Intel® RFID Sensor Platform (Intel® RSP)

Installation & User Guide

Document Revision: 2019Q2

Contents

Figures

Revision History

Date	Revision	Description
June 2018	0.0	Initial release.
July 2018	0.1	Updates from J. Belstner
July 2018	0.2	Regulatory updates (sections 2.1, 2.2, 2.3, 2.5)
July 2018	0.3	Updated various minor references, B. Wixom
August 2018	0.4	Added China RoHS Table, Section 2.5. B. Wixom
August 2018	0.5	Added various minor up dates. B. Wixom
August 2018	0.6	Removed reference to add security TODO screen shots. B. Wixom
August 2018	0.7	Revised to internal dual linear antenna gain reference from 7.5 dBi to 7.7 dBi. B. Wixom
August 2018	0.8	Removed references to RRP, replaced system diagram and included warnings about the proper configuration to insure secure data transfer. Added NFC tag programming information. J. Belstner
August 2018	0.9	Updated the software stack diagram. J. Belstner
August 2018	1.0	Added Document Number, Deleted Section 9.3.1 Normal Scan (Single Target), Revised 2.1 and 2.2 Regulatory Sections, various Figure # updates. B. Wixom
September 2018	1.1	Revisions are based on TCB Regulatory inputs: add H4000 in FCC and IC Statements, revise antenna gain reported, revise power output, add minimum distance of model, and revise Max. power level
September 2018	1.2	Added warning statements; Brazil, Mexico and Russian
September 2018	1.3	Revised various areas by adding Copy Right and Trade Mark symbols.
September 2018	1.4	Revised 4.1 Features Table, internal antenna gain values.
October 2018	1.5	Revised Figure numbers, Fig. 11 and beyond
November 2018	1.6	Revised Figure 11
November 9, 2018	1.7	Added Section 9.5 (Software/Firmware Updates. Added Reference Documents to Section 1.2. Changed all occurrences of … “Responsive Retail Sensor (RRS)” to “RFID Sensor Platform (RSP)” Updated section 10.3.6 with different antennas
November 16, 2018	1.8	Removed Section 7.2.1 Mounting, Revised wording in first paragraph Section 10.7 Mounting (H1000), Revised H1000 recommended gain values
December 18, 2018	1.9, 1.10	Revised symbols from © to ®, revised Figures 5 and 6. Fixed other TM&B issues.
January 2019	1.11	TMB, added table of figures. Updated images
January 2019	1.12	Add Intel® RSP to Hx000, H1000, H2000, H3000 in content. Edits to note for Intel® RSP H4000. Edit Brazil copy. Edit image callout
January 2019	1.13	Update footer date. 4.2. Caption Impinj* Added Intel® RSP to 2.5. Intel®
January 2019	1.14	Title Change Ref Docs. RFID Sensor Platform Application Interface (API) Guide Intel® RSP H1000, Intel® RSP H3000, and Intel® RSP H4000

April 2019	2019Q2	Corrected Header/Footer formatting Corrected Document Cross-References Re-centered all images Removed Intel Logo from Header to be consistent with the other RSP documents Added updated LED behavior to section 7.3 Updated verbiage and figure in section 9.1 Updated figure in section 9.2 Updated verbiage in section 9.3 Removed the figure in section 9.4.1 Removed the figure in section 9.4.2 Removed the figure in section 9.4.3 Removed sections/figures 9.4.4.1 and 9.4.4.2 Updated figure in section 9.5.1 Updated figure and verbiage in section 10.5.1 Updated figure and verbiage in section 10.5.2 Updated section 2.

1.0 Introduction

This document is a guide for the installation, setup and use of the Intel® RFID Sensor Platform (Intel® RSP).

1.1 Terminology

Term	Description
RSP Sensor	Intel® RFID Sensor Platform (Intel® RSP)
RSP Controller	RFID Controller for the Intel® RSP
NFC	Near Field Communications

1.2 Reference Documents

Document	Location
Intel® RFID Sensor Platform (RSP) – Application Programming Interface (API)	https://github.com/intel/rsp-sw-toolkit-gw/tree/master/docs
Intel® RSP Android NFC App - Installation & User Guide	https://github.com/intel/rsp-sw-toolkit-gw/tree/master/docs
Intel® RSP Controller App – Edge Computer Software Installation & User Guide	https://github.com/intel/rsp-sw-toolkit-gw/tree/master/docs
Intel® RSP Controller App – Edge Computer Software Application Programming Interface (API)	https://github.com/intel/rsp-sw-toolkit-gw/tree/master/docs

2.0 Regulatory and Environmental Compliance

Certifications have been acquired to operate the Intel® RSP in the following countries:

- ✓ USA (FCC)
- ✓ Argentina (ENACOM)
- ✓ Australia (RCM)
- ✓ Canada (IC)
- ✓ China (SRRC)
- ✓ Colombia (CRC)
- ✓ Costa Rica (SUTEL)
- ✓ Europe (RED)
- ✓ Hong Kong (OFCA)
- ✓ India (WPC)
- ✓ Japan (MIC)
- ✓ Mexico (NOM, IFITEL)
- ✓ Russia (FAC)
- ✓ Saudi Arabia (CITC)
- ✓ Singapore (IMDA)
- ✓ South Korea (KC)
- ✓ Taiwan (NCC)
- ✓ Thailand (NBTC)
- ✓ Turkey (BTK)
- ✓ Uruguay (URSEC)

2.1 Federal Communications Commission (FCC) Compliance

This device FCC ID: ZFL-H4000, ZFL-H3000 and ZFL-H100 and contains FCC ID: XF6-RS9113DB (for H4000), complies with FCC Part 15 and ISED license-exempt RSS standards. 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. **Caution:** Changes to this product or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

WARNING: 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.

2.2 Industry Canada (IC) Compliance

This device IC: 1000H-H4000, 1000H-H3000 and 1000H-H1000 and contains IC ID: 8407A-RS9113DB (for H4000), complies with FCC Part 15 and ISED license-exempt RSS standards. 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.

Cet appareil, qui contient ID IC: 1000H-H4000, 1000H-H3000 et 1000H-H1000 et contient IC ID: 8407A-RS9113DB (pour H4000), est conforme aux exigences FCC et ISED pour les appareils radio autorisés. L'opération est soumise aux deux conditions suivantes: (1) cet appareil ne doit pas provoquer d'interférence, et (2) cet appareil peut provoquer des interférences, y compris des interférences pouvant entraîner un fonctionnement indésirable.

Caution: Changes to this product or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

Innovation, Science and Economic Development Canada ICES-003 Compliance Label: CAN ICES-3(A)/NMB-3(A)

This device complies with 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, including interference that may cause undesired option 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 comparomettre le fonctionnement.

2.3 Voluntary Control Council for Interference (VCCI) Warning

Class A ITE
この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）クラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

2.4 Europe – EU Declaration of Conformity

Hereby, Intel® Corporation declares that the radio equipment type 1000H-H1000, 1000H-H3000 and 1000H-H4000 is in compliance with...

- Radio Equipment Directive (RED) 2014/53/EU
- EU directive 2011/65/EU (RoHS II)

2.5 China RoHS Declaration

Management Methods on Control of Pollution from Electronic Information Products
(China RoHS declaration)
产品中有害物质的名称及含量
Hazardous Substances Table

部件名称 (Parts)	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
主　机　板 Motherboard	×	○	○	○	○	○
机壳Chassis	×	○	○	○	○	○
缆线Cables	×	○	○	○	○	○
风扇 Fan	○	○	○	○	○	○
散热器Heat sink	○	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。

○：表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572标准规定的限量要求以下。

○：Indicates that this hazardous substance contained in all homogeneous materials of such component is within the limits specified in GB/T 26572.

×：表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572标准规定的限量要求。

×： Indicates that the content of such hazardous substance in at least a homogeneous material of such component exceeds the limits specified in GB/T 26572.

对销售之日的所售产品,本表显示我公司供应链的电子信息产品可能包含这些物质。注意：在所售产品中可能会也可能不会含有所有所列的部件。

This table shows where these substances may be found in the supply chain of our electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product

除非另外特别的标注,此标志为针对所涉及产品的环保使用期限标志.

某些可更换的零部件可能会有一个不同的环保使用期限(例如,电池单元模块).

此环保使用期限只适用于产品在产品手册中所规定的条件下工作.

The Environmental Protection Use Period (EPUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. Certain field-replaceable parts may have a different EPUP (for example, battery modules) number. The Environment-Friendly Use Period is valid only when the product is operated under the conditions defined in the product manual.

2.6 Intel® RSP H1000 Specific Instruction & Warning

This device has been designed to operate with the antennas listed below, and having a maximum gain of 8.5 dB. Antennas not included in this list or having a gain greater than 8.5 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Ce dispositif a été désigné pour fonctionner avec les antennes énumérées ci-dessous, et ayant un gain maximum de 8.5 dB. Les antennes non incluses dans cette liste ou ayant un gain plus grand que 8.5 dB sont strictement interdites pour l'utilisation avec cet appareil. L'antenne requise impédance est 50 ohms.

