

SEL 9630-9110

Radio Module

Instruction Manual

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Introduction and Features

Overview

The 9630-9110 is a radio module intended for use in the SEL Wireless Line Sensor System for overhead distribution circuits. This system includes sensors that attach to overhead power conductors and wirelessly transmit data to concentrators. The system provides fault detection and accurate load data to a centralized location for simple integration into a SCADA or outage management system (OMS). The line sensors and concentrator communicate via a purpose-built wireless protocol optimized for fault-monitoring applications. The 9630-9110 operates in the license-free 915 MHz industrial, scientific, and medical (ISM) band.

The 9630-9110 has an output power compensation loop that prevents the transmitted radio frequency (RF) power from exceeding the limits defined during certification testing. These limits are below the maximum allowed power of +30 dBm at the module output. The module is intended only for integration by SEL in its host devices. When the host system uses an external antenna, professional installation is required to ensure that necessary system losses remain below the maximum equivalent isotropically radiated power (EIRP) limit. When the host device uses a module with an integral antenna, the factory sets the correct transmit power level for the module.

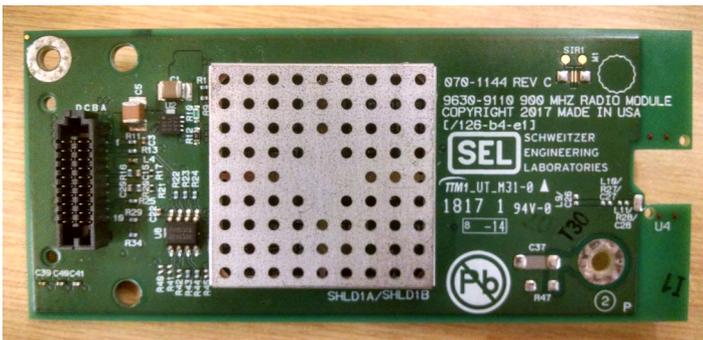


Figure 1 Top of 9630-9110 Module (External Antenna Variant)

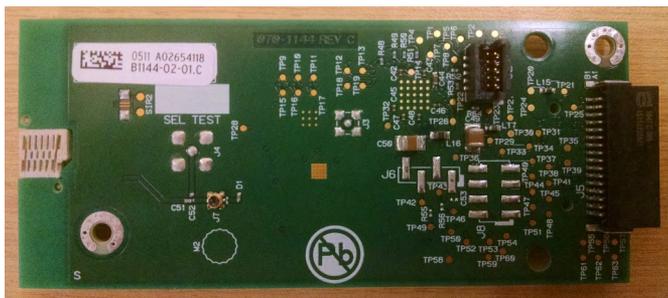


Figure 2 Bottom of 9630-9110 Module (Integral Antenna Variant)

Module Features

The 9630-9110 includes the following features:

- Operation in the license-free 915 MHz ISM band (902–928 MHz)
- Non-hopping DTS transceiver
- 25 non-overlapping channels available (903–927 MHz, 1 MHz spacing)
- +26 dBm maximum transmit power
- Transmit power settable in a range of 18–26 dBm (host-dependent)
- Can be used with either an external antenna or a PCB-mount integral antenna
- Built-in receive signal strength indicator (RSSI) reporting

Installation Into Host

Overview

The 9630-9110 radio module is intended for installation into SEL host devices. All I/O and power are routed through a board-to-board header that connects to the circuit board of the host device. The RF input/output is connected to either a PCB-mount integral antenna or an MCX RF connector for cable connection to an external antenna. Both Yagi directional antennas and omnidirectional antennas can be used as the external antenna for the 9630-9110.

Board Connections

There are two available options for the board-to-board header depending on the module variant. The external antenna variant with the MCX RF connector uses a 40-pin female header (Samtec P/N SEAF-10-06.0-L-04-2-A-K) that is oriented for the module PCB to parallel the host PCB. The integral antenna variant uses a 32-pin male right-angle header (Harting P/N 15150325601000) that allows the module PCB to mount perpendicular to the host PCB for an unobscured, omnidirectional antenna pattern.

