Impinj R700 RAIN RFID Reader

Installation and Operation Guide
Version 8.4

Copyright © 2012 - 2024 Impinj, Inc. All rights reserved

http://www.impinj.com

Impinj, Octane, Speedway, xSpan and xArray are either registered trademarks or trademarks of Impinj, Inc. Visit www.impinj.com/trademarks for additional information about Impinj trademarks.

Contents

1 Products Covered by this Guide **3**
1.1 Federal Communications Commission (FCC) Compliance . . . 3
1.2 CE Marking and European Economic Area (EEA) . . . 4

2 Before You Begin **5**

3 Introduction **6**
3.1 About this Guide . . . 6
3.2 Intended Audience . . . 6
3.3 Other Documents of Interest . . . 6
3.4 Document Conventions . . . 6
3.5 Impinj Support Information . . . 7

4 Introduction to the Impinj R700 Reader **8**
4.1 Requirements for Using the Impinj R700 Reader . . . 9
4.1.1 Environmental Requirement . . . 9
4.1.2 Hardware Requirements . . . 9
4.1.3 Power Requirements . . . 9
4.1.4 Supported Operating Environments . . . 10
4.1.5 Supported Communication Protocol . . . 10
4.1.6 Antenna Requirements . . . 11

5 Installing and Connecting the Impinj R700 Reader **12**
5.1 R700 Reader Ports and LEDs . . . 12
5.1.1 R700 Reader LED Blink Patterns . . . 13
5.1.2 R700 Reader Ethernet LED Blink Patterns . . . 14
5.2 Installing and Connecting the Reader . . . 15
5.3 Detailed Installation Procedures . . . 15
5.3.1 Step 1: Position the Impinj R700 reader and (optionally) mount the reader . . . 15
5.3.2 Step 2: Connect the antenna(s) to the R700 reader . . . 17
5.3.3 Step 3: Connect the Impinj R700 Reader to the Network . . . 18
5.3.4 Step 4: Configure the Region Setting on the Reader . . . 25
5.3.5 Step 5: Test the Installed Reader . . . 29

6 Configuring and Monitoring Impinj R700 Reader **30**
6.1 Configuring the Impinj R700 Reader . . . 30
6.1.1 Device Configuration . . . 30
6.1.2 RF Configuration . . . 32
6.2 Monitoring Impinj R700 Reader . . . 36
6.2.1 Viewing Network Parameters and Statistics . . . 36
6.2.2 Viewing RFID Parameters and Statistics . . . 37
6.2.3 Configuring and Viewing Impinj R700 Reader Logs . . . 37
6.2.4 Viewing the State of the Impinj R700 Reader . . . 38

7 Upgrading the Impinj R700 Reader Firmware **39**
7.1 A Brief Overview of the Impinj R700 Reader Firmware . . . 39
7.2 Upgrading the Firmware . . . 39
7.2.1 Upgrading the Firmware Using RShell . . . 39
7.2.2 Upgrading the Firmware Using a USB Drive . . . 40
7.2.3 Upgrading the Firmware through the Reader Management Web Page . . . 41
7.2.4 Reverting to the previous image . . . 41
7.2.5 Reboot and fallback procedures . . . 42

7.2.6 Preserving the RFID interface during an upgrade . . . 42

8 Troubleshooting **43**
8.1 Returning to the Default Configuration . . . 43
8.2 Retrieving Diagnostic Data . . . 44
8.3 Submitting Diagnostic Data for Analysis by Impinj Technical Support . . . 45

9 Appendix A: Information Specific to Regions of Operation **47**
9.1 Operation in North America . . . 47
9.1.1 Frequency Plan in North America . . . 47
9.1.2 Antenna Requirements in North America . . . 47
9.2 Operation in European Union (lower frequency band) and United Arab Emirates (UAE) . . . 49
9.2.1 Frequency Plan in EU (lower frequency band) and UAE . . . 49
9.2.2 Antenna Requirements in EU (lower frequency band) and UAE . . . 49
9.3 Operation in European Union (upper frequency band) . . . 50
9.3.1 Frequency Plan in European Union (upper frequency band) . . . 50
9.3.2 Antenna Requirements in European Union (upper frequency band) . . . 50
9.4 Operation in Other Global Regions . . . 51
9.4.1 Frequency Plans in Other Global Regions . . . 51
9.5 Operation in Japan . . . 57
9.5.1 Frequency Plan in Japan . . . 57
9.5.2 Antenna Requirements in Japan . . . 57

10 Appendix B: GPIO Details **58**

11 Notices **60**

1 Products Covered by this Guide

This guide pertains to readers with the following part numbers and communication codes:

Impinj R700 RAIN RFID Reader Part Numbers

Reader	Communication Code	Part Number	HLA Numbers
R700	ETSI	IPJ-R700-241	104901-*
R700	FGX	IPJ-R700-341	104900-*
R700	JP	IPJ-R700-441	104902-*

Note: HLA (High-Level Assembly) numbers also include a major revision number and a minor revision letter at the end, as in 103001-01H, but they are functionally equivalent for the purposes of this document. The HLA for a specific reader unit can be obtained from the RShell command `show system platform` -- see the ***Impinj RShell Reference Manual*** for more details.

1.1 Federal Communications Commission (FCC) Compliance

This equipment was tested and complies with the limits for a 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 commercial environment. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, the equipment may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation and cause harmful interference to radio or television reception. To determine if this equipment causes harmful interference to radio or television reception, turn the equipment off and on. You are encouraged to try to correct the interference by one or more of the following:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Consult the dealer or a qualified radio/TV technician for assistance.

Caution: Changes to this product or modifications not expressly approved by the party responsible for compliance could void your authority to operate per FCC Part 15.

Attention: Les modifications apportées à ce produit ou modifications pas expressément approuvés par la partie responsable de la conformité peuvent annuler votre droit à utiliser par FCC Part 15.

Note: Industry Canada (IC) Compliance

Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

This device has been designed to operate with the antenna(s) listed in Information Specific to Regions of Operation that have a maximum gain of 6 dB. Antennas not included in this list or having a gain greater than 6 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. To reduce potential radio interference with other users, the antenna type and its gain should be chosen

so that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication. The term "IC" before the radio certification number only signifies that Industry of Canada technical specifications were met.

Note: Industrie Canada (IC) Conformité

Son fonctionnement est soumis aux deux conditions suivantes:

1. Cet appareil ne doit pas provoquer d'interférences.
2. Cet appareil doit accepter toute interférence, y compris celles pouvant causer un mauvais fonctionnement de l'appareil.

Cet appareil a été conçu pour fonctionner avec l'antenne (s) énumérées à Informations Spécifiques aux Régions de l'Opération qui ont un gain maximum de 6 dB. Antennes pas inclus dans cette liste ou présentant un gain supérieur à 6 dB sont strictement interdits pour utilisation avec cet appareil. L'impédance d'antenne requise est de 50 ohms. Afin de réduire le risque d'interférence avec d'autres utilisateurs, le type d'antenne et son gain doivent être choisis de telle sorte que la puissance isotrope rayonnée équivalente (PIRE) ne soit pas supérieure à celle permise pour une communication réussie. expression "IC" avant le numéro de certification radio signifie seulement que l'industrie des spécifications techniques Canada ont été respectées.

Caution: Minimum Separation Distance: This device has been evaluated for compliance with FCC, IC, and EU/UK RF exposure limits in a mobile configuration. At least 34 cm of separation distance between the device and the user's body must be maintained at all times. This device must not be used with any other antenna or transmitter that has not been approved to operate in conjunction with this device.

Attention: Distance de séparation minimale: cet appareil a été évalué pour conformité aux limites d'exposition aux RF de la FCC, de l'IC et e l'UE/Royaume-Uni dans un appareil mobile configuration. Au moins 34 cm de distance de séparation entre l'appareil et le corps de l'utilisateur doivent être maintenus à tout moment. Cet appareil ne doit pas être utilisé avec une autre antenne ou émetteur qui n'a pas été approuvé pour fonctionner avec cet appareil.

1.2 CE Marking and European Economic Area (EEA)

RFID devices designed for use throughout the EEA operate in two approved frequency bands: (1) 865.6-867.6MHz limited to maximum radiated transmit power of 2W ERP, and (2) 916.1-918.9MHz limited to maximum radiated transmit power of 4W ERP. For other EEA restrictions on RFID device use, please refer to the Impinj Declaration of Conformity (DoC) located at support.impinj.com.

2 Before You Begin

Warning: Please read this document in its entirety before operating the Impinj R700 reader, as serious personal injury or equipment damage may result from improper use. Unauthorized opening of the Impinj R700 reader enclosure voids the warranty. To safeguard personnel, be sure to position all antenna(s) according to the specified requirements for your regulatory region. For details, see Information Specific to Regions of Operation.

Avertissement: S'il vous plaît lire ce document dans son intégralité avant d'utiliser le Impinj R700 lecteur, comme des blessures graves ou des dommages matériels peuvent résulter d'une mauvaise utilization. Ouverture non autorisée du lecteur Impinj R700 boîtier annule la garantie. Pour protéger le personnel, n'oublier pas de placer tous antenne(s) conformément aux exigences spécifiées pour votre région régulatrice. Pour plus de détails, voir Informations spécifiques aux régions de fonctionnement.

---

3 Introduction

3.1 About this Guide

This guide provides detailed instructions for installing, connecting, configuring, operating, upgrading, and troubleshooting the Impinj R700 reader. To shorten the length of this guide, the content focuses on the installation and operation of a single reader.

3.2 Intended Audience

The intended audience for this guide is anyone installing an Impinj R700 reader, such as systems engineers and IT personnel with experience and basic knowledge of:

- Software development
- Hardware systems integration
- Network connectivity

This guide also assumes that the user has a high-level understanding of RFID, RFID systems management, and a basic familiarity with the EPCglobal Gen 2 specification.

3.3 Other Documents of Interest

This guide is part of a larger documentation set that supports Impinj RAIN RFID readers. The document set includes the following five documents:

- ***Impinj R700 Series Quick Start Guide*** is a guide included with the Impinj R700 reader. It provides basic information about the hardware and instructions for obtaining additional documentation, firmware upgrades and downloads, and other support software.
- ***Impinj LTK Programmer's Guide*** provides software engineers with guidelines and best practices for working with the Low Level Reader Protocol (LLRP) Toolkit. Software engineers can also access language-specific reference guides and sample applications that illustrate the scenarios discussed in the Programmer's Guide.
- ***Impinj Octane LLRP Guide*** is intended for software engineers and describes the LLRP capabilities supported by Impinj RAIN RFID readers, which includes Impinj's custom LLRP extensions.

Note: Octane is the name for the Impinj reader firmware.

- ***Impinj RShell Reference Manual*** describes the syntax and command language for the Impinj reader RShell console.
- ***Impinj Firmware Upgrade Reference Manual*** includes detailed procedures, reference information for upgrading firmware installed on single readers, and procedures for creating a metafile to automate upgrading of multiple readers.

3.4 Document Conventions

Throughout this document, references are made to both standard and extended LLRP messages, parameters, and fields. To help visually distinguish between these different types, the following table provides details on the conventions that are used.

Document Style Conventions

Type	Example	Style
LLRP message	IMPINJ_ENABLE_EXTENSIONS	Caps with underscores
LLRP parameter	*AntennaConfiguration*	Camel-case italics
LLRP field	*ResetToFactoryDefault*	Camel-case italics
Enumerated field value	'Upon N Tags or End of AISpec'	Single-quoted
File name	**'ImpinjDef.xml'**	Single-quoted bold

Type	Example	Style
LTK function	***getLLRPStatus***	Bold italics; case matches programming syntax
LTK class names	**CIMPINJ_TCS_RESPONSE**	Bold; case matches programming syntax

3.5 Impinj Support Information

Contact Impinj Support at support@impinj.com or visit the Impinj Support web site at support.impinj.com for information about technical assistance. For guidelines about capturing data for analysis by Impinj technical support personnel, see Submitting Diagnostic Data for Analysis by Impinj Technical Support.

4 Introduction to the Impinj R700 Reader

The Impinj R700 reader is a stationary, small form factor, UHF Gen2 RFID tag reader.

Impinj R700 Reader

The reader provides network connectivity between tag data and enterprise system software. The Impinj R700 reader offers many key features that increase application flexibility:

- **Compact Form Factor:** The compact size of the Impinj R700 reader, 8.4 × 7.4 × 1.2 inches or 214 × 187 × 30 mm (with the mounting brackets) and 8.4 × 5.9 × 1.2 inches or 214 × 149 × 30 mm (without the mounting brackets), eases installation in tight spaces and in embedded applications.
- **High Performance Features:** The Impinj R700 reader uses a variety of high performance features making it possible to read more than 1100 tags per second. Features include Autoset, Low Duty Cycle, dynamic antenna switching, inventory search modes that improve tag population management, and receive sensitivity filtering for read-zone confinement.
- **Ease of Use Features:** The Impinj R700 reader uses industry-standard application interfaces, which simplifies integration with RFID middleware or custom software solutions. It also offers enterprise-class management and monitoring capability.

- **Robust Reader Design:** The Impinj R700 reader uses a single circuit board design and also sports an external case that doubles as both sturdy physical protection and a heat-sink.
- **Low Power Usage:** With a low power design, the Impinj R700 reader is fully powered using only Power over Ethernet (PoE or PoE+). Using PoE simplifies deployment and dramatically reduces costs and greenhouse gas emissions of your RFID infrastructure.

Note: Maximum transmit power varies by region and by PoE level according to the following table:

Region	PoE	PoE+
FCC	30.0 dBm	33.0 dBm
EU1	30.0 dBm	31.5 dBm
EU2	30.0 dBm	33.0 dBm
JP	30.0 dBm	30.0 dBm

4.1 Requirements for Using the Impinj R700 Reader

4.1.1 Environmental Requirement

- Operating temperature: -20º C to +50º C (-4º F to +122º F)
- Humidity: 5% - 95% (non-condensing)
- Sealing: IP50

4.1.2 Hardware Requirements

- TCP/IP network equipment is required to connect the reader to a PC (Windows, Mac, or Linux), or other network terminal. The network connection must provide power (PoE or PoE+).
- Connecting to the reader console port requires a USB cable with a micro-USB connector.
- Impinj-approved UHF RFID antenna or antennas are required, including associated RF cable or cables with an RP-TNC male connector interface.
- Wi-Fi adapters supported include the Panda PAU06 802.11n dongle and any dongle with the Ralink RT2870 chipset.

4.1.3 Power Requirements

The RF transmit power is limited by the type of power supplied (PoE, or PoE+). Power requirements also vary depending on the use of power drawn from the USB ports, the current draw from the GPIO port, and the length of the Ethernet cable from the power source to the reader. In general, the more power that is being used, the more likely that PoE+ will be needed to supply enough power to keep the reader operating without "browning out". Specifically, the supplied PoE type can be mapped to different maximum power usage scenarios involving transmit power, length of Ethernet cable (Cat 5E or better) and combined current draw on the GPIO and USB ports, as detailed in the table below.

Reader Operating States and Power Requirements

Power Source	TX Max	Cable Max	GPIO + USB Max
802.3at PoE+	33 dBm	100 Meters	5V/500 mA
802.3af PoE	27 dBm	100 Meters	5V/500 mA
802.3af PoE	30 dBm	60 Meters	None

Operating above +30 dBm requires professional installation to comply with radio regulatory laws in many countries. For more information, see Information Specific to Regions of Operation.