(A) The recommended antenna types for the Intel® RSP H1000 unit are listed below (and section 10.3.6.2):

a. Ceiling/Wall Mounting: Laird* RFID Panel Antenna, S8658PR12NF (ETSI) or S9028PCL/S9028PCR (FCC). This antenna has a circularly polarized pattern and provide 8.5 dBi gain.

b. Tabletop Point-of-Sale (POS): Times-7* RFID Near-Field Antenna, A1030. This antenna has a circularly polarized pattern and provides -15.0 dBi gain.

(B) The Intel® RSP H1000 has 4x external ports, connector type Reverse Polarity SMA (SMA-R). The maximum allowable torque for these external connectors is 10 in-lbs, max.

(C) It is possible that these port connectors require an RF adapter depending upon the actual antenna that is used and it's mating connector type.

2.7 Additional Warning Statements

[Brazil]

Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados

[Mexico]
La operaciando este equipo está sujeta a las siguientes dos condiciones:
(1) es posible que este equipo o dispositivo no cause interferencia perjudicial y

(2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

[Russia]

Подтверждение соответствия Мининформсвязи России:

Декларация соответствия № Д-ИВРД-5656 от 7.11.2018 года, действительна до 7.11.2028 года, зарегистрирована в Федеральном агентстве связи 16.11.2018 года

[Chinese, Traditional]
H4000 限定說明與警, 應避免影響附近雷達系統之操作。

3.0 Safety and Regulatory Information

3.1 Safety & Regulatory Warnings

USERS: This device is intended to be use/operated by Instructed Persons & Skilled Persons only.

Do Not Open: This device is not intended to be open by the operator. There are no user serviceable parts.

Installation and Maintenance: Do not connect/disconnect any cables to or perform installation/maintenance on this device during an electrical storm.

This equipment is only to be connected to PoE networks without routing to outside plants.

This unit is supplied by an UL Listed I.T.E. (UL E210882-A29)

International CB Scheme (IEC 62368-1)

4.0 Product Description

The Intel® RSP H1000, Intel® RSP H3000 and Intel® RSP H4000* are members of the "Smart Sensor" family that is part of the Intel® RFID Sensor Platform (Intel® RSP). These devices have capabilities for several on-board sensors including an EPC Gen 2 UHF RFID Interrogator (reader). These sensors are designed to work stand-alone, or in a network of other "Smart Sensors" as part of an Internet-of-Things (IoT) system where computing power is pushed out to the edge devices.

Intel® RSP H4000* Intel® RSP H3000 Intel® RSP H1000

Figure 1: Intel® RFID Sensor Platform Hx000 Family

* The Intel® RSP H4000 is only available through special order at this time. Contact your Intel® representative for more information.

4.1 Features

The Intel® RSP H3000 and Intel® RSP H4000 are designed to be ceiling or wall mounted facing into the retail space and hidden from view. Intel® RSP H1000 is designed to be mounted under a table or flush mounted to a wall or cabinet and hidden from view. The following features are unique to the three different models.

Feature	Description & Purpose	Intel® RSP H1000 	Intel® RSP H3000 	Intel® RSP H4000 
4.1.1 UHF RFID Reader	UHF EPC Gen 2 RFID Reader module. This module supports the core functionality of Intel® RSP (i.e. inventory management)	✓	✓	✓
4.1.2 Internal RFID Antenna	Dual Linear Antennas 865-868 MHz: Patch Antenna w/ 7.82 dBi gain. 902-928 MHz: Slot Coupled Microstrip Antenna w/ 7.67 dBi gain.	*	✓	✓
4.1.3 Passive Infra-Red Detector	Detect human motion		✓	✓
4.1.4 Accelero meter / Magnetometer	Reading the orientation of the device as it is mounted.		✓	✓
4.1.5 5MP Camera	OmniVision* OV5640 5MP camera for video and still image capture			✓
4.1.6 Wi-Fi/Bluetooth® low energy	Redpine* Signals Systems RS9113 integrated Wi-Fi /Bluetooth® low energy			✓
4.1.7 Tempera ture / Humidity	Read the temperature and humidity of the environment where the device is mounted.	✓	✓	✓

* The Intel® RSP H1000 model is designed to support up to four ***reverse-SMA RF ports*** for connecting up to four UHF RFID external antennas (not included) on the front panel.

4.2 Block Diagrams

4.2.1 Top Level

A block diagram of the PCBA common to all products is shown below.

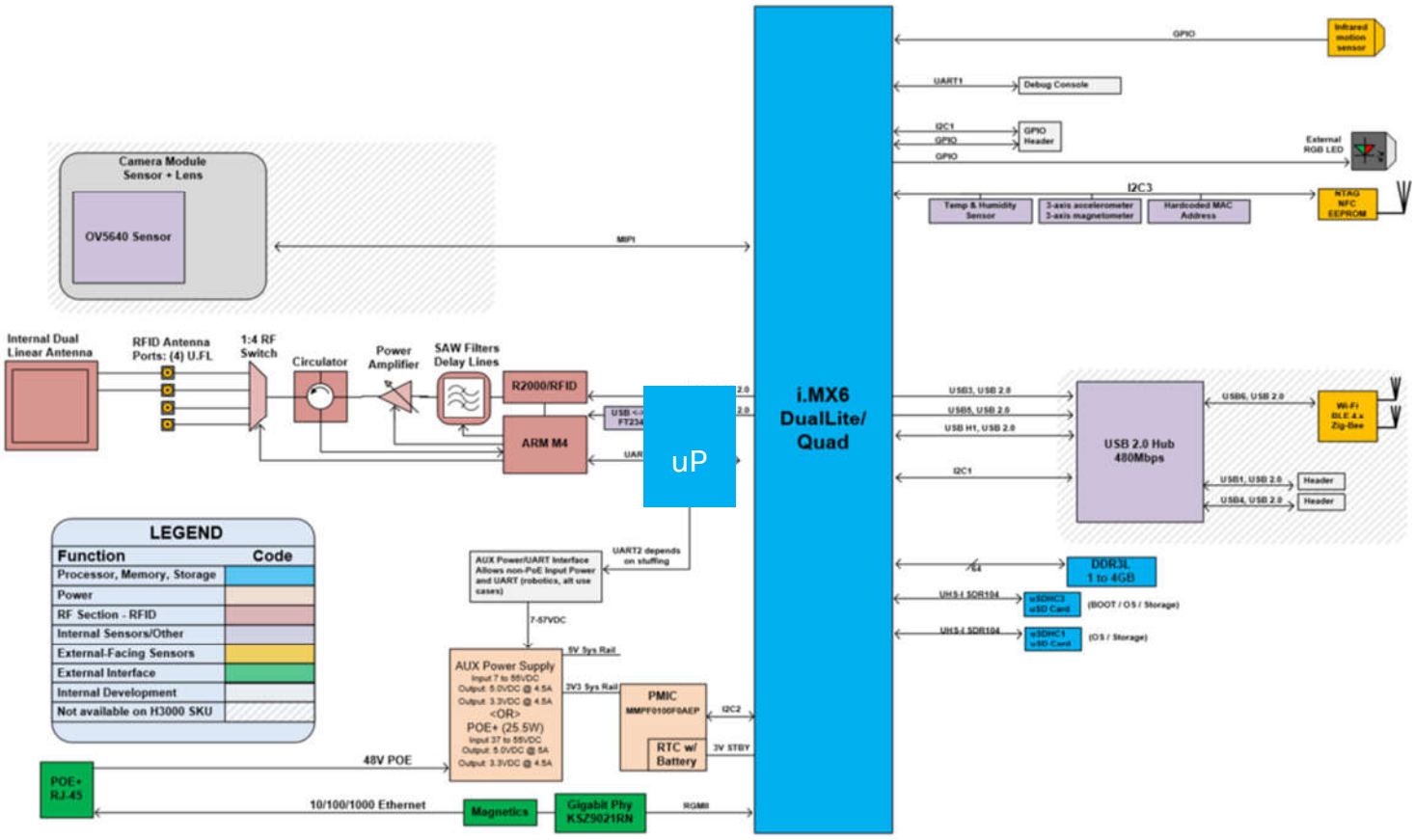


Figure 2: Intel® RSP Hx000 Functional Block Diagram

4.2.2 RF Subsystem

The R2000 subsystem (aka “RF Circuitry”) is defined as the Arm* M4 (aka Microcontroller), R2000/RFID transceiver (aka “Indy Reader Chip”), power amplifier, directional coupler, 4-port antenna switch and associated matching components. The Intel® RSP Sensor uses an internal dual linear antenna that only requires two of the four ports. The Intel® RSP H1000 brings out all four of the antenna ports to external R-SMA connectors allowing the System Integrator to use antennas that are not collocated with the Intel® RSP H1000 reader. Below is a block diagram of the Impinj* R2000 Sub-System.

