SRF305 User Manual

3 November 2014
U080.0.5-SRF305

FCC Statements

15.19 – Two Part Warning

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.

15.21 – Unauthorized Modification

NOTICE: The manufacturer is not responsible for any unauthorized modifications to this equipment made by the user. Such modifications could void the user's authority to operate the equipment.

15.27 – Special Accessories

This device is supplied with special accessories that include an RF adapter cable and antenna. These special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

15.105(b) – Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada Statements

RSS-GEN 7.1.2 – Transmitter Antenna / Antenne de L'émetteur

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 (e.i.r.p.) is not more than that necessary for successful communication.

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 (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This radio transmitter 7955A-SRF305 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio 7955A-SRF305 a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Approved Antenna List / Liste Antenne Approuvé

Manufacturer	Part Number	Stock Number	Gain	Impedance
Antenna-Factor/Linx Tech	ANT-2.4-uSP	B141	+3.8dBipeak	50 Ohm
RFM Or Equivalent	OMNI242R Or Equivalent	BB3-07	+3dBipeak	50 Ohm
Alfa Or Equivalent	ARSN19TNC Or equivalent	BB3-08	+9dBipeak	50 Ohm

RSS-GEN 7.1.3 – Notice / Délai

This device complies with 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.

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.

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Definitions:

RTM: Receive Transmit Module
Host Application: A final product ready to operate, containing and RTM
SAR: Specific Absorption Rate
Internal Antenna: gain <= +3.9dB (SAR tested), non-directional, not accessible to or removable by an operator, fully within the host application enclosure at all times.
External Antenna: gain <= +9dBi (SAR tested), non-directional, accessible to or removable by an operator, partially or fully outside the host application enclosure at any time.
Informed person: Has been properly trained in the operation of the host application.
Uninformed person: Has NOT been properly trained in the operation of the host application and/or may not be aware that the host application is operating nearby.

Notes and Observations

Cervis Inc. Safety Precautions

- ✓ ***Read and follow all instructions.***
- ✓ ***Failure to abide by Safety Precautions may result in equipment failure, loss of authority to operate the equipment, and personal injury.***
- ✓ ***Use and maintain proper wiring. Follow equipment manufacturer instructions. Improper, loose, and frayed wiring can cause system failure, equipment damage, and intermittent operation.***
- ✓ ***Changes or modifications made to equipment not expressly approved by the manufacturer will void the warranty.***
- ✓ ***Owner/operators of the equipment must abide by all applicable Federal, State, and Local laws concerning installation and operation of the equipment. Failure to comply could result in penalties and could void user authority to operate the equipment.***
- ✓ ***Turn off the module power before attempting any maintenance. This will prevent accidental operation of the controlled machinery.***
- ✓ ***Do not allow liquid to enter the module enclosure. Do not use high pressure equipment to clean the module.***
- ✓ ***Operate and store units only within the specified operation and storage temperatures defined in the Specifications of this document.***

1.0 SRF305 Introduction

The SRF305 RTM is based on a single-chip radio frequency (RF) transceiver integrated circuit (RFIC), an Atmel AT86RF231. The RT module also contains an external RF transmit power amplifier plus low noise RF receive preamplifier integrated circuit (PA/LNA), an RFaxis RFX2401C. The SRF305 RTM is intended to be integrated into Cervis Inc. products, providing a wireless RF connectivity option.

The SRF305 RTM operates in the 2.45 GHz ISM band, using spread spectrum modulation with a maximum conducted RF transmit power of +19.95dBm (per RF emission test report) at the antenna port.

The RFIC generates RF signals compliant with the Zigbee standard, IEEE 802.15.4-2006. The spread spectrum technique is direct sequence (DSSS), the modulation method is orthogonal quadrature phase shift keying (O-QPSK).

The RFIC has internal control registers that the host application can access via a serial peripheral (SPI) bus. These registers control all aspects of how the RFIC is used, which must be compliant with all applicable rules and regulations.

The SR305 RTM is interoperable various various other Cervis Inc. RTMs that use the same modulation and message data structure. Interoperability with non-Cervis RTMs, while possible, is not supported.

The SRF305 RTM is most commonly applied in half-duplex master/slave systems: the master transmits a message to a slave, the slave transmits a reply to the master. Other operating modes are possible, provided that applicable rules and regulations are not violated.

The SRF305 RTM may be realized in various PCB shapes, some with non-RF circuits applicable to the requirements of particular host applications. Variations include:

LOBSRF305 Type 1: “large mezzanine” (RF emission and SAR tested, pictured)
LOBSRF305 Type 2: “mini-module” (RF emission tested, pictured)
LOBSRF305 Type 3: “small mezzanine” (RF emission tested, pictured)
LOBSRF305 Type 4: “postage stamp” (RF emission tested, pictured)

The Type 1, 2 and 3 RTM variants are mechanically configured for use in mobile applications, with internally or externally mounted antennas.