4.1.4 Supported Operating Environments

This section describes the environments in which you can access the RShell console that is used for configuring, monitoring, and maintaining the reader. The tools that you use when you access the RShell console depend on the Operating System that is running on your computer.

Supported Operating Environments

Interface	Protocol	Recommended Tools	
		Microsoft Windows	**Linux**
Ethernet	SSH Port 22	SSH or Putty [1]	SSH
USB Host	SSH Port 22	SSH or Putty [1]	SSH

[1] https://www.putty.org

4.1.5 Supported Communication Protocol

For client control of the reader, the Impinj R700 reader supports the EPCglobal Low Level Reader Protocol (LLRP) v1.0.1 and the IoT Device Interface Protocol (IoT).

LLRP is an EPCglobal standard interface that allows communication with the reader. The Impinj IoT Device Interface provides a REST API for interfacing with the reader and an intuitive web UI for easy reader configuration and deployment.

Note: These interfaces are mutually exclusive. The reader can use only one interface at a time.

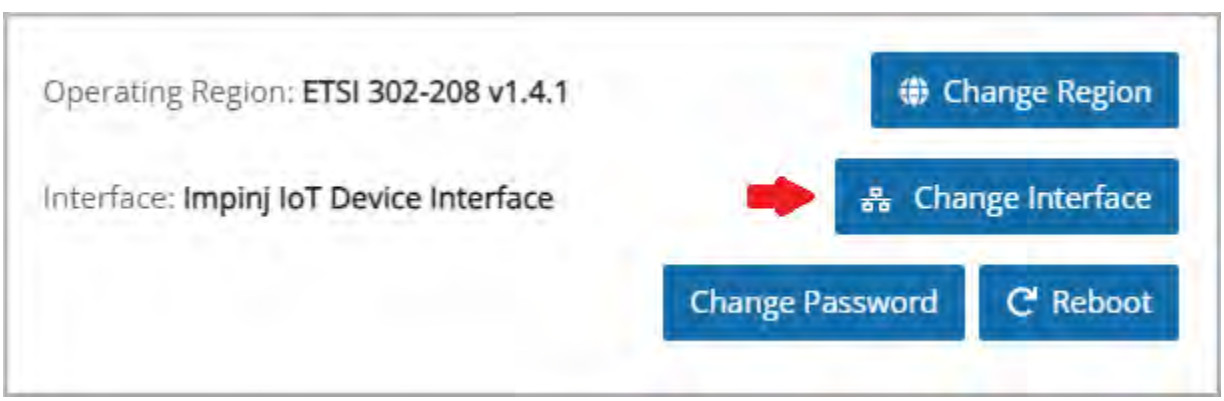
It is possible to switch between LLRP and IoT using either RSHELL or the web UI.

In RSHELL, the **config rfid interface** command sets the RFID reader interface to LLRP or to IoT using the following parameters:

Config RFID Interface Command Parameters

Command	Description
llrp	Enable Impinj LLRP Interface.
rest	Enable Impinj Impinj IoT Device Interface (default)

In the web UI, click the **Change Interface** button to switch between LLRP and IoT. The button is found at the top of the reader information panel on the web UI **Home** page, as shown in the image below.



Reader Interface Button

4.1.6 Antenna Requirements

The Impinj R700 reader provides four independent, bidirectional, and full duplex TX/RX monostatic antenna ports.

Antenna requirements vary by regulatory region. For details about the requirements for a specific region, see the relevant antenna section in Information Specific to Regions of Operation.

5 Installing and Connecting the Impinj R700 Reader

This section provides details about the R700 reader I/O ports and status LEDs. It also explains how to install the reader and connect it to your network.

5.1 R700 Reader Ports and LEDs

The following graphic illustrates the I/O ports located on the Impinj R700 reader.

R700 reader Port Connections

Note: See Appendix B: GPIO Details for functional and electrical specifications, and for details about each pin of the GPIO connectors (Phoenix Contact 1803345).

Antenna ports and LED status indicators are located on the back panel of the reader. The graphic below illustrates their locations:

R700 Reader Antenna Ports and Status LEDs

Antenna LEDs are located on the top surface of the reader, next to the antenna ports. The graphic below shows their locations:

R700 Reader Antenna Activity LEDs

The next section describes the four primary LED categories and their blink patterns, and the section following that describes the two Ethernet LEDs and their blink patterns.

5.1.1 R700 Reader LED Blink Patterns

The R700 reader has several LEDs to indicate reader operational status. The four LED categories are upgrade, inventory, antenna, and system. Each LED has its own blink patterns to convey status to the user (see below).

Upgrade LED Patterns

LED State	Reader State
OFF	FW upgrade inactive or FW upgrade fail
Blinking BLUE	FW upgrade in progress
Solid Blue (until next reboot)	FW upgrade successful

Inventory LED Patterns

LED State	Reader State
OFF	RO spec disabled (IDLE)
Blinking BLUE	RO spec inactive (ARMED)
Solid BLUE	RO spec active (RUNNING)

System LED Patterns

LED State	Reader State
OFF	Power not applied
Blinking YELLOW	Factory default restore detected
Solid YELLOW	Power applied, booting
Solid BLUE	Boot successful
Blinking RED	Boot error, USB upgrade error, other error

Antenna LED Patterns

LED State	Reader State
OFF	Antenna inactive
Solid BLUE	Antenna active

5.1.2 R700 Reader Ethernet LED Blink Patterns

The R700 reader has two LEDs to indicate Ethernet status. The two LED categories are link indication and activity. Each LED has its own blink patterns to convey status to the user (see below).

R700 Reader Ethernet LEDs

Link Indication LED Patterns

LED State	Reader State
OFF	Link inactive
Solid ORANGE	100 Mbps
Solid GREEN	1 Gbps

Ethernet Activity LED Patterns

LED State	Reader State
* See below	Ethernet inactive
Blinking YELLOW	Transmit or receive activity

Note: The inactive Ethernet state will be indicated by the Ethernet Activity LED differently depending on the reader HLA (High Level Assembly) number, as there are two different Ethernet PHY components. For the original reader assemblies, the inactive state (no data) will be represented with the Ethernet Activity LED off. For newer reader assemblies, it is the opposite, with the inactive state represented with a solid yellow light. In both cases, transmit or receive activity is indicated with a blinking yellow light.

The following table breaks down the inactive Ethernet state by region and HLA number:

Ethernet Activity LED Inactive State

Region	HLA at or below: OFF	HLA at or above: ON
EU	103001-01J	103001-01K
EU1	103004-01I	103004-01J
EU2	103005-01I	103005-01J
FCC	103000-*	N/A
FGX	103002-01I	103002-01J
JP	103003-01J	103003-01K

5.2 Installing and Connecting the Reader

The primary installation and connection steps for the Impinj R700 reader are:

1. Position the reader appropriately for your environment. This may or may not involve mounting the reader.
2. Connect the antenna(s) to the appropriate ports on the reader.
3. Connect the reader to the network.
4. Test the reader installation by reading tags.

5.3 Detailed Installation Procedures

This section provides the details for each installation and connection step.

5.3.1 Step 1: Position the Impinj R700 reader and (optionally) mount the reader

Choose the appropriate location for the reader. Ideally you should always keep the unit away from direct sunlight, high humidity, extreme temperatures, and sources of electromagnetic interference. Any combination of these conditions might degrade performance or shorten the life of the unit. Additionally, you need to account for the bend radius of the coaxial cable at the antenna connection points if it is mounted close to another perpendicular object. The Impinj R700 reader requires Power over Ethernet (PoE or PoE+) and obtains its electrical power with data via standard cable in an Ethernet network.

Depending on your environment, you might need to mount the reader to a wall or another object.

There are two options for mounting the Impinj R700 reader, using either mounting brackets or the VESA-style mounting holes.

To mount the Impinj R700 reader using the supplied mounting brackets:

1. Locate the mounting brackets with four mounting holes on the bottom of the reader, as shown in the figure below.

Impinj R700 Mounting Bracket Locations

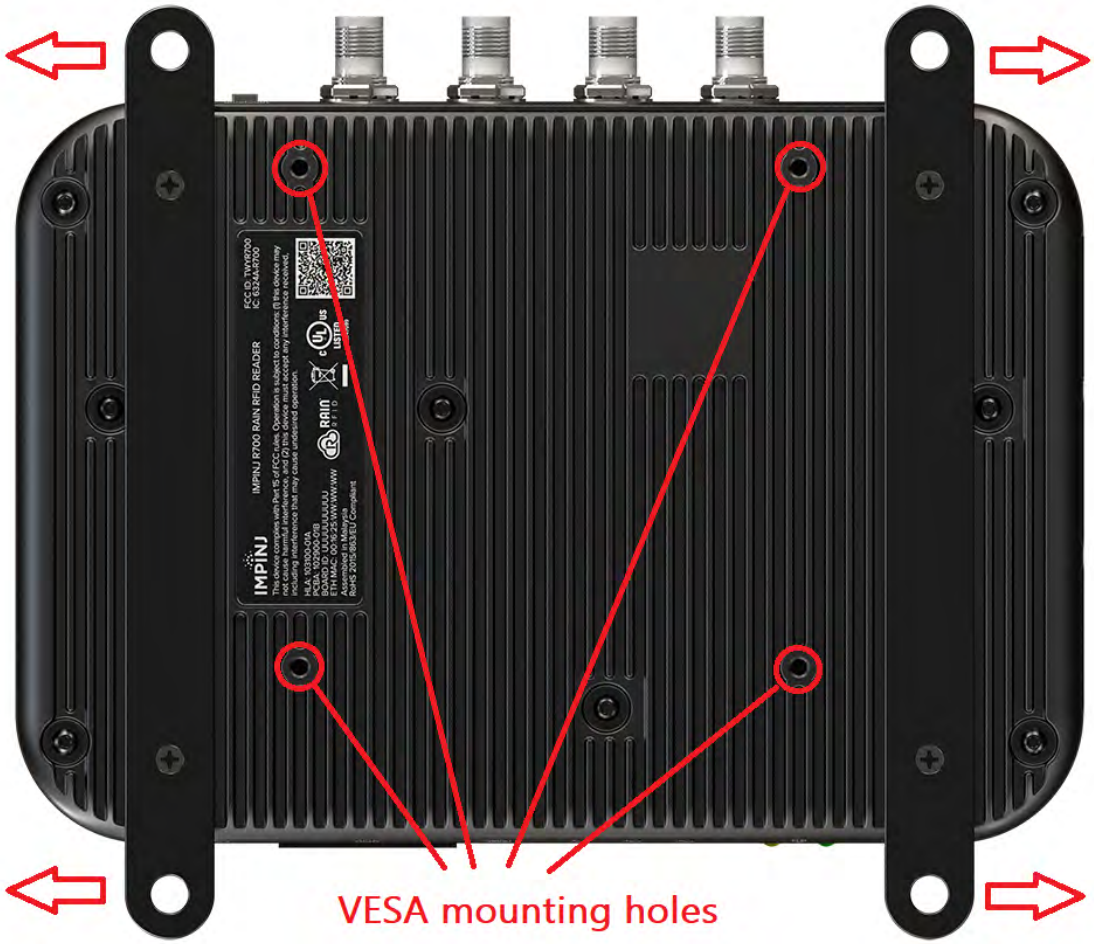
2. Use a ¼ inch diameter bolt with 20 threads per inch (¼–20) or M6 screws to secure the unit. You can mount the reader either horizontally or vertically.

Caution: If there is any chance of dust or water exposure, you should mount the reader so that the Ethernet, USB, Console, and GPIO ports are facing down to prevent ingress.

Attention: Si il n'y a aucune chance de poussière ou d'eau exposition, vous devez monter le lecteur de sorte que les ports Ethernet, USB, console et GPIO sont orientés vers le bas pour empêcher la pénétration.

To mount the R700 reader using the VESA mounting holes:

1. Remove the supplied mounting brackets.
2. Attach the reader to a standard 100 x 100 mm VESA mount, using the pre-drilled holes shown in the figure below.



R700 Reader VESA Mount Hole Locations

5.3.2 Step 2: Connect the antenna(s) to the R700 reader

The R700 reader has four antenna ports. Each port is independent, bidirectional, and full duplex TX/RX (monostatic).

Warning:

You must use Impinj-approved antennas with the Impinj R700 reader. See Information Specific to Regions of Operation for a detailed list of approved vendors. Using any other antenna may adversely affect performance or damage the reader.

The Impinj R700 reader requires professional installation to correctly set the TX power for the RF cable and antenna selected.

Avertissement:

Vous devez utiliser des antennes Impinj-approuvés avec Impinj R700. Voir Informations Spécifiques aux Régions de l'Opération pour une liste détaillée des fournisseurs approuvés. Utilisation de toute autre antenne peut affecter les performances ou endommager le lecteur.

Impinj R700 exige installation professionnelle pour définir correctement la puissance d'émission pour le câble RF et une antenne sélectionné.

Warning: You must use 50 ohm impedance cable. Select good quality, low loss cable with high quality connectors. Return loss better than 10 dB is required.

Avertissement: Vous devez utiliser un câble d'impédance de 50 ohms. Sélectionnez un câble de onne qualité à faible perte avec des connecteurs de haute qualité. Maintenir une perte de retour meilleure que 10 dB est requis.

To connect the antenna(s) to the reader:

1. Position each reader antenna, keeping the following points in mind:
   - Position the antenna(s) to achieve the most effective and efficient tag reads.
   - Position the antenna(s) to maximize operator safety. Personnel should remain at a safe distance at all times. For the specific requirements for your regulatory region, see: Information Specific to Regions of Operation.
2. Mount the antenna(s) according to the instructions provided by the antenna manufacturer.
3. Attach the antenna cable(s) to the antenna port(s) on the reader. Choose any port for any antenna.
4. Finger-tighten each connection, making sure the connection is secure. The antenna cable is properly tightened when you are no longer able to twist the cable inside the connector.

Note: A loose connection negatively impacts the performance of the antenna.

Caution: Impinj designed the R700 antenna ports to be self-terminating. It is important that you do **not** terminate unused antenna ports. Leave them unconnected.

Attention: Impinj conçu les ports antenne de R700 à auto-terminaison. C'est important que vous ne résiliez **pas** ports d'antenne pas utilisés. Laisser-les sans rapport.

5.3.3 Step 3: Connect the Impinj R700 Reader to the Network

You are now ready to connect the installed Impinj R700 reader to your network.

The network connection serves a dual purpose on the Impinj R700 reader, as it supplies both data connectivity and power.

