



**Datasheet**

# **IMPINJ R510 RAIN RFID READER**

## **DATASHEET**

## OVERVIEW

For RAIN RFID users who need a fixed-mount reader with reliable performance, simple deployment, and flexible IoT integration Impinj R510 is a high-performance RAIN RFID reader that easily connects to enterprise applications. Unlike Speedway readers, the Impinj R510 reader provides high speed enterprise connectivity with modern developer tools. Unlike Impinj R700 readers, the Impinj R510 reader provides lower read sensitivity at a price comparable to Speedway R220. Existing Speedway customers can effectively migrate to R510 and build off an IoT-ready platform to advance on their IoT journey.

This document constitutes the electrical and mechanical specifications pertaining to the Impinj R510 RAIN RFID reader. It contains a functional overview, mechanical characteristics, and electrical specifications. For technical support, visit the Impinj Support Portal at [support.impinj.com](https://support.impinj.com).

**Table 1: Impinj R510 Key Specifications**

Specification	Description
<b>Physical Dimensions</b>	With mounting brackets 8.4 in. long x 7.4 in. wide x 1.2 in. deep (21.5 cm x 18.7 cm x 3.0 cm) Without brackets: 8.4 in. width x 5.9 in. depth x 1.2 in. height inch (21.4 x 14.9 x 3.0 cm)
<b>Power Supply</b>	PoE (802.3af), PoE+ (802.3at) with LLDP for power negotiation
<b>Air Interface Protocol</b>	EPCglobal UHF Gen2 v2 / ISO 18000-63 RFID
<b>Antenna Ports</b>	4, Monostatic (RP-TNC)
<b>Frequency Range</b>	IPJ-R510-341 Global Reader: 902 – 928 MHz
<b>Transmit Power Range</b>	PoE: 10 to 30 dBm PoE+: 10 to 33 dBm
<b>Receive Sensitivity</b>	-93 dBm <sup>1</sup>
<b>Processor</b>	Dual-core 1 GHz ARM Cortex-A7
<b>Memory</b>	1 GB Flash, 1 GB RAM
<b>Network Connectivity</b>	10/100/1000 BASE-T Ethernet
<b>Device Connectivity</b>	3 USB Type-A, 1 micro USB
<b>General Purpose I/O</b>	3 out, 2 in

