RFID DAS 9200 Reader
Installation and Operations Guide

www.pervasid.com

Federal Communications Commission (FCC) / IC Canada Compliance Statement

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

This equipment has been tested and found to comply with the limits for a Class B device under Part 15 of the FCC regulations. The limits are designed to provide protection against harmful interference in a commercial environment. This equipment is designed to intentionally radiate RF energy and if not installed correctly in accordance with instruction, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in any given installation. If this equipment does cause interference which can be determined by turning the equipment on and off, the interference may be reduced by:
Increasing the separation between the equipment and the receiver
Reorient or relocating the equipment antenna.

Only the recommended antennas listed in Appendix A should be used with this equipment and the output power should be set depending on the cable length in accordance with the PervasID Power tool. (see section on antenna connection)

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65 and RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated so that the antennas are kept at least 7.9 inches (20 cm) or more away from a person's body (excluding extremities: hands, wrists, feet and
ankles).

ETSI Compliance

The RFID DAS 9200 Reader (the Reader) is a product and has been certified to IEC 60950-1/EN 60950-1 and EN 301 489-1/EN 301 489-3.

Warning: Please read this manual in its entirety before operating the RFID DAS 9200 Reader, as personal injury or equipment damage may result from improper use. Under no circumstances should the RFID DAS 9200 enclosure be opened.

Caution: Risk of explosion if lithium battery (Model Number: CR 1216; located inside the RFID DAS 9200 reader) is replaced by an incorrect type. Dispose of used batteries according to the instructions.

Caution: Only the power supply unit (PSU) (Model number: AEB70US24 or AEB100PS24; XP POWER - AC-DC converter, EXTERNAL PLUG IN), supplied with the RFID DAS 9200 reader can used for powering the RFID DAS 9200 reader. Any

Other PSU could be dangerous and failure to ensure this could make the product unsafe.

Check List

The PervasID RFID DAS 9200 system is a 4-port UHF DAS RFID Reader (the Reader), capable of feeding eight antennas and allowing tag information to be uploaded over its Ethernet interface to a server for processing, analysis and display. The real-time information of assets is thereby logged. The reader consists of:

1. A controller box with Ethernet interface
2. A +24 VDC external power supply
3. Coaxial cables
4. UHF Antennas

Table of Contents

List of Acronyms

CRC Cyclic Redundancy Check

DAS Distributed Antennas System

EIRP Effective Isotropically Radiated Power

EPC Electronic Product Code

ERP Effective Radiated Power

ETSI European Telecommunications Standards Institute

FCC Federal Communications Commission

ISO International Organization for Standardization

RF Radio Frequency

RFID Radio Frequency Identification

RSSI Received Signal Strength

Rx Receiver

Tx Transmitteer

UHF Ultra High Frequency

1 Introduction

This manual provides detailed instructions for installing, connecting, configuring and operating the RFID DAS 9200 Reader.

The intended audience for this manual is the operator installing and operating the RFID DAS 9200 Reader. It is presumed that the operator has a good knowledge of RF propagation, exposure limits, radio interference, RFID, the EPC Gen2 spec, software, hardware systems integration and network connectivity.

1.1 RFID DAS 9200

The RFID DAS 9200 is a fixed UHF RFID Reader and allows sensitive detection of RFID tags over areas of up to 400 square metres.

Figure 1: PervasID DAS 9200 system

The RFID DAS 9200 system consists of a centralised RFID DAS controller/Reader unit and antennas connected using co-ax cables. The antennas should be distributed over the interrogation area, for instance by placing four antennas at the corners of an interrogation area with a 5th, 4 port antenna located centrally in the interrogation area. Antennas should typically not be separated by more than 10m, and optimum locations will also depend on the operating environment, tags used and application.

The RFID DAS unit is equipped with an Ethernet interface allowing tag information to be uploaded to a server for processing, analysis and display.

1.2 Requirements for Using RFID DAS 9200

IT Interface Requirements

TCP/IP network equipment is required to connect to the Reader. The PervasID testing server is on IP address 93.93.128.16 and requires open ports in the range 9200-9200. NTP is also required for the reader internal clock.

Power Requirements

An external universal AC to DC power supply, a suitable +24 VDC power supply is provided with the Reader. This must be fed by an AC single phase supply of 100-240V.