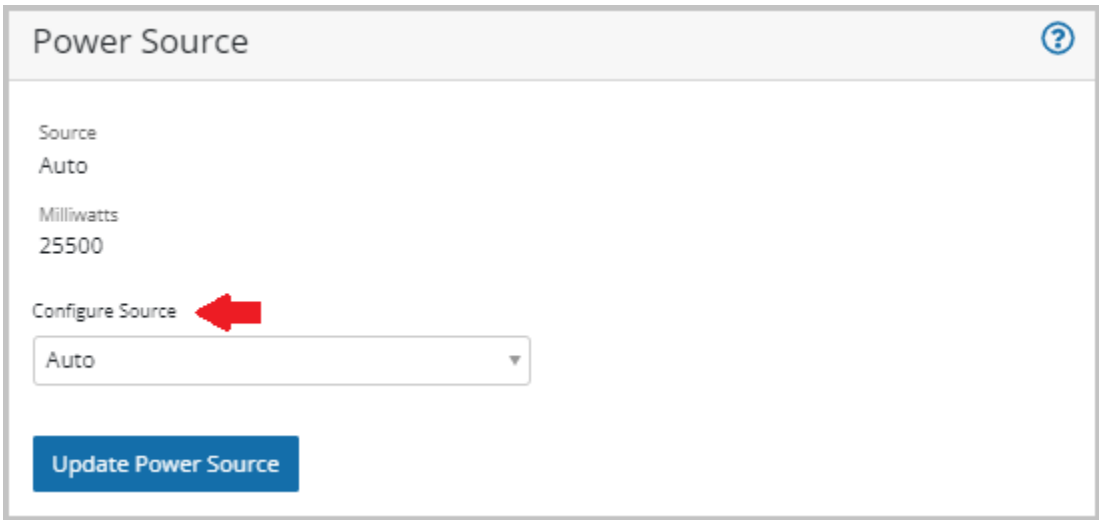
To power the Impinj R700 reader with the Ethernet connection, there are two options:

- If your network switch directly provides PoE or PoE+, simply connect to the switch with an Ethernet cable.
- If your network switch does not have PoE or PoE+ capability, use a PoE injector adapter. The PoE injector adapter connects to the end of the un-powered Ethernet cable from your switch or PC, and then another Ethernet cable runs from the power-injector to the Impinj R700 reader.

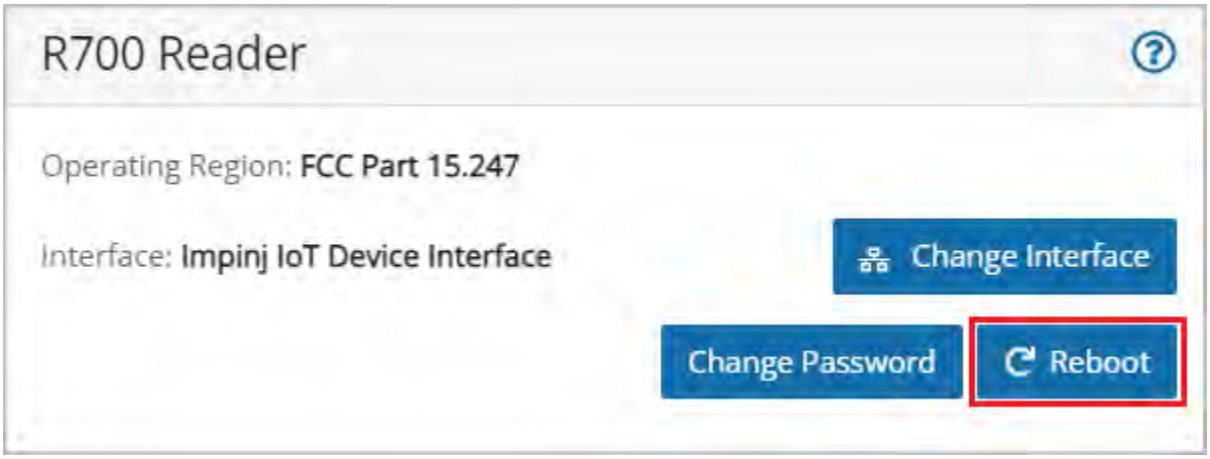
IMPORTANT: Automatic selection of PoE+ depends on LLDP support at the power source. If your switch or injector adapter does not support LLDP but does provide PoE+ power levels, you must manually configure the expected power levels using the RShell command:

```
> config system power source PoE+
```

You can also set the power source with the web UI:



After manually setting the power source to PoE+, you must reboot the reader so that the change can take effect. Please refer to the ***Impinj RShell Reference Manual*** for more details on doing this with RShell. The following screenshot shows how to reboot with WebUI.



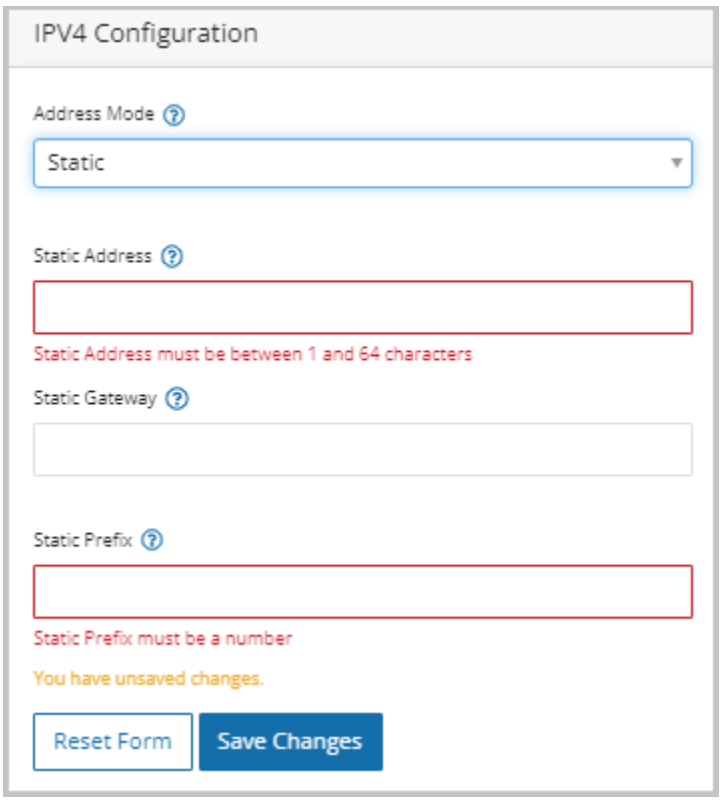
The selected power source will persist across reboots, but will need to be configured again after a full system reset.

The boot sequence begins in either case when power is supplied to the reader. This sequence typically completes within 30 seconds. After the boot sequence finishes, the reader accepts commands, not before. The Power and Status LEDs on the reader alert you to the status. For more information, see Impinj R700 Reader Ports and LEDs.

Note that the network address of the reader will depend upon your network configuration and preferences:

- If your network supports DHCP, you can connect the reader directly to your Ethernet network. The DHCP server will assign an address to the reader.
- If your network does not support DHCP, the reader defaults to the following fixed IP address: 169.254.1.1. If this address is already in use, the reader will select a random fixed IP address in the 169.254.xxx.xxx link local address range. You can also connect to the reader via the micro-USB port and use the reader's RShell command-line interface to configure a static IP address for the reader. After that is completed, you can connect the reader to your Ethernet network.

The following screenshot shows how to set a static IP address using WebUI. First, select **Network** from the menu at the top of the page. Next, select your interface from the **Interface List**. Finally, enter your address in the **IPV4 Configuration** dialog box (see below) or **IPV6 Configuration** box (not shown).



The Impinj R700 reader supports both IPv4 and IPv6 protocols. In a dual network environment (where both an IPv4 and IPv6 address are assigned to the reader), Octane will preferentially choose the IPv6 address for the LLRP connection. However, if the IPv6 address is not available when the reader is booting, but the IPv4 address is available, then Octane will choose an IPv4 address. You can confirm which IP address Octane is using for the LLRP connection via either WebUI or the RShell console (using the "show network summary" command). To confirm the reader's IP address with WebUI, first select the **Network** menu item at the top of the page, then select your interface from the **Interface List**, and finally, consult the following dialog box:

Details about how to complete each connection option are described in the table below. Before proceeding, make note of the reader's factory default network settings.

Default Network Settings

Settings	Description
Hostname	`impinj-xx-xx-xx`, where `xx-xx-xx` is the last three bytes of the reader's MAC address
DHCP	Enabled. The reader also reports its hostname to the DHCP server.

Note: The reader's MAC address is printed on the label attached to the reader case.

Note: When the reader is plugged into a network that doesn't have a DHCP server **OR** when the PC is connected directly to the reader via Ethernet cable, the reader defaults to a fixed IP address (169.254.1.1). If this address is not available, the reader then randomly selects a fixed IP address in the 169.254.xxx.xxx link local address range.

To connect the Impinj R700 Reader to the Ethernet network

- Using a standard Ethernet cable, connect the RJ-45 connector on the reader to a LAN drop or network switch.

Note: If you need to connect a PC directly to the Ethernet port, you can use a standard Ethernet cable. A crossover cable is not necessary.

To troubleshoot Ethernet network connections

Use the following steps to troubleshoot problems with connecting to the reader over TCP/IP:

1. "Ping" the reader, for example **ping impinj-1d-00-dd.local** (for the Impinj R700 reader). If you are on an enterprise network, you usually don't have to use '.local'.

   When the reader is directly connected to the PC, make sure the PC is on the same subnet as the reader. For example, if the reader's IP address is 169.254.1.1, set the PC's IP address somewhere in the 169.254.xxx.xxx address range.

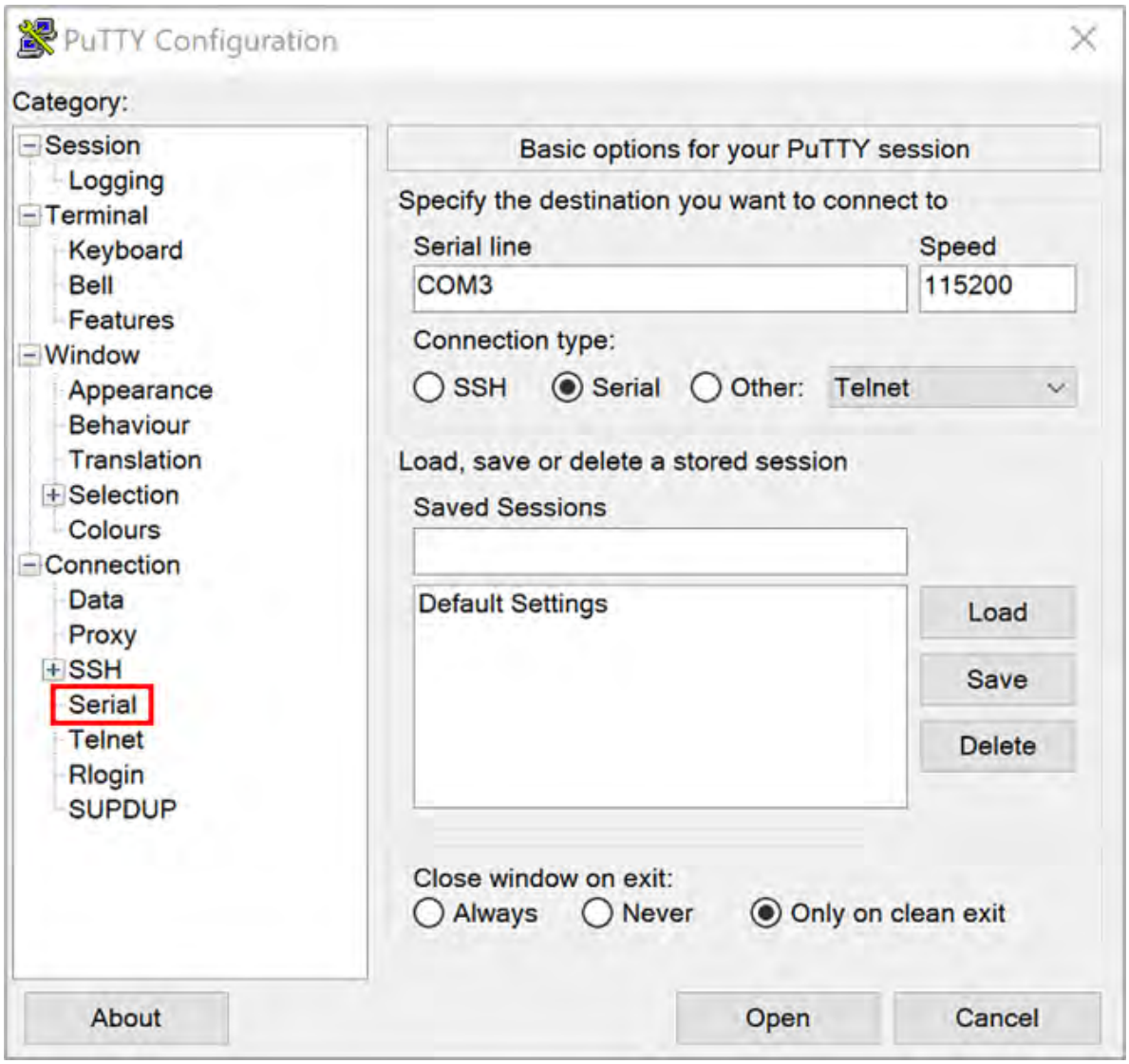
2. If the ping is NOT successful, you will probably see one of these three error messages:

   - "Ping request could not find host"
   - "Request timed out"
   - "Destination host unreachable"

The likely cause for these errors is that your PC does not have Bonjour Print Services installed. For installation instructions, see http://support.apple.com/kb/dl999. (For Linux-based clients, one equivalent service is the Avahi daemon.)

