

HARDWARE SETUP GUIDE

FS-GM201

Favite Inc.

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CHAPTER 1

Introduction

This *Hardware Setup Guide* provides instructions for installing and operating the FS-GM201 RFID Readers.

This document is designed for use by RFID system integrators and software developers - those who wish to develop software products and extended systems that take full advantage of the RFID Reader's capabilities.

Included with each reader or developer kit is the *Favite RFID Reader Software Developer's Kit and User Documentation* CD-ROM.

RFID Reader Overview

The Favite FS-GM201 RFID reader is designed to read and program any EPC Class 1 Generation 1 or 2 tag (see below) and issue event reports to a host computer system. The reader is also designed to read Class 0 tags and to read and program Class 1 tags. The host computer can be locally connected to the reader via USB, RS-232, or at a remote network location.

The RFID Reader is delivered with the following components and accessories:

- One (1) RFID Reader
- One (1) USB cable, or (1) RS-232 serial cable, or (1) Ethernet Cable (to connect to host computer)
- One (1) power supply and cord

Favite RFID Reader Software Developer's Kit and User Documentation CD-ROM

EPC Class 1 UHF RFID Tags

The Favite FS-GM201 RFID reader is designed to read and program any EPC Class 1 Generation 1 or 2 tag (see below) and issue event reports to a host computer system. The reader is also designed to read and program Class 1 tags.

Class 1 tags are "passive" devices meaning they do not have a battery or other onboard power source. They are powered solely by the RF energy transmitted by an RFID reader.

They communicate with the reader through backscatter modulation in which the tags do not actually transmit RF energy. Instead, they change their reflective characteristics in a systematic way and reflect RF energy back to the reader. An analogy to this is the way you can use a mirror to transmit information by reflecting light from the Sun.

Favite Inc. manufactures user-programmable EPC Class 1 tags compliant with all key commercial and DoD mandates. Favite offers a variety of designs capable of delivering optimal performance worldwide, including Europe and Asia.

For more information about RFID tags from Favite Inc., please visit our website at <http://rfid.favite.com>.

Requirements

To interface with the RFID Reader you will need the following:

A PC running Windows 98 or higher, with CD-ROM drive, an available USB port, or RS-232

serial port, or Ethernet connectivity

Standard 110/220 VAC 50/60 Hz Power supply and cord (included with reader)

Host software (Favite Gateway demo software or your own custom software)

Specifications

Specifications for key components of the RFID Reader system are provided in the tables below:

| System | |
|--|--|
| Host Interface (Module) | USB/UART |
| Host Interface (Module with Housing) | USB; RS-232 (Option); LAN (Option) |
| Chipset | PHY: Impinj R1000 MAC: ATMEL AT91SAM7S-256 |
| Operating Voltages | 5.0V+/-5% |
| DC Power | 1.2A @ 30dBm |
| Protocol | |
| RFID Protocol Support | EPC Class 1 Gen 2; ISO 18000-6C |
| Support EPC DRM | Yes |
| RF Features | |
| Frequency | US: 902 ~ 928MHz EU: 865 ~ 868MHz |
| Demodulation | ASK or PSK |
| Modulation Depth | 90% nominal |
| Data Encoding | FM0 or Miller code |
| Bit Rate | 250K (default for DRM) 40K~640Kbps (option) |
| TX Output power | 5 ~ 30dBm in 1dB step |
| Antenna Type | Dual Mono-static or Single Bi-static(option) |
| Antenna connector | 2 SMA connectors or 1 MHF connector |
| Regulatory and Environmental Compliance | |
| EMC certification | FCC, CE, NCC |
| Temperature Range | Operating: 0 ~ 55 degree C, Storage: -20 ~ 85 degree C |
| Humidity | 10% ~ 85% Non-condensing |
| Software | |
| Driver | Windows XP / Linux |
| Mechanical (Module) | |
| Dimension | 60mm x 40mm x 7 mm ± 0.25mm |
| Weight | 21 g |
| Mechanical (Module with Housing) | |
| Dimension | 76mm x 72mm x 29.8 mm ± 0.25mm |
| Weight | 135 g |

