Garmin A04349 IoT Transceiver Module

Specification Document

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Revision History

Revision	Date	Description of Change	ECO #
1	04/21/2023	Initial Release	
2	05/09/2023	Section 3 rewritten to fulfill FCC and ISED Canada requirements.	
2.1	05/12/2023	Additional changes to section 3, Regulatory Approvals and Compliance.	
3	10/16/2023	RF path of the host values	
4	07/05/2024	Complete section 2.3 Antenna Requirements	
5	07/15/2024	Rewrite confidential information, update section 3.4.2 Non-Detachable Antenna	

1. Overview

1.1 Introduction

The A04349 module is a surface mount, standalone 2-way satellite communication transceiver solution. The host application interfaces to the module via a UART interface and other GPIO control signals, as well as provides power to the transceiver.

The module includes an optional GNSS pass-through feature, allowing for a single antenna solution for both GNSS and satellite. If this option is not used, proper termination of these signals must be used.

1.2 Dimensions

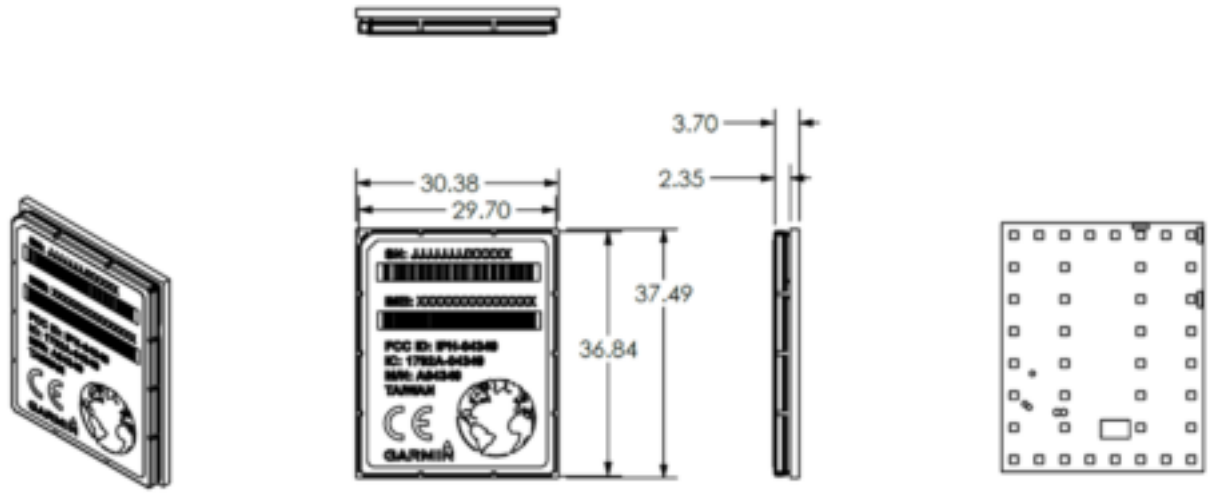


Figure 1: A04349 Module Dimensions

1.3 Transceiver Overview

The module includes a 4W RF power amplifier (RFPA) to support satellite transmissions. The RFPA is powered from 5VDC supplied by the host and must be capable of supplying >3.2A (peak) with <40mVpp ripple. See section 2.1.1 for detailed host-supplied power requirements.

2 System Requirements

2.1 Host Requirements

The host system must provide DC power (1.15V, 1.8V, 3.3V, 5V), (1) UART, (3) GPIO, and a satellite/GNSS antenna (GNSS optional).