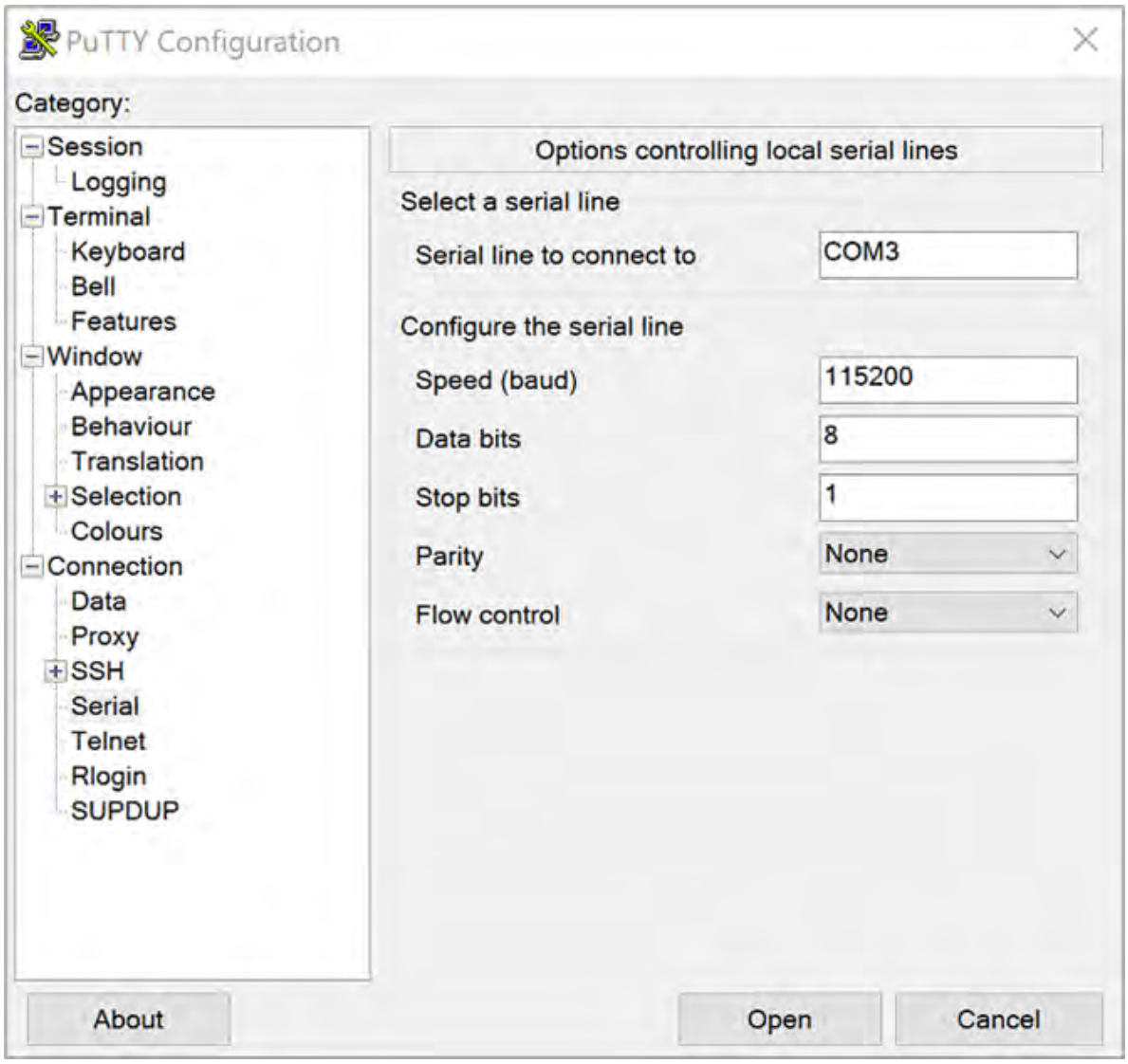
To connect an Impinj R700 reader to your PC over the host USB connection

1. Confirm that you have the latest version of PuTTY, a free and reliable SSH, and serial client. PuTTY version 0.60 or later contains support for serial connections.
2. Connect a USB cable to the mini-USB connector on the back of the reader (the right-most port in the figure showing the port connections).
3. Power up the reader and wait for the boot sequence to complete.
4. On the PC, run the PuTTY application and adjust the session options to use the Serial connection type, and set the Serial line to **COM1**. Note: If you are using a serial to USB adapter, this field can be set to a different COM port.
5. Set **Speed** to **115200**.



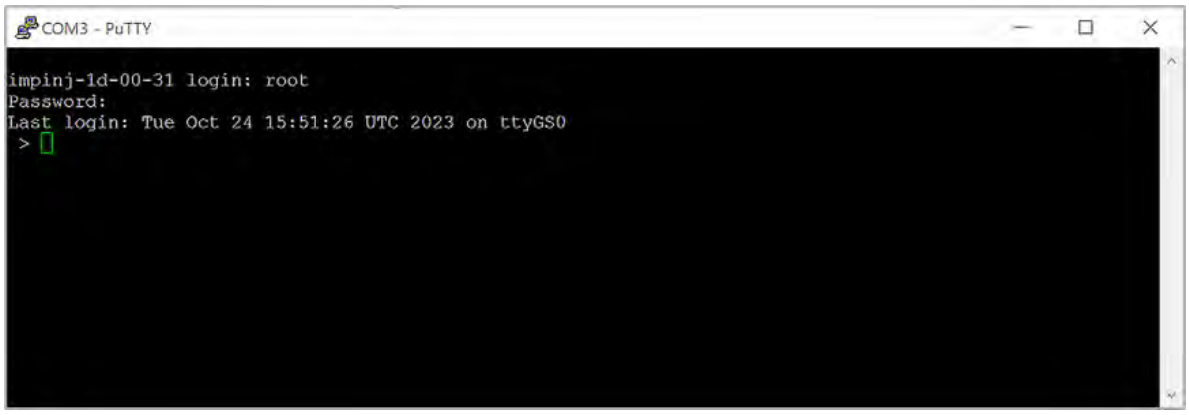
PuTTY Session Settings

6. In the left-hand **Category** panel of the PuTTY application, click on the **Serial** category. The right-hand panel will display the options for controlling local serial lines. The general session settings will populate the appropriate fields.
7. Set **Flow control** to **None**, and then click **Open**.



PuTTY Serial Settings

8. On the RShell console window, press **Enter**. The RShell login prompt displays.



COM1 PuTTY Login Prompt

9. At the RShell login prompt shown in the figure directly above, log in to the reader using the administrator credentials. The default credentials are as follows.

   username: root

   password: impinj

10. When the RShell command-line prompt displays, begin configuring the network settings for the reader. For more information, see Using RShell to Configure Network Settings for Impinj R700, or see the figure below for the appropriate WebUI dialog.

11. When you have completed configuration of the appropriate network settings, connect the reader to your Ethernet network.

    Note: If you decide to connect to DHCP after connecting serially, remember to use RShell to change the IP address on the reader from static to dynamic. For more information, see Using RShell to Configure Network Settings for Impinj R700.

The dialog box below shows how to configure network settings with WebUI. You must first select **Network** from the menu at the top of the page, and then select your interface from the **Interface List**.

5.3.4 Step 4: Configure the Region Setting on the Reader

ETSI readers require that the specific region of operation be set by the professional installer. Note that readers cannot be altered and only operate per the regulatory laws in USA/Canada.

Warning: The RF settings must match the country/region of operation to comply with local laws and regulations. You, the user, are responsible to ensure operation with the correct RF settings and are solely responsible for any fines and other damages due to incorrect or non-compliant country/region settings on your Reader.

Avertissement: Les paramètres RF doivent correspondre au pays / région d'exploitation se conformer aux lois et règlements locaux. Vous, l'utilisateur, sont chargés d'assurer le fonctionnement avec les paramètres RF correctes et sont seuls responsables de toutes les amendes et autres dommages imputables à des manipulations ou les paramètres de pays / région non-conformes sur votre lecteur.

Out of the box, the ETSI R700 reader is configured to use the EU1 region by default. If the EU2 region is desired instead, it can be selected and set with RShell or WebUI.

Note: The default for FGX readers is region NONE, which must be changed in order to perform RFID operations.

To set the region for a Reader by using a web interface

1. Connect to the Reader by using a web browser using the following format:

`http://<reader name or IP address>`.

Examples:

`http://impinj-1d-00-dd`

`http://10.0.10.44`

2. Log in to the reader using the administrator credentials. The default credentials are as follows.

   username: root

   password: impinj

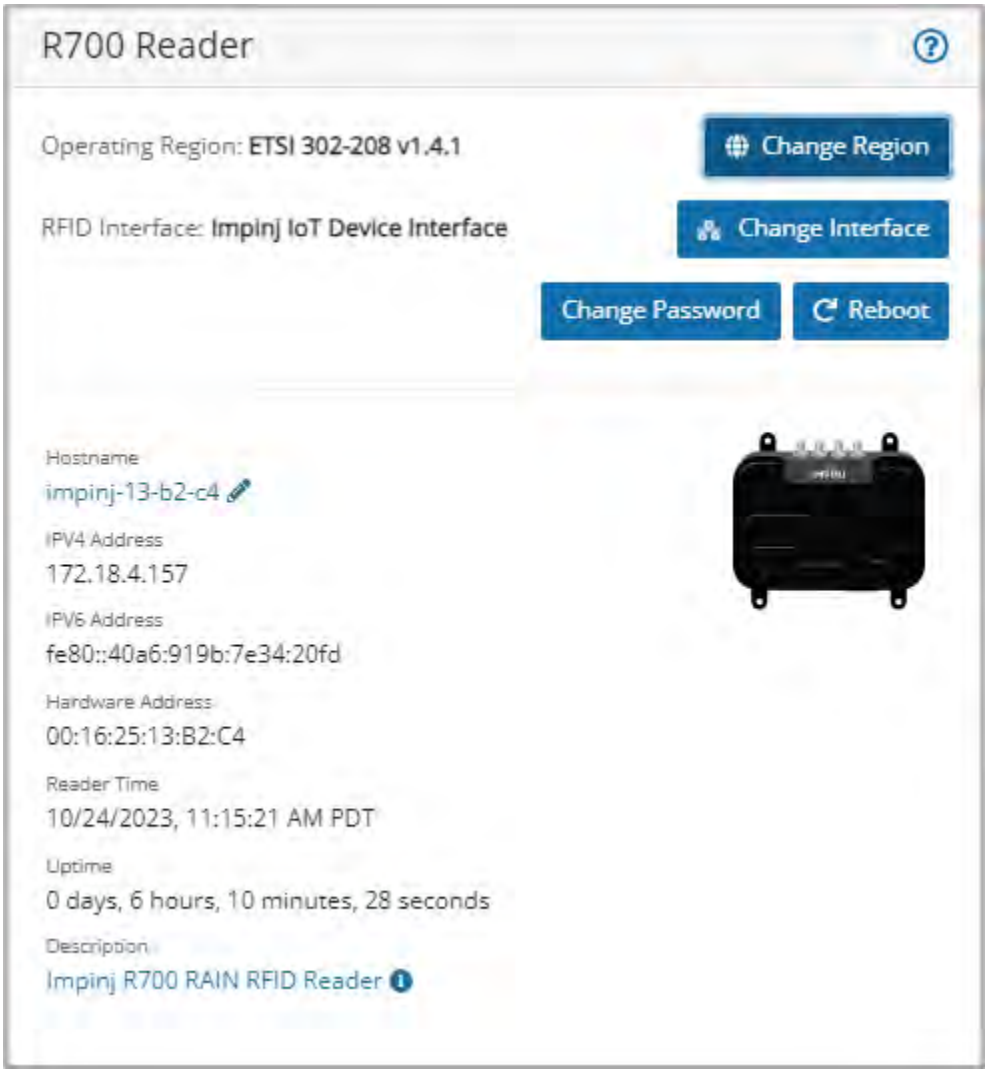
   Note: 'impinj' is the default password. It is recommended you create your own after logging on for the first time.

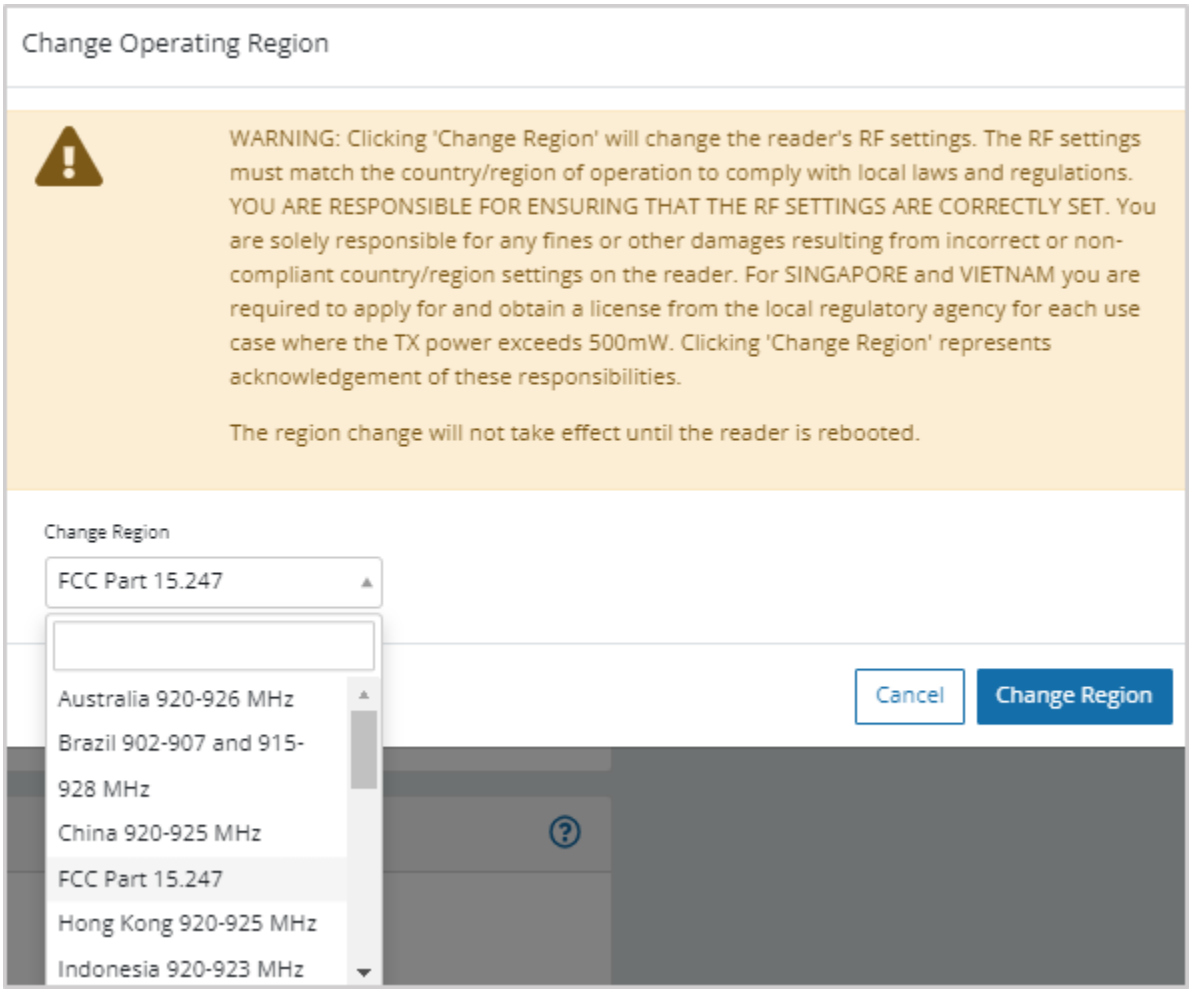
3. Select one of the available regions from the dropdown list, as shown in the figure below.

   Note: If you don't see your country or region listed, contact Impinj to find out about current regulatory approval status.

4. On the **Change Regulatory Region** dialog, click **Reboot**. When you change the Reader's operating region, the change does not take effect until the next reboot. If you attempt RFID operations on the Reader after you change the region but before you reboot the Reader, you will get unexpected behavior.

The following illustrations show how to change the reader's region with WebUI.


R700 Reader
Operating Region: ETSI 302-208 v1.4.1
Change Region
RFID Interface: Impinj IoT Device Interface
Change Interface
Change Password
Reboot
Hostname
impinj-13-b2-c4
IPV4 Address
172.18.4.157
IPV6 Address
fe80::40a6:919b:7e34:20fd
Hardware Address
00:16:25:13:B2:C4
Reader Time
10/24/2023, 11:15:21 AM PDT
Uptime
0 days, 6 hours, 10 minutes, 28 seconds
Description
Impinj R700 RAIN RFID Reader



Change Regulatory Region Web Interface

Note: If only one region is available on your reader, the **Change Region** button will not be available.

To set the region for a Reader by using RShell commands

Alternately, you can use the following RShell commands to set or change an ETSI region of operation:

```
> show system region
```

This shows the configured region and a list of selectable regions.

```
> config system region X
```

This sets the region to the region number X. For example, to set the ETSI region to EU2, type config system region 29.

```
> reboot
```

When you change the Reader's operating region, the change does not take effect until the next reboot. If you attempt RFID operations on the Reader after you change the region but before you reboot the Reader, you will get unexpected behavior.

Note: Region numbers are listed, in various tables, in the LLRP Guide.