Mechanical: Reader Physical Size

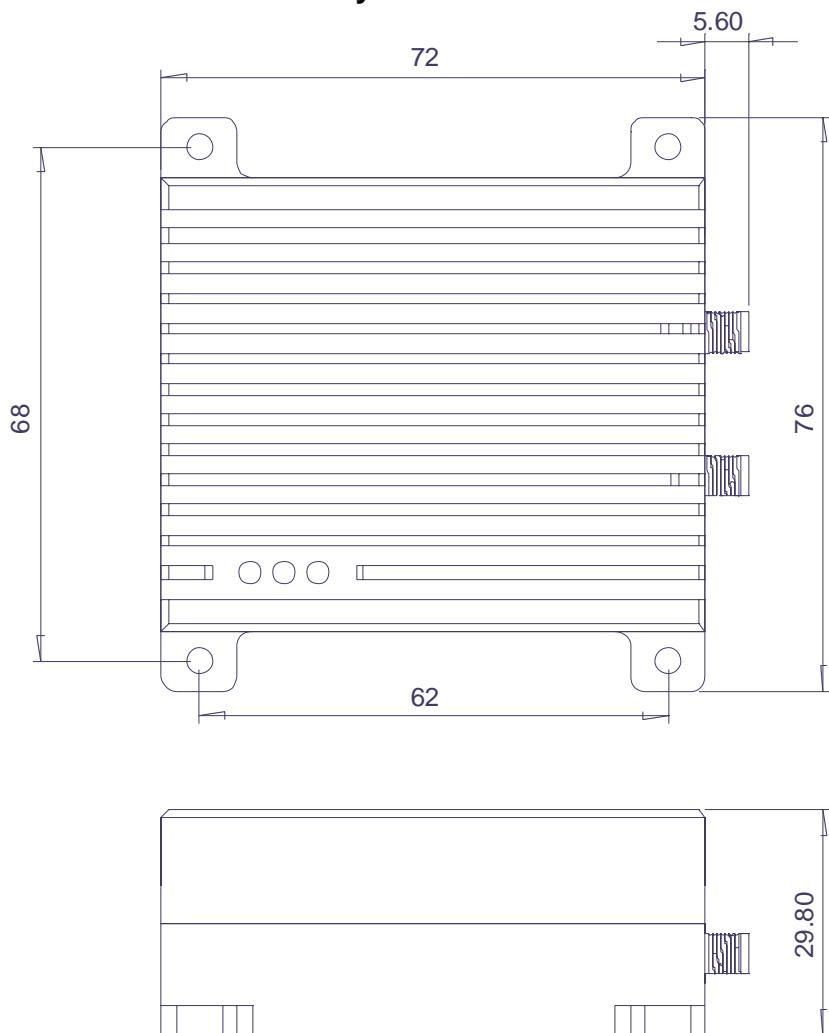


Figure 1 - Outline Drawing of the FS-GM201

USB Port Pinouts

Pin 1 5V VCC
Pin 2 Data+
Pin 3 Data-
Pin 4 Ground
Pin 5 Ground

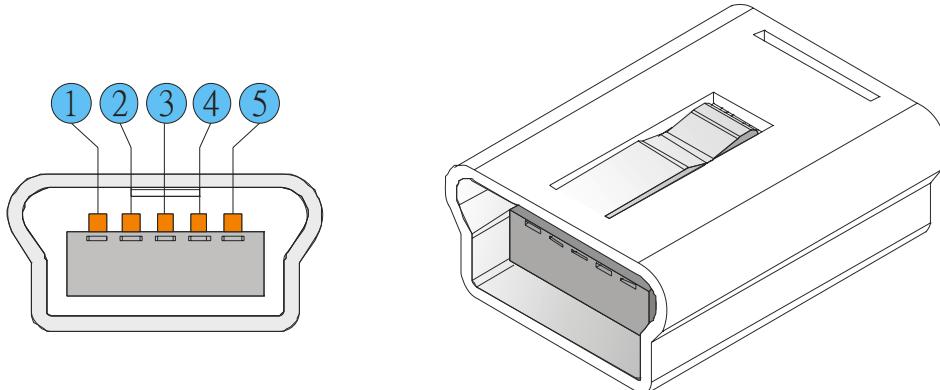


Figure 2 - USB CONNECTOR (Mini-USB, FEMALE) – LOOKING AT READER

RS-232 Port Pinouts

RS-232 Connector (Female DB-9F)