Antenna Requirements

The RFID DAS 9200 is equipped with eight independent TX/RX antenna ports.

1) **PeravsID ceiling tile**

   A 4 beam ceiling tile antenna may be used with the reader in a configuration such that 5 tiles are required for a cell, with corner antennas shared between multiple readers. The antenna has a 7.5dBic gain, and the output power of the reader must be adjusted to account for cable loss.

2) **Other Antennas**

   Operators must use the recommended antennas by PervasID and further details can be found on page 20. The transmit power must be adjusted according to the cable length and antenna gain to ensure 2W ERP limit.

It is the installers responsibility to ensure that the combination of the configured reader output power, cables losses and antenna gain used do not exceed local regulations. PervasID provide a spreadsheet tool to help calculate the power settings of the reader which should be used to achieve the maximum allowed output power for various antenna and cable combinations.

All eight antenna ports may be used in order to maximise the coverage area. However, should the operators wish to operate with fewer antennas, then the unused ports MUST be terminated with a 50 ohms load (terminator) or damage to the unit will result (50 ohms loads are provided with the unit for this purpose).

2 Installing the DAS RFID 9200 System

The following figures (Figures 2 and 3) illustrate the I/O ports, including antenna ports, located on the RFID DAS 9200 Reader. Antenna ports and LED status indicators are located on the front panel of the Reader while power, Ethernet and USB interfaces are located on the back panel of the Reader. An illuminated Green light on *Power* indicates that the Reader is powered. An illuminated Green LED light on any RF port (ie. RF 1 – RF 8) means that that port is active. An illuminated Green light on *Read* implies that the Reader is successfully detecting tags while an illuminated Green light on *CRC* implies that there is a CRC error over a tag read.

Under normal operation, the LEDs of the active ports will flicker indicating activity on the ports and the read LED will flicker as tags are read while the reader is reading.
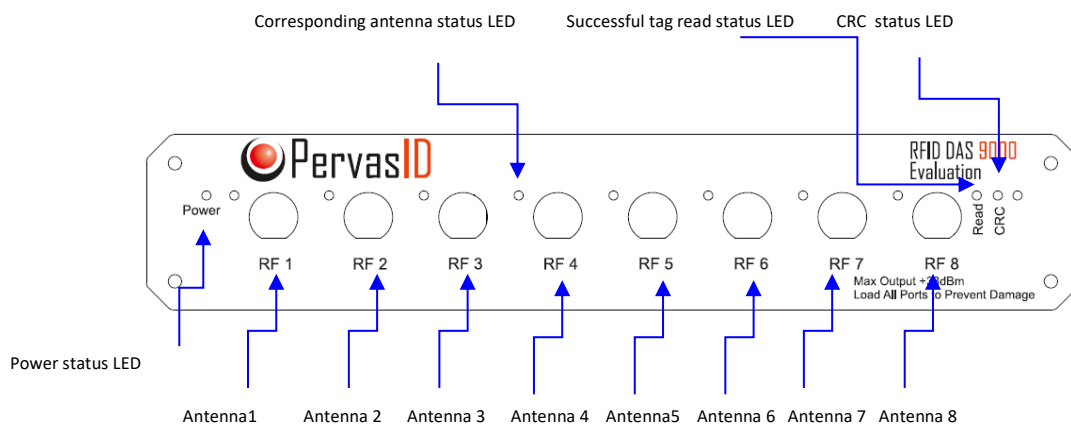
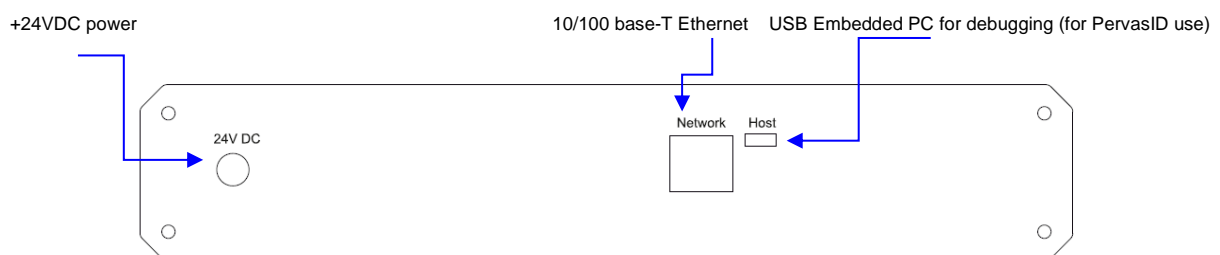Figure 2: DAS RFID Antenna Ports and Status LEDs

Figure 3: RFID DAS Port Connections

The USB Embedded PC interface labelled *Host* on Figure 3 gives access to the embedded WinCE PC and may be used to configure the reader IP address. Please contact PervasID should you require access to this interface.