Table 1: A04349 Module Pinout

Schematic Name	Signal Level
GPS_L5_OUT	RF
GPS_L1_OUT	RF
***_BOOTED**	3.3V
***_SPI_CS**	3.3V
***_SPI_MISO**	3.3V
***_SPI_SCLK**	3.3V
***_SPI_MOSI**	3.3V
V_3.3V_*2	3.3V
V_3.3V_*1	3.3V
V_1.8V_*	1.8V
V_1.15V_*	1.15V
***_UART_B_RX**	3.3V
***_UART_B_TX**	3.3V
***_UART_A_RX**	3.3V
***_UART_A_TX**	3.3V
GPS_L1_EN	1.8-3.3V
GPS_L5_EN	1.8-3.3V
***_TX_DET**	3.3V
V_5.0V_*	5V
ANTENNA	
V_3.3V_*_ON	3.3V
***_SYNC_OUT**	3.3V
***_SYNC_IN**	3.3V
***_PWR_HOLD_ON**	3.3V
***_WAKE_OUT**	3.3V
***_WAKE_IN**	3.3V
***_EN**	3.3V
***_SUPPLY2_EN**	3.3V
***_PA_SUPPLY_EN**	3.3V
GND	

Table 2: Signal Level Requirements

Parameter	Symbol	MIN	TYP	MAX	Unit
Input High Voltage	VIH	2.0		5.5	V
Input Low Voltage	VIL	-0.3		0.8	V
Output High Voltage	VOH	2.4			V
Output Low Voltage	VOL			0.4	V
Low Level Output Current	IOL	4.4	6.9	8.4	mA
High Level Output Current	IOH	5.5	11.6	18.3	mA

Figure 2: Host-Module Electrical Requirements

2.1.1 Power Supply Requirements from Host

Table 3: Power Supply Requirements from Host

Voltage Rail	V_{MIN}	V_{TYP}	V_{MAX}	Current (PEAK)	Notes
V_1.15V	1.14	1.15	1.16	600mA	Core
V_1.8V	1.70	1.80	1.95	800mA	I/O rails
V_3.3V_ON	2.97	3.30	3.63	3mA	GNSS path-through
V_3.3V	2.97	3.30	3.63	2.4A	I/O rails and RF
V_5.0V	4.50	5.00	5.50	3.2A	RFPA

Note that care must be taken to ensure the 5V supply can meet requirements over the full battery discharge cycle and across operating temperature. The 5V supply is critical for proper module operation and must guarantee the following specs:

- The 5V supply voltage droop during a transmission burst must be less than 500mV, 200mV ideal
- The supply should limit in-rush current to the module
- The supply shall include over current protection against faults
- The supply noise should be less than the following limits:
  - 100 mVpp from 0 – 50 kHz
  - 5 mVpp at 1 MHz measured in 50 kHz bandwidth
  - 10 mVpp at 1 MHz measured in 1 MHz bandwidth
  - 5 mVpp above 5 MHz measured in 1 MHz bandwidth

The above are required to provide proper operation within the module's power supply regulation on the module itself.

2.2 A04349 Module Radio Specifications

The RFPA on every module is factory calibrated to 34.2dBm for B1, 32.0dBm for C1/C2, +/- 0.5dBm

Table 4: Satellite Communication Frequency Range

Parameter	Value
Frequency Range	1616 MHz – 1626.5 MHz
Duplexing Method	TDD (Time Domain Duplex)
Input/Output Impedance	50Ω
Multiplexing Method	TDMA/FDMA
Modulation	DE-QPSK, QPSK

2.3 Antenna Requirements

Note the following guidelines for handling the antenna and pass-through connections of the module:

- Always terminate antenna feed with a suitable antenna or a 50Ω, 5W, RF load when the module is powered ON. Do not leave unterminated.
- GPS_L1_OUT should be 50Ω terminated if not used.

Table 5: Satellite Communication Antenna Requirements

Parameter	Value	
Impedance	50 Ω nominal	
VSWR	<1.7:1	
Gain	0 – 2200 MHz	6 dBi
	Above 2200 MHz	9 dBi
Axial Ratio	< 9.6dB	
Polarization	RHCP	

3 Regulatory Approvals and Compliance

3.1 List of Applicable FCC Rules and ISED Canada Radio Standards Specifications and Procedures

The following Parts of US Title 47, Code of Federal Regulations, and Innovation, Science and Economic Development Canada (ISEDC) Radio Standards Specifications (RSS) and Procedures (RSP) apply to this module. Additional requirements of the host equipment are not listed in the table.

