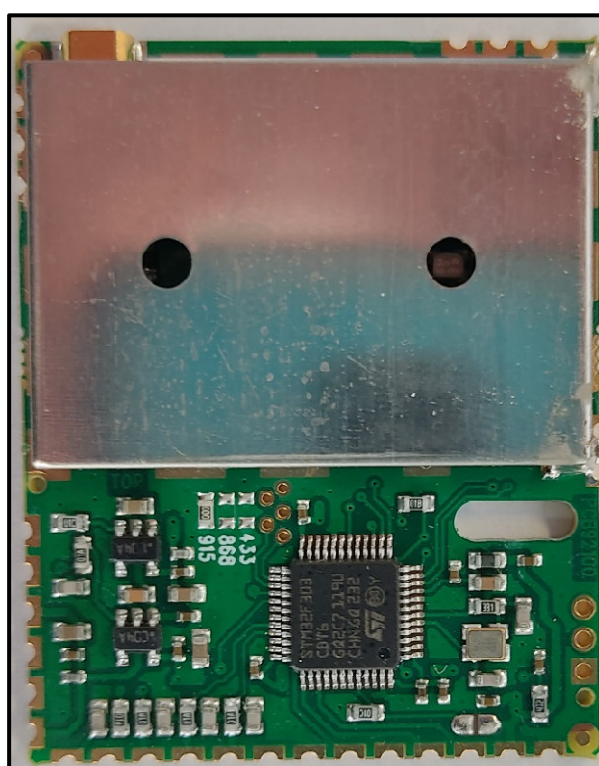


RF TRANSCEIVER MODULE 915-928MHz FOR IMET RADIO REMOTE CONTROL SYSTEMS MODEL B921C



(M880 THOR2; M880 ZEUS2; KRON; M880 ZED; M880 ARES2; M880 MODIN; M880 AXT, M880 TITAN; M880 WAVE2; M880 RAY; M880 G4; M880 HDC; M880 HAC; M880 LDC; M880 LAC; M880 SAC; M880 SDC; M880 MAC)

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This technical manual is for internal use by IMET s.r.l. only to facilitate the developments and production of the IMET Radio remote controls of the M880 series:

- M880 THOR2,
- M880 ZEUS2;
- M880 KRON;
- M880 ZED;
- M880 ARES2;
- M880 WAVE2;
- M880 RAY;
- M880 G4;
- M880 TITAN;
- M880 MODIN;

and for the receiver units (base station)

- M880 HDC;
- M880 HAC;
- M880 LDC;
- M880 LAC;
- M880 SDC;
- M880 SAC;
- M880 MAC;

all these projects can mount the B921C module for communication.

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Conventions used in this document



This symbol indicates instructions to be strictly followed for the RF B921C module to work properly



This symbol indicates useful suggestions for the proper use of the B921C module

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1.0 Device Overview and Description

The B921C transceivers have been designed to extend wireless communication in IMET radio control systems in the 915MHz to 928MHz frequency range making 64 Frequency hopping Channels in the assigned bands. The devices are integrated into the logic units of the IMET industrial remote-control systems, to allow greater coverage and reliability in the communication between the remote unit (radio control or transmitter unit of the M880 series) and the base station (M880 series receiver unit).

The B921C transceiver module has a single RF input /output with MMCX connector and it uses the FHSS modulation technique with 64 hopping channels to transmit data for industrial remote control. The B921C is assembled by welding and has its own internal voltage regulators one for the RF part and one for the microcontroller logic part and its own oscillators.

The module can it be easily integrated (surface mount) with M880 systems, freeing up the design dedicated to the RF communication part and from the compliance tests with the reference standards listed in the section 6.0 *“Approval and Certification”* allowing more faster construction times for the new M880 products.

The B921C module is approved for modular devices in the United States (FCC) and Canada (IC). Modular approval removes the need for expensive RF and antenna design, and allows the end user to place the B921C module inside a finished product and does not require regulatory testing for an intentional radiator (RF transmitter).

To maintain conformance, refer to module settings in Annex A.1 for the United States and Annex A.2 for Canada.