Type 4 modules are mechanically configured for use in portable applications with internally mounted antennas, although they may be used with externally mounted antennas. Type 4 modules may be used in mobile applications as needed.

In all applications of all type of modules, it is required that proper engineering practices be followed to ensure that RF emissions remain compliant with all applicable regulations and SAR limitations are not violated. Any changes that affect the nature of RF emissions or RF exposure limits may require additional testing and/or new approvals.

1.1 SRF305 Features

2405-2480 MHz Operation
5 MHz Selectable Channel
Orthogonal Quadrature Phase Shift Keying (O-QPSK)
Direst Sequence Spread Spectrum (DSSS)
250 kbps Data Rate (tested)
500 kbps Data Rate (capable, not tested)
1000 kbps Data Rate (capable, not tested)
2000 kbps Data Rate (capable, not tested)

Up to +19.95dBm Output Power (Per RF emission report)
Use with a variety of approved, supplied internal and external antennas
IEEE 802.15.4-2006 messaging
SPI host interface
Simple power requirements
Compliant will all FCC (and equivalent IC) requirements for a modular transmitter

In accordance with FCC Rule Part 15.212 for the product certified under FCC ID: LOBSRF305, the following elements confirm that LOBSRF305 complies with the definition of a modular transmitter:

a. The radio elements of the modular transmitter have their own shielding. The physical crystal and tuning capacitors are located internal to the shielded radio elements.

b. The modular transmitter has buffered modulation/data inputs to ensure that the module will comply with part 15 requirements under conditions of excessive data rates or over-modulation.

c. The modular transmitter has its own power supply regulation.

d. The modular transmitter complies with the antenna and transmission system requirements of §§15.203, 15.204(b) and 15.204(c). hen installed in the host application, the antenna is either be permanently attached or employs a “unique” antenna coupler (at all connections between the module and the antenna, including the cable). The “professional installation” provision of §15.203 is not applicable to modules but can apply to limited modular approvals under paragraph (b) of this section.

e. The modular transmitter has been tested in a stand-alone configuration, i.e., the module must not be inside another device during testing for compliance with part 15 requirements. When the transmitter module is not battery powered it complies with the AC line conducted requirements found in §15.207. AC or DC power lines and data input/output lines connected to the module do not contain ferrites, unless they will be marketed with the module (see §15.27(a)). The length of these lines shall be the length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see §15.31(i)).

f. The modular transmitter is equipped with a permanently affixed label displaying its FCC identification number.

g. The modular transmitter complies with any specific rules or operating requirements that ordinarily apply to a complete transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization.

h. The modular transmitter must comply with any applicable RF exposure requirements in its final configuration.

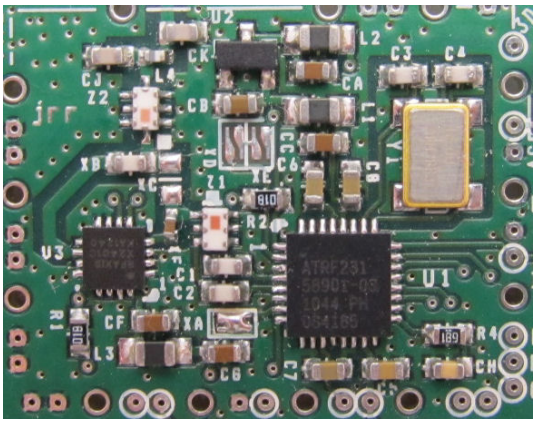

Figure 1. **SRF305 RF section Front**

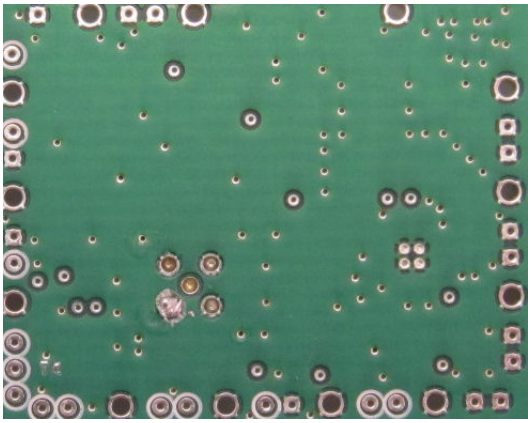

Figure 2. **SRF305 RF section Back**

1.2 SRF305 Pinouts

Table 1-4 show the pinouts and interface signals on several alternative packaging options for the SRF305 RTM:

Table 1. 07440205 PCB (SRF305 Type 1) – plug-in connector HDR1

Pin	Name	Signal	Details
1	SPI_CLK	SPI data clock in	Clock from SPI master
2	GND	ground	Low impedance ground
3	MISO	SPI data out	Data from SPI slave
4	MOSI	SPI data in	Data from SPI master
5	RF_SLP_TR	RFIC control	Multipurpose control signal from master
6	/RF_RST	RFIC reset	Low from SPI master
7	/RF_CS	RFIC chip select	Low from SPI master
8	RF_IRQ	RFIC interrupt output	Input to SPI master
9	RF_PAEN	Enable external PA	High from SPI master