47 CFR Part/RSS/RSP	Title
Part 15.212(b)	Modular transmitters. (Limited modular approval.)
PART 25	SATELLITE COMMUNICATIONS
Part 2.1091	Radiofrequency radiation exposure evaluation: mobile devices.
RSP-100 Issue 12 RSP-100, Form D	Certification of Radio Apparatus and Broadcasting Equipment Modular Approval Attestation
RSS-170 Issue 4	Mobile Earth Stations and Ancillary Terrestrial Component Equipment Operating in the Mobile-Satellite Service Bands
RSS-102 Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

3.2 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.
The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. As noted in 996369 D01 Module Certification Guide DR09-45040, “intrinsic to testing a host for compliance to 15B under SDoC or Certification provides the opportunity to confirm when the module transmitter is operating to ensure that no out-of-complaint emissions as a composite result from any stray host signals being reradiated out of compliance.”

3.3 Unauthorized Changes

This product does not contain any serviceable parts. Unauthorized repairs or modifications could result in permanent damage to the equipment and void the warranty and the authority to operate this device under Part 15 regulations.

3.4 Limited module procedures

The A04349 module does not meet all the conditions of Part 15.212(a) or RSP-100 Form D for a Single Modular Transmitter. As such, according to Part 15.212(b), it is subject to Limited Modular Approval (LMA). The exceptions listed in sections 3.4.1, 3.4.2, and 3.4.3 below must be met by the host product.
Also, because of the LMA condition below for the host to provide regulated power supplies, the A04349 module is subject to FCC Pre-Approval Guidance (PAG) under the PAG code MODLIM.

3.4.1 Host Regulated Power Supplies

The host must provide regulated 5 V, 3.4 V, 1.8 V, and 1.15 V supplies according to section 2.1.1, Power Supply Requirements from Host of this document. Verification testing is required according to Garmin ENG-0072 Engineering Lab Overstress Testing Guidelines, section 5.3.1 Operating Voltage Range. A differential oscilloscope probe is recommended to verify that the Periodic And Random Disturbances (PARD, a.k.a. ripple and noise) are within the specified voltage ranges.

Additionally, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. The integrated host and module emissions must remain compliant over the variation in input voltage.

For example, if the host is powered by a 5 VDC supply such as USB, the input power or the radiated signal level of the fundamental frequency (1616 – 1626 MHz), as appropriate, shall be measured while the supply voltage is varied over the range 4.25 – 5.75 VDC. Note: Since the USB operating voltage range is specified to be 4.75 – 5.25 VDC, the host may discontinue operating outside of this voltage range, but the input power or the radiated signal level shall be measured over the entire 4.25 – 5.75 VDC range.

3.4.2 Non-Detachable Antenna

As tested, the A04349 module did not meet the requirements of Part 15.212(a)(1)(iv) for either a permanently attached antenna or a detachable antenna with a unique connector. And so, the host product manufacturer must comply by providing a permanently attached antenna or a detachable antenna with unique connector(s). The maximum antenna peak gain per frequency band is specified in section 4.5 below, Operational Use Conditions.

3.4.3 Radiofrequency Radiation Exposure Evaluation

The A04349 module is approved for use in mobile and fixed configurations per 47 CFR 2.1091.
This equipment complies with Maximum Permissible Exposure (MPE) limits to radiofrequency electromagnetic fields for General Population/Uncontrolled Exposure per 47 CFR 1.1310 for a minimum separation distance of 20 cm between the RF source's radiating structure(s) and the body of the user.

For mobile and fixed installations, this module must be installed to maintain a minimum separation distance of 20 cm between the radiating structure(s) and the body of the user.

For installation of this module in portable equipment, the integrator must perform radiofrequency radiation exposure evaluation according to 47 CFR Part 2.1093.

3.4.4 Verification Test Procedures

In addition to the host power supply verification specified in section 3.4.1 above, the host product manufacturer shall spot-check the output power of the integrated module according to Part 2.1046, Part 25.204 and RSS-170 section 5.5. The conducted output power shall not exceed the values in the table below:

Modulation	Output Power (dBm)
B1 (DE-QPSK)	34.2 + 1 dB
C1 (QPSK)	32.0 + 1 dB
C2 (QPSK)	32.0 + 1 dB

3.5 Operational Use Conditions

The RF path of the host (including the antenna) shall have a maximum gain at any elevation angle and at any azimuth angle for each frequency band as shown in the table:

Frequency Band	Gain
0 – 2200 MHz	6 dBi
Above 2200 MHz	9 dBi

Measurements shall be taken according to Part 2.1041 and ANSI C63.10, American National Standard for Compliance Testing of Unlicensed Wireless Devices.

