2019-04)	IEC 62638-1:2014 EN 50665: 2017
FCC	FCC 47 CFR Part 2: 2018 FCC 47 CFR Part 25: 2018	FCC 47 CFR Part 15B: 2018	
Industry Canada	RSS170 Issue 3 (2015-07) ISEDC RSS-GEN Issue 5 + A1 (2019-03)	ISEDC RSS-GEN Issue 5 + A1 (2019-03)	

6.1 Unauthorised Changes

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

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

6.2 Radio Interference

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

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

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

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

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: 3.0 dBi. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la IC pour un environnement non contrôlé. L'antenne doit être installé de façon à garder une distance minimale de 30 centimètres entre la source de rayonnements et votre corps. Gain de l'antenne doit être ci-dessous: 3.0 dBi. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

6.4 FCC Class B Digital Device Notice

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

determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

6.5 Labelling Requirements for the Host device

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

Contains FCC ID: Q639770 or Contains transmitter module FCC ID: Q639770
Contains IC: 4629A-9770 or Contains transmitter module IC: 4629A-9770

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: Q639770 or Contains transmitter module FCC ID: Q639770
Contains IC: 4629A-9770 or Contains transmitter module IC: 4629A-9770

6.6 CAN ICES-3 (B) / NMB-3 (B)

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

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

6.7 Simplified EU Declaration of Conformity

Iridium Satellite LLC hereby declares that the radio equipment Iridium Certus™ 9770 Transceiver complies with Directive 2014/53/EU. The full text of the EU declarations of conformity is available at the following internet address: www.iridium.com under partner resources.