<sup>1</sup> CISC, Ideal RL/Cable, +30dBm Tx, mode 3: BLF 160kHz, M=8

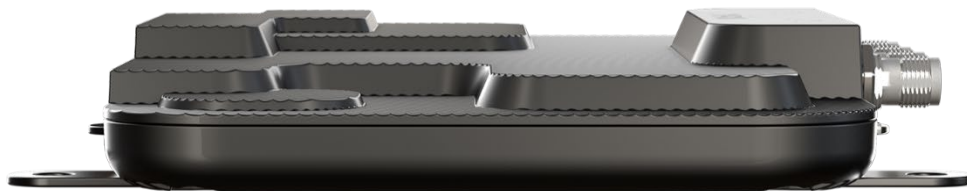
Figure 1: Impinj R510 Top View



Figure 2: Impinj R510 Bottom View



**Figure 6: Impinj R510 Right View**



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# 1 INTRODUCTION

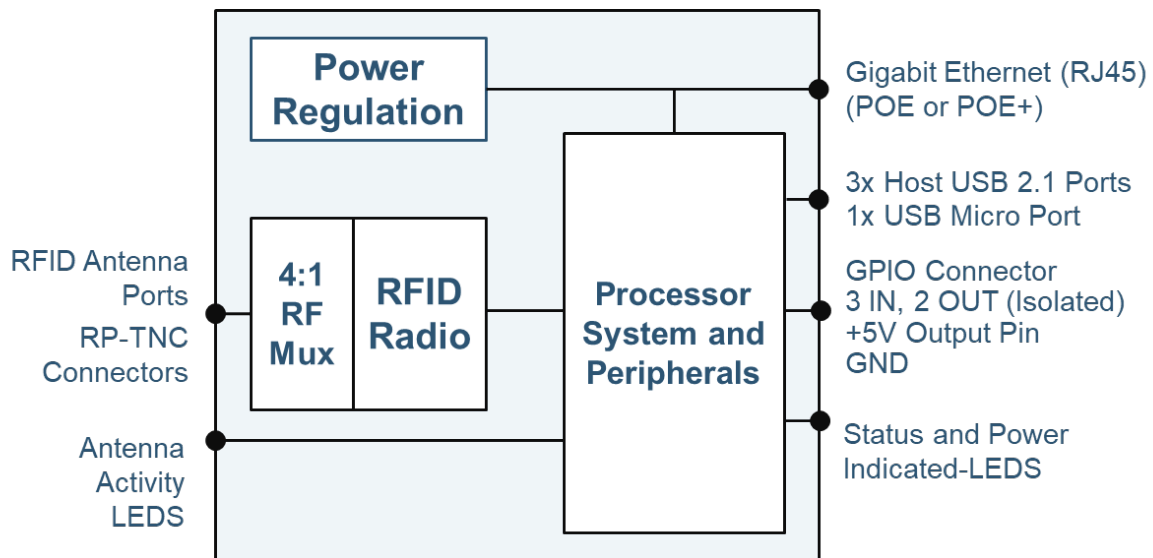
The Impinj R510 RAIN RFID reader is a four-port RFID reader compliant with the GS1 UHF Gen2v2 protocol which ISO/IEC standardizes as 18000-63. Impinj R510 is specifically designed to meet the increasing demands of next-generation IoT solutions and enterprise-grade RAIN deployments.

## 1.1 Features & Benefits

- **Developer-friendly interface:** Easily connects IoT applications to configure and control devices, and to consume RAIN data
- **Efficient Design:** Enables cost-effective, energy-efficient IoT solutions with over 25% lower power consumption than Impinj R700 readers
- **Powerful edge processing:** Enables on-reader intelligence for tag-processing algorithms that leverage 10x the processing power of Impinj Speedway
- **High-performance receive sensitivity:** Empowers reading tags farther and faster with comparable RF performance to Impinj Speedway readers
- **Secure, upgradable Linux OS:** Delivers enterprise-grade security and reliability
- **Rich peripheral support and flexible 4-port and 2-port options:** Provides flexibility to seamlessly integrate into customized IoT solutions

## 1.2 Block Diagram

Figure 7: Impinj R510 Block Diagram



## 2 SPECIFICATIONS

### 2.1 Mechanical

**Table 2: Impinj R510 Mechanical Specifications\***

Specification	Description
<b>Physical Dimensions</b>	With mounting brackets 8.4 in. long x 7.4 in. wide x 1.2 in. deep (21.5 cm x 18.7 cm x 3.0 cm) Without brackets: 8.4 in. width x 5.9 in. depth x 1.2 in. height inch (21.4 x 14.9 x 3.0 cm)
<b>Mounting</b>	VESA 100 ×100 mm on bottom of the enclosure Two removable brackets compatible with Impinj Speedway mounting system with center-to-center hole measurements of (H x W) (169.0mm x 152.2mm).
<b>Weight</b>	2.12 lb., 0.96 kg
<b>Housing Material</b>	Die-cast Aluminum
<b>Factory Reset Button</b>	Restores reader to known factory state
<b>LED Indicators</b>	System status, inventory, firmware upgrade, antenna activity, network activity

\*Impinj R510 uses an identical housing to the Impinj R700.

### 2.2 Environmental

**Table 3: Impinj R510 Environmental Specifications\***

Specification	Description
<b>Operating Temperature</b>	-4° F to 122° F (-20° C to 50° C)
<b>Storage Temperature</b>	-4° F to 158° F (-20° C to 70° C)
<b>Humidity</b>	5% - 95% non-condensing
<b>Sealing</b>	Ingress Protection (IP) 50 rating
<b>Shock and Vibration</b>	United States Military Standard MIL-STD-810G

\*These specifications provided are from the Impinj R700. Using the same external housing, environmental specifications of the Impinj R510 should be comparable.