Table 1 and *Table 2* show the required pinouts for the 40-pin and 32-pin headers, respectively.

Table 1 40-Pin Female Header Pinout

Pin	Description
A1, A2, A5, A6, B7, B8, B9, B10, C8, C9, C10	GPIO (includes SPI and I ² C) Refer to radio module design documentation for specific details
B1, B2, B3, B4	+3V3
D1, D2, D3, D4	+V_IN
A8, A9, A10, C5, C7, D6, D7, D8, D9, D10	No Connect
A3, A4, A7, B5, B6, C1, C2, C3, C4, C6, D5	GND

Table 2 32-Pin Male Header Pinout

Pin	Description
A11, A12, A13, B1, B2, B10, B11, B12, B13	GPIO (includes SPI and I ² C) Refer to radio module design documentation for specific details
A1, A2, A3, A4	+3V3
B4, B5, B6, B7	+V_IN
A10, A15, A16, B16	No Connect
A5, A6, A7, A8, A9, A14, B3, B8, B9, B14, B15	GND

DC Power Input Requirements

The 9630-9110 module requires two dc voltage inputs from the host device: the +3V3 input (which powers the wireless MCU) and the +V_IN input (which powers the RF front end). The module can operate across a wide voltage range on both inputs. Guidelines regarding the voltage ranges and current ratings must be followed when the radio module is integrated into a host device to maintain compliance with limited modular approval (LMA) authorization.

The +3V3 voltage input must be in the range of 2.7 Vdc to 3.465 Vdc. The wireless transceiver chipset on the module further regulates this input to provide a stable voltage for the RF transmitter. The +3V3 input must support a current draw of 20 mA in active RX mode and 50 mA in active TX mode.

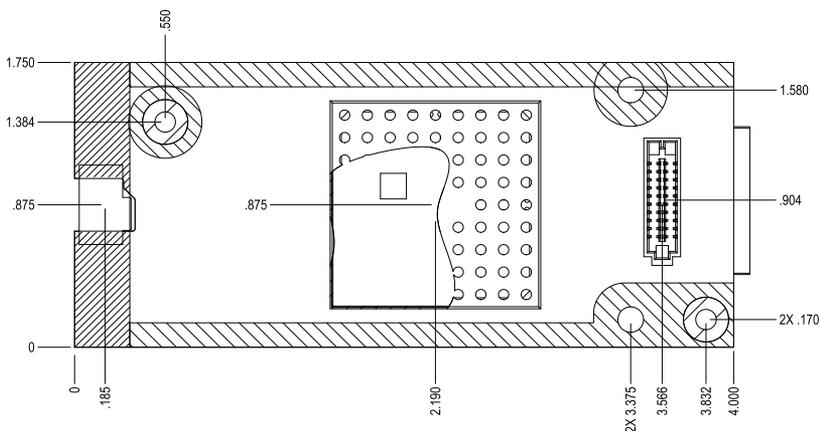
The +V_IN voltage input rail powers the RF front end via a low-dropout voltage regulator. The voltage must be in the range of 2.7 Vdc to 5.025 Vdc to ensure compliance with RF output requirements. The +V_IN input must support a current draw of 30 mA in active RX mode and 450 mA in active TX mode.

Radio Settings

The 9630-9110 is programmed through a serial peripheral interface (SPI) bus that connects to the host board through the header. There are no settings to adjust on the radio module itself. The grantee's host device, in which the radio module is installed, performs all settings configuration.

Only the RF output power and the channel radio module settings are available to the installers of the host device. The RF output power can be set in the range of 18–26 dBm. The channel can be set to one of 25 non-overlapping channels. The channel range is 903–927 MHz with each channel spaced 1 MHz apart.