Pin 1 Not Available
Pin 2 Tx
Pin 3 Rx
Pin 4 Not Available
Pin 5 Ground

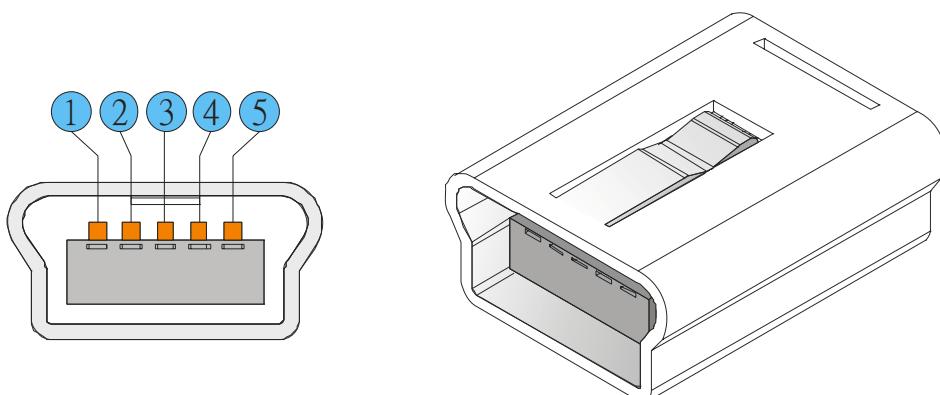


Figure 3 - RS-232 CONNECTOR (Mini-USB, FEMALE) – LOOKING AT READER

GPIO Port Terminal Interface

Pin 1 Ground A
Pin 2 Input 1

Pin 3 Ground B
Pin 4 Input 2

Pin 5 Output 1
Pin 6 VCC 1
Pin 7 Ground C

Pin 8 VCC 2
Pin 9 Ground D
Pin 10 Output 2

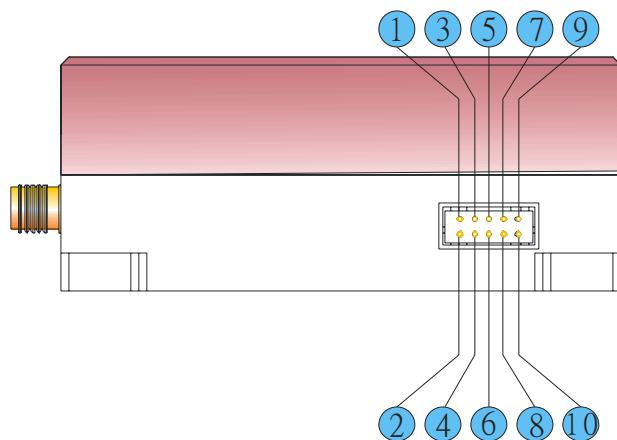
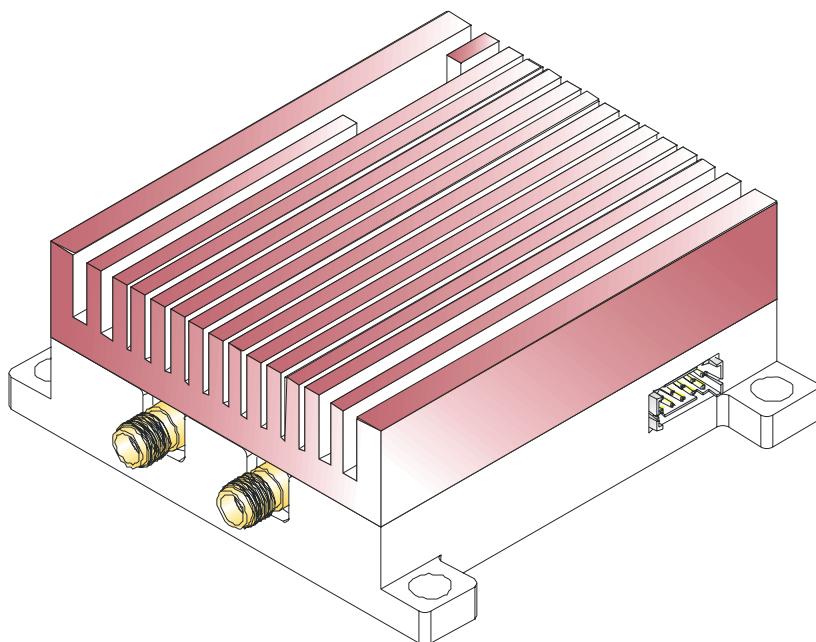