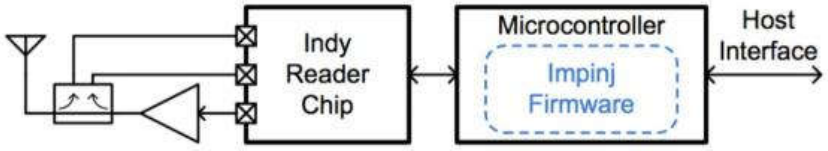


Figure 3: RF Subsystem

4.2.3 Impinj* R2000 ASIC

For reference, a block diagram of the Impinj* R2000 ASIC internal components is shown below.

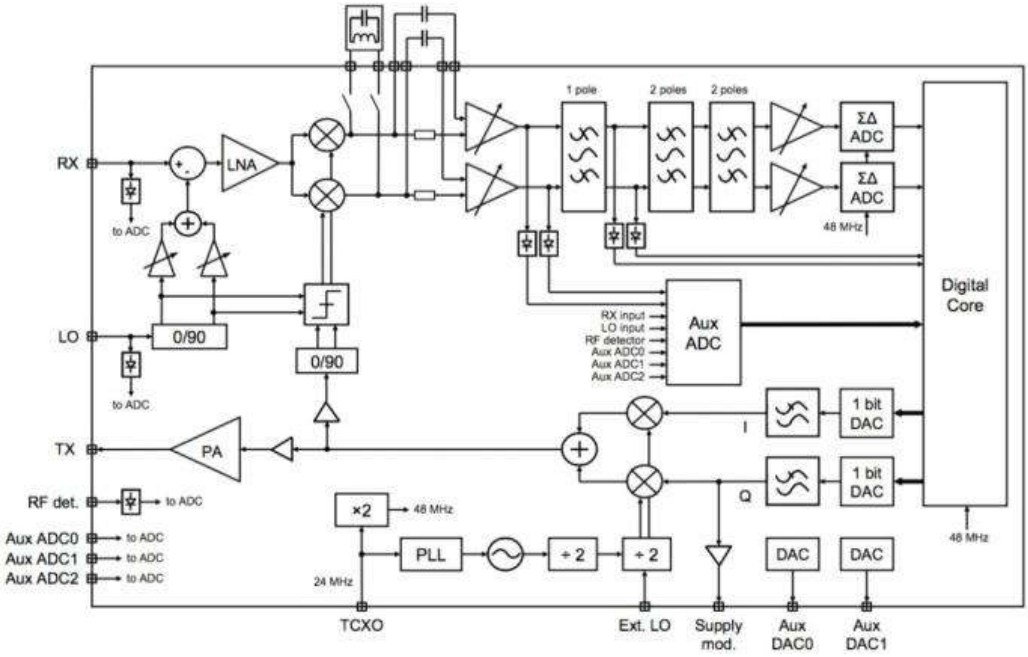


Figure 4: Impinj* R2000 ASIC Block Diagram

5.0 Product Specifications

			
Model	Intel® RSP H1000	Intel® RSP H3000	Intel® RSP H4000*
Electrical:			
Air Interface Protocol	EPC UHF RFID Class 1 Gen 2 (ISO 18000-6C)	EPC UHF RFID Class 1 Gen 2 (ISO 18000-6C)	EPC UHF RFID Class 1 Gen 2 (ISO 18000-6C)
Operating Frequency	902-928 MHz (US), 865-868 MHz (ETSI)	902-928 MHz (US), 865-868 MHz (ETSI)	902-928 MHz (US), 865-868 MHz (ETSI)
Radiated Power	N/A	Up to 4W EIRP (2W ERP)	Up to 4W EIRP (2W ERP)
Antenna	N/A	Integrated 7.7 dBi Dual-Linear Polarized	Integrated 7.7 dBi Dual-Linear Polarized
Power Output	Up to +27.03 dBm	Up to +28.15 dBm	Up to +28.16 dBm
Power Source	PoE+ (IEEE 802.3af, 802.3at, Cisco* UPOE)	PoE+ (IEEE 802.3af, 802.3at, Cisco UPOE)	PoE+ (IEEE 802.3af, 802.3at, Cisco UPOE)
Power Consumption	16W max, 5W max idle	16W max, 5W max idle	13W max, 5W max idle
Tag Read Range	Based on external antenna type	>15m	>15m
Tag Read Rate	>600 tag reads/sec	>600 tag reads/sec	>600 tag reads/sec
Visual Indicators	Single tri-color LED	Single tri-color LED	Single tri-color LED
IR Detection	N/A	Panasonic* PIR Sensor	Panasonic* PIR Sensor
Video Camera	N/A	N/A	5MP, FOV-D 110˚, H.264 or raw video, module rotation 0˚ to 90˚
Antenna Ports	4-Ports, Reverse SMA	N/A	N/A
Mechanical:			
Dimensions	6.25" x 6.25" x 1.25" (15.9cm x 15.9cm x 3.2cm)	10.4" x 9" x 2" (26.4cm x 22.9cm x 5.1cm)	12" x 9" x 2" (30.5cm x 22.9cm x 5.1cm)
Weight	1.46 lbs. (0.66 kg)	4.00 lbs. (1.82 kg)	4.35 lbs. (1.98 kg)
Mounting	Custom mounting plate, or desk top	VESA 75mm pattern, M4 threads	VESA 75mm pattern, M4 threads
Color	Black	Black or White	Black or White
Environmental:			
Operating Temperature	0°C to +35°C	0°C to +35°C	0°C to +35°C
Rating	IP-50	IP-50	IP-50
Application Interface:			
Network Connectivity	Ethernet 10/100	Ethernet 10/100	Ethernet 10/100
IP Address Configuration	DHCP or static	DHCP or static	DHCP or static
Data Protocol	JSON-RPC 2.0 over MQTT	JSON-RPC 2.0 over MQTT	JSON-RPC 2.0 over MQTT
Configuration/Management	mDNS/DNS-SD	mDNS/DNS-SD	mDNS/DNS-SD
Time Synchronization	Network Time Protocol (NTP)	Network Time Protocol (NTP)	Network Time Protocol (NTP)
Software/Firmware Update	Remotely upgradable	Remotely upgradable	Remotely upgradable
Sensor Provisioning Function	Near Field Communications (NFC), no power required	Near Field Communications (NFC), no power required	Near Field Communications (NFC), no power required
4x External Antenna Ports	For use with customer supplied external antenna, up to 4x simultaneously. 4-Ports, Reverse SMA	N/A	N/A
Regulatory:			
Safety Compliance	IEC 60950-1	IEC 60950-1	IEC 60950-1
Radio Approvals	[1] FCC, ETSI, PRC (China), Singapore, Japan, among others	[1] FCC, ETSI, PRC (China), Singapore, Japan, among others	[1] FCC, ETSI, PRC (China), Singapore, Japan, among others

* Intel® RSP H4000 is available through special order at this time.

6.0 Hardware Description

6.1 Intel® RSP H4000 and Intel® RSP H3000 Models

Figure below highlights the external interfaces.

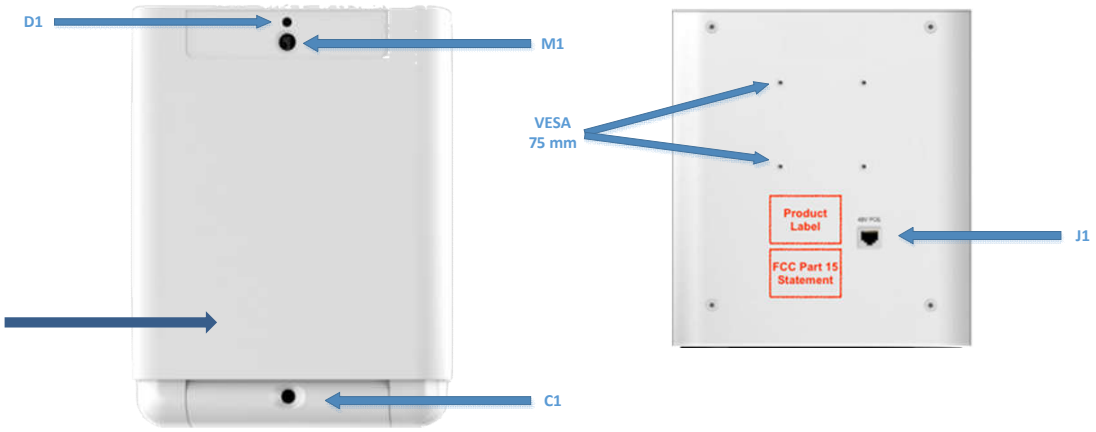


Figure 5: Intel® RSP H4000 Front and Intel® RSP H3000 Back interfaces

6.1.1 Mounting Holes VESA 75mm

The Intel® RSP H3000 and Intel® RSP H4000 sensors provide a 75-mm hole pattern compatible with various mounting brackets. The holes can accept up to a 1 cm M4 threaded fastener.