2.1 Installing and Connecting the RFID DAS 9200 Reader

The primary installation and connection steps for the RFID DAS 9200 system are:

1. Position the Reader appropriately and mount the Reader in a stable location

Choose an appropriate location for the Reader. You should always keep the unit away from extreme temperatures and sources of electromagnetic interference as this may degrade performance and lifetime of the Reader.

It should be noted that heat is generated when the Reader is actively running and care should be taken to ensure appropriate ventilation. Other instruments or items should not be placed on top of the Reader.

2. Connect the antennas to the RF ports on the Reader

Each RF port should be connected to a recommended RFID antenna or ceiling tile port. Where a port is left used for any reason it must be terminated with a 50 ohms load (both on the antenna and reader).

Warning: The Reader will be seriously damaged if any of the ports are not connected to an antenna or terminated with a 50 ohm load before operating it.

The following steps need to be taken in order to install the antennas reliably:

1) Select the antenna locations. The recommended antenna arrangement is shown in figure 4 (for Space Ranger applications, other potential antenna configurations are detailed in the Installation Guide). The antennas should also be positioned:
Away from metallic objects which fall in their field of view,
Away from sources of interference (such as compact florescent lights)
With a separation between antennas greater than 0.25m
Away from locations where persons are likely be within 0.25m of the radiating face of the antenna for periods exceeding 6 minutes.

2) The antennas should be securely mounted in accordance with the instructions supplied with the antenna.

3) Attach the antenna cables to the antenna ports on the Reader as detailed in the installation diagram. The cable connectors should be a tight as can comfortably achieved by hand, but under no circumstances should tools be used to tighten. A note should be made of the cable type and length connected to each antenna port.
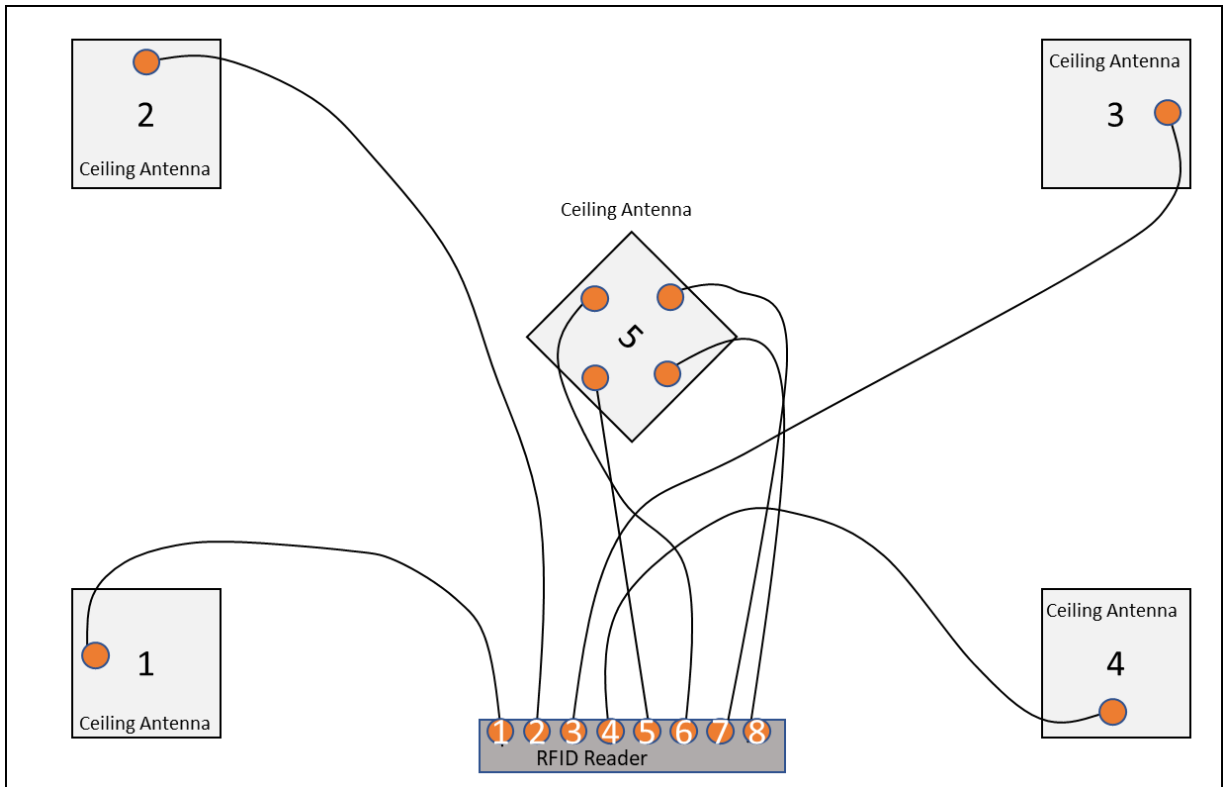
Figure 4: Example antenna placements over an interrogation area