10	RF_HGM/BPA	Enable external LNA or Read BPA jumper	Function not used in SRF305 Input to SPI master
11	GND	ground	Low impedance ground
12	GND	ground	Low impedance ground
13*	DISPLAYCS	Display chip select	Low from SPI master
14*	/RFEE_CS (reserved)	EE chip select	Low from SPI master
15*	DISPLAYRS	Display register select	From SPI master
16*	DISPLAYBLANK	Display on/off	From SPI master
17	reserved	reserved	reserved
18	reserved	reserved	reserved
19*	DISPLAYRST	Display reset	Low from SPI master
20	reserved	reserved	reserved
21*	LED_6	Indicator	High from SPI master
22*	LED_7	Indicator	High from SPI master
23*	LED_4	Indicator	High from SPI master
24*	LED_5	Indicator	High from SPI master
25*	LED_2	Indicator	High from SPI master
26*	LED_3	Indicator	High from SPI master
27*	LED_0	Indicator	High from SPI master
28*	LED_1	Indicator	High from SPI master
29	GND	ground	Low impedance ground
30	GND	ground	Low impedance ground
31*	+24VDC	+3.0-30V	Power indicator LED
32*	+5VDC	+3.0-30V	Power indicator LED
33	+3.3VDC	+3.3V	Power indicator LED, RF & logic power. Low noise 150mA max.
34*	REVBAT	+3.0-30V	Power indicator LED
	*Not required for SRF305		

The 07440305-2H-x-12R PCB assembly, SRF305 Type1, includes all circuits and features required for properly implementing the SRF305 RTM. A variety of approved antennas may be used.

The PCB also provides circuits and mounting for various optional non-RF features of use to a host application, including:

12 indicator LEDs (default installation)
LED/LCD display module (future use)