5.3.5 Step 5: Test the Installed Reader

Confirm that connections and functionality are correct by reading tags. You can quickly verify reader operation by using ItemTest, a Windows PC test application from Impinj. To use ItemTest, you configure various reader parameters and then run simple inventory operations. For more information about how to access and use ItemTest, see Using ItemTest to Configure and Test R700.

6 Configuring and Monitoring Impinj R700 Reader

This section provides a high-level overview of the configuration and monitoring options available for the Impinj R700 reader.

6.1 Configuring the Impinj R700 Reader

You can think of Impinj R700 reader configuration in two categories: configuring the device itself and configuring the reader's RF behavior. This section provides the basics for each type of configuration.

6.1.1 Device Configuration

RShell is a proprietary command-line management interface used to configure and manage network settings, firmware upgrades, and other device-oriented operations. This section introduces the RShell commands to use to install and connect the reader. The ***RShell Reference Manual*** provides full details and syntax for all RShell commands.

Note: RShell is a machine interface and is almost always backward compatible with previous reader hardware versions. Existing inputs and outputs will never change. When new arguments are added, they are always optional and always added to the end of the parameter list.

Using RShell to Configure Network Settings for Impinj R700

You can often get up and running with little or no configuration if you use the default configuration settings in the Impinj R700 reader. However, if you are not using DHCP to assign IP addresses, you will need to configure a few of the reader's network settings.

The following procedure outlines the RShell commands you might need to connect the reader to your network.

To configure the reader's network settings

1. Open the RShell console. For more information, see the procedure to connect over host USB.
2. View the reader's current configuration settings by entering the *show network summary* command at the RShell command prompt as shown in the following example:

   ```
   > show network summary
   ```

   ```
   Status='0,Success'
   PrimaryInterface='eth0'
   ActiveInterface='eth0'
   Hostname='impinj-1d-00-dd'
   connectionStatus='Connected'
   ipAddressMode='Dynamic'
   ipAddress='10.0.10.41'
   ipMask='255.255.0.0'
   gatewayAddress='10.0.0.10'
   broadcastAddress='10.0.255.255'
   ```

3. Configure the appropriate TCP/IP parameters for your environment. The applicable commands are:

   Setting Hostname

   ```
   > config network hostname <HOSTNAME>
   ```

   Setting Static IP Address

   ```
   > config network ip static <IP ADDRESS> <NETMASK> <GATEWAY>
   ```

   Note: The IP address is required, however the other parameters are optional. The default value is used if an optional parameter is omitted from the ip command.

Note: The reader MUST be rebooted for this command to take effect.

Enabling DHCP

```
> config network ip dynamic
```

Note: The reader MUST be rebooted for this command to take effect.

Configuring NTP Servers

```
> config network ntp disable
> config network ntp add <NTP SERVER ADDRESS>
> config network ntp enable
```

4. After successfully configuring all required network settings, connect the reader to the network through the Impinj R700 Ethernet port.

To edit your network settings with the Web UI, select the **Network** option from the menu at the top of the page, and then select the interface you're using from the **Interface List**. You will then be able to edit your settings in the **IPV4 Configuration** dialog box or **IPV6 Configuration** box (not shown).

6.1.2 RF Configuration

How you configure your reader's RF behavior depends entirely on your implementation approach. You might be using a custom software application, middleware running on a server, or some other approach. ItemTest, described in the next section, is an example of a PC client application. Regardless of the application you're using, the underlying protocol is the same, Low-Level Reader Protocol (LLRP).

LLRP is a standard, asymmetric, binary protocol used for communication between a client application and the reader. LLRP controls the reader's receive sensitivity, its antenna transmit power configuration, and the operating reader configuration, among other features. For more information, see the following documents:

- ***LLRP Standard*** This document provides the specifics of the LLRP standard ratified by EPCglobal. http://gs1.org/sites/default/files/docs/epc/llrp_1_0_1-standard-20070813.pdf
- ***Octane LLRP*** This document provides details of the LLRP capabilities that are supported by the Impinj R700 reader. It also describes custom LLRP extensions added by Impinj.
- ***Impinj LTK Programmer's Guide*** This guide is intended for software engineers and provides guidelines and best practices for working with the LLRP Toolkit. In addition, software engineers can access language-specific reference guides and sample applications that illustrate the scenarios discussed in the Programmer's Guide.

Using ItemTest to Configure and Test Impinj R700

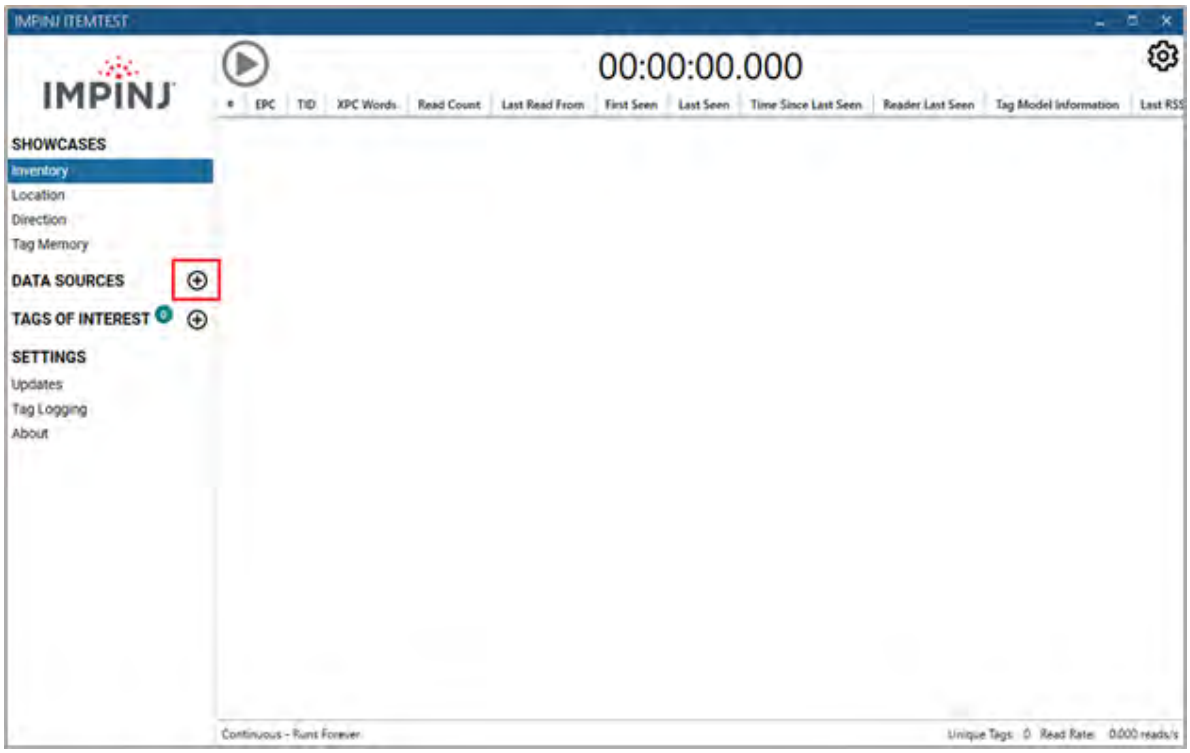
Impinj provides a simple, easy-to-use application to use to configure and test the basic RF behavior of the Impinj R700 reader. The ItemTest application is available from the Impinj support Web site at support.impinj.com. ItemTest version 2.0 and later will support the Impinj R700 reader. To use ItemTest, your computer must be running a minimum of Windows 7 and have .NET Framework 4.6.1 installed.

Note: ItemTest must be installed by a user with administrator privileges.

This section describes how to connect to and configure a reader's RF parameters by using ItemTest. It also provides a high-level description of each parameter.

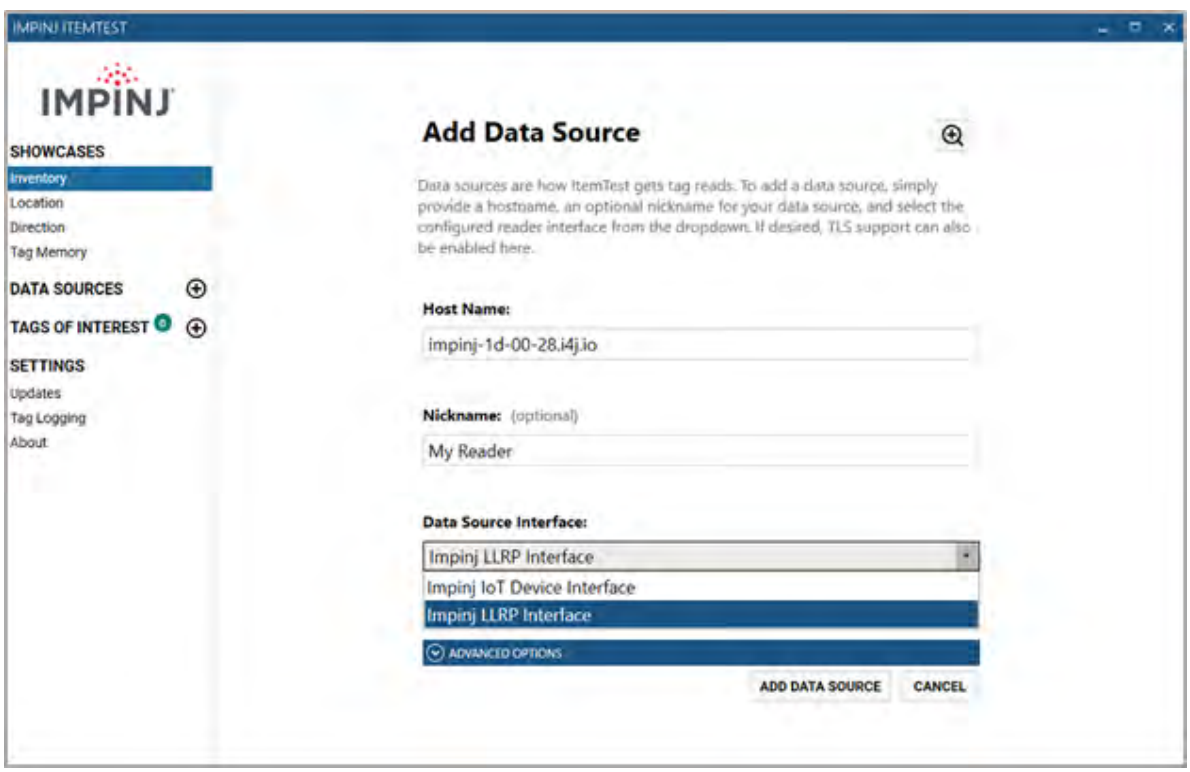
To configure and test a reader by using ItemTest

1. Install and launch the ItemTest application. The screen shown in the figure below displays.



ItemTest Initial Screen

2. Click the "plus" button next to **Data Sources**. The **Add a data source** screen displays.



ItemTest Add a Data Source Screen

3. On the **Add a data source** page, in **Hostname** field, type the reader's hostname or IP address.

   Note: You can find out the name and the IP address from the Home page of the Reader WebUI or by using the RShell **show network summary** command. The **show network summary** command provides the dynamic values that are returned by DHCP or LLA if the current configuration is dynamic. The local hostname resolution feature (mDNS) gives the reader a local hostname in addition to an IP address as its network identity. On an isolated network that lacks DNS service but that has mDNS enabled, a reader with hostname **impinj-1d-00-dd**, for example, can be reached using **impinj-1d-00-dd.local**.

4. Enter a nickname for this reader (This field is optional, and can be shorter and/or more memorable than the reader hostname or address).

5. In the **Data Source Type** field, select either "Impinj IoT Device Interface" or Impinj LLRP Interface.

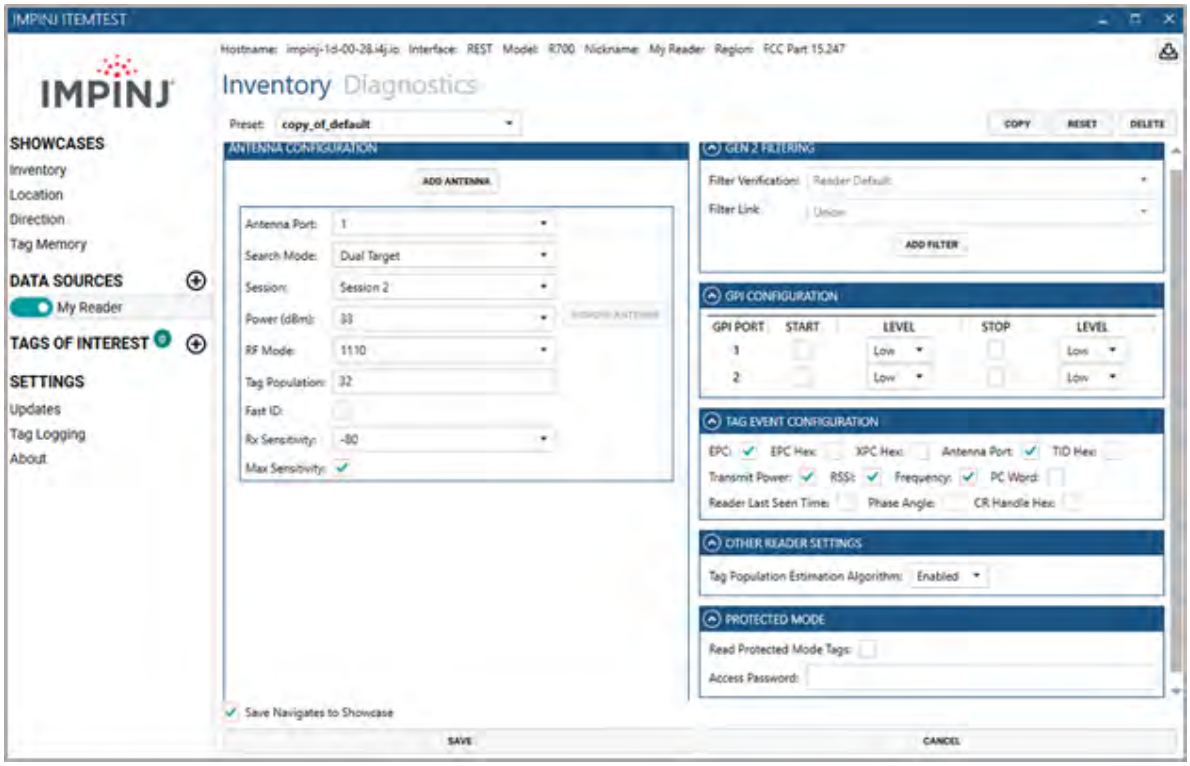
   Note: This must match the interface your Reader is currently using. You can determine the interface that your Reader is using from the Home page of the Reader WebUI.

6. If you want to configure ItemTest to use TLS Protocol when making the connection to the reader, click the **Use TLS Protocol** toggle button and select the version of TLS that you want to use. The default is "Operating System Default".

7. Click the **ADD DATA SOURCE** button. The initial start screen returns and your reader appears as a Data Source, as shown in the image below.

ItemTest Inventory Start Screen

8. Under the list of **DATA SOURCES**, click the name of the recently added reader. A configuration page will display, using the **default** preset, as shown in the figure below. For testing the Reader, these settings can be left at their defaults. Later, you can adjust these settings as needed when you begin using the reader in a live RFID operation.