Other read and antenna configurations are outlined in the PervasID installation guide.

3. Connect the Reader to the network

You are now ready to connect the installed RFID DAS 9200 to your network.

You should connect the Reader directly to your Ethernet network. Once the Reader is powered, it will communicate with a hosted server.

Make sure that there is no firewall in place which might prevent the Reader communicating with the hosted server. You must be able to communicate with the server (93.93.128.16) over the port assigned for your trial (default port 9200) and NTP on port 123. The reader is configured be default to a static IP address in the 192.168.14.X subnet.

4. Connect power to the Reader

You should connect the 24VDC external universal power supply into a suitable power outlet.

Once you have successfully connected, the Power and Status LEDs on the Reader should indicate that the Reader is on. The connection and activity LEDs on the Ethernet should indicate a network connection.

5. Connecting to the database
Access the server by to the following location http://93.93.128.16/phpmyadmin
When prompted for a username and password enter the username and password supplied for your trial:
Username: trial7User
Password: pervasid528

The connection of the reader can be checked by looking at the reader_status table. This should display the reader_id (mac address), ip address, connection time and status 0. The connection can be confirmed by refreshing the table and ensuring that the server_timestamp is incrementing.

6. Selecting and configuring the setting on the Reader
The output power of each port should be configured according to the desired output power, cable length and antenna in-use. The PervasID cable calculator spreadsheet tool can be used to determine the power setting which should be used. Other settings as required by your application can also be configured.

Reader settings are configure through the server database.
Under the tables tab on the left hand side click reader_settings
All the readers which have been connected to your installation (including those previously connected) will be displayed.
The switch_states entry should be set according to your antenna configuration. For the standard Space Ranger configuration it should be set to 13.

7. Test the Reader installation by reading tags

You can confirm that connections and functionality are correct by reading tags. Using the PervasID Dashboard software interface, you can quickly verify Reader operation by running an inventory operation.
To allow verification of the performance, the reference_tags table is provided. This should contain all the all of the tags which you expect the reader to detect for comparison and benchmarking. Data can be imported by selecting the reference_tags table, then clicking import along the top menu. We recommend that data is supplied as a csv file with no headers. The file should be a single column of EPCs represented as strings in hexideciamal format.

e.g.
```
<begin file>
3039ECBC017BBE412A05F525
3039ECBC00BB9CC12A05F653
3039ECBC03AA39412A05F57C
<end of file>
```

The TRUNCATE operation in the 'Operations' tab can be used to remove all the EPCs from this table.

To start and stop the reader, the Reader_commands table is used. Each time a command is set, the 'processed' flag should be set to zero, this will be overwritten back to 1 when the command executes. To start the reader select the desired reader in the table and click 'edit', set the command to 1 and processed to 0, then click 'go'. To stop the reader, the same process is followed, with the command set to 2 and processed set to 0.