Diagram and Dimensions



(Dimensions are in Inches)

Figure 3 9630-9110 Module Dimensions

Antenna and RF Output Power Configuration

Overview

This section includes the following:

- FCC Part 15 and Industry Canada RSS Notices
- Limited Modular Approval Notice
- RF Exposure Warnings
- RF Output Power Regulations

FCC Part 15 Interference Statement

This equipment has been tested and found to comply with the limits for 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 radiates 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 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.

FCC Part 15 and Industry Canada RSS Notices

CAUTION

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

English

This device complies with Part 15 of the FCC Rules and Industry Canada license-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 that may cause undesired operation of the device.

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

The radio transmitter described herein (IC ID: 4468A-900FLTR) 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.

French

Cet appareil est conforme à la Partie 15 des règlements de la FCC et Industrie Canada exempts de licence standard RSS (s). Son utilisation est soumise à deux conditions: (1) ce dispositif ne peut causer des interférences, (2) cet appareil doit accepter toute interférence pouvant causer un mauvais fonctionnement du dispositif.

En vertu des règlements d'Industrie Canada, cet émetteur radio ne peut fonctionner avec une antenne d'un type et un maximum (ou moins) approuvés pour gagner de l'émetteur par Industrie Canada. Pour réduire le risqué d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisies de façon que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas ce qui est nécessaire pour une communication réussie.

L'émetteur radio décrit ci-après (IC ID: 4468A-900FLTR) a été approuvé par Industrie Canada pour fonctionner avec les types d'antennes énumérées ci-dessous avec le gain maximal admissible et nécessaire antenne d'impédance pour chaque type d'antenne indiqué. Types d'antennes ne figurent pas dans cette liste, ayant un gain supérieur au gain maximum indiqué pour ce type, sont strictement interdites pour une utilisation avec cet appareil.

FCC Limited Modular Approval Notice

This device is authorized as an FCC Part 15 unlicensed limited modular approval (LMA). The transmitter module is only approved for use with specific antenna, cable, and RF output power configurations that have been tested and approved for use when installed in devices produced by the grantee. Modifications to the radio, antenna system, or power output which have not been explicitly specified by the grantee are not permitted, and any such modifications may render the transmitter module non-compliant with regulatory authorities.

Any enclosure containing this radio module shall be labeled with “Contains FCC ID: R34-900FLTR, Contains IC: 4468A-900FLTR” on a durable label affixed to the outside of the host device.

RF Exposure Warning

CAUTION

Although the power level is low, concentrated energy from a directional antenna may pose a health hazard. Do not allow users to come closer than 23 cm (9 in) to the antenna when the transmitter is operating in indoor or outdoor environments. Professional installation is required.

RF Output Power

The 9630-9110 operates as a DTS system in the license-free 902–928 MHz band. The output power limits are dependent on the antenna configuration used. The method for determining the calculated EIRP is shown in *Equation 1*.

Equivalent Isotropically Radiated Power

EIRP is the amount of equivalent power transmitted equally in all directions during use of a theoretical isotropic antenna. EIRP takes into account the power output of the radio, line feed losses, and the gain of the antenna, as shown in *Equation 1*.

$$\text{EIRP (dBm)} = \text{Power Output (dBm)} - \text{Line Feed Loss (dB)} + \text{Ant. Gain (dBi)}$$

Equation 1

The EIRP for each antenna type must comply with the limits listed in *Table 3*. These are the power levels at which the 9630-9110 transmitter module was tested and certified. The required antenna impedance is 50 Ohms.

Table 3 EIRP Antenna Limits

Antenna Type and Gain (dBi)	Peak Output Power at Antenna Connector (dBm)	Cable (System) Loss (dB)	Max Authorized EIRP (dBm)
Integral SMD Helical, 0.8	26.725	0	27.53
Yagi, 8.55	26.725	0.3	34.98
Yagi, 14.15	26.725	4.9	35.98
Omni, 9.15	26.725	0.5	35.38

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