Figure 4 – GPIO Port Terminal Interface

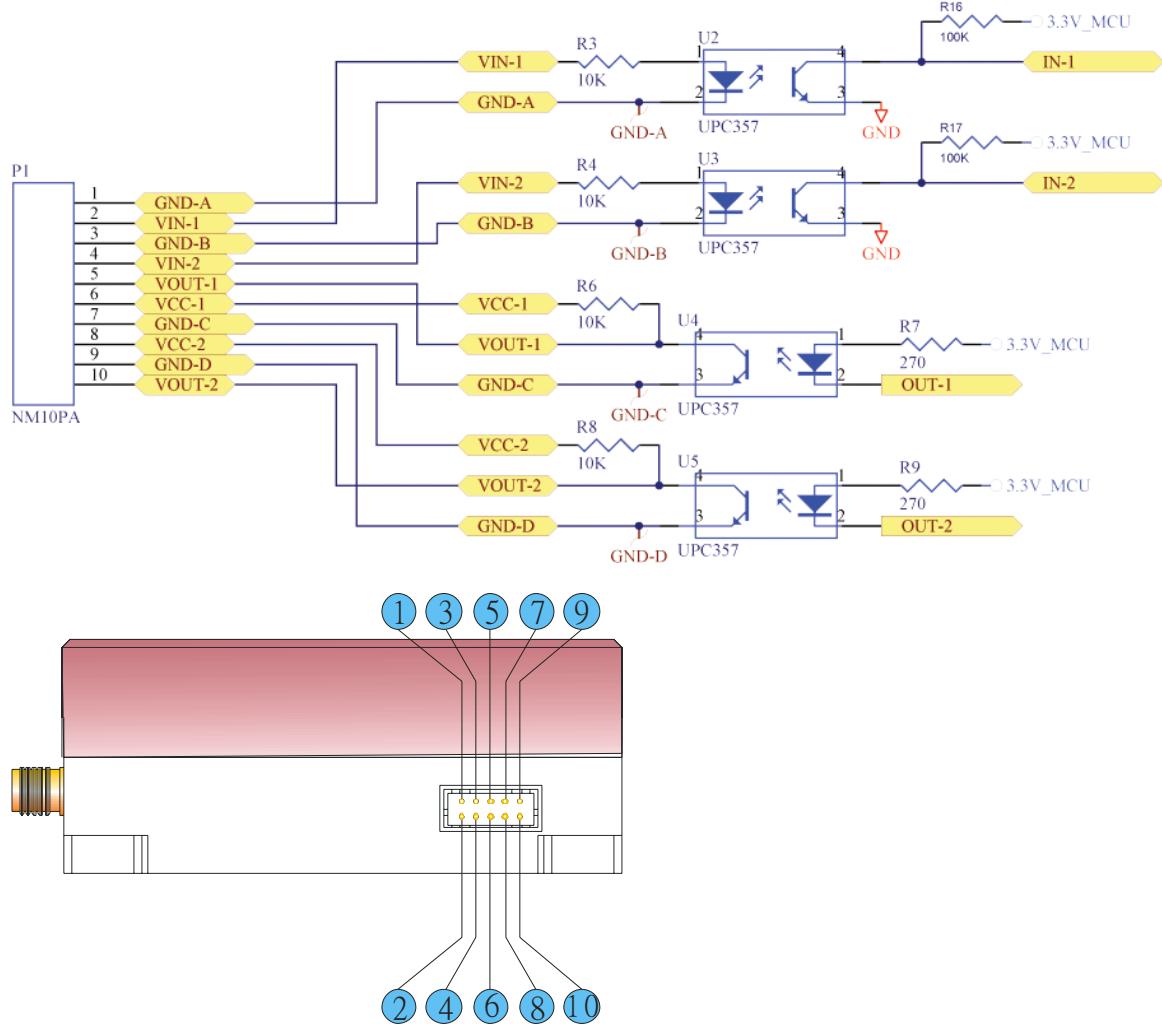


Figure 5 - GPIO PORT SCREW TERMINAL (FEMALE) – LOOKING AT READER

CHAPTER 2

Reader Hardware Installation and Operation

This chapter describes the RFID Reader and provides installation and operation information.

Receiving the RFID Reader

Your RFID Reader Kit is shipped with the items listed below. Please verify the contents of your received shipment before assembling.

RFID Reader

Power supply and cables (two sections: one attached, one detached)

USB or RS-232 reader-to-PC cable, or Ethernet Cable

CD-ROM containing demonstration software, user guides and documentation



Figure 6 - FS-GM201 Developer's Kit

Reader I/O Panel

The I/O panel (shown below) houses the following:

4-pin female I/O terminal block

USB port, or 9-pin D female RS-232 serial port, or LAN TCP/IP port

Power connector



Figure 7 - FS-GM201 Reader Connections (GPIO Connector) I



Figure 8 - FS-GM201 Reader Connections (Power Connector & Mini-USB Connector)

Diagnostic LEDs

The FS-GM201 includes diagnostic LEDs on the face of the reader to provide easy and convenient external indication for various operating conditions:

POWER (red) - indicates power is applied to the reader

READ (yellow) – indicates that the reader is receiving data from a tag

FAULT (green) – indicates a fault condition with the reader.