6.1.2 Motion Sensor (M1)

The Intel® RSP H3000 and Intel® RSP H4000 sensors uses a passive infrared sensor to detect human motion in the field of the RFID antenna.

6.1.3 Connector J1 (RJ-45)

The Intel® RSP H3000 and Intel® RSP H4000 sensor is a 48V Power Over Ethernet (POE) Class 3 device as defined in IEEE 802.3af. Both sensors use a 10/100 Ethernet connector.

6.1.4 Camera (C1)

The Intel® RSP H4000 uses an OmniVision* 5MP camera with a 100 degree horizontal field of view. The Intel® RSP H4000 microprocessor is capable of streaming 1080p video at 30 frames per second. The camera module offers a rotation range of 0˚ to 90˚.

6.1.5 Status LED (D1)

The Intel® RSP H3000 and Intel® RSP H4000 sensors have a status LED which will illuminate at various times to indicate status, alerts and other functions. A list of the status colors and their meanings are shown in Section 7.3. The Status LED is off during Intel® RSP normal operation.

6.1.6 NFC Tag (NFC)

The Intel® RSP Hx000 sensors have an embedded NFC tag for storing security credentials. The tag uses NDEF formatted data fields to store a certificate hash and user token.

6.2 Intel® RSP H1000 Model

Figure below highlights the external interfaces.

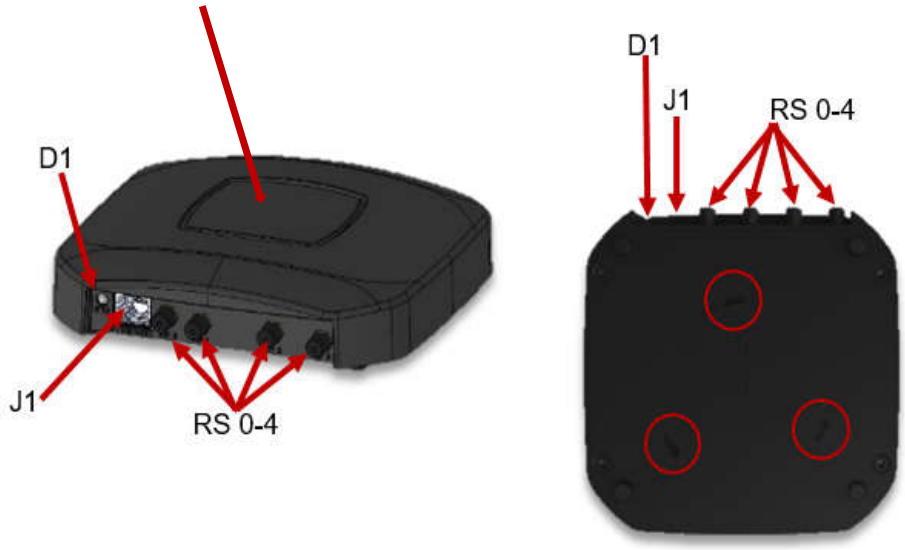


Figure 6: Intel® RSP H1000

6.2.1 Connector (J1) RJ-45

The Intel® RSP H1000 is a 48V Power Over Ethernet (POE) Class 3 device as defined in IEEE 802.3af. The Intel® RSP H1000 supports 10/100 Ethernet on this same connector.

6.2.2 Reverse-SMA Connectors (RS 0-4)

The Intel® RSP H1000 provides four Reverse-SMA RF ports for connecting up to four UHF RFID external antennas (not included).

6.3 Visual Indicator (D1) Tri-Color LED for all models

The Intel® RSP Sensor provides a multicolored visual indicator to notify the user of the following operational states.

6.3.1 OFF

An LED state of “off" indicates the Intel® RSP Sensor has either been commanded to disable its visual indicator or is otherwise non-operational.

6.3.2 GREEN (Power On)

An LED state of "solid green" is the default to indicate power has been successfully applied to the Intel® RSP. This initial LED state should not last longer than 2 – 3 minutes. After 2 – 3 minutes, the LED color should transition to indicate successful OS boot.

6.3.3 Light BLUE

An LED state of “solid light blue" indicates the Intel® RSP Sensor has successfully booted to the Linux* OS, but the RFID Applications are not yet running.

6.3.4 Flashing WHITE

An LED state of “flashing white" after boot up indicates the Intel® RSP Sensor is in the process of discovering the RSP Controller. The state of “flashing white" can also be commanded (i.e. Beacon Mode) by the RSP Controller via JavaScript* Object Notation (JSON) Remote Procedure Call (RPC) for visually identifying the Intel® RSP.

6.3.4.1 Alternating WHITE/GREEN

During the RSP Controller Discovery process, the Intel® RSP Sensor must acquire time using the ntp protocol. If the sensor is successful in getting time from the advertised ntp server, the LED will flash WHITE/GREEN three times.

6.3.4.2 Alternating WHITE/RED

If the sensor is unsuccessful in getting time from the advertised ntp server, the LED will flash WHITE/RED three times.

6.3.4.3 Flashing PINK

During the RSP Controller Discovery process (if configured to do so), the Intel® RSP Sensor must read the provisioning token out of the embedded NFC tag. If the sensor is successful in reading the provisioning token, the LED will briefly flash PINK.

6.3.5 Solid Yellow (Idle)

Following RSP Controller Discovery, an LED state of “solid yellow" indicates that The Intel® RSP Sensor is in the idle state and ready to accept commands.

6.3.6 BLUE

An LED state of “solid blue" indicates the Intel® RSP Sensor is currently in an Inventory Cycle (i.e. transmitting) but not receiving any tag data.

6.3.7 Flashing BLUE

An LED state of “flashing blue" indicates the Intel® RSP Sensor is currently in an Inventory Cycle (i.e. transmitting) and successfully communicating with RFID tags.

6.3.8 Flashing RED

An LED state of “flashing red" indicates the Intel® RSP Sensor has detected a failure. This will continue until the alert is acknowledged by the RSP Controller or the CLI.

7.0 Software Description

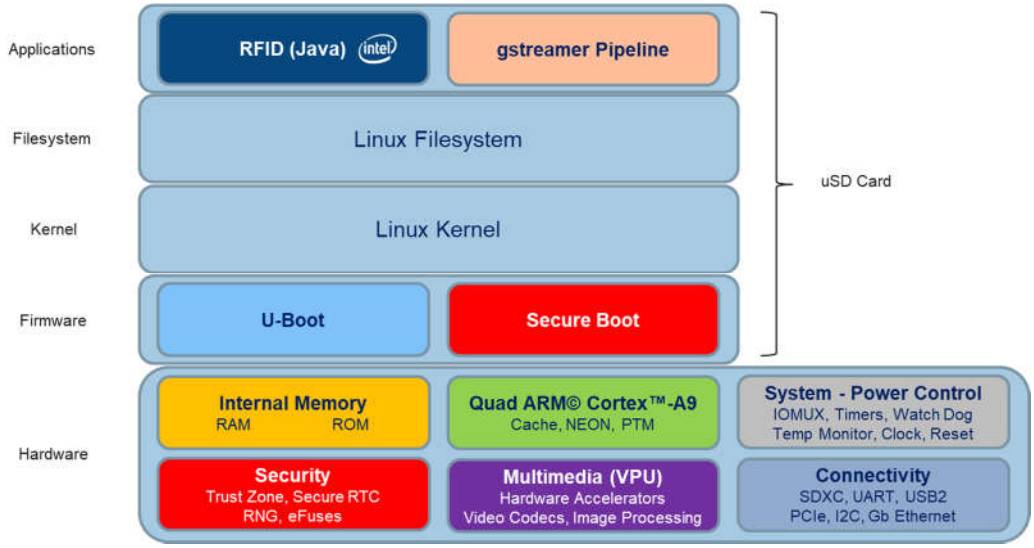


Figure 7: Intel® RSP Hx000 Software Stack

7.1 Operating System

The Intel® RSP Hx000 Series Sensors use the Freescale* I.MX6 processor running a Yocto Project* Linux* kernel and file system.

7.2 Secure Platform

The Intel® RSP Hx000 Series Sensors incorporate both secure boot, file system encryption and software packages that are signed by the Intel® EDSS to insure that only the software intended for this device is allowed to run.

7.3 Security Provisioning

The Intel® RSP Hx000 Series Sensors include an embedded NFC tag for programming the security information. An Android* Application is available to easily program this information into the sensor. The screenshots below show how to use this application to program the Intel® RSP Hx000 Series Sensors.