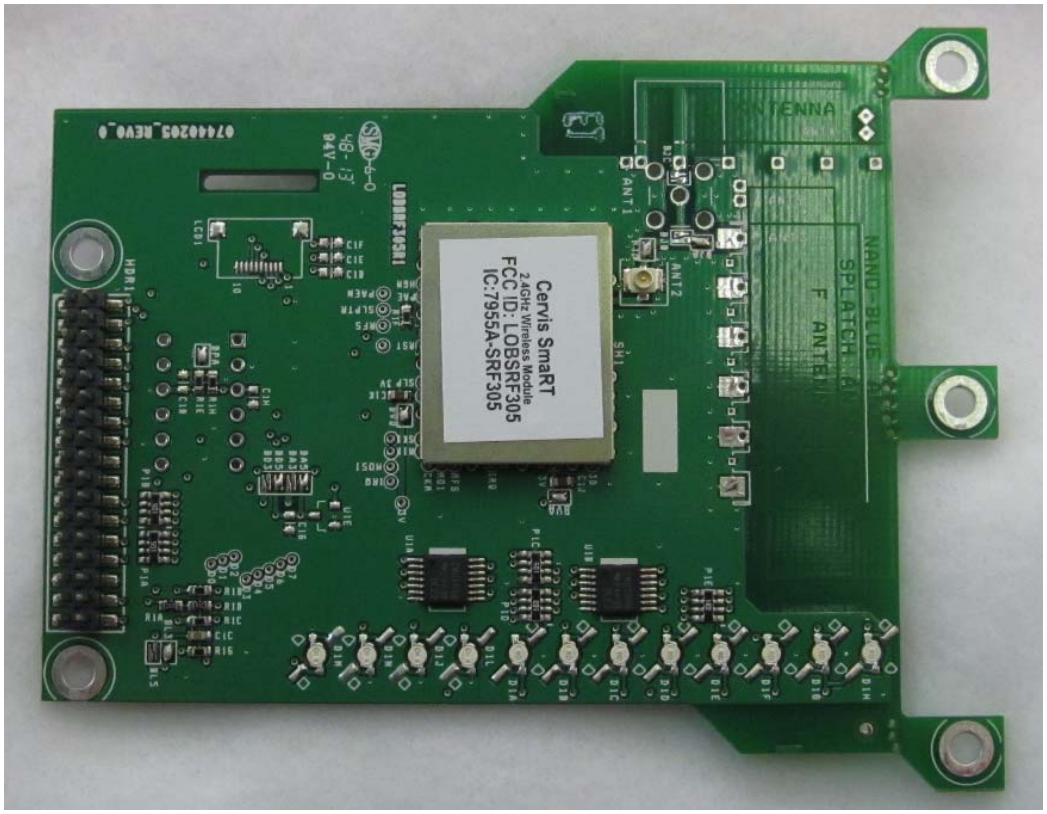

***Figure 3*. 07440305-2H-U-12R (SRF305 Type 1), component side, shield, internal label, external antenna connector**

Table 2. 07610204 PCB (SRF305 Type 2) – plug-in connector J1

Pin	Name	Signal	Details
1	SPI_CLK	SPI data clock in	Clock from SPI master
2	GND	ground	Low impedance ground
3	MISO	SPI data out	Data from SPI slave
4	MOSI	SPI data in	Data from SPI master
5	RF_SLP_TR	RFIC control	Multipurpose control signal from master
6	/RF_RST	RFIC reset	Low from SPI master
7	/RF_CS	RFIC chip select	Low from SPI master
8	RF_IRQ	RFIC interrupt output	Input to SPI master
9	RF1_3VD	+3.0-3.3V	RF & logic power. Low noise 125mA max.
10	GND	ground	Low impedance ground
11	RF1_3VA	+3.0-3.3V	RF analog power. Low noise 25mA max.
12	GND	ground	Low impedance ground
13	RF_PAEN	Enable external PA	High from SPI master
14	RF_HGM/BPA	Enable external LNA or Read BPA jumper	Function not used in SRF305 Input to SPI master
15	GND	ground	Low impedance ground

The 07610304-2H-U PCB assembly, SRF305 Type 2, is similar to the approved 07440305-2H-x-12R PCB assembly, except for elimination of non-RF circuits and a change in the shape and connector to accommodate use in host applications that utilize the form-factor of the 07610304-2H-x. Except for some minor differences outside the shielded RF section, the operation of 07610304-2H-U is compliant with the SRF305 modular approval, as demonstrated by testing.

The RF connection of 076100304-2H-U is always via a coaxial cable and unique connector. Choice of an approved antenna for internal or external mounting depends on the design of the specific host application.

The 07610304-2H-U PCB assembly includes all circuits and features required for properly implementing the SRF305 RTM

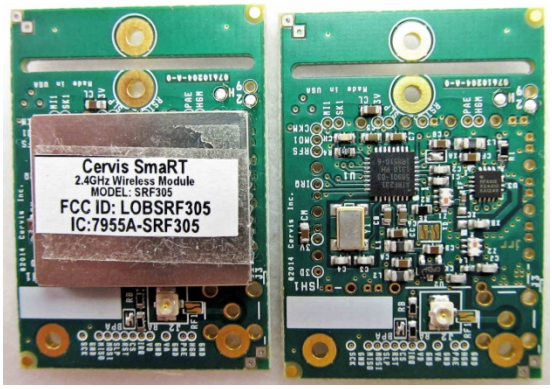

Figure 4. **07610304-2H-U SRF305 Type 2,, component side, shield, internal label, external antenna connector**

Table 3. 07440206 PCB (SRF305 Type 3) – plug-in connector HDR1

Pin	Name	Signal	Details
1*	/RFEE_CS (reserved)	EE chip select	Low from SPI master
2	RF_SLP_TR	RFIC control	Multipurpose control signal from master
3	/RF_RST	RFIC reset	Low from SPI master
4	RF_IRQ	RFIC interrupt output	Input to SPI master
5	/RF_CS	RFIC chip select	Low from SPI master
6	RF_PAEN	Enable external PA	High from SPI master
7	RF_HGM/BPA	Enable external LNA or Read BPA jumper	Function not used in SRF305 Input to SPI master
8	SPI_CLK	SPI data clock in	Clock from SPI master
9	MOSI	SPI data in	Data from SPI master
10	MISO	SPI data out	Data from SPI slave
11	GND	ground	Low impedance ground
12	GND	ground	Low impedance ground
13*	LED_7	Indicator	High from SPI master
14*	LED_6	Indicator	High from SPI master
15*	LED_5	Indicator	High from SPI master
16*	LED_4	Indicator	High from SPI master
17*	LED_3	Indicator	High from SPI master
18*	LED_2	Indicator	High from SPI master
19*	LED_1	Indicator	High from SPI master
20*	LED_0	Indicator	High from SPI master
21	GND	ground	Low impedance ground

22	GND	ground	Low impedance ground
23*	REVBAT	+3.0-30V	Power indicator LED
24*	+5VDC	+3.0-30V	Power indicator LED
25	+3.3VDC	+3.3V	Power indicator LED, RF & logic power. Low noise 150mA max.
26*	+24VDC	+3.0-30V	Power indicator LED
	*Not required for SRF305		

The 07440306-2H-x-12R PCB assembly, SRF305 Type 3, is similar to the approved 07440305-2H-x-12R PCB assembly, except for a change in the shape and connector to accommodate use in host applications that utilize the form-factor of the 07440306-2H-x-12R. Except for some minor differences outside the shielded RF section, the operation of 07420305-2H-x-12R is compliant with the SRF305 modular approval, as demonstrated by testing.