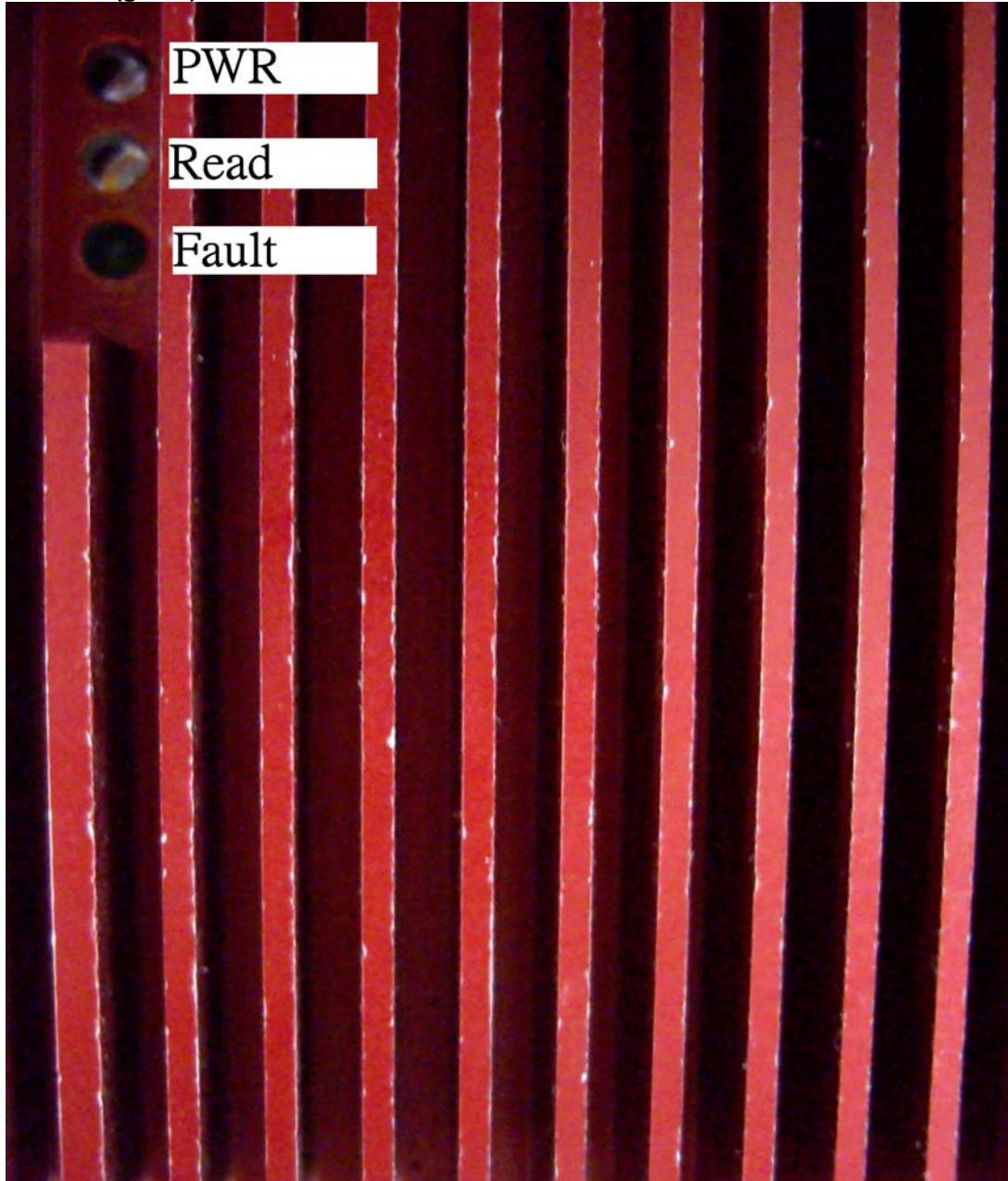


Figure 9 – FS-GM201 Reader Diagnostic LEDs

Antenna Panel

The antenna panel (opposite the reader's I/O panel) contains two coax antenna connector ports as shown below. These are SMA connectors.