8.0 Theory of Operation

The power of Intel® RSP is in the networked communication and coordination that exists between the Sensor Platforms themselves and between the Intel® RSP Controller. Whether a particular RFID system deployment has 5 or 500 Intel® RSP devices, this communication and coordination greatly simplifies initial configuration as well as the operational management. This section defines the messages used between the RFID Sensor and the rest of the system that facilitates this orchestration.

Some of these messages affect the RF power output and modulation scheme being transmitted. The Impinj* R2000 RF subsystem buffers all commands received from the RSP Controller via the Host Processor. NOTE: Any command that attempts to set a parameter to a value that is outside its valid range or would otherwise cause the Intel® RSP Sensor to no longer be compliant with its certification will return an error code and the previous command settings will persist.

Several Use Cases have been defined that illustrate initial discovery, configuration and tag population management. Detailed message definitions can be found in the Intel® RFID Sensor Platform API and the Intel® RSP Controller Application API.

8.1 Security Provisioning with NFC

The Intel® RSP Hx000 contains an NFC tag that is used to store a root certificate hash and an authentication token. This hash and token are necessary to complete the mutual authentication protocol with the RSP Controller and obtain the credentials needed to connect to the MQTT broker.

An Open Source Android project for programming the token and hash information can be downloaded from the Intel® Open Source Portal (https://01.org). The project is located in the "Developer Toolkits" section under "Intel® RSP SW Toolkit". Follow the repository links to obtain the software.

The Android device must be tapped within 1 – 2 inches of the NFC tag to successfully program. The Figure below shows the location of the NFC tag on each RSP.

Figure 8: NFC Tag Locations Identified

8.2 RSP Controller Discovery

A goal of the Intel® RFID Sensor Platform is to be as much of a “zero-conf" installation as possible. Once power is applied, the Intel® RSP sensor autonomously acquires a network address via DHCP and discover the Intel® RSP Controller with Intel® RFID Sensor Platform SW Toolkit (Intel® RSP SW Toolkit). It then synchronizes its system clock and registers. The Intel® RSP Sensor supports encryption via a TLS connection to the MQTT broker. An optional “provisioning tag” containing a hash and token can be used for the Intel® RSP Sensor to authenticate the Cloud and the Intel® RSP Controller authenticate the sensor as it connects. The Figure below illustrates the message exchange involved in this use case.

Figure 9: Device Discovery

8.3 RFID Behavior Control

In addition to using default values, the Intel® RFID Sensor Platform supports RFID behavior configuration via API command. The parameters that can be controlled by this command are shown below. See document 338178 RSP-Hx000 Message API for a complete set of command definitions.

Parameter	Definition
Action	Specifies the action to be taken. The valid values are “START" and “STOP".
action_time	Specifies the millisecond epoch time to apply the behavior. If zero or not included, the behavior is applied immediately.
behavior	Optional set of behavior parameters (see below).
id	The ID string assigned to this behavior
operation_mode	The embedded RFID module transmit operation mode. The valid values are "Continuous" and "NonContinuous". The default value is "NonContinuous".
link_profile	The RF Link Profile to be used for this behavior (see below). The valid range is 0 – 4.
power_level	The power output level in dBm to be used for this behavior. The valid range is 0 – 31.5.
dwell_time	The maximum amount of time (ms) spent on a particular virtual port before switching to the next virtual port during an inventory cycle. If this parameter is zero, the “inv_cycles" parameter may not be zero. The valid range is 0 – 65535.
inv_cycles	The maximum amount of inventory cycles to attempt on a particular virtual port before switching to the next virtual port during an inventory cycle. If this parameter is zero, the “dwell_time" parameter may not be zero. The valid range is 0 – 65535.
selected_state	Specifies the state of the “SL" flag to be used for this behavior when specifying a select protocol operation. The valid values are: “Any", “Deasserted" and “Asserted".
target_state	Specifies which inventory session flag is matched against the state specified by “target_state" (see below). The valid values are “S0", “S1", “S2" and “S3".
session_flag	Specifies the state of the inventory session flag specified by “session_flag" that are to apply the subsequent tag protocol operation. The valid values are “A" and “B".
q_algorithm	The specific Q algorithm being configured. The valid values are “Fixed" and “Dynamic". When using a “Fixed" algorithm, the number of time slots is 2^Q. When using a “Dynamic" algorithm, the Intel® RSP’s embedded module will vary the number of slots dynamically based on the number of tags responding.

fixed_q_value	The fixed Q value to use (valid when q_algorithm = Fixed). The valid range of this parameter is 0 – 15.
repeat_until_no_tags	Specifies whether or not the singulation algorithm should continue until no more tags are singulated. The valid values are “true" or “false".
start_q_value	The initial Q value to use at the beginning of an inventory round (valid when q_algorithm = Dynamic). The valid range of this parameter is 0 – 15.
min_q_value	The minimum Q value that would ever be used during an inventory round (valid when q_algorithm = Dynamic). The valid range of this parameter is 0 – 15.
max_q_value	The maximum Q value that would ever be used during an inventory round (valid when q_algorithm = Dynamic). The valid range of this parameter is 0 – 15.
threshold_multiplier	A 4X multiplier applied to the Q-adjustment threshold as part of the dynamic-Q algorithm. The valid range of this parameter is 0 – 255.
retry_count	The number of times to try another execution of the singulation algorithm before either toggling the target flag or terminating the operation. The valid range of this parameter is 0 – 255.
toggle_target_flag	Specifies whether or not to toggle the targeted flag. The valid values are “true" or “false".
toggle_mode	When toggle_target_flag is true, this value specifies when to toggle the targeted flag. The valid values are “None”, “OnInvCycle", OnInvRound”, or “OnReadRate".
perform_select	Specifies whether or not to perform a select command based on the previously configured criteria The valid values are “true" and “false".
perform_post_match	Specifies whether or not to perform a post singulation match based on the previously configured criteria. The valid values are “true" and “false".
filter_duplicates	Specifies whether or not the Intel® RFID Sensor Platform should filter out duplicate tag information before sending to the Intel® RSP Controller. The valid values are “true" or “false".
auto_repeat	Specifies whether or not to continue performing inventory rounds until the “stop_inventory" command is received. When this value is "No", an "inventory_complete" indication will be sent from the Intel ® RFID Sensor Platform to the RSP Controller at the end of the inventory round. The valid values are “true" and “false".
delay_time	The amount of time (ms) that the transmitter is turned off between subsequent inventory rounds. Used when "auto_repeat" is true to control the transmit duty cycle. The valid range is 0 – 65535.

Parameter / Profile Index	0	1	2	3	4
Modulation Type	DSB-ASK	PR-ASK	PR-ASK	DSB-ASK	DSB-ASK
Tari Duration (us)	25	25	25	6.25	6.25
Data 0/1 Difference	1	0.5	0.5	0.5	0.5
Pulse Width (us)	12.5	12.5	12.5	3.13	3.13
R-T Calculation (us)	75	62.5	62.5	15.63	15.63
T-R Calculation (us)	200	85.33	71.11	20	33.33
Divide Ratio	8	21.33	21.33	8	21.33
Data Encoding	FM0	Miller-4	Miller-4	FM0	FM0
Pilot Tone	1	1	1	1	1
Link Frequency (kHz)	40	250	300	400	640
Data Rate (kbps)	40	62.5	75	400	640

Session	Tag Energized	Tag Not Energized
S0	Indefinite	None
S1	500 ms < persistence < 5 s	2 s < persistence
S2	Indefinite	2 s < persistence
S3	Indefinite	2 s < persistence

8.4 Managing Large Tag Populations

The RSP Controller with Intel® RSP SW Toolkit can segregate a large tag population into several smaller ones using the Intel® RSP's sensor to more accurately inventory a tag population by avoiding collisions. This same functionality can also be used to isolate a single tag that might be located in a challenging RF environment or perhaps physically oriented in a less than optimal fashion.

A challenge in managing larger tag populations is dealing with "tag collisions" during the query-response (more than one tag responding at exactly the same time). The Intel® RSP Sensor offers an adaptive algorithm (Dynamic-Q) function to mitigate tag collisions. An adaptive Q algorithm increases the reading efficiency significantly thereby reducing the time it takes to completely inventory a large tag population. The Intel® RSP Sensor allows the RSP Controller to optimally configure the Q Algorithm based on a known tag population. Dynamic-Q is used by default, which relieves the RSP Controller from having to explicitly set the Q-value.

8.4.1 Normal Scan (Dual Target)

This Use-Case illustrates the most common situation where a number of tagged items are being continuously inventoried on an RFID-enabled "smart shelf" or perhaps an overhead Intel® RSP Controller in an RFID-enabled "smart store". This mode will allow multiple reads per tag for a moderate update of tag status to alert the Intel® RSP system should a tagged item be moved. No tag filtering is specified.