The 07440306-2H-x-12R PCB assembly includes all circuits and features required for properly implementing the SRF305 RTM. The PCB also provides circuits and mounting for various optional non-RF features of use to a host application, including:

12 indicator LEDs (default installation)

***Figure 5*. 07440306-2H-U-12R, SRF305 Type 3,, component side, shield and internal label, external antenna connector**

Table 4. 14001200 PCB (SRF305 Type 4) – connections

Pin	Name	Signal	Details
1	SPI_CLK	SPI data clock in	Clock from SPI master
2	GND	ground	Low impedance ground
3	MISO	SPI data out	Data from SPI slave
4	MOSI	SPI data in	Data from SPI master
5	RF_SLP_TR	RFIC control	Multipurpose control signal from master
6	/RF_RST	RFIC reset	Low from SPI master
7	/RF_CS	RFIC chip select	Low from SPI master
8	RF_IRQ	RFIC interrupt output	Input to SPI master
9	RF1_3VD	+3.0-3.3V	RF & logic power. Low noise 25mA max.
10	GND	ground	Low impedance ground
11	RF1_3VA	+3.0-3.3V	RF analog power. Low noise 125mA max.
12	GND	ground	Low impedance ground
13	RF_PAEN	Enable external PA	Active high from SPI master
14	RF_HGM/BPA	Enable external LNA or Read BPA jumper	Function not used in SRF305 Input to SPI master
15	GND	ground	Low impedance ground
16	GND	ground	Low impedance ground
17	GND	ground	Low impedance ground
18	GND	ground	Low impedance ground
19	GND	ground	Low impedance ground
20	RF Port	Antenna connection	50 Ohm RF In/Out port
21	GND	ground	Low impedance ground

The 14001300-2H PCB assembly, SRF305 Type 4, is similar to the SRF305 Type 2 RTM, except for elimination of PCB structure required for connectors, where the physical connection to the host application is now made by directly soldering the RTM to the host PCB. The SRF305 Type RTM depends on the host application for all connections to approved antennas.

***Figure 6*. 14001300-2H, SRF305 Type 4, component side and with shield.**

Type 4 Module Application Engineering:

The Type 4 module requires that the host application provide suitable mechanical and electrical mounting, control and power signals, an approved antenna that is properly mounted a proper RF transmission line to connect the RF port on the module to the antenna feed port, and all SAR-related safety spacings are maintained. An example of a typical Type 4 module properly integrated into a portable host application PCB is shown in Figure 7 (left) and Figure 8. RF exposure spacing is enforced when the PCB is assembled into the enclosure.

Mounting: This module must be mounted on a ground plane that extends at least 8mm from the RF shield edges. All connections between the host application and the module are to be soldered.

Note: 8mm is the minimum ground plane extent measured from the RF shield on a Type 1 module.

Power and Control Signals:All connections listed in Table 4 must be made.

RF Transmission Line: The RF connection between the module RF port and the antenna feed port must have a nominal 50 Ohm impedance, have low insertion loss and be as short as practical. Microstrip transmission line may be implemented as part of the host PCB. Coaxial cable may be used to connect to an external antenna. Coaxial cable can be attached either with a suitable connector or may be directly soldered to where the host PCB attaches to the RF port of the module. If a replaceable external antenna is used the user-accessible external connection must be a unique type such as RP-TNC, RP-SMA, etc.

Antennas: Low gain internal antennas may be located anywhere within a host application, provided that the design is properly engineered and safety spacings are maintained. Certain antenna types, such as dipoles, do not need any ground plane to work properly, just a proper RF transmission connection the RF port of the module. Other common antenna such as those made using PCB traces typically require attachment to a ground plane to work properly. The ground plane should extend without significant interruptions from the ground point(s) of the antenna by at least ¼ wavelength (30mm for 2450 MHz), and may be shared with other ground plane areas, including that used to mount the RT module.

Examples of host applications using the Type 4 module are shown in Figures 8 and 9. Compared to a similar Type 1 module in Figure 9, the important RF features are essentially the same. The modules are similarly equipped and configured for using an internal PCB-trace style antenna with a nominal +3dBi maximum gain.

The yellow (not to scale) rectangles show the internal antenna mounting relative to the RF shield (which defines the active RF circuit area).

The orange rectangles (not to scale) indicate where microstrip PCB transmissions lines are implemented in the host or module PCBs. The length of the transmission line is not critical, but it should be no longer than needed in order to minimize losses. A coaxial cable could be used.

The red rectangles (not to scale) indicate the 8mm copper ground plane surrounding the RF shield. The copper thickness is not critical.

The green rectangles (not to scale) indicate the copper ground plane area required for proper operation of the installed antenna. The copper thickness is not critical. In Figures 8 and 9 the illustrated antenna is a variant of the “planar PCB-F” PCB trace antenna. As such, it requires a ground plane area extending at least ¼ wavelength from the connected edge of the antenna, approximately 31mm at 2450 MHz. Alternative antennas such as a dipole do not require any ground plane. The RF engineer must consider antenna ground requirements when designing the host application.