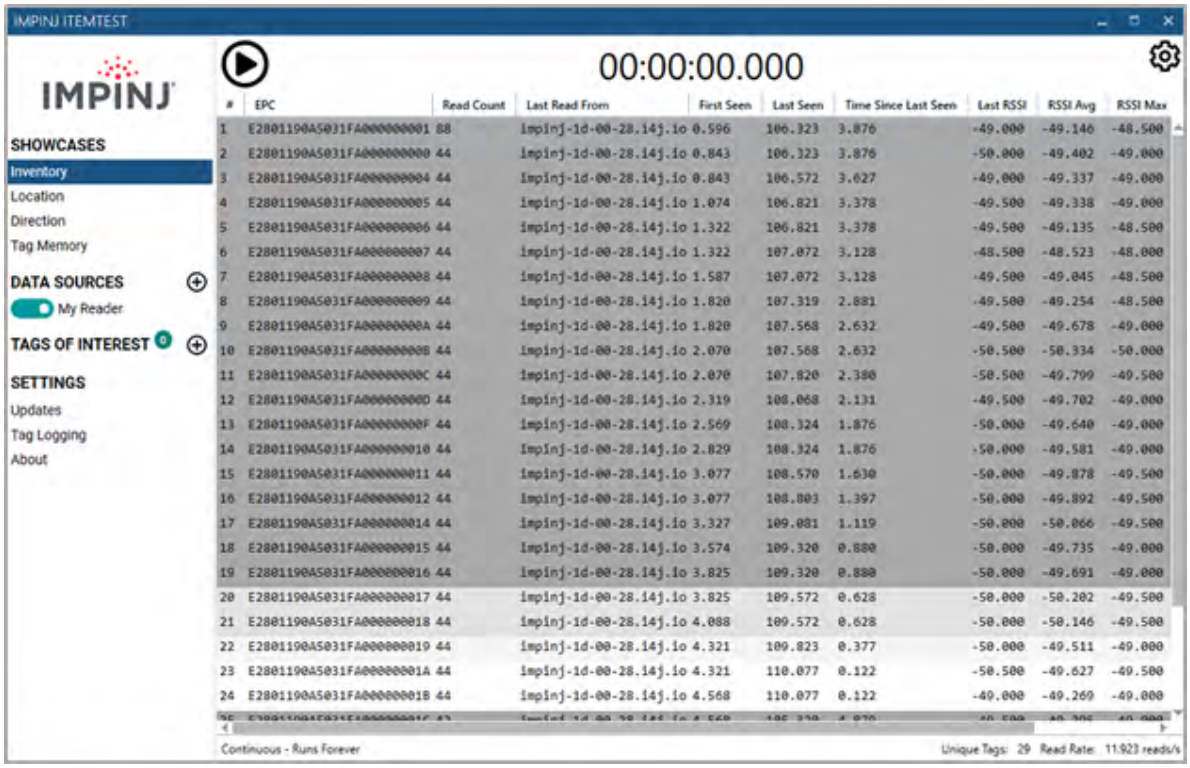
ItemTest Reader Inventory Settings Screen

Note: The default preset cannot be modified, so when you make changes to these settings, you will be required to create a new preset. When you click the **Save** button, a **Set Preset Name** form appears, as shown in the image below. Enter a name for your preset and click **OK**. This creates a new preset thatappears on the **Profile Presets** page of the WebUI.

9. Assuming you have made no changes, click the **Cancel** button to exit this form and return to the Inventory start screen.

10. Test your reader installation. Place one or more tags in the read-zone of one or more of the attached antennas. On the ItemTest Inventory screen, click the start button at the top of the window. Tag reads appear under the data headings and are continuously updated with the latest readings for each unique EPC.

    When you are satisfied that you are seeing the expected tags, click the stop button at the top of the screen (in the same location where the start button used to be). Unique EPCs with tag read counts will be listed on the Inventory screen, as shown in the figure below.



ItemTest Tag Inventory Results

In the results shown in the figure above, the reader detected 129 unique tags. Because the search mode is **Dual Target**, the reader continuously reads the tags, first reading the A flags, and then reading the B flags. Notice that two of the tag entries are shown with a darker gray background. The tag entry background changes to a darker level of gray the more time has passed since it was last actively read.

6.2 Monitoring Impinj R700 Reader

Use RShell to monitor the health and performance of the reader when the Impinj R700 reader is up and running. This section presents the primary RShell commands to use for viewing network and RFID statistics, in addition to the reader logs. For more information about these commands, see the ***RShell Reference Manual***.

6.2.1 Viewing Network Parameters and Statistics

Use the RShell **show network** command to display networking parameters and statistics. When you use this command with the parameters shown in the table below, you can see the following information:

Show network Command Parameters

Parameter	Displayed Information
dns	Summary of DNS settings
icmp	ICMP statistics
dnssd	Summary of DNS-SD settings
mdns	Summary of mDNS settings
ntp	Summary of NTP settings
summary	Summary of system-wide network settings
tcp	TCP statistics
udp	UDP statistics

Parameter	Displayed Information
http	HTTP status
lldp	LLDP status
ssh	SSH status
portsecurity	Port security status
sftp	SFTP status

For details about the specific settings and statistics available for each of these parameters, see the ***RShell Reference Manual***.

6.2.2 Viewing RFID Parameters and Statistics

Use the RShell **show rfid stat** command to display a reader's RFID parameters and statistics. Using this command with the appropriate parameter, you can view information shown in the Parameter and display table below.

Description of show rfid stat Command Parameters

Parameter	Description
ReaderOperationalStatus	Whether RFID applications are running on the reader.
Antenna<n>OperationalStatus	Whether an antenna is physically connected and functional.
Antenna<n>EnergizedTime	The elapsed time that antenna<n> has been powered, in milliseconds.
Antenna<n>UniqueInventoryCount	The number of unique tags counted at antenna<n>.
Antenna<n>TotalInventoryCount	The total inventory count for antenna<n>.
Antenna<n>ReadCount	The number of tags read at antenna<n> that matched the configured filters.
Antenna<n>FailedReadCount	The number of failed reads.

Note: <n> indicates the antenna port on the reader, a value of 1-4.

Note: FailedReadCount refers specifically to the number of tags where a read was attempted at antenna<n> because the tag matched the configured filter, but the read failed.

The table above shows a sample of the commands available to get RFID statistics. For the full list as well as syntax details, see the ***RShell Reference Manual***.

Note: You can see statistics for the LLRP interface between the reader and a client by using the **show rfid llrp stat** command. For more information, see the ***RShell Reference Manual***.

6.2.3 Configuring and Viewing Impinj R700 Reader Logs

The Impinj R700 reader uses the standard Syslog protocol to forward its logged events to a remote Syslog server. The reader stores the logged events in its file system, accumulating and retaining this information across reboots. Logs can be retrieved from the reader at `http://root:{PASSWORD}@${READER_NAME}/cgi-bin/syslog`. The default password is "impinj".

Logs are classified into three categories:

- Management
- RFID
- System

All logged events have an associated severity level. There are eight possible levels listed in decreasing order from most severe to least severe:

1. Emergency
2. Alert
3. Critical
4. Error
5. Warning
6. Notice
7. Info
8. Debug

Configure the log levels that you want to display. The reader then retains only the events with a severity greater than or equal to the configured level. For example, if you choose a logging level of Warning, then the logs will contain the following levels: Warning, Error, Critical, Alert, and Emergency.

Note: Regardless of the configured log level, the reader always retains logs of events with **Error** level or higher in an independent log.

Use the **RShell config logging** command to configure options for storing and forwarding logged events. Use the **show logging** command to display the logging configuration as well as the actual logged information in text form. For more information about these commands, see the ***RShell Reference Manual***.

6.2.4 Viewing the State of the Impinj R700 Reader

To display information about the current state of the reader itself, use the RShell **show system** command. When you use this command, you can see the following statistics:

- A summary of system information — **show system summary**
- Platform memory usage and available application space — **show system cpu**
- Generic platform statistics — **show system platform**

For more information about the **show system** command, see the ***RShell Reference Manual***.

7 Upgrading the Impinj R700 Reader Firmware

The Impinj R700 reader contains firmware known as Octane. The current version of Octane is version 8.4.0. This section describes how to manually upgrade a single reader.

In addition to supporting upgrade procedures, the Impinj R700 reader also provides methods for reverting firmware to a previous valid image and restoring firmware to factory default settings. The procedure for reverting to the previous valid image is explained in this section. The procedure for returning to factory defaults is explained in Troubleshooting.

7.1 A Brief Overview of the Impinj R700 Reader Firmware

To minimize downtime and maximize the robust handling of possible upgrade failures, the Impinj R700 reader contains dual images of its firmware. When a firmware image upgrade is requested, the reader continues to operate using the primary image. In the background, the Impinj R700 reader upgrades the secondary image. When the upgrade completes, the reader reboots to the newly upgraded image. The Impinj R700 reader retains the previous firmware version in case there are problems with the upgrade.

There are three individual partitions within each firmware image that logically organize the system software. Although you do not need a full understanding of this architecture to perform a simple manual upgrade, it is a good idea to be familiar with its structure at a high level. For a more in-depth discussion of the firmware and how firmware is organized, see the ***Embedded Developer's Guide***.

The three partitions in firmware are:

1. **System Operating Partition (SOP)** — The SOP is the primary system partition of the Impinj R700 reader. It contains the Linux kernel, FPGA firmware, RFID management software, reader management software (RShell), logging management software, firmware upgrade control, system watchdog software, and the factory default data.
2. **System Persistent Partition (SPP)** — Files in this partition are automatically generated and maintained by the software that runs on the reader. It contains the reader configuration (network settings, LLRP configuration, log settings, and so on), reader logs, and debug information used by Impinj engineers.
3. **Custom Application Partition (CAP)** — This partition contains custom application software, other items required by the custom application (extra libraries or tools, and configuration files), and custom application logs.

7.2 Upgrading the Firmware

The Impinj R700 reader provides three methods for upgrading:

1. The RShell command line interface
2. Firmware saved on a USB memory drive plugged into the reader host port
3. The Impinj R700 reader management web page

7.2.1 Upgrading the Firmware Using RShell

Use this procedure to use RShell to upgrade the firmware:

1. Obtain the firmware upgrade file from the Impinj support Web site, support.impinj.com. The upgrade file extension is **.upgx**. (Example: **Impinj_R700_Firmware_v8.4.0.upgx**).

2. Place the upgrade file on a server (http or sftp) that is accessible by the reader you are upgrading.

3. Using an SSH client application such as Putty, connect to the reader using by SSH or serial, and then log in.

4. From the RShell command prompt, issue the following command:

```
> config image upgrade
```

where <URI> is the server location and the name of the upgrade file.

For example:

```
> config image upgrade http://usacorp/rfid/reader/image/Impinj_R700_Firmware_v8.4.0.upgx
```

or

```
> config image upgrade sftp://user:pass@myserver/dir/Impinj_R700_Firmware_v8.4.0.upgx
```

5. After you start the upgrade, view the upgrade status at any time by issuing the following command:

   ```
   > show image summary
   ```

6. This command displays the current upgrade status, the last operation, the status of the last operation, and information about the primary and secondary images. Reissue the `show image summary` command if you want to track the upgrade status. Some status values you might see are:

   - `WaitingForImageFileTransfer`
   - `WaitingForCommitImage`
   - `WaitingToActivateImmediate`

   The upgrade is complete when the UpgradeStatus parameter value is `Ready`.

   The `LastOperation` parameter should be set to `WaitingToActivateImmediate` and the `LastOperationStatus` should be set to `WaitingForManualReboot`.

7. Reboot the reader by issuing the following command:

   ```
   > reboot
   ```

The reboot process displays messages in the RShell console as it goes through each stage of the process. The reboot completes, and then the reader login prompt displays on the console. The reader System LED displays solid blue.

For more information about LED activity during an upgrade, see the tables in Impinj R700 Ports and LEDs.

7.2.2 Upgrading the Firmware Using a USB Drive

The Impinj R700 reader supports upgrading the firmware by using a USB drive.

First, obtain the firmware upgrade file from the Impinj support Web site, support.impinj.com. The upgrade file extension is ***.upgx***. (Example: *Impinj_R700_Firmware_v8.4.0.upgx*).

To prepare the USB drive for the upgrade

1. Insert a USB drive into your computer.
2. Format the USB drive as FAT32.
3. Create a directory named `impinj` in the root of the USB drive, and create the subdirectories `revolution`, `upgrade`, and `images`. The names of these directories are case sensitive and must all be lower case.
4. Copy the desired firmware upgrade ***.upgx*** file into the directory: `impinj\revolution\upgrade\images`.

   Note: If multiple ***.upgx*** files exist in the `images` directory, the reader will use the most recently modified file.

5. Remove the USB drive from your computer.

To use the USB drive to update the reader

1. Confirm that the reader is ready for upgrade, and that the System LED is solid blue and the Upgrade LED is off.
2. Insert the USB drive into the "USB Host" port on the reader. Within 5-10 seconds, the reader will begin upgrading the reader and the Upgrade LED will blink blue. If the Upgrade LED remains off, the reader likely cannot locate the images directory and ***.upgx*** file on the USB drive.
3. The upgrade process completes in 20-60 seconds and then the Upgrade LED changes to solid blue.
4. Remove the USB drive from the "USB Host" port and reboot the reader.

During the upgrade process, the reader will attempt to append information to a `status.log` file in the `impinj/revolution/upgrade` directory. The `status.log` file is intended to provide an audit trail for the upgrade of one or more readers.

If the firmware upgrade process fails, the System LED will blink red. Remove the USB drive, reboot the reader, and check the `status.log` file for the reason of the failure.

7.2.3 Upgrading the Firmware through the Reader Management Web Page

You can also update the device firmware from the **Firmware and CAP** panel of the web UI **Home** page. This panel displays the current firmware version. Click on the version number for additional firmware version details such as build revision, build date and time, and build plan.

1. Connect to the reader using a web browser and navigate to `http://<reader name or IP address>`.

   Examples:

   `http://impinj-1d-00-dd`

   or

   `http://10.0.10.44`

2. Log in to the reader using the following credentials:

   username: **root**

   password: **impinj**

3. Select a ***.upgx*** or ***.raucb*** file either by clicking on the **select** link or by dragging the file into the boxed region.
4. After the upgrade is complete, click the **Reboot** button from the R700 Reader panel.

Note: The new firmware is not active until the reader is rebooted.

7.2.4 Reverting to the previous image

Use the following procedure if you need to revert to the pre-upgrade image.

1. To revert to the pre-upgrade image, enter the following command from the RShell prompt:

   ```
   > config image fallback
   ```

   When the command completes successfully, the reader automatically reboots and returns to the login prompt.

2. Log in to the reader. The pre-upgrade image is now running.

   Note: If there is no valid previous image, the response to the **config image fallback** command is Status='8, Permission-Denied'.

7.2.5 Reboot and fallback procedures

After failing to boot five times within 90 seconds, the reader will fall back to the previous image and attempt to boot again. This behavior enables the reader to boot when the main boot image is corrupt or has other issues.

7.2.6 Preserving the RFID interface during an upgrade

In some cases when upgrading to Impinj R700 Reader firmware version 8.0 or higher from firmware before 8.0, the upgrade process will select the IoT Device Interface by default. Here is a workaround to avoid unexpectedly switching the interface. It is useful for CAPs as well as other clients.