8.4.2 High Mobility (Dual Target)

This Use-Case addresses the situation where a number of tagged items are being continuously inventoried, and higher numbers of reads per tag are required to detect tag mobility.

8.4.3 Deep Scan (Single Target)

This Use-Case illustrates a thorough "Deep Scan" using the most robust RF link to insure that all tags within the coverage area are successfully read at least once. This mode also uses suppression to allow weaker tags to respond without competing with the multiple responses of other tags and is recommended only in situations where multiple reads per tag is not required. Sessions 2 and 3 are used to provide longer suppression times while scanning. Alternating between sessions 2 and 3 (and between A and B) allows for a rapid recovery when rescanning the tag population. This use-case insures that even the most distant tags with the weakest backscatter signal can be eventually read.

8.4.4 Searching for a Single Tag or Group of Tags

There are two ways to search for an individual tag or group of tags using The Intel® RSP Sensors.

The “select" function configures the Intel® RSP Sensor with set of tag filter criteria and instructs those tags that match that filter criteria to modify a certain register flag, forcing it to a known value prior to singulation. The tag protocol operation (i.e. read, write, kill) is applied only to those tags that meet the filter criteria. When tag populations are relatively large (> 1000) or when it is critical to apply a tag protocol operation to only a single tag, this method of filtering is preferred. A good example of an applied use of the "select" function would be at the point-of-sale (POS) where tags could be deactivated (killed) prior to exiting a controlled area.

The "post-match" function configures The Intel® RSP Sensor with set of tag filter criteria that is applied "post" singulation or after a particular tag protocol operation is performed. Even though the tag still has to compete in the RF environment of the singulation process, the only data sent to the RSP Controller is from those tags that match the filter criteria defined in the "post match" function. “Post Match" filtering is a single step process, tag memory is not modified and all tags respond to the inventory request. When tag populations are relatively small (< 1000), this method of filtering on certain tags is more efficient. A good example of an applied use of the "post match" function would be when searching a larger tag population with a hand scanner for a particular tag or group of tags.

8.5 Software/Firmware Updates

8.5.1 Automatic Update

Software update of the Intel® RSP Hx000 is designed to be an autonomous operation. The RSP Controller sends an opkg Repository URL to the sensor in the Connect Response Message. The Sensor periodically goes out to this repository and downloads those packages that need updating. The figure below illustrates the message flow of this process.

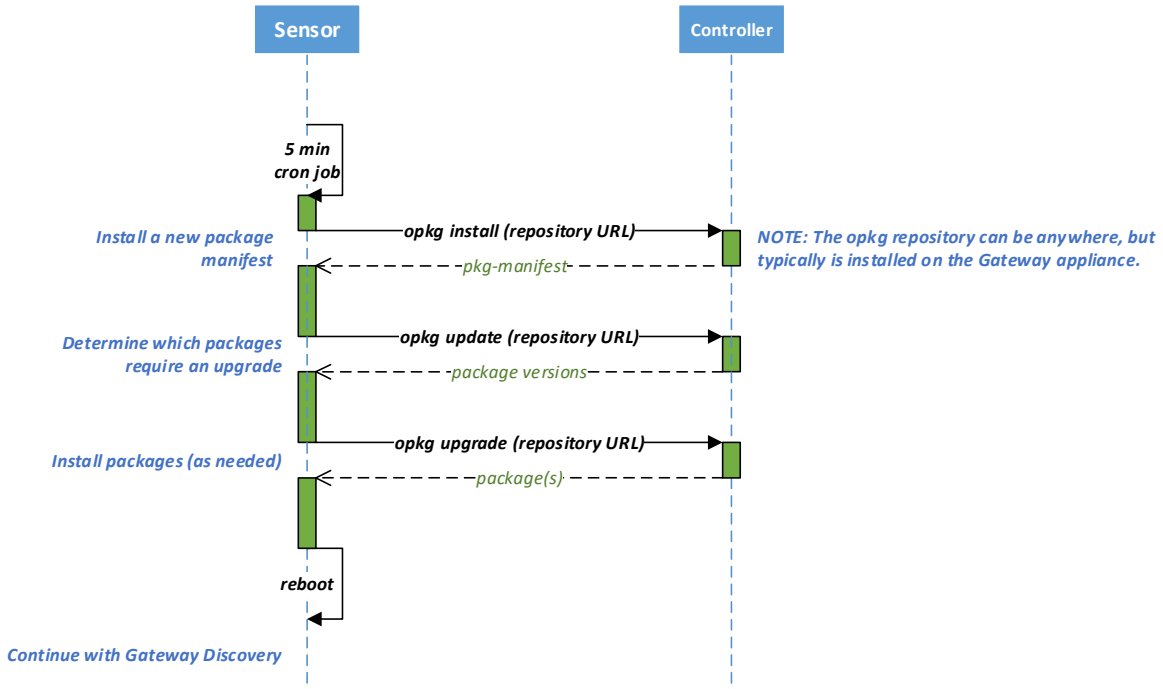


Figure 10: Software Update Data Flow

8.5.2 Manual Update

Individual Linux Packages can be updated on the Intel® RSP Hx000 by manually installing the .ipk from the command line. All the Linux Packages used on the Intel® RSP Hx000 are available for individual download from the Intel® RSP Support website.

Copy and install each package to the Intel® RSP as shown below. The highlighted text indicates user input.

```
$ scp –P62939 -i mfg_key.pvt <package>.ipk rrs-admin@<ip address>:~
$
$ ssh –p62939 rrs-admin@<ip address> -i mfg_key.pvt
<hostname>:~$ su –
root@<hostname>:~# cd /home/rrs-admin/
root@<hostname>:/home/rrs-admin# ipkg install <package>.ipk
Installing <package> to root...
Configuring <package>
Successfully terminated.
root@<hostname>:/home/rrs-admin# rm <package>.ipk
root@<hostname>:/home/rrs-admin# exit
logout
<hostname>:~$ exit
logout
Connection to <hostname> closed.
$
```

9.0 System Installation

9.1 RF Exposure Statement

Caution: The radiated output power of this device is below the FCC and International radio frequency exposure limits. To avoid the possibility of exceeding these exposure limits, always maintain a minimum distance of 34 cm (minimum distance of model H1000 is 26 cm) between the antenna and the human body. Details regarding the authorized configurations can be found at http://www.fcc.gov/oet/ea/ by entering the FCC ID from the device.

Caution: L'antenne (s) utilisée (s) pour cet émetteur doit être installée pour assurer une distance de séparation d'au moins 34 cm (la distance minimale du modéle H1000 est de 26 cm) de Personnes et ne doivent pas être co-situés ou fonctionner conjointement avec une autre antenne ou émetteur. Utilisateurs et Les installateurs doivent être munis d'instructions d'installation d'antenne et de conditions d'exploitation de l'émetteur pour Conformité à l'exposition RF.

9.2 Information to the User

§15.105 Information to the user

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 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 to another POE source.
- Consult the system integrator or authorized technician for help.

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

9.3 Cabling Infrastructure

Poorly or incorrectly installed network cabling can cause numerous problems in the Intel® RSP Sensor network. However small it may appear, a problem with network cabling can have a catastrophic effect on the operation of the network. Even a small kink in a cable can cause an Intel® RSP to have intermittent connection with the RSP Controller, and a poorly crimped connector may compromise Power over Ethernet (POE) functionality.

If there is existing cabling in an installation, it should be tested first using a Fluke Networks* LSPRNTR-100 or equivalent device to insure proper RJ-45 connector pin out and Power over Ethernet (POE) capability before using with to power an Intel® RSP.

9.3.1 Correct Wiring Standards

There are two wiring standards for network cabling: T568a and T568b. **DO NOT COMBINE** T568a and T568b on the same cable!

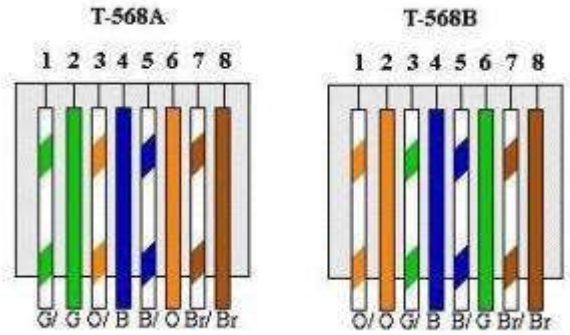


Figure 11: T-568A vs. T-568B

RJ-45 connectors are designed for either stranded or solid cable, but usually not both. Ensure use of the correct crimping tool for the specific type of connector. Ethernet cables have four pairs of color-coded twisted wires (orange, green, blue and brown). These cables are designed for high-speed data transfer with very little cross talk. It is important that no more than about 6 mm of the cable is untwisted at either end.