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1.1 Main technical Characteristics and Features

B921C RF module is a Frequency Hopping Spread Spectrum transceiver ideal for robust and reliable wireless solution and in particular for IMET radio remote control systems M880 series listed in the section 1.0 “Device overview”;



The main technical characteristics are listed in the following table

B921C MAIN CHARACTERISTICS
• High receiver sensitive up to -122 dBm;
• Advanced Ranging Engine and Time of Flight
• Size B921C: 36,2 x 45,09 x 4,70 mm (L x W x H with shield);
• Weight: 8.00 g (with shield)
• Integrated crystal oscillator for RF and logic unit
• 915-928MHz bands transceiver with 64 hopping Channels automatic selectable
• Wide band transceiver at 125kHz band per channel
• Channel Spacing of 200kHz for each
• Spread spectrum modulation with forward error correction (FEC) technique to increase the range and robustness of the radio communication. It is superior immunity to interference
• Internal voltage Regulator at 3.3 V with LDO (low Drop Out)
• One External 50Ω Antenna Connector: Micro-miniature coaxial (MMCX) connector, 50Ω
• Surface mountable in the IMET Remote control unit
• UART and JTAG communication interface available

Table 1



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1.2 Main Application

B921C is designed for industrial automation application and in particular for IMET radio REMOTE control listed in section 1.0 “Device Overview”.

1.3 Main Operational characteristics and storage

RF transceiver B921C is designed to operate in the following environmental condition



- Operating Voltage range: 3,7Vd.c. to 5V d.c.;
- Operating Temperature Range: -25°C to + 70°C (-13°F to +131°F);
- Storage Temperature Range: -40°C to +85°C (-40°F to +185°F);
- Operating and storage Humidity Range: 30% to 65%



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1.4 List of available RF Hopping channels from 915MHz to 928MHz

In the following table is reported the list of available hopping channels than can be used by the RF module. Declared Occupied Channel With is 200kHz and Occupied Channel Bandwidth is 125kHz.

List of Available Hopping Channels	
Channel Number	Channel Frequency (MHz)
1	915,200000
2	915,400000
3	915,600000
4	915,800000
5	916,000000
6	916,200000
7	916,400000
8	916,600000
9	916,800000
10	917,000000
11	917,200000
12	917,400000
13	917,600000
14	917,800000
15	918,000000





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List of Available Hopping Channels

Channel Number	Channel Frequency (MHz)
16	918,200000
17	918,400000
18	918,600000
19	918,800000
20	919,000000
21	919,200000
22	919,400000
23	919,600000
24	919,800000
25	920,000000
26	920,200000
27	920,400000
28	920,600000
29	920,800000
30	921,000000
31	921,200000
32	921,400000





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List of Available Hopping Channels

Channel Number	Channel Frequency (MHz)
33	921,600000
34	921,800000
35	922,000000
36	922,200000
37	922,400000
38	922,600000
39	922,800000
40	923,000000
41	923,200000
42	923,400000
43	923,600000
44	923,800000
45	924,000000
46	924,200000
47	924,400000
48	924,600000
49	924,800000





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List of Available Hopping Channels

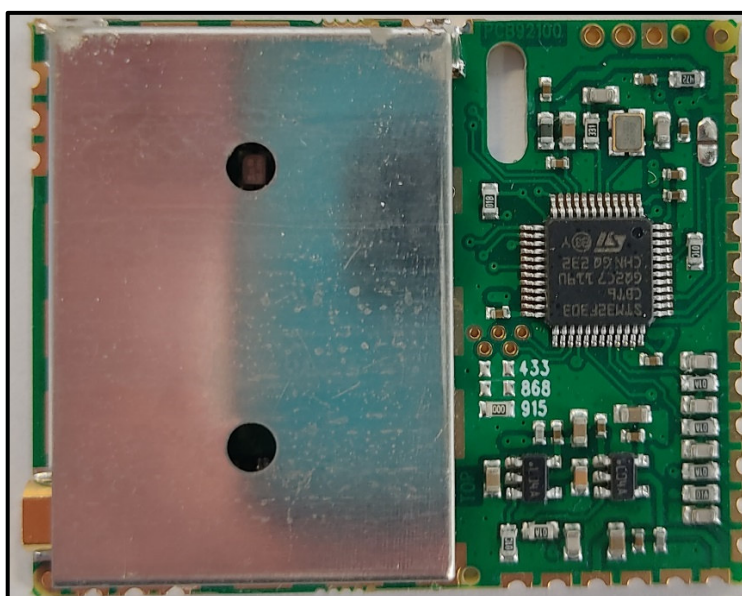
Channel Number	Channel Frequency (MHz)
50	925,000000
51	925,200000
52	925,400000
53	925,600000
54	925,800000
55	926,000000
56	926,200000
57	926,400000
58	926,600000
59	926,800000
60	927,000000
61	927,200000
62	927,400000
63	927,600000
64	927,800000