1. Set the RFID interface to one you *don't* wish to use.
2. Next, set the interface to the preferred one.
3. Upgrade to Impinj R700 Reader firmware, version 8.0.

The result should be an upgrade with the preferred RFID interface selected.

Here is a second workaround, which works for programmatic clients (either CAPs running on the reader or external clients), which works both before and after the upgrade to 8.0.

1. Check which interface is selected before issuing RFID commands.
2. Set the interface to the correct one if necessary, using either RShell or API endpoints.

Note: the RFID interface is a shared resource and can be changed in multiple ways:

1. From the WebUI
2. From the RShell interface
3. From the Host Configuration portion of the IoT Device Interface API

8 Troubleshooting

After failing to boot five times within 90 seconds, the reader will fall back to the previous image and attempt to boot again. This behavior enables the reader to boot when the main boot image is corrupt or has other issues.

8.1 Returning to the Default Configuration

If you are experiencing a problem with the reader and are having difficulty pinpointing the cause, it is useful to return the reader to a known state. We recommend resetting to the default configuration. Then try your reader again.

Important: Configuration Default Restore returns the reader configuration to its default state. It leaves any custom applications installed in the CAP intact. To restore the reader to its default state *and* remove any CAP contents, use Factory Default Restore.

There are two ways to return the Impinj R700 reader to its defaults:

1. Issue an RShell command. This leaves any installed CAP in place.
2. Press the **Default Restore** button on the device. This removes any installed CAP.

To use RShell to return the reader to its default configuration and leave CAP intact

1. At the RShell prompt, enter the following command:

   ```
   > config image default
   ```

   When the command completes successfully, the reader automatically reboots and returns to the login prompt.

2. Log in to the reader. The reader is now running with the default configuration, and CAP applications are intact.

To use the Default Restore button on the reader to restore to its default configuration and remove any CAP

1. Power off the reader.
2. Use an object with a sharp tip, such as a probe or paper clip, to press and hold the **Default Restore** button on the back of the reader while the reader is powered off.
3. Be sure to be pressing the **Default Restore** button while plugging in power to the reader.
4. Release the Default Restore button when the LED blinks blue once, when 5 or more seconds have passed. The reader will boot up normally with the default configuration and any installed CAP will have been removed.

Caution: When you press the Default Restore button, press straight down, and only hard enough to make the button move. Otherwise, you might damage the Impinj R700 reader.

Avertissement: Lorsque vous appuyez sur le bouton de restauration par défaut, appuyez tout droit vers le bas, et seulement assez fort pour faire bouger le bouton. Sinon, vous risquez d'endommager le Impinj R700 lecteur.

Insert and hold sharp point here for 3 seconds.
Release before 10 seconds.

Default Restore button

The following table lists the default configuration values.

Default Configuration Values

Parameter	Default Value
User	root
Password	impinj
Upgrade Retrieve Mode	Manual
Logging	No syslog servers
Management Logging Level	Error
RFID Logging Level	Error
System Logging Level	Error
Network Mode	Dynamic (DHCP)
DHCP Send Hostname	On
Hostname	impinj-xx-xx-xx (where xx-xx-xx is the last three digits of the MAC address)
Static DNS Servers	None
Static NTP Servers	None
LLRP Inbound Port	5084
LLRP Inbound Service	Enabled
LLRP Outbound Service	Enabled
LLRP Outbound Servers	None
LLRP Outbound Retry Secs	5
LLRP Outbound Timeout Secs	2

8.2 Retrieving Diagnostic Data

The reader can generate "diagnostic bundles", including debug bundles containing current diagnostic information, and watchdog bundles generated by watchdog reboots. These diagnostic bundles contain logs, core files, the RDD buffer, and other reader configuration and state information.

For example, to generate and download a diagnostic log, you can issue the following command (replace the string `$READER_HOSTNAME` with the IP address of the reader):

```
curl -vkL -u root:impinj --output diagnostic_bundle.zip \
https://$READER_HOSTNAME/api/v1/system/diagnostics/debug-bundle/
```

For more information, consult the Octane RESTful API.

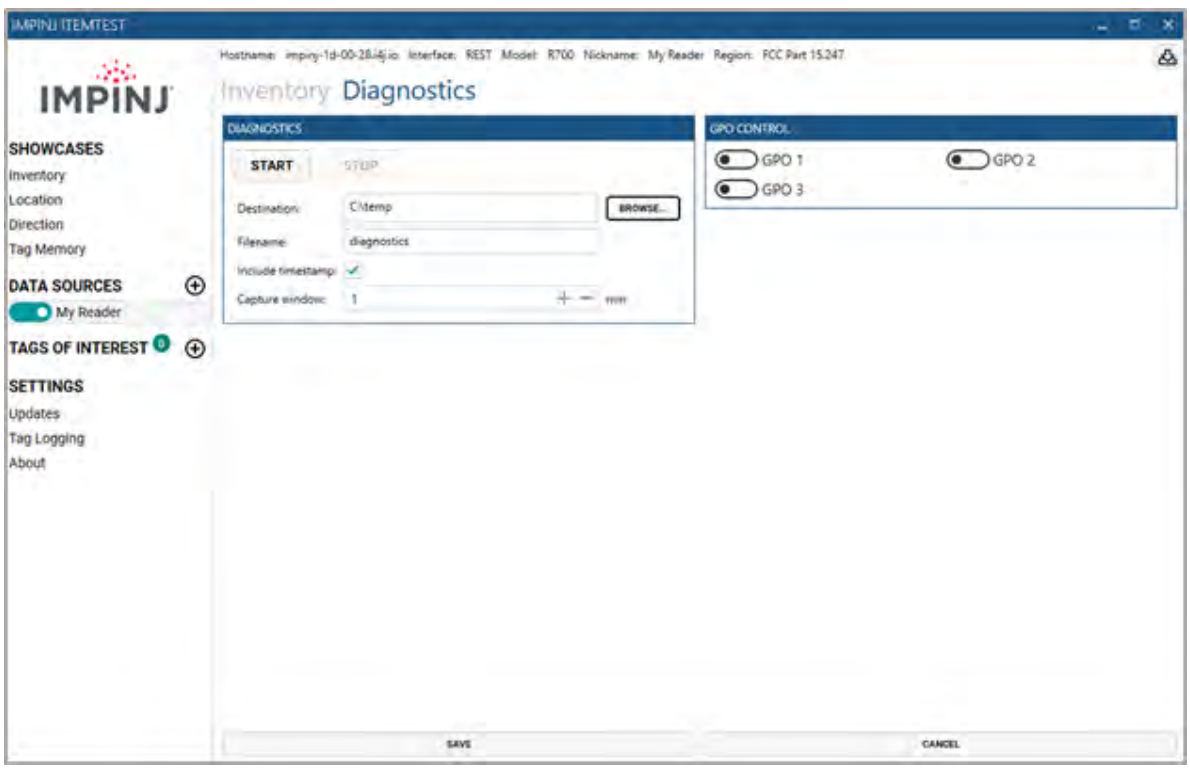
8.3 Submitting Diagnostic Data for Analysis by Impinj Technical Support

If the Impinj R700 reader is exhibiting RF behavior that is different from what you expect and you are unable to determine the cause, you might want to submit relevant data for analysis by Impinj Technical Support. You can use the Impinj ItemTest application to easily capture data related to the problem scenario. By creating and providing a Reader Diagnostic Data file, Impinj's Technical Support team can troubleshoot your issue.

To capture data to a Reader Diagnostic Data file

1. Open ItemTest and connect to the appropriate reader. For more information, see the figure entitled Item Test Initial Screen, shown earlier in this document.
2. Select the desired reader under the Data Sources heading in the left panel.
3. Select the **Diagnostics** tab near the top of the resulting reader page.
4. Enter or browse for a destination folder.
5. Choose a file name prefix (cannot be empty) and the desired capture window time in minutes (must be 1 or greater; the practical upper limit is 10).
6. Select **Start** to begin the capture session.

   ItemTest connects to the reader and begins "listening" for any RF activity. The reader captures data surrounding any RF activity it detects.



Reader Diagnostic Data Capture

7. Configure and initiate the reader operation you would like to troubleshoot.
8. Select **Stop** to stop the session. Two diagnostic files will be saved in a folder named after the reader (full host name) inside of the **Destination** folder specified earlier. The diagnostic files will be named starting with the **Prefix** provided earlier, plus the start time of the data capture. One data file will have the file extension *.fdd* and one will have the file extension *.rdd*.

This completes the capture activity.

9. Send any *.fdd*, *.rdd*, or *.sdd* files to Impinj Technical Support.

   Visit the Impinj support Web site, support.impinj.com, for submission details or talk with your Impinj representative.

Note: Another option to capture diagnostic data is to create a network trace by using Wireshark, a free protocol analyzer download from the Internet.

9 Appendix A: Information Specific to Regions of Operation

The Impinj R700 reader is designed to work in various regulatory regions. This appendix contains frequency ranges and antenna requirements specific to each supported region.

9.1 Operation in North America

9.1.1 Frequency Plan in North America

The FCC specifies frequency hopping across the North American spectrum (USA, Canada, and Mexico) allocated to UHF RFID (902-928 MHz) using FHSS (frequency-hopping spread spectrum). The frequency plan is further explained in the table below:

Frequency Plan for North America

Transmit Channel Number	Center Frequency (MHz)
1	902.75
2	903.25
3	903.75
4	904.25
...	...
49	926.75
50	927.25

9.1.2 Antenna Requirements in North America

Positioning

FCC Maximum Permissible Exposure (MPE) guidelines require the antenna's surface to be at least 25 centimeters away from personnel working in the area. For more information, see the following FCC bulletins:

- FCC OET Bulletin 65: *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*
- FCC OET Bulletin 56: *Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields*

Canadian ISED Maximum Permissible Exposure Guidelines require the antenna's surface to be at least 35 centimeters from personnel working in the area. For more information see Radio Standards Specification RSS-102 Issue 5 dated April 2018

Installation

The Impinj R700 reader is capable of up to +33.0 dBm conducted power on the housing RF connector and requires professional installation.

Power

When paired with an antenna, the reader may radiate no more than 36dBm EIRP per FCC Part 15.247 regulations. The reader output power can be increased to provide the maximum allowable EIRP subject to a maximum conducted power allowance of 30 dBm at the antenna connector. The maximum allowable output power of the reader can be set to satisfy both the conductor and radiated maximum criteria. The expression for the maximum reader power setting is:

Maximum power setting (in dBm) = the Smaller of: (36 - Composite Antenna Gain (in dBm)), or (30 + Cable Lost (in dBM))

where the composite antenna gain comprises the maximum linear antenna gain in dBi minus any cable loss between the reader and antenna in dB. Approved antenna vendors, model numbers, and associated gain are listed in the next section.

Note: The composite antenna gain comprises the maximum linear antenna gain in dBi minus any cable loss between the reader and antenna in dB.

The Impinj R700 reader may be operated with any antenna which has been certified by Impinj for FCC compliance in conjunction with the reader. Alternatively, an antenna may be used in lieu of a certified antenna if it is of the same type with equal or lower gain. The reader may not be operated with any antenna that is neither certified nor of the same type/gain as that of a certified antenna. Certified antennas, including vendor, model number, and associated gain are listed in the next section.

The Impinj R700 reader may be operated with any antenna which has been certified by Impinj for FCC compliance in conjunction with the reader. Alternatively, an antenna may be used in lieu of a certified antenna if it is of the same type with equal or lower gain. The reader may not be operated with any antenna that is neither certified nor of the same type/gain as that of a certified antenna. Certified antennas, including vendor, model number, and associated gain are listed below.

Certified Antennas

- Impinj model number IPJ-A0301-USA (Mini-Guardrail) with SMA female connector; -15 dBi gain.
- Impinj model number IPJ-A0404-000, Matchbox antenna with 20cm integrated pigtail to SMA connector; -20 dBi composite gain.
- Times-7 model number A5010 with RP-TNC female connector; 5.5 dBi composite gain.
- Times-7 model number A5020 with RP-TNC female connector; 2.5 dBi composite gain.
- Laird Technologies model number S9028PCL/R (left- or right-hand CP), with integrated 8-foot pigtail to RP-TNC male connector; 5.5 dBi composite gain.

Warning: The use of any antenna not listed above may damage the reader or adversely affect performance.

Avertissement: L'utilisation de toute antenne ne figurent pas ci-dessus peut endommager le lecteur ou affecter les performances.

9.2 Operation in European Union (lower frequency band) and United Arab Emirates (UAE)

9.2.1 Frequency Plan in EU (lower frequency band) and UAE

For European operation, the Impinj R700 reader supports the frequency plan listed in the table below and are compliant with the current ETSI EN 302 208 specification for the 865.6-867.6MHz frequency band. Impinj implements the four-channel high power plan that doesn't use listen-before talk, the maximum continuous transmit time on a channel is four seconds, and the Reader enforces the 100 milliseconds off time before reusing the same channel.

Lower Frequency Plan for European Union

LLRP Channel Number	Transmit Channel Number	Center Frequency (MHz)
1	4	865.7
2	7	866.3
3	10	866.9
4	13	867.5

9.2.2 Antenna Requirements in EU (lower frequency band) and UAE

Power

EU and UAE regulations allow a maximum radiated power of 33 dBm ERP (Effective Radiated Power) for high power RFID systems. The maximum Speedway output power is determined by the following equation:

Maximum power setting (in dBm) = 33 – Antenna Gain (in dBd) + Cable loss (in dB)

For example, for an application with an antenna gain of 6 dBd and cable loss of 2 dB, the Reader output power can be set no higher than 33-6+2 = 29 dBm. The maximum transmit power of Speedway is 31.5dBm measured at the RF antenna port.

Note: It is important to apply the antenna gain expressed in dBd (dB with respect to a dipole), which is equivalent to the isotropic antenna gain (in dBi) minus 2.15 dB. Additionally, the antenna gain used to set the output power must be the maximum linear gain of the applicable antenna.

Approved antenna vendors, model numbers, and associated gain are listed below.

Approved Antennas

- Laird Technologies Model Number S8658PCL/R (left- or right-hand CP) with integrated pigtail to RP-TNC male connector; 3.85 dBd gain.
- Impinj model number IPJ-A0311-EU1 Threshold Antenna, with 12-inch integrated pigtail to BNC male connector, 6 dBi composite gain.
- CSL CS-777-1 (Brickyard) with 7-foot integrated pigtail to RP-TNC male connector; 0 dBd composite gain.
- MTI MT-242032/NLH (left-hand CP) or MT-242032/NRH (right-hand CP) with N-type female connector (antennas available in IP54 or IP67 ratings); 1.85 dBd gain.
- Sensormatic Electronics Corp. Model number IDANT10CEU25 (left-hand CP only) with 6-foot Belden 7806A coaxial cable (0.1 dB per foot loss) to RP-TNC male connector; 3.25 dBd composite gain.
- Impinj model number IPJ-A1100-EU1 (Times-7 model A5010, part #60002 or 60004) with SMA female connector; 6.35 dBd gain.
- Impinj model number IPJ-A1200-EU1 (Times-7 model A5020, part #60011) with SMA female connector; 3.35 dBd gain.