9.3.2 Proper Cable Type

For in-store Intel® RSP installations, it is recommended to use high-quality CAT 5e or CAT 6 cabling. Cables are categorized according to the data rates that they can transmit effectively. The specifications also describe the material, the connectors and the number of times each pair is twisted per meter. The most widely installed category is CAT 5e. Ensure that the category (CAT) of cabling used in the RFID system installation fulfills the required data rates.

- Cat 3 (no longer used) up to 16 MHz
- Cat 5e up to 100 MHz
- Cat 6 up to 250 MHz
- Cat 6A up to 500 MHz
- Cat 7 up to 600 MHZ
- Cat 7A up to 1 GHz

Video and image files are generally much larger than JSON text files and need to be moved around the network as quickly as possible. In general, it is possible to use good-quality CAT 5 cabling for gigabit networks. However, it is generally recommended to use CAT 5e or CAT 6 cabling for gigabit connectivity, even if the existing network switches and routers support only 100 Mbps. This will ensure that the infrastructure in place can support gigabit data rates when an upgrade becomes necessary.

9.3.3 Proper Cable Length

Ensure that your cabling meets the requirements of your equipment. The distance between an Intel® RSP and the switch cannot be greater than 100 m. If installing sockets, remember to consider the distance between the socket and the Intel® RSP. A good rule of thumb is 90 meters for horizontal runs, and ten meters for the patch cabling.

Do **NOT** run cabling next to electrical cabling due to the potential for interference.

Since network cabling typically uses solid wire, cabling should not be twisted or bent into a tight radius (not less than 4 times the diameter of the cable). Do not use metal staples to secure cable runs, nor tightly adjusted cable wraps.

Avoid a daisy chain network topology using intermediate switches or butt connectors to extend the length of an otherwise "too short" cable run. Use a single continuous cable run from the Intel® RSP to the switch.

9.3.4 Environmental Conditions

The Intel® RSP Hx000 Series Sensor is designed to operate at 100% transmit duty-cycle in ambient temperature conditions of up to 35˚C provided there is airflow across the back plate of the device. The Intel® RSP can also operate at 100% transmit duty-cycle in ambient temperature conditions of up to 35˚C when mounted with the back-plate flush against a horizontal surface.

The Intel® RSP Sensor can operate at higher ambient temperature conditions by autonomously controlling the transmit duty-cycle. However, once the internal microprocessor reaches a temperature of 104˚C, the Intel® RSP software will shut down to prevent damage and memory corruption.

9.3.5 Power over Ethernet

Power over Ethernet (POE) is a mechanism for supplying power to network devices over the same cabling used to carry network traffic. POE allows the Intel® RSP to receive both power and data over a single cable. This feature simplifies network installation and maintenance by using an Ethernet switch with integrated POE as a central power source for all types of Intel® RSP. The challenge during installation is to calculate the total power consumption required making sure it is less than the power budget of the Ethernet switch. The Juniper* EX2200-24P-4G is a recommended switch for Intel® RSP networks due to its remote manageability and sufficient 400W power budget to provide POE for an Intel® RSP on each of the 24 ports. However, any 48V POE+ switch is sufficient.

9.3.6 Antenna and Mounting Consideration for the Intel® RSP H1000

9.3.6.1 Antenna Cabling Infrastructure

Poorly or incorrectly installed RFID Antenna cabling can cause problems with the Intel® RSP H1000. Even a small kink in the cable can cause an impedance mismatch resulting in poor tag read performance. Always be sure to follow the instructions provided by the antenna manufacturer.

9.3.6.2 Recommended Antennas

This device has been designed to operate with the antennas listed below, and having a maximum gain of 8.5 dB. Antennas not included in this list or having a gain greater than 8.5 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Ce dispositif a été désigné pour fonctionner avec les antennes énumérées ci-dessous, et ayant un gain maximum de 8.5 dB. Les antennes non incluses dans cette liste ou ayant un

gain plus grand que 8.5 dB sont strictement interdites pour l'utilisation avec cet appareil. L'antenne requise impédance est 50 ohms.

9.3.6.2.1 Ceiling or Wall Mount

For ceiling or wall mount installations, the Laird* RFID Panel Antenna S8658PR12NF (ETSI) or S9028PCL/S9028PCR (FCC) is recommended. These antennas have a circularly polarized pattern and provide 8.5 dBi gain.

Figure 12: Circular Polarized Panel Antenna

9.3.6.2.2 Tabletop Point-of-Sale (POS)

For Point-of-Sale (POS) installations, the Times-7* RFID Near-Field Antenna A1030 is recommended. The A1030 antenna offers outstanding near field performance in a unique and optimized footprint, improving workflow and eliminating stray tag reads. These antennas have a circularly polarized pattern and have -15.0 dBi gain.

Figure 13: Near Field POS Antenna

9.3.6.3 Proper RF Cable Type

The type and length of coax cable can greatly affect the tag read performance of the installation. RF performance (aka read range) is determined by a combination of transmit power, receive sensitivity, cable losses, antenna gain and tag type. For a given RFID reader and tag, the variables to consider during installation are cable losses and antenna gain. The longer the cable, the greater the loss. If longer coax cable runs are required, a larger diameter, lower loss cable type should be used to mitigate the losses due to the increased length. The table below, Cable Loss Chart is provided for common coax cables used for RFID installations

Length (ft)	LMR-195	LMR-240	LMR-400	LMR-600
5	0.6 dB	0.4 dB	0.2 dB	0.1 dB
10	1.1 dB	0.8 dB	0.4 dB	0.3 dB
25	2.8 dB	1.9 dB	1.0 dB	0.6 dB

9.4 Power Output Calculations

One of the parameters in the "apply_behavior" command from the RSP Controller is the output power level. This level can be adjusted from 0 to 31.5 dBm. To ensure compliance with the maximum EIRP restrictions defined in the certification grant, these commands must be scripted **by an authorized installer or system integrator**.

The maximum power level is a function of the antenna gain and the cable/connector losses as shown in the equation below.

$$P_{out} + G_{ant} - L_{cable} < EIRP_{limit}$$

The table below shows the maximum power level allowed for the various types of antennas, including the two recommended in this section.

EIRP Limit (dBm)	Ant Gain (dB)	Cable Loss (dB)	Max Power Level	Cable and Connector detail
36	9	0.5	27.5	1 m of RG-400 (teflon) R-SMA and TNC connectors
36	9	3.1	30.1	10 m of RG-400 (teflon) R-SMA and TNC connectors
36	7	1.1	30.1	3 m of RG-400 (teflon) R-SMA and TNC connectors
36	5.5	0.5	31.0	1 m of RG-400 (teflon) R-SMA and TNC connectors
36	10	5.2	20.8	16 m of RG-400 (teflon) R-SMA and TNC connectors

9.5 Connectivity

9.5.1 Physical

The figure below shows the physical components of an in-store RFID network deployment and how they would be connected.

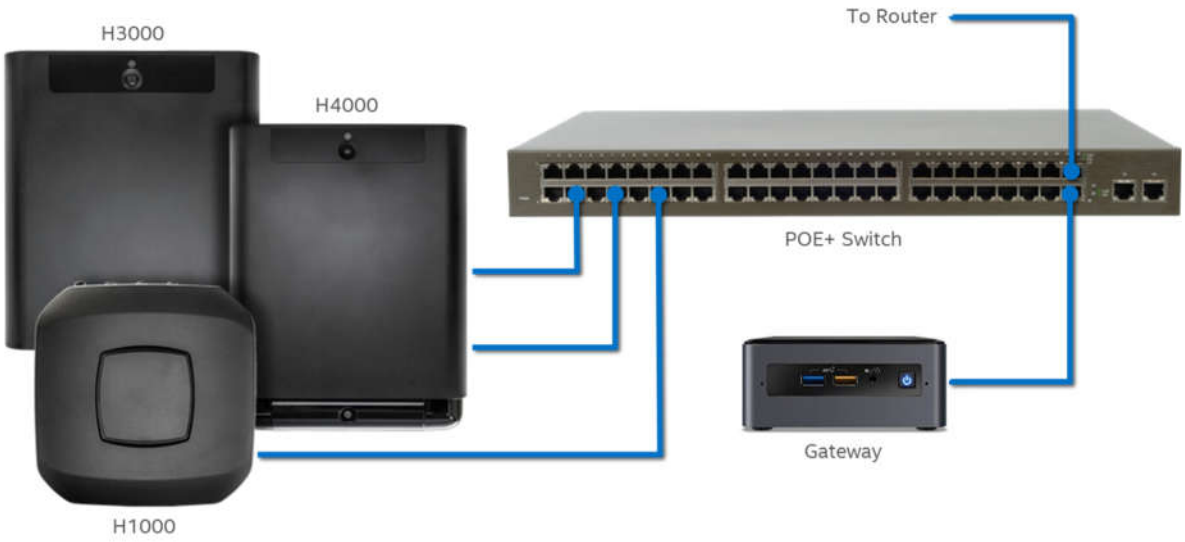


Figure 14: Physical In-Store Connectivity

9.5.2 Network

Certain firewall rules may be necessary for proper functionality of the system. In addition to a more traditional network diagram the figure below shows a list of domains, protocols and ports that the Intel® RSP requires access to for proper functionality of the system.