## 2.3 RFID

**Table 4: Impinj R510 RFID Specifications**

Specification	Description
<b>Air Protocol</b>	EPCglobal UHF Class 1 Gen 2 v2 / ISO 18000-63 RFID
<b>Transmit Power</b>	10 – 30 dBm (PoE) 10 – 33 dBm (PoE+)
<b>Transmit Power Resolution</b>	0.25 dB
<b>Transmit Power Accuracy</b>	0.5 dB
<b>Frequency Range</b>	IPJ-R510-341 Global Reader: 902 – 928 MHz
<b>Return Loss</b>	10 dB min
<b>Read Rate</b>	Up to 1100 reads per second
<b>Antenna Impedance</b>	50 ohms
<b>Max Receive Sensitivity</b>	-92 dBm <sup>1</sup>
<b>Gen 2 Reader Modes</b>	Static and Dynamic RF Modes various per region

<sup>1</sup> CISC, Ideal RL/Cable, +30dBm Tx, mode 3: BLF 160kHz, M=8

### 2.3.1 Transmit Power

The user configures Impinj R510 transmit power, the conducted power available at the RF port on the reader. For all Impinj R510 reader models, the reader will limit the maximum transmit power to 30 dBm while configured to use PoE power. When configured to use PoE+ power, the reader may allow for a higher maximum transmit if the region allows for it. The Impinj R510 will only present valid output powers for the region it is configured to operate in. For additional information on how to properly set transmit power to comply with regulatory rules, refer to the Impinj R510 Installation and Operations Guide. For additional information on the differences between PoE and PoE+ power refer to section 2.4.1 of this datasheet.

### 2.3.2 Gen 2 Reader Modes

The Impinj R510 includes support for two types of reader modes: static and dynamic. The number of modes varies per region and comply with regulatory agencies. For additional detail on Reader Modes visit the Impinj Support Portal.

### 2.3.3 Read Rate

The Impinj R510 read rate varies depending on the reader configuration and number of tags in the field of view. The maximum read rate can only be achieved while using reader mode 0 in an FCC-like region.

## 2.3.4 Receive Sensitivity

The receive sensitivity of the Impinj R510 varies depending on the RF mode chosen to perform Inventory. Applications that require the lowest (i.e. best) receive sensitivity should choose Dense Reader M8 mode. Receive sensitivity can be measured with various methods. To best inform partners, we define a Max, Typical, and Minimum receive sensitivity values below. Note: receive sensitivity can degrade up to 3 dB as Tx power increases from +30dBm to +33dBm.

	Max <sup>2</sup>	Typical <sup>3</sup>	Min <sup>4</sup>
<b>Rx Sensitivity<sup>1</sup></b>	-93 dBm	-86 dBm	-72 dBm

<sup>1</sup> LLRP Mode 3 (M=8, BLF=160kHz), Tx power = +30 dBm, 1E-3 PER

<sup>2</sup> Max: Ideal Return Loss (RL), 0m cable length; CISC sensitivity measurement

<sup>3</sup> Typical: ~15dB RL, ~2m cable length

<sup>4</sup> Min: 10dB RL, ~10m cable length

## 2.4 Connectivity

**Table 5: Impinj R510 Connectivity Specifications**

Specification	Description
<b>Network</b>	10/100/1000 Base-T Ethernet (RJ45)
<b>Antenna Ports</b>	4 monostatic ports (RP-TNC)
<b>USB</b>	3 Type A host, 1 micro device
<b>Power</b>	PoE (802.3af), PoE+ (802.3at) with LLDP for power negotiation
<b>Power Consumption</b>	7W – 13W (dependent on reader settings)
<b>General Purpose I/O</b>	3 out, 2 in optically isolated
<b>General Purpose I/O Header</b>	Phoenix Contact 9 pin 3.81 mm pitch

### 2.4.1 Power

The Impinj R510 is powered exclusively through Power over Ethernet (PoE) or PoE+ via the ethernet port. For applications where the reader is not connected to a PoE capable switch, users can apply a midspan injector to add inline power to a network connection via a power supply. By default, the Impinj R510 will attempt to negotiate power using Link Layer Discovery Protocol (LLDP). If the negotiate fails, the Impinj R510 will default to using PoE power.

