

Description and Manual:

SensThys S-PWRSENS3 Reader Module

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Operational Description

The S-PWRSENS3 reader module is an RFID reader module, with an RF output power of 33 dBm, operating per the guidelines of RAIN RFID Gen2v2 specifications.

The heart of the S-PWRSENS3 is the MTI E-Chip SIP, which contains the Impinj E710 reader chip.

The reader module is capable of operating in the ETSI and FCC frequency ranges, making it suitable for global applications.

The reader has three external antenna connections and one internal antenna connection.

This module is only used internally to SensThys readers. As such, this document is not a public document.



Product Compliance

FCC Notices

This equipment has been tested and found to comply 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.

Any change or modification to this product voids the user's authority to operate per FCC Part 15 Subpart A. Section 15.21 regulations.

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.

Certification Information: S-PWRSENS3

The third generation SensThys readers, specifically those designed after 2025, including SensArray Enterprise 3, or SAE3, utilize an integrated UHF RFID reader module, the S-PWRSENS3. These products are FCC certified at both the module and product level.

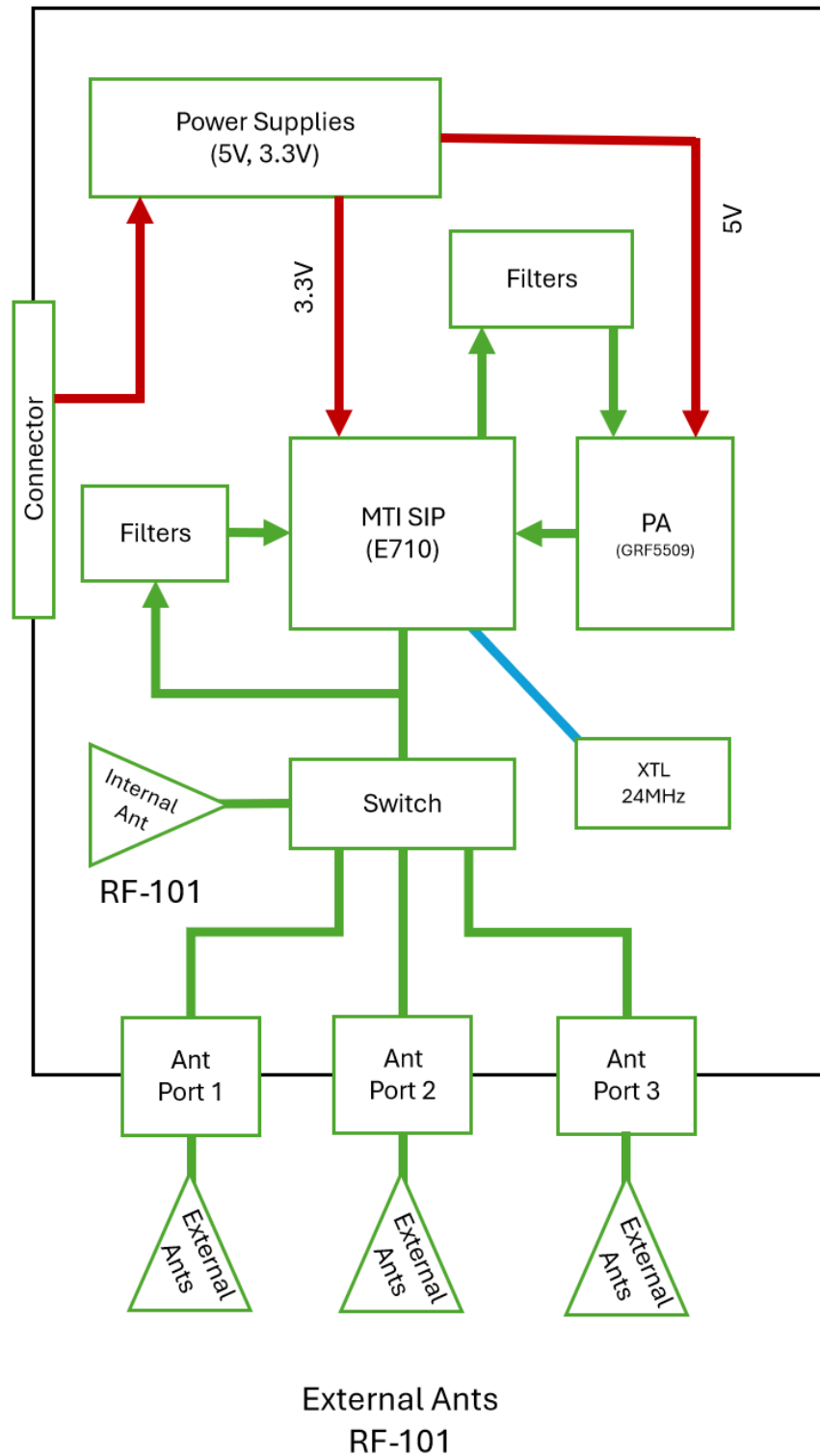
S-PWRSENS3 complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This module complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. This equipment must not be co-located or operated in conjunction with other antennas or transmitters.