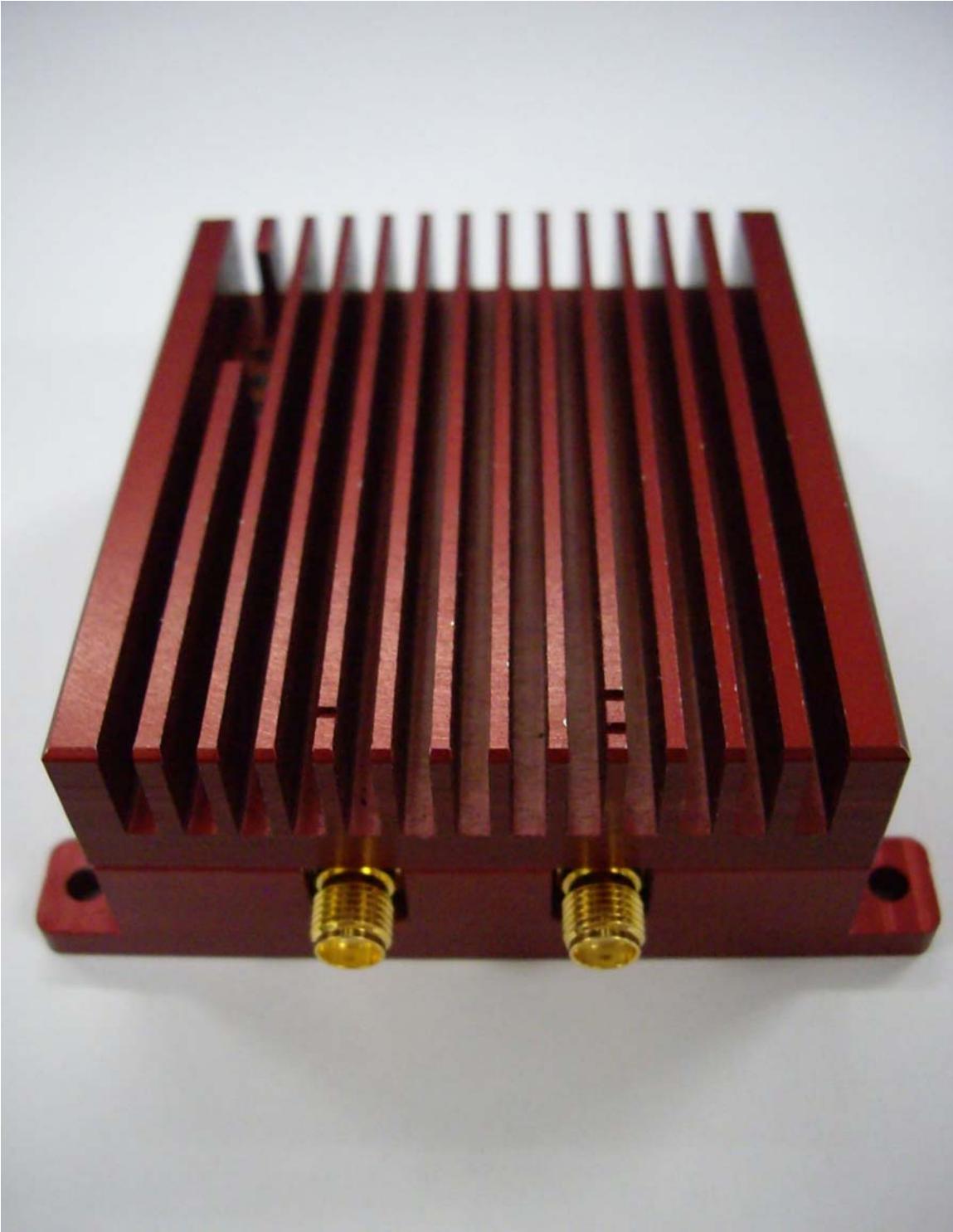


Figure 10 - Antenna Connections

System Assembly and Bench Test

Assembling the RFID Reader system is easy. We recommend you set up the system and verify its operation in a bench test configuration (shown below) before installing it in a production setting.



Figure 11 - Typical Bench Test Setup

Bench Test Configuration

- 1. Place the Reader on a tabletop.** Ensure the following conditions:
A standard 110 or 220 VAC outlet is nearby.

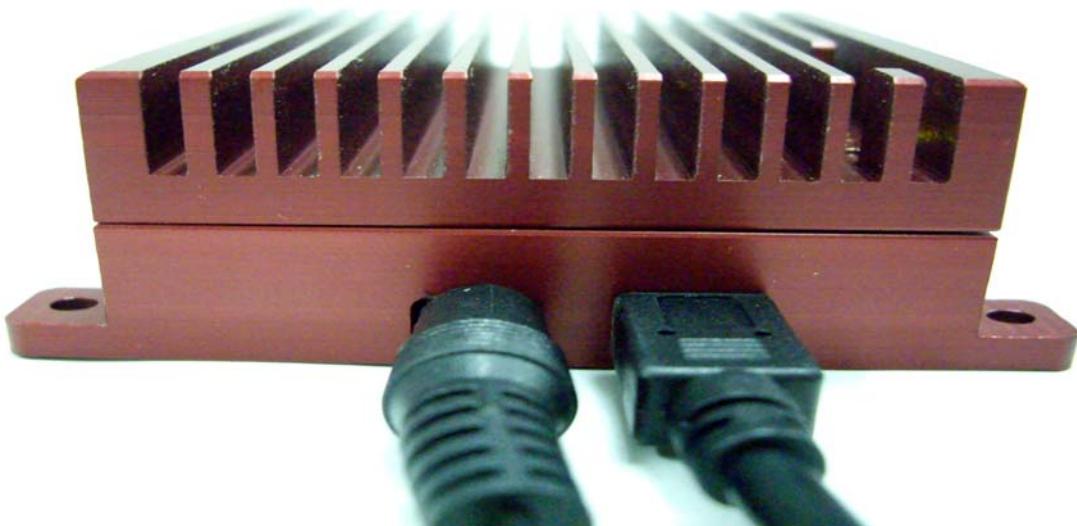


Figure 12– USB, RS-232, and Power Connections

Sufficient space is available on the tabletop for the reader and antenna.