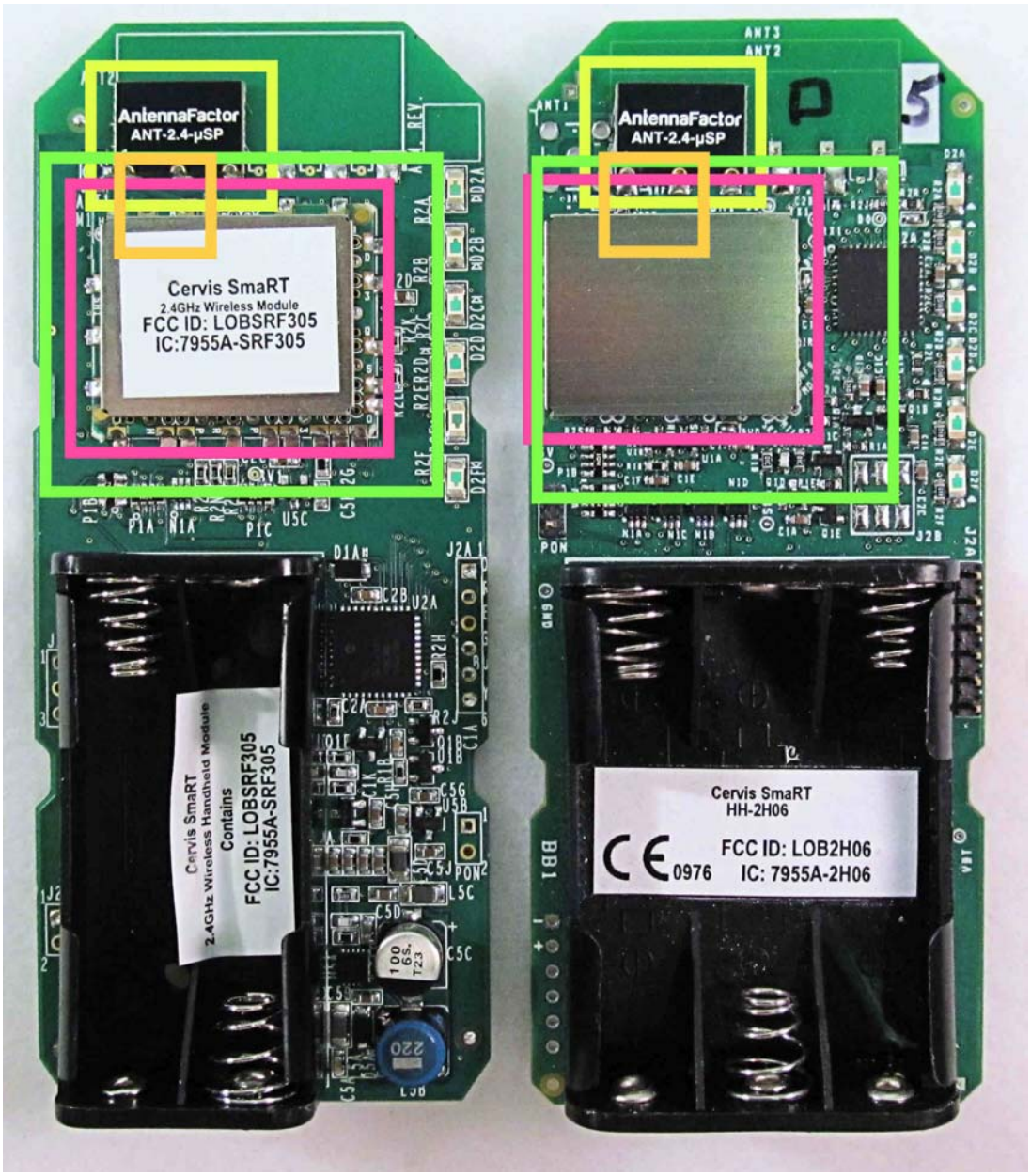

***Figure 7*. HH-2H10 (left) implemented with Type 4 module, compared to HH-2H06 with non-modular RF circuit integrated into the application PCB. In both applications the RF circuit under the shield is identical.**