To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication. According to Part 25.204(d): “Notwithstanding the e.i.r.p. and e.i.r.p. density limits specified in the station authorization, each earth station transmission shall be conducted at the lowest power level that will provide the required signal quality as indicated in the application and further amended by coordination agreements.”

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons. Co-location of this module with other transmitters that operate simultaneously are required to be evaluated using the FCC multi-transmitter procedures.

3.6 Host Compliance Requirements

3.6.1 Host Compliance Requirements, General

For additional hosts other than the specific host originally granted with a limited module i.e., Garmin 012-04349-T1 (PCB Assy, IoT transceiver module Test Interface Board), a Class II Permissive Change according to FCC Part 2.1043 is required on the module grant to register the additional host as a specific host also approved with the module.
Similarly, because of LMA, integration of the module into a host product requires reauthorization of the module according to the Class IV Permissive Change requirements of RSP-100 section 10.4.
As the module manufacturer, Garmin International, Inc. is responsible for approving the host environment in which the limited module is used.
The host integrator must follow these integration instructions and ensure that the composite-system end product complies with the FCC and ISEDC requirements by a technical assessment or evaluation to the FCC rules, KDB Publication 996369, and ISEDC Radio Standard Specifications and Procedures.

3.6.2 Host Requirements, End-User Manual.

The host integrator shall provide Information to the user according to 47 CFR Parts 15.21, 15.105, 2.935 (for e-labelling, if applicable), RSS-GEN section 8.4 and Annexes B.2 and B.5 (for e-labelling, if applicable).

3.6.3 Host Requirements, Labelling

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: XYZMODEL1" or "Contains FCC ID: XYZMODEL1." Any similar wording that expresses the same meaning may be used.

The ISED certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the ISED certification number for the module, preceded by the word "contains" or similar wording expressing the same meaning, as follows:
Contains IC: XXXXXX-YYYYYYYYYY.

Specific examples follow:

Contains FCC ID: IPH-04349.
Contains IC: 1792A-04349.

Host products with an integrated display screen may have the required label information represented electronically in an e-label instead of on a physical label or nameplate.
Refer to FCC Part 15.212(a)(1)(vi) and RSS-GEN sections 4.2 – 4.4 for the above labelling requirements. For more detail on e-labelling requirements, refer also to 47 CFR 2.935 and RSS-Gen Annex B.

3.7 FCC Compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
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 may cause harmful interference to radio communications if not installed and used in accordance with the instructions. 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 of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the 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.

This product does not contain any user-serviceable parts. Repairs should only be made by an authorized Garmin service center. Unauthorized repairs or modifications could result in permanent damage to the equipment, and void your warranty and your authority to operate this device under Part 15 regulations.

3.8 Innovation, Science and Economic Development Canada Compliance

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;

2) L’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.