2. Connect the USB, or RS-232 cable to the reader.

Align the male cable connector so that its shape and pins match the shape and holes of the female USB port or RS-232 port. (Connector Type are both mini-USB Connectors)

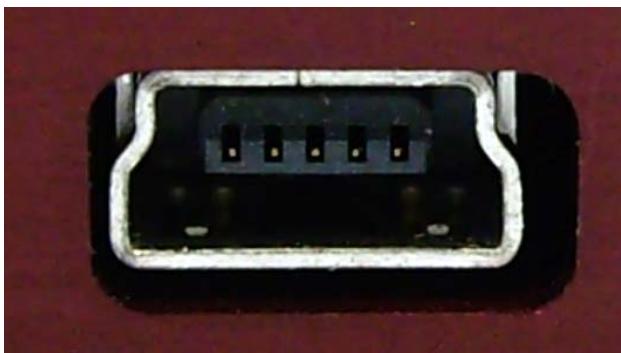


Figure 13 – USB or RS-232 Connector (mini-USB Connector)

Push the aligned connector into the port.

Finger-tighten the screws to secure the cable/connector to the reader.

3. Connect the USB cable to the USB port on the PC.

Settings for RS-232 are 115200 Bits per second, 8 data bits, no parity, 1 stop bit, and no flow control.

Start up terminal software on the PC, such as HyperTerminal with these settings, and be prepared to observe the reader's messages as it boots up.

4. Connect the RS-232 cable to the serial port on the PC.

Settings for RS-232 are 115200 Bits per second, 8 data bits, no parity, 1 stop bit, and no flow control.

Start up terminal software on the PC, such as HyperTerminal with these settings, and be prepared to observe the reader's messages as it boots up.

5. Connect the power supply to the reader.

Using the thin cable attached to power supply, push the connector into the port until it is

securely seated. Do not plug the power supply into the wall outlet yet.

Finger-tighten the securing ring onto the connector.

The FS-GM201 power supply has a safety feature that turns the power supply off in the event that it detects an abnormal AC line condition.

When this happens, the green LED on the power supply brick will not be lit. To reset the power supply, unplug the AC power cord from the wall or power strip, and plug the power cord back in.

6. Connect the coaxial cable(s) to antenna ports (in pairs).

Antenna port 0 is on the top right-side, if viewing the reader from the front with the flange side down. The FS-GM201 has two (2) antenna ports. If using the Favite Gateway software, please note that ANT 0 is selected by default when first initialized.

Antennas must be connected in pairs (one to transmit, one to receive). At this time, the reader pairs antenna 0 with antenna 1, and antenna 2 with antenna 3. This means that when antenna 0 is the active (transmit) antenna, antenna 1 will be the receive antenna, and vice versa. The same pairing applies to antennas 2 and 3.

Align the coax cable's center pin and push into the port

Screw the fitting from the cable end onto the reader connector *clockwise* until finger-tight to secure the cable to the reader.

Connect additional antennas to their respective ports and tighten fittings clockwise until finger-tight.

7. Plug power cord into power supply.

Use the female end of a standard 3-pronged power cord (a power cord is included with each reader)

8. Plug the power supply cable into the wall outlet and verify power.

The green POWER LED will illuminate when power is on.

9. Observe the reader's bootup trace, and determine the network settings.

The RS-232 port displays useful information while the reader boots, including network settings. Toward the end of the trace, the reader displays a block of text similar to the following:

```
=====
Network Settings:
MAC Address : 00:80:66:10:2D:12
DHCP : 1
IP Address : 10.9.8.10
Netmask : 255.255.255.0
Gateway : 10.9.8.2
DNS : 10.9.8.1
TimeServer : time-a.timefreq.bldrdoc.gov
TimeZone : -7
=====
```

Once the reader boots and you see the "Boot>Ready!" prompt, pressing return will bring up the "Favite>" prompt.

10. Ensure the PC has compatible network settings.

In order for you to be able to connect to the reader over TCP/IP, the host PC must be on the same subnet as the reader. If you are unfamiliar with how to do this, consult your local IT service for assistance.

Once the initial connection is made, you may configure your reader's network settings as you choose. Refer to the *Reader Interface Guide* for instructions on how to do this.

You are now ready to bench test or demonstrate the RFID Reader system.

Bench Test Procedure

1. Access an operational mode suitable for bench testing.

Select a mode that will allow multiple consecutive reads of a single tag, such as Global Scroll if using the Favite Gateway software.

Refer to the applicable software application user guide for specific instructions.

2. Position the reader so you can see the diagnostic LEDs.

You may also want to position the PC so you can view the monitor simultaneously for later tests.

3. Move a tag slowly away from the antenna's range.

Begin with the tag well inside the expected read range (~2m or 6 ft) and move it toward the antenna while observing the LEDs.

4. Verify the READ LED illuminates when the tag is inside the read window.

READ should be illuminated green.

5. Verify the host receives the tag data.

Refer to indications specified in applicable user guide to verify the tag was read successfully.

6. If bench test conditions are verified, proceed to installation.

NOTE: To perform a hard reboot of the system, simply cycle power on the reader.