Impinj recommends PoE+ power when using the Impinj R510 to source power to external USB devices or through the general-purpose outputs.

## 2.4.2 GPIO

The Impinj R510 utilizes a Phoenix Contact 9 position 3.81 mm pitch header to expose the GPIO signals. To connect external signals, a matching terminal block must be installed. Pin 1 is located nearest the push-pin factory reset button.

**Table 6: Impinj R510 GPIO Pin Assignments**

Pin	Assignment
1	+5V (500 mA max current)
2	Chassis GND
3	IN 0
4	IN 1
5	OUT 0
6	OUT 1
7	OUT 2
8	V MINUS
9	V PLUS

**Figure 8: Impinj R510 GPIO Pin Locations**



**Table 7: Impinj R510 GPIO Electrical Specifications**

Specification	Description
V PLUS	5 – 30 V (reference to V MINUS)
Input Logic 0	0 - 0.8 V
Input Logic 1	3 – 30 V
Output Logic 0	0 – 0.5 V (reference to V MINUS)
Output Logic 1	V PLUS – 0.5 V
GPO Current Draw	1.5 A Source or Sink
Isolation	Optical

## 2.5 Operating System

Table 8: Impinj R510 Operating System Specifications

Specification	Description
Processor	Dual-Core 1 GHz Cortex A7
Memory	1 GB Flash, 1 GB RAM
Operating System	Linux, 5.4 kernel
Firmware	Impinj R510 Firmware
Firmware Upgrade	Web-based and remote capable
Network Stack	IPv4, IPv6
Network Services	SSH, HTTP, HTTPS, NTP, DHCP, SFTP, mDNS
Network Security	802.1x port security
Network Management	Event logs with syslog forwarding

## 3 DEVELOPMENT LIBRARIES

Table 9: Impinj R510 Supported Development Libraries

Specification	Description
Reader configuration REST API	OpenAPI compatible RESTful configuration API with support for over 80 languages.
Impinj Octane SDK	Host-based applications (.NET, Java)
Impinj Octane LLRP toolkit	Host-based applications (.NET, Java, C, C++) compatible with LLRP 1.0.1 with Impinj Extensions
Impinj R700 embedded toolkit	Compiler (C, C++) and precompiled Octane LLRP libraries to develop on-reader applications

## 4 REGULATORY SPECIFICATIONS

Table 10: Impinj R510 Regulatory Specifications

Specification	Description
<b>RF</b>	USA and Canada <ul style="list-style-type: none"> <li>Federal Communications Commission (FCC) Part 15.247 and 15.249</li> <li>Professional Installation required under FCC rules</li> </ul>
<b>Safety</b>	USA and Canada <ul style="list-style-type: none"> <li>UL listed</li> </ul>
<b>Hazardous Substances</b>	RoHS3 2015/863 compliant

The latest regional certifications are available on the Impinj Support Portal.

