SRF310 User Manual

12 January 2017
U098.0.00 User Manual for SRF310

Final

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-SRF309 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-SRF309 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-916-SP Or Equivalent	353	+1.49dBipeak	50 Ohm
Nearson	S467TR-915S Or Equivalent	BB3-06	+2dBipeak	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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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.***
- ✓ ***Make sure that the machinery and surrounding area is clear before operating. Do not activate a remote control system until certain that it is safe to do so.***
- ✓ ***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 SRF310 Introduction

The SRF310 receive/transmit module (RTM) is based on a single-chip radio frequency (RF) transceiver integrated circuit (RFIC), an Atmel AT86RF212B. The SRF310 RTM is intended to be integrated into Cervis Inc. products, providing a wireless RF connectivity option.

The SRF310 RTM operates in the 915 MHz ISM band, using spread spectrum modulation with a maximum conducted RF transmit power of **+22.07dBm** (161mW) 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 binary phase shift keying (BPSK).

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 SRF310 RTM is interoperable 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 SRF310 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 SRF310 RTM is realized as a solder-down leadless PCB module. The Type 4 form factor is a unique proprietary mechanical design.

1.1 SRF310 Features

FCC Part 15 certified
IC Certified
CE certified
902-928 MHz Operation, inclusive of sidebands
Selectable Channels in 100 KHz steps
Direct Sequence Spread Spectrum (DSSS)
Orthogonal Quadrature Phase Shift Keying (O-QPSK) modulation
1000 kbps Data Rate
Up to **+22.07dBm** peak Conducted Output Power
IEEE 802.15.4-2006 messaging
SPI host interface
Simple power requirements: 3.0-3.3V low noise regulated, 25-100mA

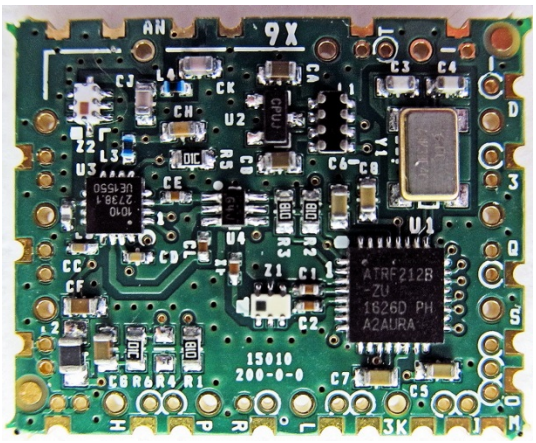

Figure 1. **SRF310 RF section Front**

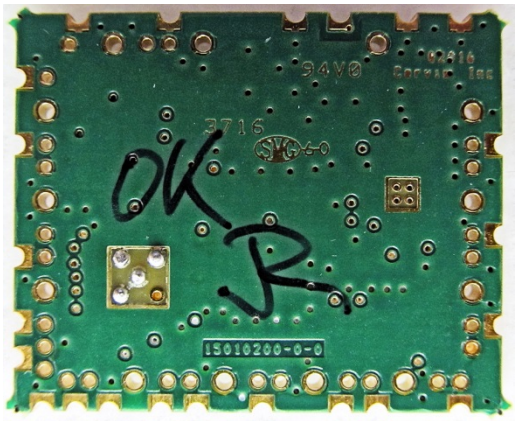

Figure 2. **SRF310 RF section Back**

1.2 SRF310 Pinouts

Table 1 shows the interface signals for the SRF310 RTM:

Table 1. 15010300 PCB (SRF310 Type 4) interface signals

Name	Signal	Details
SPI_CLK	SPI data clock in	Clock from SPI master
GND	ground	Low impedance ground
MISO	SPI data out	Data from SPI slave
MOSI	SPI data in	Data from SPI master
RF_SLP_TR	RFIC control	Multipurpose control signal from master
/RF_RST	RFIC reset	Active Low from SPI master
/RF_CS	RFIC chip select	Active Low from SPI master
RF_IRQ	RFIC interrupt output	Input to SPI master
RF1_3VD	+3.0-3.3V	RF & logic power. Low noise 100mA max.
RF1_3VA	+3.0-3.3V	RF analog power. Low noise 25mA max.

RF_PAEN	Enable external PA	Active High from SPI master
RF_HGM/BPA	*Enable external LNA or* *Read BPA jumper*	*Function not used in SRF310* *Input to SPI master*
RF Port	Antenna connection	50 Ohm RF In/Out port
GND	ground	Low impedance ground

The 15010300 PCB assembly includes all circuits and features required for properly implementing the SRF310 Type 4

Figure 3. **15010300, component side with shield and label.**

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 and a proper RF transmission line to connect the RF port on the module to the antenna feed port.