Installation

This section provides guidance for configuring components in your RFID system. You should consider the overall design of your specific system before permanently mounting the equipment.

Installation involves all the same connection steps required for bench test. However, instead of placing equipment on a tabletop, the reader, antenna, and their accessories are mounted in your application environment.

Requirements

Before installing your RFID Reader system, you will need the following:

A PC running Windows 98 or higher, with USB connectivity and, optionally, one available RS-232 serial port.

Standard 110 or 220 VAC power for the reader

Host software (Gateway, for example)

(Optional) extra antennas (if desired for additional coverage or configurations)

Additional RS-232 cables or antenna coax cables needed to accommodate routing requirements

Standard grounded, three-pronged power cord of desired length

Mounting hardware suitable for the surface to which equipment is to be attached (e.g., wood screws, moly-bolts, brackets, etc.)

Hardware Installation Procedure

1. Select mounting position for antenna(s).

CAUTION: Reader antennas should be positioned so that personnel in the area for prolonged periods may safely remain at least 23 cm (9 in) in an uncontrolled environment from the antenna's surface. See FCC OET Bulletin 56 "Hazards of radio frequency and electromagnetic fields" and Bulletin 65 "Human exposure to radio frequency electromagnetic fields."

Mount the antennas at the periphery of the desired read window (either overhead or at the side), so that the position of the most distant tag passing through the window is no farther from the antenna than the maximum range specified for your system design.

Position the antennas at a height approximately midway between the highest and lowest expected tag position. (For example, a pallet tag may be the lowest tag position to be read, while the top-most case on a fully stacked pallet may represent your highest tag position.)

Mount the second antenna approximately 18 inches from the first antenna, facing the read zone, unless otherwise indicated in your system design specification.

NOTE: To maintain compliance with FCC regulations, use only antennas supplied with the unit.

2. Select mounting position for reader.

Reader should be positioned close enough to the antenna to accommodate the cable length without putting strain on the connectors.

Be sure power is available at the selected reader location.

3. Install reader.

Secure the reader through the two mounting holes on either flange to its mounting location (wall, post, mounting bracket) using appropriate hardware.

If desired, position the reader so that the LEDs are easily observed.

4. Install antennas.

Secure each antenna through the mounting holes on either flange to its mounting location using appropriate hardware.

5. Connect antennas to reader.

Route coax cables from the antennas to the reader according to your system design specifications and secure them properly.

Align the connector for each cable with the reader antenna port, push into the port, and finger-tighten the screw fitting.

6. Connect reader power.

Push the power supply connector into the reader port and tighten the retaining ring finger tight.

Plug the female end of the power cord into the power supply.

Plug the male end of the power cord into the 120 VAC outlet.

7. Connect reader to host PC.

Align the USB connector with the corresponding mini-USB port on the reader and push the connector in. Connect to the other end to a Host PC.

Configure your terminal software as described previously in the Bench Test Configuration topic.

9. You are now ready to use the reader. If using the Favite Gateway software, please refer

to the *Demonstration Software Guide* included on your CD.

System Operation: Software Control

The FS-GM201 RFID Reader is controlled from software running on a host system that communicates with the reader using the ASCII-based Favite Reader Protocol. All applications use this protocol to communicate with the reader.

You may operate the reader from your own application code, using the example code provided on the Developer's Kit CD, or using the Favite RFID Gateway application which is a demonstration program also included on your CD.

For more details, refer to either the *Reader Interface Guide* or the *Demonstration Software Guide* described briefly below.

Reader Interface Guide

The Favite Reader Protocol, mentioned previously, is described in detail in the *Reader Interface Guide*. Using this interface, the reader can be configured to read tags when queried or after one of a variety of event triggers (e.g., a rising edge on one of the I/O pins, or a timer).

Tag data acquired in response to these triggers can be transmitted to the host in a number of formats (e.g., text, XML or custom) and under a number of conditions (e.g., on a new tag being observed, or a tag disappearing from view).

If you are a software developer, the *Reader Interface Guide* provides the information you will need to connect to the reader from a host computer, communicate with it, and customize its performance.

Demonstration Software Guide

The *Demo Software Guide* describes the installation and operation of the Favite RFID Gateway application.

The Favite RFID Gateway application is a useful demonstration program that allows users to explore the reader's functionality and build customizable demos with a user-friendly interface.

Using the Gateway, the various operating modes of the reader can be controlled and custom interactive demos can be constructed using sounds, images, and text.

FCC statement in User's Manual (for class B)

"Federal Communications Commission (FCC) Statement

This Equipment has been tested and found to comply 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 residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution:

1. The 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.
2. This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.
3. Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user authority to operate the equipment.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product which integrates this module.

23cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 23cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: XLG-FS-GM201 ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

Professional Use:

FCC NOTICE: To comply with FCC part 15 rules, the system must be professionally installed to ensure compliance with the Part 15 certification. It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States.