Warning: The use of any antenna not listed above may damage the reader or adversely affect performance.

Avertissement: L'utilisation de toute antenne ne figurent pas ci-dessus peut endommager le lecteur ou affecter les performances.

9.3 Operation in European Union (upper frequency band)

9.3.1 Frequency Plan in European Union (upper frequency band)

For European operation, the Impinj R700 reader also supports the frequency plan listed in the table below and are compliant with the current ETSI EN 302 208 draft specification for the 916.1-918.9MHz frequency band.

Upper Frequency Plan for European Union

LLRP Channel Number	Transmit Channel Number	Center Frequency (MHz)
1	3	916.3
2	6	917.5
3	9	918.7

9.3.2 Antenna Requirements in European Union (upper frequency band)

Power

EU regulations for upper frequency band allow a maximum radiated power of 36 dBm ERP (Effective Radiated Power) for high power RFID systems. The maximum Speedway output power is determined by the following equation:

Maximum power setting (in dBm) = 36 – Antenna Gain (in dBd) + Cable loss (in dB)

For example, for an application with an antenna gain of 6 dBd and cable loss of 2 dB, the Reader output power can be set no higher than 36-6+2 = 32 dBm. The maximum transmit power of Speedway EU2 reader is 33dBm measured at the RF antenna port.

Note: It is important to apply the antenna gain expressed in dBd (dB with respect to a dipole), which is equivalent to the isotropic antenna gain (in dBi) minus 2.15 dB. Additionally, the antenna gain used to set the output power must be the maximum linear gain of the applicable antenna.

Approved antenna vendors, model numbers, and associated gain are listed in the next section.

Approved Antennas

The EU upper frequency band is contained within the FCC approved band. For approved antennas refer to the list under the North America operation (FCC) section above.

9.4 Operation in Other Global Regions

For the Impinj R700 reader, all of the Rest of the World (ROW) regions use the FGX SKU except Japan, which has its own JP SKU. Please contact our support site to learn which countries and regions are currently certified.

9.4.1 Frequency Plans in Other Global Regions

IPJ-R700-341 (FGX)

Australia operating frequency band is 920 to 926 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	36	920.25 MHz
2	37	920.75 MHz
3	38	921.25 MHz
4	39	921.75 MHz
5	40	922.25 MHz
6	41	922.75 MHz
7	42	923.25 MHz
8	43	923.75 MHz
9	44	924.25 MHz
10	45	924.75 MHz

Brazil operating frequency band is 902-907.5 and 915-928 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	1	902.75
2	2	903.25
3	3	903.75
4	4	904.25
5	5	904.75
6	6	905.25
7	7	905.75
8	8	906.25

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
9	9	906.75
10	10	907.25
26	41	922.75
27	42	923.25
28	43	923.75
29	44	924.25
30	45	924.75
31	46	925.25
32	47	925.75
33	48	926.25
34	49	926.75
35	50	927.25

China operating frequency band is 920 to 925 MHz with 250kHz channel spacing.

LLRP Channel Number	China Channel Number	Center Frequency (MHz)
1	3	920.625 MHz
2	4	920.875 MHz
3	5	921.125 MHz
4	6	921.375 MHz
5	7	921.625 MHz
6	8	921.875 MHz
7	9	922.125 MHz
8	10	922.375 MHz
9	11	922.625 MHz
10	12	922.875 MHz
11	13	923.125 MHz
12	14	923.375 MHz
13	15	923.625 MHz
14	16	923.875 MHz
15	17	924.125 MHz
16	18	924.375 MHz

Hong Kong operating frequency band is 920 to 925 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	36	920.25 MHz
2	37	920.75 MHz
3	38	921.25 MHz
4	39	921.75 MHz
5	40	922.25 MHz
6	41	922.75 MHz
7	42	923.25 MHz
8	43	923.75 MHz
9	44	924.25 MHz
10	45	924.75 MHz

Indonesia operating frequency band is 920 to 923 MHz with 500 kHz channel spacing.

LLRP Channel Number	Center Frequency (MHz)
1	920.0 MHz
2	920.5 MHz
3	921.0 MHz
4	921.5 MHz
5	922.0 MHz
6	922.5 MHz
7	923.0 MHz

Latin America operating frequency band is 902 to 928 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	1	902.75
2	2	903.25
3	3	903.75
4	4	904.25
5	5	904.75
6	6	905.25
7	7	905.75
8	8	906.25
9	9	906.75
10	10	907.25
11	11	907.75
12	12	908.25
13	13	908.75
14	14	909.25
15	15	909.75
16	16	910.25
17	17	910.75
18	18	911.25
19	19	911.75
20	20	912.25
21	21	912.75
22	22	913.25
23	23	913.75
24	24	914.25
25	25	914.75
26	26	915.25
27	27	915.75
28	28	916.25
29	29	916.75
30	30	917.25
31	31	917.75
32	32	918.25
33	33	918.75
34	34	919.25
35	35	919.75
36	36	920.25
37	37	920.75
38	38	921.25
39	39	921.75
40	40	922.25

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
41	41	922.75
42	42	923.25
43	43	923.75
44	44	924.25
45	45	924.75
46	46	925.25
47	47	925.75
48	48	926.25
49	49	926.75
50	50	927.25

Malaysia operating frequency band is 919-923 MHz with 500 KHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	34	919.25 MHz
2	35	919.75 MHz
3	36	920.25 MHz
4	37	920.75 MHz
5	38	921.25 MHz
6	39	921.75 MHz
7	40	922.25 MHz
8	41	922.75 MHz

New Zealand operating frequency band is 921.5 to 928 MHz with 500 kHz channel spacing.

LLRP Channel Number	Center Frequency (MHz)
1	921.5 MHz
2	922.0 MHz
3	922.5 MHz
4	923.0 MHz
5	924.5 MHz
6	925.0 MHz
7	925.5 MHz
8	926.0 MHz
9	926.5 MHz
10	927.0 MHz
11	927.5 MHz
12	928.0 MHz

Philippines operating frequency band is 918 to 920 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	32	918.25
2	33	918.75
3	34	919.25
4	35	919.75

Singapore operating frequency band is 920 to 925 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	36	920.25 MHz
2	37	920.75 MHz
3	38	921.25 MHz
4	39	921.75 MHz
5	40	922.25 MHz
6	41	922.75 MHz
7	42	923.25 MHz
8	43	923.75 MHz
9	44	924.25 MHz
10	45	924.75 MHz

South Korea operating frequency band is 917 to 920.8MHz with 200kHz channel bandwidth.

LLRP Channel Number	Center Frequency (MHz)
1	917.3 MHz
2	917.9 MHz
3	918.5 MHz
4	919.1 MHz
5	919.7 MHz
6	920.3 MHz

Taiwan operating frequency band is 920 to 928 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	37	920.75 MHz
2	38	921.25 MHz
3	39	921.75 MHz
4	40	922.25 MHz
5	41	922.75 MHz
6	42	923.25 MHz
7	43	923.75 MHz
8	44	924.25 MHz
9	45	924.75 MHz
10	46	925.25 MHz
11	47	925.75 MHz
12	48	926.25 MHz
13	49	926.75 MHz
14	50	927.25 MHz

Thailand operating frequency band is 920 to 925 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	36	920.25 MHz
2	37	920.75 MHz
3	38	921.25 MHz
4	39	921.75 MHz
5	40	922.25 MHz
6	41	922.75 MHz

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
7	42	923.25 MHz
8	43	923.75 MHz
9	44	924.25 MHz
10	45	924.75 MHz

Uruguay operating frequency band is 916 to 928 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	28	916.25 MHz
2	29	916.75 MHz
3	30	917.25 MHz
4	31	917.75 MHz
5	32	918.25 MHz
6	33	918.75 MHz
7	34	919.25 MHz
8	35	919.75 MHz
9	36	920.25 MHz
10	37	920.75 MHz
11	38	921.25 MHz
12	39	921.75 MHz
13	40	922.25 MHz
14	41	922.75 MHz
15	42	923.25 MHz
16	43	923.75 MHz
17	44	924.25 MHz
18	45	924.75 MHz
19	46	925.25 MHz
20	47	925.75 MHz
21	48	926.25 MHz
22	49	926.75 MHz
23	50	927.25 MHz
24	51	927.75 MHz

Note: Vietnam is divided into two regions:

Vietnam region 9 operating frequency band is 918-923 with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	32	918.25 MHz
2	33	918.75 MHz
3	34	919.25 MHz
4	35	919.75 MHz
5	36	920.25 MHz
6	37	920.75 MHz
7	38	921.25 MHz
8	39	921.75 MHz
9	40	922.25 MHz
10	41	922.75 MHz

Vietnam region 11 operating frequency band is 920-923 with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	37	920.75 MHz
2	38	921.25 MHz
3	39	921.75 MHz
4	40	922.25 MHz

South Africa Alternate operating frequency band is 915 to 919 MHz with 500 kHz channel spacing.

LLRP Channel Number	FCC Channel Number	Center Frequency (MHz)
1	27	915.750
2	28	916.250
3	29	916.750
4	30	917.250
5	31	917.750
6	32	918.250
7	33	918.750

9.5 Operation in Japan

9.5.1 Frequency Plan in Japan

The Impinj R700 reader operates within the 915.7 to 920.9MHz band approved for use in Japan. The four high power channels that do not require carrier sense (LBT) are supported as listed in the table that follows.

Frequency Plan for Japan

LLRP Channel Number	Japan Channel Number	Center Frequency (MHz)
1	6	916.8
2	12	918.0
3	18	919.2
4	24	920.4

9.5.2 Antenna Requirements in Japan

Power

The Impinj R700 reader may only be operated with Impinj-approved antennas and can radiate no more than 36 dBm EIRP per the Japan RFID regulations. The output power is limited per the Japan RFID regulations to 30dBm.

Approved Antennas

Contact your value-added distributer for the current list of approved antennas for use in Japan.

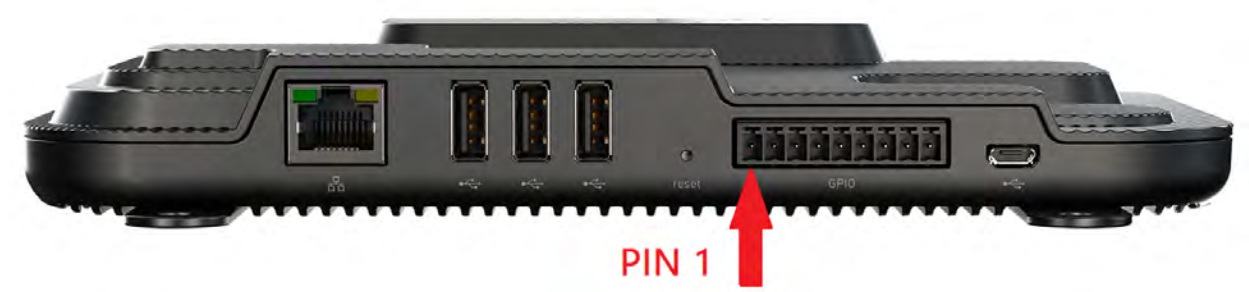
10 Appendix B: GPIO Details

The Impinj R700 reader includes a multipurpose I/O port that provides two general-purpose opto-isolated inputs, three opto-isolated outputs, and a +5V supply. You access these features through a 9-pin connector mounted on the side of the reader.

The two opto-isolated inputs have a range of 0–30V. The reader treats an input of 0–0.8V as a logic 0, and an input of 3–30V as a logic 1. The reader has a per-input debounce interval that is configurable via LLRP. (See the document titled Octane LLRP for more information). This value dictates the minimum pulse width of an input. Impinj recommends that external devices guarantee a minimum pulse width of at least 100 milliseconds.

The reader also provides three opto-isolated outputs. For the GPIO outputs to function, an external user supply must be connected between V+, and V-. The maximum voltage for this supply is 30V. When the user configures a selected GPIO output via LLRP to output logic 0, an isolated FET switch within the reader effectively shorts that output to V- with a current sink capability of up to 1500mA. When the user configures a selected GPIO output to logic 1, the selected output is pulled to V+ through a 10K resistor. If GPIO isolation is not required, the reader provides a +5V supply and a ground pin on the connector that can be connected to V+ and V-. The +5V pin is current limited to 500mA, max.

The figure below shows the location of the connector on the reader, with pin 1 highlighted to reveal the numbering scheme.



GPIO Port Location

Note: As described above, both the input and output pins are opto-isolated.

The GPIO connector is a Phoenix Contact MC 1,5/ 9-G-3,81 modular connector, which also goes by the part number 1803345. Use this part name/number when looking for a compatible adapter.

Warning: Do not attach a lightstack or other output device that requires reader output to sink more than 1500mA. Attaching non-approved devices will result in unrecoverable damage to the reader and is not covered by warranty, as it is outside the specified operating parameters.

Avertissement: Ne pas fixer d'lightstack ou tout autre périphérique de sortie qui nécessite une sortie de la lecteur à s'enfoncer de plus de 1500mA. Connexion de périphériques non autorisés entraînera des dommages irréparables pour le lecteur et n'est pas couvert par la garantie car il est en dehors des paramètres de fonctionnement spécifiées.

The following table explains the function of each pin.

GPIO Connector Pin-Out

Pin	I/O Name	I/O Function
1	+5V Supply	Reader supplied (not isolated) power source, 500mA max
2	Chassis Ground	Reader (not isolated) return
3	User IN 0	Isolated input 0
4	User IN 1	Isolated input 1
5	User OUT 0	Isolated output 0 (active pull down to V-)
6	User OUT 1	Isolated output 1 (active pull down to V-)
7	User OUT 2	Isolated output 1 (active pull down to V-)
8	V MINUS	Return for isolated inputs and outputs
9	V PLUS	Power source for isolated outputs

11 Notices

Copyright 2024, Impinj, Inc. All rights reserved.

Impinj gives no representation or warranty, express or implied, for accuracy or reliability of information in this document. Impinj reserves the right to change its products and services and this information at any time without notice.

EXCEPT AS PROVIDED IN IMPINJ'S TERMS AND CONDITIONS OF SALE (OR AS OTHERWISE AGREED IN A VALID WRITTEN INDIVIDUAL AGREEMENT WITH IMPINJ), IMPINJ ASSUMES NO LIABILITY WHATSOEVER AND IMPINJ DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATED TO SALE AND/OR USE OF IMPINJ PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT.

NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY PATENT, COPYRIGHT, MASK WORK RIGHT, OR OTHER INTELLECTUAL PROPERTY RIGHT IS GRANTED BY THIS DOCUMENT.

Impinj assumes no liability for applications assistance or customer product design. Customers should provide adequate design and operating safeguards to minimize risks.

Impinj products are not designed, warranted or authorized for use in any product or application where a malfunction may reasonably be expected to cause personal injury or death or property or environmental damage ("hazardous uses") or for use in automotive environments. Customers must indemnify Impinj against any damages arising out of the use of Impinj products in any hazardous or automotive uses.

Impinj, GrandPrix™, Indy®, Monza®, Octane™, QT®, Speedway®, STP™, True3D™, xArray®, and xSpan® are trademarks or registered trademarks of Impinj, Inc. All other product or service names are trademarks of their respective companies.

These products may be covered by one or more U.S. patents. See impinj.com/patents for details.

For more information, contact support@impinj.com