The Tag reads from the reader are held in the tag_reads_simple table. This displays the tag_read_id, an auto incrementing integer which is unique for each read. Zone which corresponds to the group of readers were the tag read orginated. Time_stamp which is representation of the time at which the read occurred (referenced to the internal clock of the RFID reader), in milliseconds since 00:00 January 1st 1970 UTC/GMT.
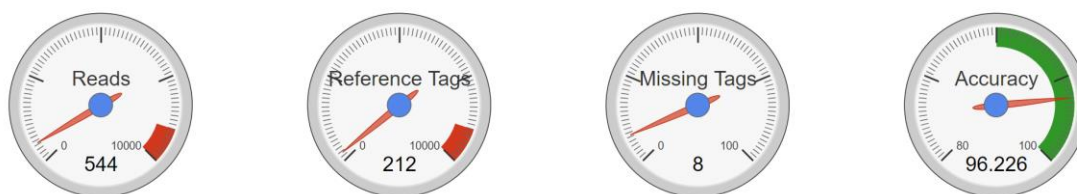
8. PervasID Dashboard Interface
The PervasID Dashboard Interface is supplied to allow easy evaluation of the PervasID system. The dials of the dashboard are shown below.

The displays show: the number of unique EPCs detected (as held in the tag_reads_simple table), the number of reference tags (held in the reference_tags table), the number of missing tags (tags held in the reference_tags which have not been found in tag_reads_simple, initially this will be equal to the number of reference tags) and the resulting reader accuracy which is the number of missing tags divided by the

number of reference tags. The clock at the bottom displays the elapsed time since the reader was started.

2.2 Compliance with ETSI Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

European Council Recommendation 1999/519/EC details basic restrictions and reference levels on human exposure to electromagnetic fields as advised by the ICNIRP and states that adherence to these recommended restrictions and reference levels should provide a high level of protection as regards the established health effects that may result from exposure to such fields.

By the very nature of the RFID DAS 9200 reader system design and installation for correct operation, users should not find themselves within close proximity of the antennas. EN 62311:2008 is the applicable Harmonised Standard for EM fields generated by this RFID DAS 9200 system and all installations comply with this standard and the recommendations, and are safe when antennas are installed such that:

(a) A minimum antenna separation of 0.25m is maintained

and

(b) An individual can be no nearer than 0.25m from an antenna for a period of 6 minutes at any one time.

These guidelines are based on the Maximum Permissible Exposure (MPE) Calculation Report generated by UL. Please get in touch with PervasID should you wish you see the report [4].

Warning: We strongly recommend that users must follow above guidelines. Under no circumstances should the RFID DAS 9200 be installed and operated outside these specifications.

4 Troubleshooting

If you experience a problem with RFID DAS 9200, this brief section presents a few suggestions to correct the issue.

Error	Cause	Resolution
Reader_status server_timestamp is not incrementing	Network connection between the Reader and sever is not active	(a) Reset power to the Reader and wait for few seconds (b) Check communication by pinging 93.93.168.16 (c) Ensure ports 9XXX and 123 are open by connecting 93.93.168.16 via Telnet on those ports – a connection refused message indicates a firewall problem.
Offset between server_timestamp and time_stamp in reader_status table	Reader internal clock is not properly set	Ensure that the reader has correctly configured NTP access.
No illuminated Green LED light is observed	Power is not supplied to the Reader	Check the power connection to the Reader
Power LED is on but no other LED lights are on during an inventory operation	The reader is not correctly configured.	Check the reader parameters.

If you are still unable to determine the cause, you may want to contact PervasID directly. Please send an e-mail to support@pervasid.com in the first instance.

References

[2] EPCglobal Specification for RFID Air Interface, [Online].Available: http://www.epcglobalinc.org/standards/uhfc1g2/uhfc1g2_1_2_0-standard-20080511.pdf

[3] EPCglobal Class1 Gen2 RFID Specification, Alien, [Online].Available: http://www.rfidproductnews.com/whitepapers/files/AT_wp_EPCGlobal_WEB.pdf

[4] Safely Technical Justification Document for Electromagnetic Fields generated by PervasID "RFID DAS 9200", Maximum Permissible Exposure (MPE) Calculation Report, Sulis Consultants Limited, April 2013.

Appendix

Recommended Antennas

• Laird, model number S8658PCL/PCR Reader antenna 865-868MHz 8.5dBic LHCP and RHCP (ETSI region only)

• Laird, model number S9028PCL/PCR Reader antenna 902-928MHz 8.5dBic LHCP and RHCP (FCC region only)

• Laird, model number S8658WPL/WCR Reader antenna 865-956MHz 8dBic LHCP and RHCP

• Pervasid ceiling tile antenna 7.5dBic 4 ports