The equipment provided with this product allows for transmission only in the frequency range 902.75 -927.25 MHz.

Operational Manual

Block Diagram



Specifications

Interface Specifications

Parameter	Specification
Interface	FFC connector with lock, with 22 conductor ribbon cable on 1 mm pitch
Power Supply	5VDC, 4Amps
Power Consumption (33 dBm, Idle)	13W, 3W

RF Specifications

Parameter	FCC	ETSI
Reader Architecture	Impinj E710	
Reader Protocol	EPC Class 1 Gen 2v2 and 18000 – 6C/63	
Operating Frequency	902.75 MHz – 927.25 MHz	865.6 - 867.6 MHz
Hopping Channels	50	4
Channel Spacing	500 KHz	600KHz
Channel Dwell Time	< 0.4 seconds	
RF Transmitter Power	< +33 dBm	
Modulation Methods	PR-ASK, DB-ASK	
20 db Modulation Bandwidth	< 100 KHz	
Internal Antenna connector	UFL	
External Antenna ports	3 x RP -SMA connectors	

Physical and Environmental Specifications

Parameter	Specification
Dimensions	(cm) 12.7 x 6.3 x 0.6 • (in) 5 x 2.5 x 0.25
Weight	Approximately 50 grams (2 oz)
Maximum Operating Temperature	50C, with proper heatsinking
Maximum Duty Cycle (30dBm) at Max Temperature	>25%
Operating Environment	-40 to 50C, non-condensing
Compliance Certifications	FCC Part 15; FCCID: In Progress, IEC 60950-1

Labelling of the Module

This module is designed to be integrated into SensThys readers. In these designs, the module, with FCC labeling, is not visible from the outside. Therefore, the label visible to the user of the SensThys reader shall clearly state “Contains FCC ID: 2ANPR-S-PWRSENS3”.

SensThys readers are permanently sealed. **Opening the reader to remove the included module is not allowed, and no user instructions to disassemble SensThys readers shall be provided.**

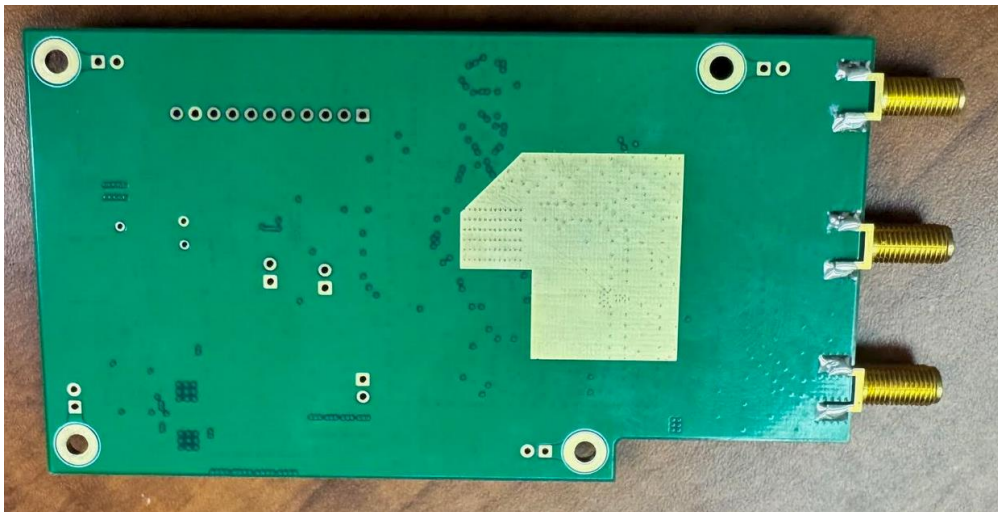
Module Control

The S-PWRSENS3 is controlled by a separate microcontroller within the SensThys reader. **As such, the S-PWRSENS3 has no control features directly accessible by the end user.** The reader commands that control this module are contained within operating instructions for the reader that incorporates within it the RFID module.