## 5 ORDERING INFORMATION

### 5.1 Reader

Table 11: Impinj R510 Part Number Information

Specification	Description
<b>IPJ-R510-341</b>	Impinj R510 RAIN RFID reader, 4-Port, FGX

## 5.2 Accessories and Warranties

**Table 12: Impinj R510 Hardware Accessories and Services**

Part Number	Name	Description																												
<b>IPJ-A6010</b>	Impinj R700 antenna hub	The Impinj R700 antenna hub expands the number of antennas that can connect to an Impinj R510/R700 reader by allowing eight antennas to connect to one antenna port for a total of 32 antennas per reader.																												
<b>IPJ-A5100-000</b>	Impinj R700 water-resistant case	IP54 water resistant case for R510/R700 reader.																												
<b>IPJ-A2010</b>	PoE+ Midspan Injector	PoE+ midspan power injector (without AC power cord)																												
<b>IPJ-A2041-xxx</b>	AC Power Cord for PoE+ injector	<table border="0"> <tr> <td>ARG</td> <td>Argentina</td> <td>RSA</td> <td>South Africa</td> </tr> <tr> <td>AUS</td> <td>Australia, New Zealand</td> <td>UK1</td> <td>UK, Singapore</td> </tr> <tr> <td>BRA</td> <td>Brazil</td> <td></td> <td>Malaysia,</td> </tr> <tr> <td>CHN</td> <td>China</td> <td></td> <td>Hong Kong</td> </tr> <tr> <td>EU1</td> <td>Europe</td> <td>USA</td> <td>USA</td> </tr> <tr> <td>IND</td> <td>India</td> <td></td> <td></td> </tr> <tr> <td>JPN</td> <td>Japan</td> <td></td> <td></td> </tr> </table>	ARG	Argentina	RSA	South Africa	AUS	Australia, New Zealand	UK1	UK, Singapore	BRA	Brazil		Malaysia,	CHN	China		Hong Kong	EU1	Europe	USA	USA	IND	India			JPN	Japan		
ARG	Argentina	RSA	South Africa																											
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BRA	Brazil		Malaysia,																											
CHN	China		Hong Kong																											
EU1	Europe	USA	USA																											
IND	India																													
JPN	Japan																													
<b>IPJ-C205x</b>	Warranty extension	<table border="0"> <tr> <td>1</td> <td>1-year</td> </tr> <tr> <td>2</td> <td>2-year</td> </tr> <tr> <td>3</td> <td>3-year</td> </tr> </table>	1	1-year	2	2-year	3	3-year																						
1	1-year																													
2	2-year																													
3	3-year																													
<b>IPJ-C2001</b>	Firmware Updates	Firmware Updates (1-year)																												

### 5.3 Antennas and Antenna Cables

**Table 13: Antenna and Antenna Cable Ordering Information**

Part Number	Part Name	Description
<b>IPJ-A0303-000</b>	Impinj Mini-Guardrail antenna	Impinj Mini-Guardrail antennas are ideal for fixed spaces that need exceptional control in a small zone. The antenna is unobtrusive and optimal for monitoring items within cabinets or other small enclosures. Provides broadband support for optimal performance globally.
<b>IPJ-A0311-xxx</b>	Impinj Threshold antenna EU1 ETSI USA FCC	Impinj Threshold antennas identify items as they pass over or under a threshold or boundary. The antenna's high-capacity read range is designed to maximize intensity in highly specific zones providing wide zone coverage ideal for a road race course or other boundary or threshold crossing. Provides optimized performance in FCC- and ETSI-supported regions.
<b>IPJ-A0400-xxx</b>	CSL Brickyard Antenna EU1 ETSI USA FCC	Brickyard antennas by CSL are ideal for fixed spaces that need exceptional control in a small zone. These antennas are unobtrusive and are optimal for tracking items on tables, point of sale terminals, or within cabinets.
<b>IPJ-A0402-xxx</b>	Impinj Guardwall Antenna EU1 ETSI USA FCC	Deployed in pairs, Impinj Guardwall antennas provide a tightly controlled read zone to monitor items, packages, or cases moving on conveyor systems. Provides optimized performance in FCC- and ETSI-supported regions.
<b>IPJ-A0404-000</b>	Impinj Matchbox Antenna	The Impinj MatchBox antenna is ideal for tight-proximity spaces that need exceptional control in a small zone. The antenna is unobtrusive and can monitor items within cabinets or other small enclosures. Provides bi-directional, short-range coverage and broadband support for optimal performance globally.
<b>IPJ-A1000-xxx</b>	Laird Far-Field LHP antenna EU1 ETSI USA FCC	Far-Field antennas by Laird provide highly efficient coverage with a weather-resistant design. These antennas have maximum performance at distances over 5 feet and are ideal for situations where the tagged item will be at different angles and heights.  Left hand circularly polarized (LHP) version.
<b>IPJ-A1001-xxx</b>	Laird Far-Field RHP antenna EU1 ETSI USA FCC	Far-Field antennas by Laird provide highly efficient coverage with a weather-resistant design. These antennas have maximum performance at distances over 5 feet and are ideal for situations where the tagged item will be at different angles and heights.  Right hand circularly polarized (RHP) version.