Table 2 – List of available channels



2.0 Foto of the Device

2.1 Top side with Shield



2.1 Bottom side



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3.0 Device Marking plate



B921C is marking with FCC ID: for Unite State as modular approval in accordance with Part 15.212 Modular Transmitter approval

B921C is marking with IC ID: for Canada as modular approval according to Radio Standards Specification (RSS) RSS-210 and RSSGen.

4.0 Device PIN Diagram and Layout

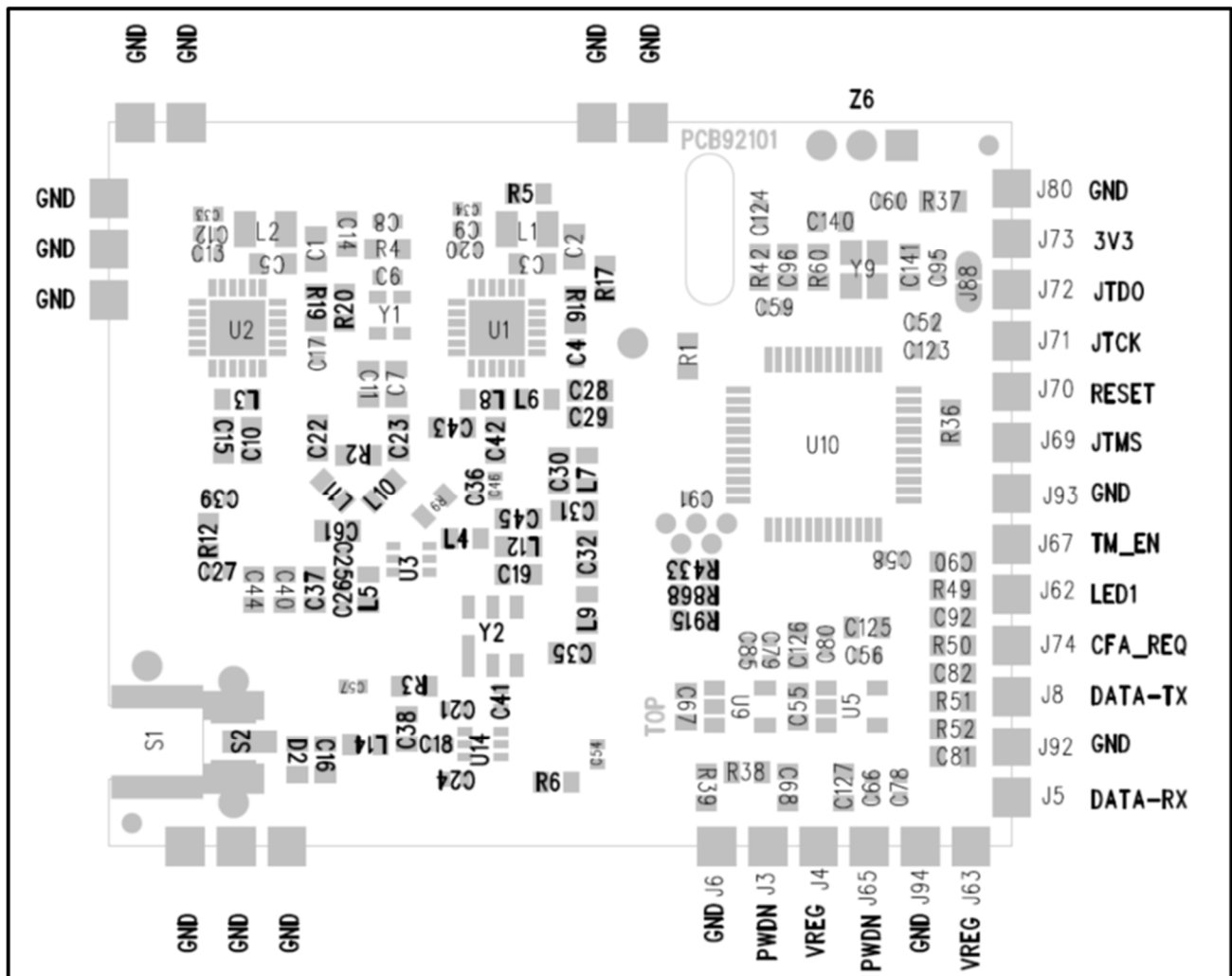


Figure 1 – Pin Layout

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4.1 PIN Description table

PIN	Symbol	Type	Description
J65	PWDN	LDO	<i>Power enable; Power ON / Power OFF the RF module</i>
J94	GND	Ground	<i>Ground</i>
J92	GND	Ground	<i>Ground</i>
J93	GND	Ground	<i>Ground</i>
J80	GND	Ground	<i>Ground</i>
J63	VREG	Power	<i>Power supply input</i>
J12	GND	Ground	<i>Ground</i>
J62	LED1	GPIO	<i>General porpouse digital input /output use only for debug</i>
J100	LED2	GPIO	<i>General porpouse digital input /output use only for debug</i>
J101	LED3	GPIO	<i>General porpouse digital input /output use only for debug</i>
J5	DATA -RX	DI	<i>UART Serial communication data input</i>
J68	GND	Ground	<i>Ground</i>
J8	DATA-TX	DO	<i>UART Serial communication data output</i>
J74	CFA-REQ	DI	<i>Digital input for frequency change request</i>
J67	TM_EN	GPIO	<i>Reserved for internal used</i>
J64	GND	Ground	<i>Ground</i>