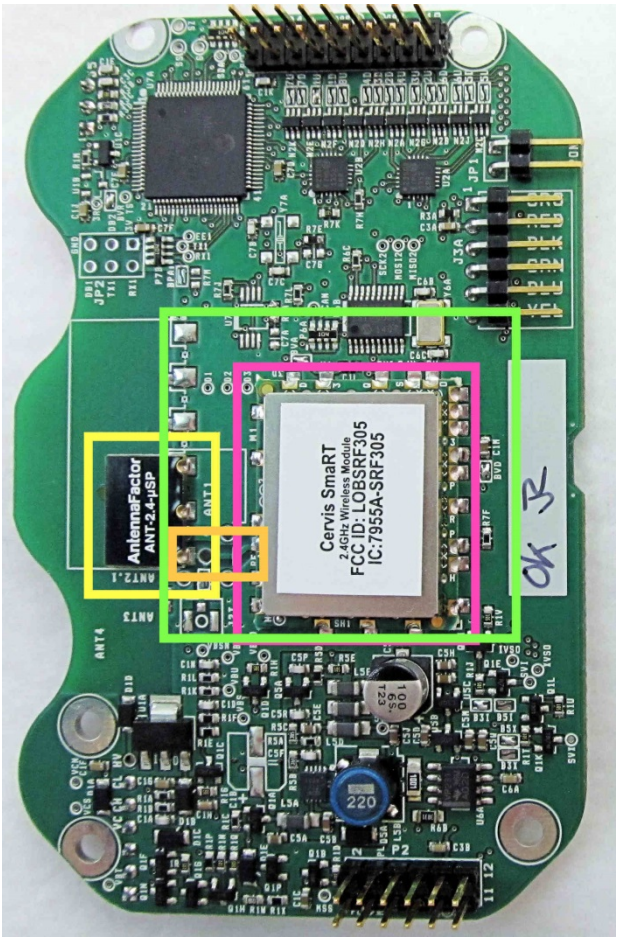

***Figure 8*. PG-2H implemented with Type 4 module, antenna mounting and RF transmission line are part of the application PCB.**

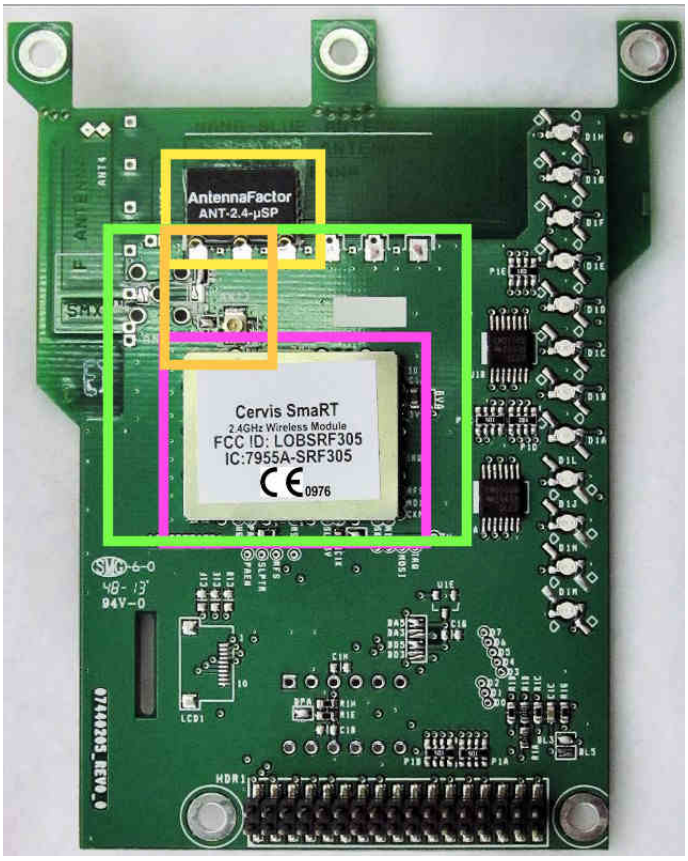

***Figure 9*. SRF305 Type 1 module, antenna mounting and RF transmission line are part of the module PCB.**

2.0 SRF305 Installation

When integrating an SRF305 RTM into a host application, the user must provide all text in the “FCC Statements” and “Industry Canada Statements” in the host application’s user manual (see Forward Material). The text must not be modified in any way and presented in a conspicuous manner that the end user can be reasonably expected to access.

When integrating the SRF305 RTM into host application hardware, the user must properly connect all the circuits identified in Table 1 to suitable host application signals. The host application firmware must properly control the RTM to ensure that emitted RF signals comply with all applicable regulatory approvals.

The SRF305 RTM is always provided with an approved type of antenna, either internal fixed or external replaceable. If a fixed internal antenna is provided as part of the RTM, the on-board coaxial cable connectors are not populated. If the module is assembled for use with an external antenna, one of the on-board coaxial cable connector positions will be populated. The choice of the particular type of coaxial connector that is installed will be decided by the designer of the host application. The on-board connector is not accessible to users, so it does not need to be unique.

When provided, external replaceable antennas always have a unique connector such as: RP-N, U.FL/IPEX, RP-SMA, RP-BNC or RP-TNC. A suitable coaxial cable jumper with appropriate connectors must be used to connect the SRF305 RTM external antenna port to the external antenna. The details of a particular host application will affect the design of the jumper coax, but the external connector must always be of an acceptable unique type.

The coaxial cable used to make the jumper between the RTM and the external antenna mounting position must be suitable for use at 2450 MHz and have 50 Ohm impedance. Low loss cable such as RG-316 is suggested, although signal loss will be small if the jumper length is short.

External coaxial cables may be used to help mount the replaceable external antenna in a more useful location. Such cable must have appropriate unique connectors and must be made from low loss 50 Ohm coaxial cable. Cables equivalent to LMR-195 are suitable for lengths up to 30 feet. Longer cables must have suitably lower signal loss, typically using larger cable such as LMR240, LMR-300, or larger (or equivalent). At some point, a practical limit is reached where losses in extension cables negate any gains from relocating the antenna.