- Outbound Ports
  - TCP & UDP 1883, 8883 (MQTT)
  - TCP 80, 443 (HTTP, HTTPS)
  - UDP 123 (NTP)
- Inbound Ports
  - none
- Internal Ports
  - UDP 5353 (DNS-SD)

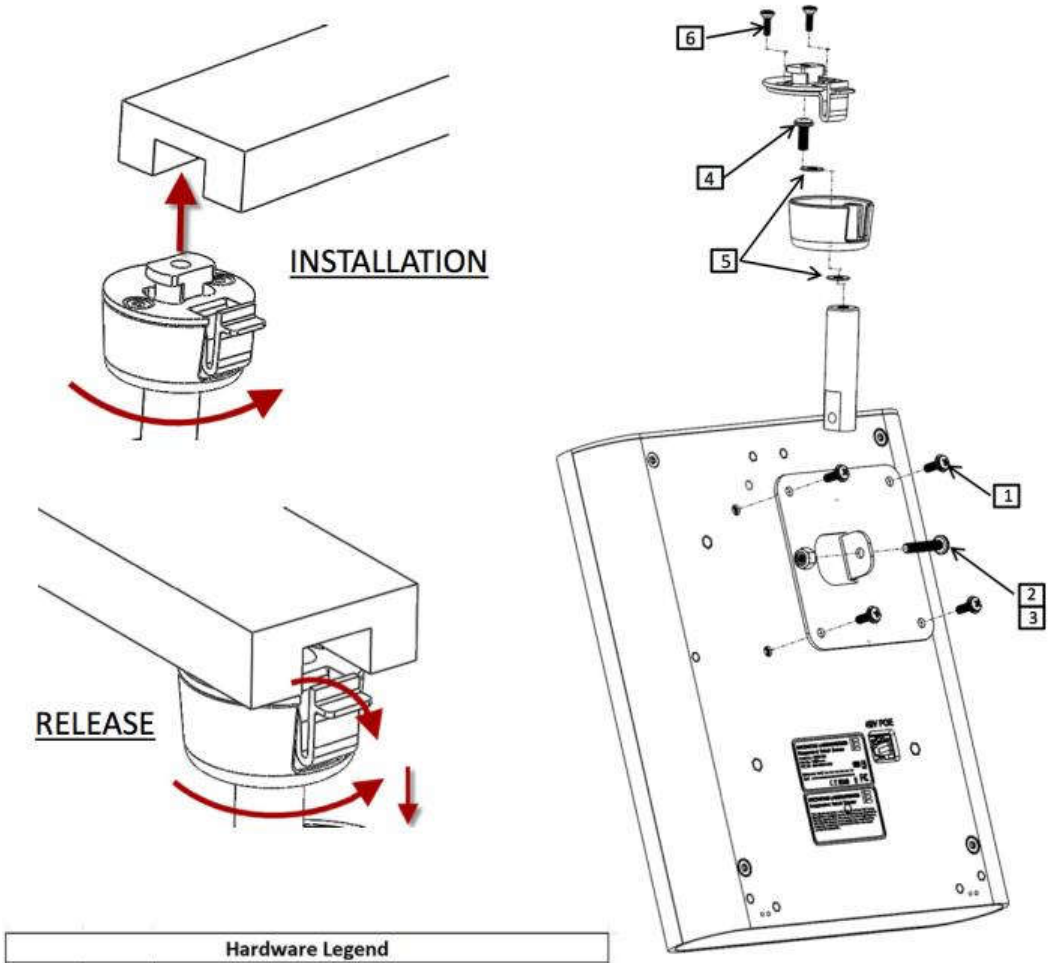
9.6 Mounting (Intel® RSP H4000 and Intel® RSP H3000)

The typical Retail RFID installation will require the Intel® RSP sensors to be mounted from the ceiling. A common mounting technique is to utilize existing track-light rails. The figure below shows how the Intel® RSP can blend in with the actual lights mounted to the same rail.

Figure 15: Intel® RSP H4000 Stealth

9.6.1 Track Light Mounting Bracket

Encinitas Labs* provides a mounting bracket that allows the SENSOR to be mounted from a track light rail. (see below)

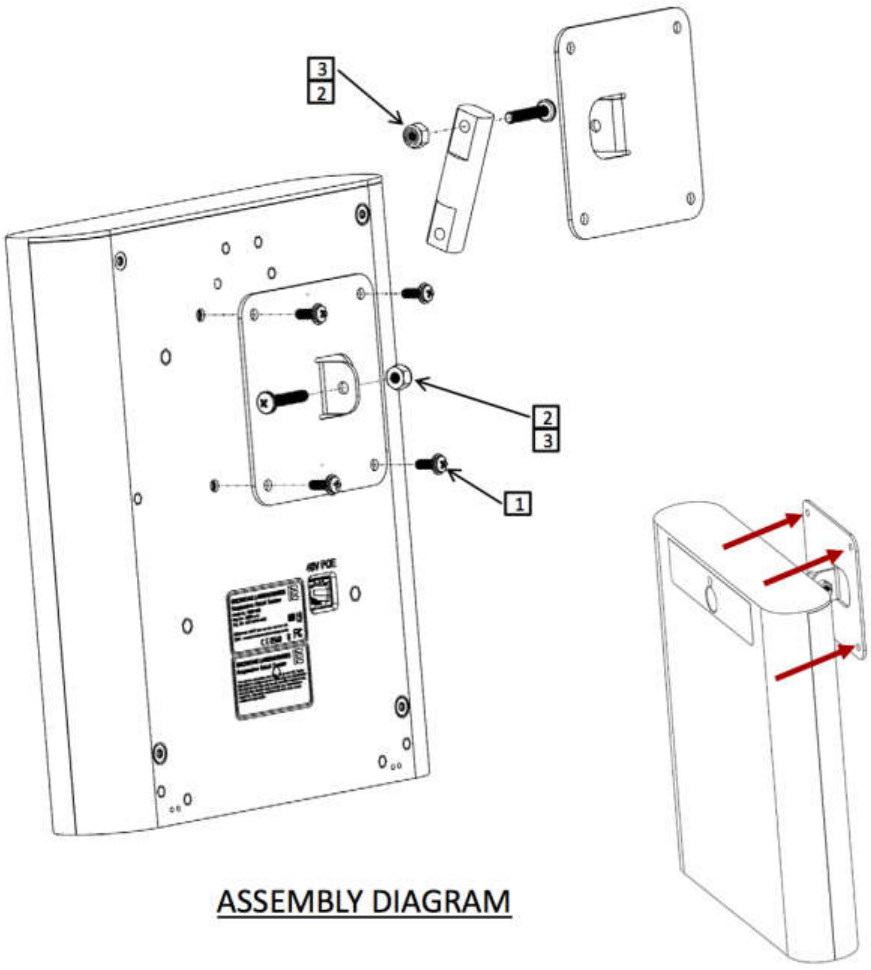


Hardware Legend		
Item	Qty	Description
1	4	Screw, M4 x 12mm L, w/ captive washer, PH, Phil Drive
2	1	Screw, 10-32 x 1" L, PH, Phil Drive
3	1	Nut, 10-32 with nlyon locking
4	1	Screw, 10-32 x .5" L with nylon patch, PH, Phil Drive
5	2	Washer, #10, Nylon
6	2	Screw, M3.5 x 12mm L, Flat Head, Torx 15 Drive

Figure 16: Intel® RSP H4000/Intel® RSP H3000 Track Light Mount Assembly

9.6.2 Wall Mounting Bracket

Encinitas Labs* provides a mounting bracket that allows the sensor to be mounted to a flat surface (see below).



Hardware Legend		
Item	Qty	Description
1	4	Screw, M4 x 12mm L, w/ captive washer, PH, Phil Drive
2	2	Screw, 10-32 x 1" L, PH, Phil Drive
3	2	Nut, 10-32 with nlyon locking

Install onto mounting surface using Customer supplied hardware, 4x.

Figure 17: Intel® RSP H4000/Intel® RSP H3000 Wall Mount Assembly

9.7 Mounting (Intel® RSP H1000)

In a typical Intel® RSP H1000 installation, the sensor can be mounted vertically in the case of portal over a doorway or horizontally under a table in the case of “point-of-sale”. The Intel® RSP H1000 is mounted using the plate shown (see figure below)

Figure 18: Intel® RSP H1000 Mounting Plate

If at all practical or possible, the Intel® RSP H1000 should be mounted onto a vertical surface for the best possible convection cooling. The device should not be mounted in a way that blocks air flow between the unit and the mounting plate and the device should be mounted in a way to allow free air flow for passive cooling.