<b>IPJ-A1100-xxx</b>	Times-7 Slim Outdoor antenna EU1 ETSI USA FCC	Slim Outdoor antennas by Times-7 provide maximum zone coverage in a low-profile design for both indoor and outdoor use. These rugged antennas have optimal read performance in a broad range of environments over long read ranges up to 29 feet.
<b>IPJ-A1200-xxx</b>	Times-7 Compact Outdoor antenna EU1 ETSI USA FCC	Compact Outdoor antennas by Times-7 provide read zone coverage in a compact design for both indoor and outdoor use. These compact antennas have an aesthetically pleasing design and provide optimal performance in a broad range of environments over long read ranges up to 19 feet. Provides optimized performance in FCC- and ETSI-supported regions
<b>IPJ-A300x-000</b>	Antenna Cable 2 2 meters 4 4 meters 8 8 meters	RG58, SMA male to R-TNC male
<b>IPJ-A311x-000</b>	Antenna Cable 2 2.1 meters 4 4.6 meters	Low Loss/High Flex, SMA male to R-TNC male
<b>IPJ-A312x-000</b>	Antenna Cable 2 2.1 meters 4 4.6 meters	Low Loss/High Flex, SMA male to SMA male



## 6 IMPINJ FIXED READER COMPARISON

Table 14: Impinj Fixed Reader Comparison

Feature	Impinj R510	Impinj R700	Impinj R420*	Impinj R220*
Antenna Ports	4	4	4	2
Read Zones (max)	32	32	32	16
Read Rate (max per-second)	1100	1100	1100	200
Transmit Power (max, dBm)	33.0	33.0	32.5	32.5
Receive Sensitivity (max, dBm)	-84	-92	-84	-84
Processor Speed	1 GHz (dual core)	1 GHz (dual core)	400 MHz (single core)	400 MHz (single core)
Random Access Memory (MB)	1024	1024	256	256
Custom Application Partition (MB)	128	128	32	32
Impinj IoT device interface	yes	yes	no	no
USB Peripheral Slots	3	3	1	1
GPIO Connector	Integrated	Integrated	Accessory	Accessory
Ethernet Network Speed	10/100/1000	10/100/1000	10/100	10/100
Power Over Ethernet Support	PoE PoE+	PoE PoE+	PoE PoE+ EU2 model	PoE

**\*The Impinj R420 and R220 are currently undergoing the End-of-Life process and not recommended for new designs.**

## 7 ADDITIONAL USER DOCUMENTATION

The following table lists documents that may be helpful in operating the Impinj R510. These documents can be found on the Impinj Support Portal at [Impinj R700 Reader Documents](#).

**Table 15: Impinj R510 User Documentation**

Document	Description
<b>Impinj R510 Quick Start Guide</b>	Simple guide to begin using the Impinj R510
<b>Impinj R510 Installation and Operations Guide</b>	Detailed instructions for installing, connecting, configuring, operating, upgrading, and troubleshooting the Impinj R510
<b>Technical Training</b>	Detailed training for technical audiences of R510
<b>Impinj R510 Migration Guide</b>	Migration guide for Impinj R510

## 8 CHANGE LOG

### 8.1 October 2021

- Document Created

## 9 NOTICES

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