J69	JTMS	JTAG	<i>Test mode select</i>
J70	RESET	Reset	<i>Microcontroller Reset PIN</i>
J71	JTCK	JTAG	<i>JTAG clock during programming</i>
J102	JTDI	JTAG	<i>JTAG data input</i>
J72	JTDO	JTAG	<i>JTAG data output</i>
J103	JTNRS	JTAG	<i>JTAG negative test reset</i>
J73	3.3V	3.3V	<i>Power supply for microcontroller during programming phase</i>

DO = Digital Output; DI = Digital Input; GPIO = general porpouse input output

Table 3- PIN Description

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5.0 Mounting Details

The B921C module is a surface mountable module and module dimension are shown in figure 3. The module B921C is 1,6mm thick with castellated mounting point on the edge.

In the host PCB of the B921C module it is recommended to extend the ground plane at least 5mm (0,2”) around the module.

The module was assembled using standard lead free reflow profile The module is compatible with standard lead-free solder reflow profiles. To avoid damaging the module, the following recommendations are given:

- Refer to the solder paste data sheet for specific reflow profile recommendations;
- Use no-clean flux solder paste;
- Do not wash as moisture can be trapped under the shield;
- Use only one flow. If the PCB requires multiple flows, apply the module on the last flow;

The B921C has 50Ω MMCX connector.



Caution: The MMCX connector is fragile and can only tolerate very limited number of insertions and disinsertions