Mounting: This module must be mounted over 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.

Power and Control Signals:All power, ground and control signal connections listed in Table 1 must be made, except RF_HGM/BPA.

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.

Grounding: The SRF310 module must be connected to a good RF ground plane that is part of the host circuit board.

2.0 SRF310 Installation

When integrating an SRF310 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 SRF310 RTM into host application hardware, the user must properly connect all the circuits, except _RF_HGM/BPA, 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 SRF310 RTM is always used with a provided approved type of antenna, either internal fixed or external replaceable. If a fixed internal antenna is provided as part of the RTM’s host application, the host’s on-board coaxial cable connectors are not populated and a direct connection is made to the internal antenna. If an external antenna is provided as part of the RTM’s host application, one of the host’s on-board coaxial cable connectors is populated and a coaxial cable connection is made to the external antenna port. The choice of the particular type of coaxial connector that is installed will be decided by the designer of the host application. The internal coaxial cable 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, RP-SMA, RP-BNC or RP-TNC. A suitable internal coaxial cable jumper with appropriate connectors must be used to connect the SRF310 RTM host application external antenna port to the external antenna. The details of a particular host application will influence 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 port must be suitable for use in the 902-928 MHz band and have 50 Ohm impedance. Low loss cable such as RG-316 is suggested, other models of cable may be used provided that signal loss will be small.

External coaxial cables may be used to help mount a replaceable external antenna in a more useful location. Such cable must have appropriate unique connectors throughout 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.

Figure 4. **SRF310 installed in a typical host application.**

3.0 SRF310 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. Limitation of conducted peak RF power and duty cycle is controlled by proprietary firmware that may not be modified by an end user.

4.0 SRF310 Electrical Characteristics

4.1 Supply Voltage and Current

The SRF310 RTM (the components under the RF shield) requires the host application to provide a low noise (linear regulator as opposed to a switching regulator) regulated 3.0-3.3 VDC source that can provide 20mA without losing regulation. The RTM does not provide under-voltage, over-voltage, or reverse polarity protection so use caution when applying power. The RTM contains a low noise linear 2.5V regulator (Fig 1."U2", top-center) that buffers the analog power to the RFIC RF section. The RFIC has another internal low noise 1.8V regulator (see the data sheet for Atmel AT86RF212B).

All external connection points designate as signal "GND" should be connected to the host application "GND" circuit so as to maintain as low a resistive and reactive impedance as practical. The PCB hosting the RTM should be fabricated with low impedance copper floods that connect to "GND". The grounded copper area around the RTM must extend at least 8mm on all sides of the RTM.

The SRF310 RTM can safely operate with a supply voltage over the range of 3.0-3.3V with minimal changes in RF performance. Testing was performed at 3.3V, the preferred supply voltage.

4.2 Operating Current

The SRF310 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, ~25mA
TX	RFIC is transmitting, ~25-100mA, 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 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 SRF310 RF Characteristics

5.1 General RF Information

The RFIC used in the SRF310 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 AT86RF212B RFIC data sheet.

The SRF310 general spread spectrum scheme is DSSS. The modulation type is O-QPSK. The data rate is 1000 kbps.

5.2 RF Exposure Considerations

The SRF310 RT module may be used in a variety of host applications that fall into two general categories: mobile or portable. Mobile applications are any operating locations that are **not** on a human body. Portable applications are those where the transmitting equipment **is** located on the hand, arm or other part of the human body. In mobile applications the host application is typically affixed to mobile equipment, with either an internal or external antenna. In portable applications the equipment is typically held in the hand of an operator or affixed to either a belt or harness on the torso.

Equipment containing the SRF310 RT module has been evaluated for RF exposure hazards by two approaches: Maximum Permissible Exposure (MPE) for “mobile” applications and SAR for portable applications. Mobile applications are any operating locations that are not on a human body.

The required separation distances are measured from the actual location of the radiated part of the antenna. An antenna may be inside the host application, affixed to the enclosure of the host application or at the end of an optional extension coaxial cable.

Mobile applications:

Equipment must be mounted in a location at least 20cm away from areas likely to be occupied by an unaware person.

Handheld applications:

All operators of handheld equipment with any type of antenna require training in the proper operation of the equipment and such training must include RF exposure safety instructions. Once training is completed they are considered to be aware persons.

If the portable operating pose is on the hand or arm it is required that a 5mm separation between the radiating part of the antenna and nearby human tissue

If the portable operating pose is on the body it is required that a 15mm separation between the radiating part of the antenna and nearby human tissue.

No safety warnings or precautions beyond normal operator training are required.

Required Training:

All installers and operators of host applications that include an SRF310 RT module **must** be trained to use proper RF Safety precautions as presented in this section.

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