3.9 Responsibility

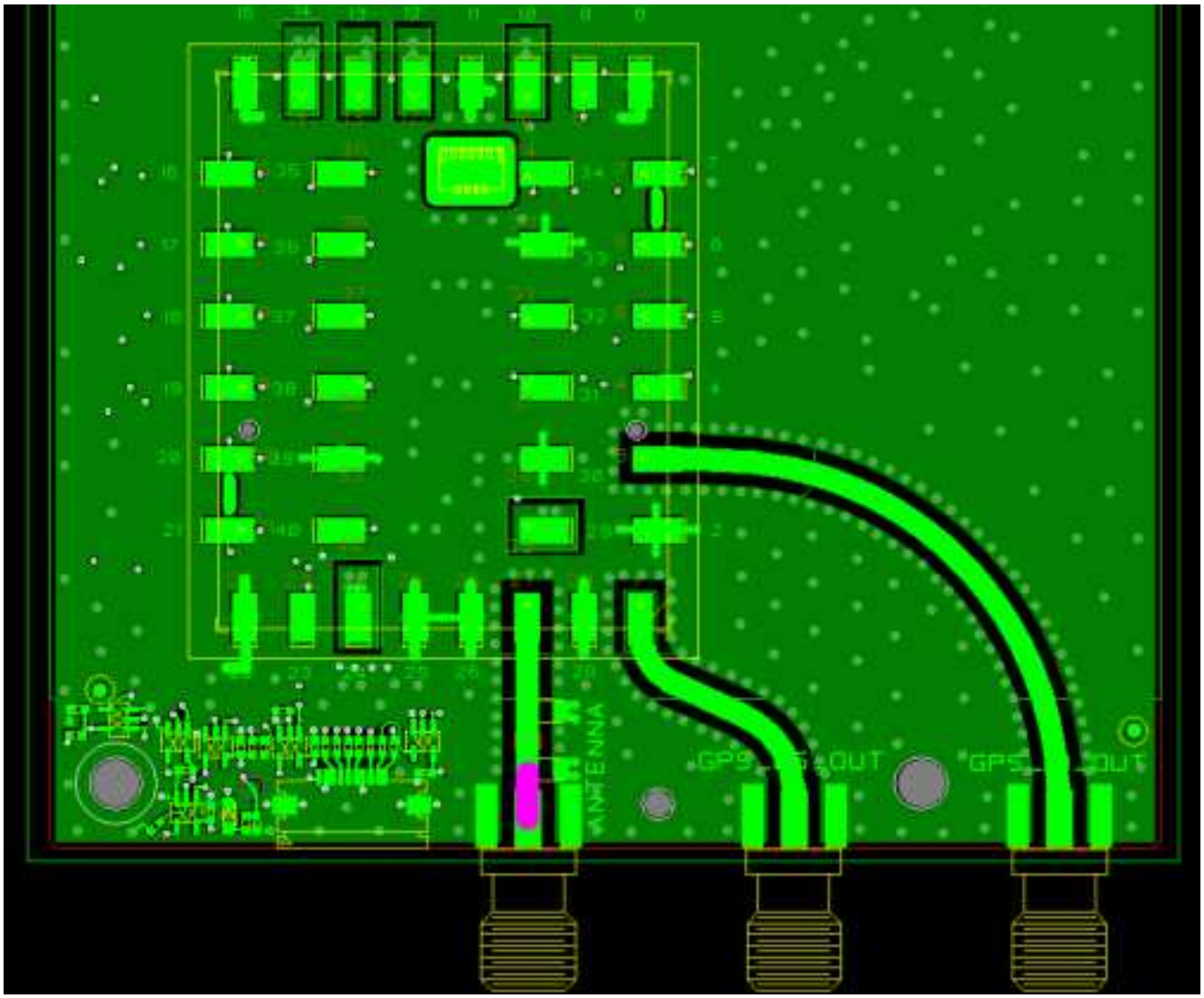
The Garmin Compliance Engineer assigned to the host project qualifying the MES module will determine the required Compliance testing, Certification requirements and documentation, as needed.

3.10 Host Antenna Trace, Other Considerations

Whenever possible, for a new model of the same form factor and PCB outline, preserving the host antenna trace (a.k.a. “trace design”) will simplify the FCC Authorization procedure.

For more information, refer to the FCC Knowledge Database (KDB) document 996369 D02 Module Q&A v01,page 4, Question 11, available here:
https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=44637

The host antenna trace for the Garmin 012-04349-T1 (PCB Assy, IoT transceiver module Test Interface Board) is shown below, one segment of which is highlighted magenta.


ANTENNA
GPS_OUT
GPS_OUT

The parameters of the above host antenna trace are as follows:

Parameter	**Value**	**Units**
Trace type	Co-planar waveguide/microstrip	
Characteristic impedance	50	ohms
Trace length	453 (11.5)	Milli-inches (mm)
Trace width	62 (1.57)	Milli-inches (mm)
Spacing	34.6 – 34.9 (0.879 – 0.887)	Milli-inches (mm)
Dielectric coefficient	4.3	n/a
Dielectric thickness	33.3 (0.846)	Milli-inches (mm)