5.1 Module Dimension Details

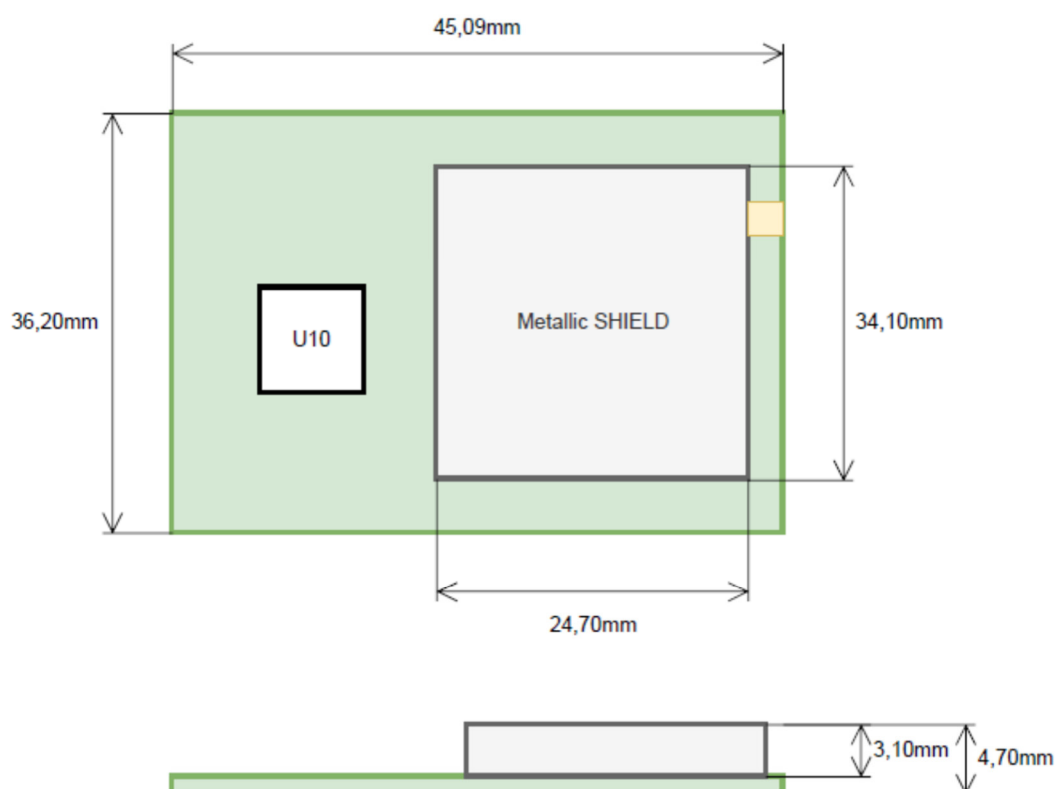


Figure 3 – Dimension Details



5.2 External Antenna for B921C

The RF B921C modules have a 50Ω Micro-miniature coaxial (MMCX) connector to connect to an external 915MHz – 928MHz antenna. Modular certification of the B921C module was performed with antenna types listed in the following table:

TESTED EXTERNAL ANTENNA TYPES			
IMET CODE	TYPE	Nominal Gain	Description
-	ANT-916-CW-HW	1,631 dBi Peak	SMA ½-wave center-fed dipole antenna

Table 4

An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Refer to Section *Regulatory Approval* for specific regulatory requirements by country.



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5.3 Electrical Characteristics

Description	Technical Data				
	Condition	Min	Typical	Max	Unit
Ambient Operating Temperature	–	-25		+70	°C
Supply voltage Range	–	3.7	4.2	5.0	V
B921C Current consumption	TX mode at maximum Output Power		60		mA
	RX mode		25		mA
	Sleep mode		-		mA
Receiver Characteristics					
Parameters	Condition	Min	Typical	Max	Unit
RF Input Frequency		915,200		927,800	MHz
RF sensitivity			-122		dBm
Max RF Input	50Ω			13	dBm
Blocking immunity	@ +/- 1 MHz		70		dB
	@ +/- 2 MHz		70		dB
	@ +/- 10 MHz		70		dB
Adjacent channel rejection			45		dB
Maximum Tolerance frequency offset between transmitter and receiver without sensitive degradation,		-50		+50	ppm
Transmitter Characteristics					
Parameters	Condition	Min	Typical	Max	Unit
RF Carrier Frequency range		915,200		927,800	MHz
RF Output Power	50Ω	-4		+13.01	dBm
Raw data rate (slow modulation)			8.416		kb/s
Raw data rate (fast modulation)			17.254		kb/s
Crystal oscillator frequency			32		MHz
Channels Number			32		
Channel Nominal Bandwidth			125		kHz

Table 5 – Electrical Characteristics

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6.0 Approval and Certification

RF module B921C is complying with the following Directive, Standards and Regulations

- FCC (Federal Communications Commission) Part 15

PART 15.207:2018

PART 15.209:2018

PART 15.247:2020

- IC (Industrial Canada) RSS-247 issue 3:2023

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.

Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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ANNEX A- Regulatory Approval



This section outlines the regulatory information for the B921C module for the following countries:

- United State;
- Canada;

A.1 United State

The B921C module is received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” modular approval in accordance with Part 15.212 Modular Transmitter approval. Modular approval allows the end user to integrate the B921C module into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

The finished product is required to comply with all applicable FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product; to requirements for unintentional radiators (Part 15 Subpart B “Unintentional Radiators”), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification, or Declaration of Conformity) (e.g., transmitter modules may also contain digital logic functions) as appropriate.

A.1.1 Labelling and User Information Requirements

The B921C module has been labelled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the

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module is installed must also display a label referring to the enclosed module. This exterior label can use wording as follows:

Contains Transmitter Module FCC ID: 2AYRTB921C or Contains FCC ID: 2AYRTB921C. 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*

A user's manual for the product should include the following statement:

This equipment has been tested and found to complying 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.



WARNING:

Changes or modifications made to this equipment not expressly approved by IMET may void the FCC authorization to operate this equipment.

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A.1.2 RF Exposure

All transmitters regulated by FCC must comply with RF exposure requirements.

If appropriate, compliance with exposure guidelines for portable and unlicensed devices can be accomplished by the use of warning labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas. The following statement must be included as a CAUTION statement in manuals and OEM products to alert users of FCC RF exposure compliance:

To satisfy FCC RF Exposure requirements for portable devices, a separation distance of 10 mm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

If the B921C module is used in a portable application the integrator is responsible for performing Specific Absorption Rate (SAR) testing in accordance with FCC rules 2.1093.

A.1.3 Approved External Antenna Types

To maintain modular approval in the United States, only the antenna types that have been tested shall be used. It is permissible to use different antenna manufacturer provided the same antenna type and antenna gain (equal to or less than) is used.

Testing of the B921C module was performed with the antenna types listed in Tested External Antenna Types on section 5.2.

A.2 Canada

The B921C module is certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSSGen. Modular approval permits the installation of a module in a host device without the need to recertify the device.

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A.2.1 Labelling and User information Requirements

Labelling Requirements for the Host Device (see RSS-Gen, issue 5, Amendment 2 (February 2021), chapter 4): The host device shall be properly labelled to identify the module within the host device. The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the Industry Canada certification number of the module, preceded by the words “*Contains transmitter module*”, or the word “*Contains*”, or similar wording expressing the same meaning, as follows:

Contains transmitter module IC:

User Manual Notice for License-Exempt Radio Apparatus (see RSS-Gen, issue 5, Amendment 2 (February 2021), chapter 8.4): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

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, and**
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.**

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, et*
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

Transmitter Antenna (see RSS-Gen , issue 5, Amendment 2 (February 2021), chapter 6.8): User manuals for transmitters shall display the following notice in a conspicuous location:

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This radio transmitter 26923-B921C has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Cet émetteur radio 26923-B921C a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous, avec le gain maximal autorisé indiqué. Les types d'antenne non inclus dans cette liste qui ont un gain supérieur au gain maximum indiqué pour tout type répertorié sont strictement interdits pour l'utilisation avec cet appareil.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi) and required impedance for each.

A.2.2 Approved External Antenna type

Transmitter Antenna (from RSS-Gen, issue 5, Amendment 2 (February 2021) chapter 6.8):

The B921C (26923-B921C) module can only be operated with antennas with which it was approved. Transmitter may be approved with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest gain antenna of each combination of transmitter and antenna type for which approval is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type having equal or lesser gain as an antenna that had been successfully tested with the transmitter, will also be considered approved with the transmitter, and may be used and marketed with the transmitter. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power limits. Testing of the B921C module was performed with the antenna types listed in Section 5.2 "External Antenna for B921C".

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A.2.3 RF Exposure

All transmitters regulated by ISED must comply with RF exposure requirements.

To satisfy ISED RF Exposure requirements for portable devices according to RSS 102 – Issue 6, a separation distance of 10 mm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

If the B921C module is used in a portable application the integrator is responsible for performing Specific Absorption Rate (SAR) testing in accordance with ISED rules RSS 102– Issue 6.