3.0 SRF305 Tune-up Procedure

There is no tune-up procedure. The module contains no adjustable components.

Proper RF operation of the module is verified during the manufacturing process using suitable equipment and methods.

4.0 SRF305 Electrical Characteristics

4.1 Supply Voltage and Current

The SRF305 RTM by itself requires a low noise regulated 3.0-3.3 VDC source that can provide 150mA without losing regulation. The module does not provide under-voltage, over-voltage, or reverse polarity protection so use caution when applying power. It is the responsibility of the host application to provide an appropriate source of 3.0-3.3V adequate to power the RTM, plus any other non-RF circuits that may also be implemented on the same PCB.

All external connection points designate as signal “GND” should be connected to the host application “GND” circuit so as to maintain a low resistive and reactive impedance as practical.

The PCB hosting the RTM should be fabricated with low impedance copper floods that connect to “GND”.

The SRF305 RTM can safely operate with a supply voltage over the range of 3.0-3.3V with minimal changes in RF performance.

4.2 Operating Current

The SRF305 RTM has four primary operating conditions that draw differing amounts of current from to 3.0-3.3V power source:

Off	RFIC is powered down, minimal load
PLL_ON	RFIC is ready to transmit or receive, ~5mA
RX	RFIC is receiving a message, ~12mA
TX	RFIC is transmitting, ~15-100mA, depending on TX output power

In TX mode the operating current may be less than the maximum if the drive to the external PA is reduced because the full +19.95dBm RF output power is not required.

4.3 SPI Interface

The SPI interface between the RFIC (slave) and the host application (master) microcontroller requires four signals:

SCLK – The serial data clock from the SPI master. Must be less than 8 MHz.
MOSI – Serial data from the SPI master.
MISO – Serial data from the SPI slave.
RF_CS – Chip select from the SPI master.

The SPI controller setting must be established by the host application microcontroller to be compatible with the SPI interface timing specified by the RFIC data sheet.

5.0 SRF305 RF Characteristics

5.1 General RF Information

The RFIC used in the SRF305 RTM implements RF modulation modes and timings in compliance with IEEE 802.15.4-2006. The RFIC implements additional proprietary RF modulation modes. Details may be found in the AT86RF231 RFIC data sheet.

The SRF305 general spread spectrum scheme is DSSS. The modulation type is O-QPSK. The data rate is 250kbps.

5.2 RF Exposure Considerations

Separation distances stated in this section are based on SAR test results from the SRF305 Type 1 RT module, “SAR.20131205” from RF Exposure Lab, submitted as “SRF305 FCC Rev A_s.pdf”. The minimum measured safe distances, specifically stated in the blue box on page 1, are 3mm for an internal antenna and 8mm for an external antenna. Laboratory measurements indicate that the primary radiation comes from the antenna and is minimal from other parts of the module or host application. Proper application of SRF305 Types 1, 2 3 and 4 will result similar RF emission characteristics.

A: Mobile and portable host applications incorporating SRF305 Type 1, 2, 3 or 4 RT modules with internal (entirely within the enclosure) antennas must ensure that users are physically separated from the antenna by at least 3mm.

B: Mobile host applications incorporating SRF305 Type 1, 2, 3 or 4 RTMs with external (fully or partially exposed outside the enclosure) antennas must ensure that users are physically separated from the antenna by at least 8mm, per the SAR test report. This separation requirement may met by including an installation guideline in the user manual that states that the any external antenna must be located at least 20cm from any space likely to be occupied by an uninformed person.

C: Portable host applications incorporating SRF305 Type 1, 2, 3 or 4 RTMs with external (fully or partially exposed outside the enclosure) antennas must ensure that informed users are physically separated from the antenna by at least 8mm. This separation requirement may met by including in the user manual a guideline indicating the normal operating pose.

D: Any parties creating mobile and portable host applications incorporating SRF305 Type 1, 2, 3 or 4 RTMs are responsible for ensuring compliance with RF exposure limitations and any other applicable regulations. Changes may require new testing and approval submission."

These separation requirements must be included in end-user manuals for host applications that include any SRF305 RTM and antenna combination.

The following table summarizes the antennas that may be used with the SRF305 RT modules and the required separation distances. Mobile applications with external antennas assume that an uninformed person may be nearby, thus the 20cm separation guidance rather than the tested safe separation of 8mm.

Module Type	Portable	Portable (informed)	Mobile	Mobile (uninformed)
	Internal <= +3dBi Antenna	External <= +9dBi Antenna	Internal <= +3dBi Antenna	External <= +9dBi Antenna
1	> 3mm	> 8mm	> 3mm	> 20cm
2	> 3mm	> 8mm	> 3mm	> 20cm
3	> 3mm	> 8mm	> 3mm	> 20cm
4	> 3mm	> 8mm	> 3mm	> 20cm

Table 5. Antenna/user separations for various application conditions.

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