For information on the usage of this module, please refer to the operating instructions of the SensThys reader of interest. As example, the SensArray Enterprise 3 incorporates the S-PWRSENS3, with operating instructions found in the **Owner's Manual for the Enterprise 3.**

Module Heatsinking

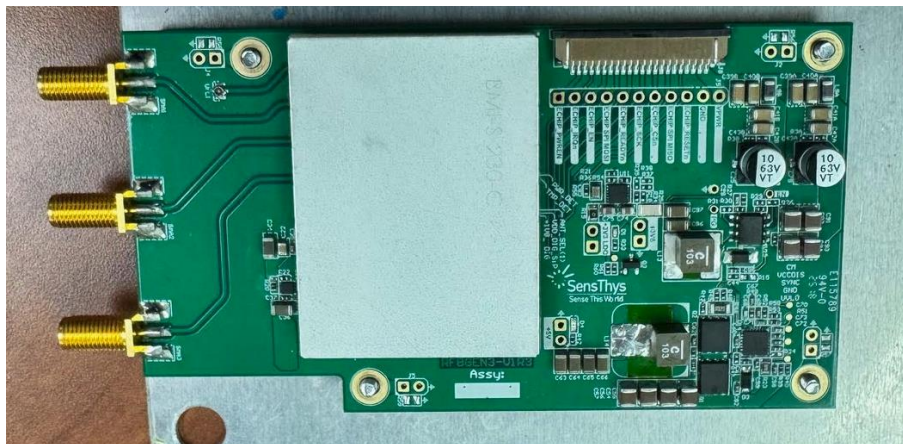
RFID modules produce substantial heat. The S-PWRSENS3 module has an exposed metal region on the back, shown below, that is intended to mate with a heatsink. Generally, this heatsink is an aluminum block that guides the heat from the module to the chassis of the SensThys reader.



The heatsink, mounts with thermally conductive “grease” to the back metal plate of the reader as shown below.



The reader module is mounted such that the metal opening on the module is in physical contact with the Al heatsink as shown below.



Control of the Module

The S-PWRSENS3 module requires external control and external power. Both control and power enter the module through a ribbon connector.

Frequency stabilization of the module is achieved by a 24 MHz oscillator connected to the E710 SIP.

In the case of the SensThys SAE3 reader, the module controlled comes from the PIC processor. This processor operates with “bare metal” coding, i.e., without an operating system.

However, the S-PWRSENS3 module can also be driven by processors using a Linux operating system if more on-board computational capability is desired.

Operation of the S-PWRSENS3 is facilitated by a separate host processor and will not be discussed here. The operation of SensThys readers that contain the S-PWRSENS3 is described in operational manuals for the finished readers.

The module requires a host processor to deliver commands. In the E3, the processor is a Microchip processor.

The chip within the module is the Impinj E710, and the documentation of the E710 is used for programming the host processor to control the E710.

Driving the Antennas

The module drives a total of four antennas. One antenna connection is intended to drive an internal antenna. In the case of the E3, this antenna is the Internal RF-101 – a broadband 9 dBiC antenna. The external ports, with SMA connections, also can be used to drive the RF-101 as an external antenna.

Outgoing RF Signal Path

The PIC processor dictates the basic operation of the module, providing the RF mode of operation, Gen2v2 setting, power levels, operating region, filtering instructions, etc.

Once this information is provided to the reader module, the reader can configure a collection of switches. The first switch set chooses either ETSI or FCC frequency and routes the RF signal through the appropriate filter set as the RF signal leaves the RFID chip. Following the filter and gain adjustment stage, the RF enters the power amplifier (PA), the Guerilla 5509 chip, configured for a good linearity and high output power.

Following the PA, the signal passes through a filter designed to stop all non-desired harmonic signals. The signal is then split, with a small portion of the signal reentering the RFID die to function as the local oscillator, with the majority routed to the antenna multiplex switch.

The switch is controlled by the RFID chip (which is controlled by the PIC processor). The switch is a simple 1:4 switch, allowing the RF signal to be sent to the internal antenna or to one of three external antennas.

The external antenna used here is the SensThys RF-101. The internal antenna is identical to the RF-101, sharing all parts and having the same electronic and RF performance as the RF-101.

Incoming RF Signal path

The RF signal travels out to the RFID tag(s) and is backscattered to return to the reader. The return signal passes through the 1:4 switch. A fraction of the signal is mixed with the local oscillator, and the resultant signal is passed to either a high pass filter (HPF) or through the dense reader mode (DRM) filter. After passing through the filters, this signal is presented to the high sensitivity RF receive circuit.

Processing and Communication

The signal, which is created by mixing the local oscillator with backscattered RF from the tag, is received by the RFID chip. The RFID chip uses the Gen2v2 standard, and the reader settings, to properly analyze the received signal.

The data of the read, which can include the unique tag identifier (TID), electronic product code (EPC), protocol control (PC), time stamps, reader power, returned signal strength, additional data for forward error correction (FEC), and the contents of memory locations in the RFID tag chip.

The module passes this data directly to the host processor.