

User's Guide

MP9320 v2.8
EPC™ UHF Reader



Declaration of Conformity



Manufacturer: Samsys Technologies, Inc.
44 East Beaver Creek Rd., Unit 11
Richmond Hill, Ontario, Canada
L4B 1G8

EU Contact: Midvaag
Rownham Hill
Leigh Woods
Bristol BS8 3PU
United Kingdom

Standard(s) to which Conformity is Declared:

EN300 220-3, EN301 489-3, IEC60950-1, EN50364, EN55022 (Class A),
EN61000-(3-2, 3-3), EN61000-(4-2, 4-3, 4-5, 4-6, 4-8, 4-11)

Product Model No.: Model MP9320

Description: 869.525 MHz Radio
Frequency Identification
Reader/Interrogator
module with AC/DC
power supply

The product(s) herewith comply with the requirements of the R&TTE Directive 99/5/EC.

14 July, 2003
Date

Signature

Mr. James Wiley
President and Chief Operating Officer

SAMSys

MP9320 v2.8 UHF Reader User's Guide

First Edition (April 21, 2005)

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About SAMSys

SAMSys Technologies, Inc. is a world-leading provider of RFID reader hardware solutions in the LF, HF, and UHF segments of the RFID marketplace. SAMSys is a public company listed on the Toronto Stock Exchange under the symbol SMY.

SAMSys Technologies, Inc.
44 East Beaver Creek Rd., Unit 11
Richmond Hill, Ontario L4B 1G8 Canada
Phone: (905) 707-0404
Toll Free: (877) 367-4342
Fax: (905) 707-9944
E-mail: samsys@samsys.com
Web: www.samsys.com

Manual Part Number: HI469320-28-UG-P1.0

Federal Communications Commission (FCC) Notice (Preliminary)

This device was tested and found to comply with the limits set forth in Part 15 of the FCC Rules. Operation is subject to the following 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. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This device generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, the product may cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case, the user is required to correct the interference at their own expense.

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Introduction

This chapter provides a general description of the MP9320 V2.8 EPC UHF Reader. Topics discussed in this chapter include the following:

- Unpacking the Reader
- About the MP9320 V2.8
- Physical Description

Unpacking the Reader

After opening the shipping container perform the following:

1. Unpack the contents of the shipping container.
2. Inspect the shipping container for damage. If damaged, notify the carrier and SAMSys Technologies. Keep the shipping materials for inspection by the carrier.
3. Verify your reader package includes the following items:
 - MP9320 V2.8 EPC UHF Reader
 - Power cord
 - 15 Vdc power supply with cable
 - Sample RFID tags
 - RS-232 communication cable
 - Ethernet LAN Cable
 - System documentation CD
 - Antennas (optional)



Figure 1—MP9320 Reader and Accessories

About the MP9320 V2.8

The MP9320 V2.8 is the next generation of the SAMSys MP9320 UHF RFID reader. This multi-protocol device incorporates Digital Signal Processing (DSP) and currently supports many of today's most popular UHF tags including EPC and ISO. This reader recognizes multiple protocols simultaneously during operation. With full-duplex capability, the device can read or write to any tag, depending on the tag capabilities.

The MP9320 V2.8 incorporates a scalable architecture that enables the reader to be implemented as a stand-alone UHF solution or included in a networked reader environment using the embedded TCP/IP device server and Ethernet LAN connection.

With its extended read range and high data rates, the MP9320 is especially suited for asset management and logistics applications requiring the simultaneous reading of a large number of tags at greater distances. Typical RFID applications supported by the MP9320 V2.8 include the following:

- Warehouse Logistics
- Inventory Management
- Asset Management
- Pallet Tracking
- Parking Lot Access
- Aggregated Container Tracking
- Loading Dock Portals

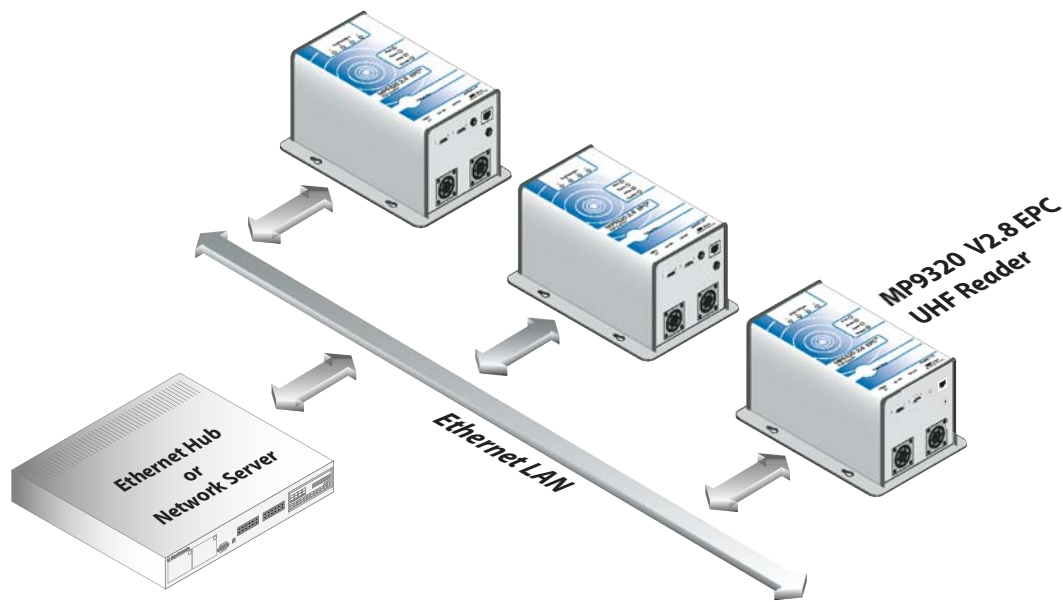


Figure 2–SAMSys MP9320 V2.8 EPC UHF Reader Network

In addition to the scalable, multi-protocol architecture, the MP9320 V2.8 includes the following features:

- LED indicators (operational and antenna transmit)
- (4) antenna ports
- Multiple host interface connections (RS-232, RS-485, Ethernet LAN)
- Digital input and output lines
- Integrated real-time clock with battery backup (optional)
- On-board temperature sensor (optional)

Physical Description

NOTE: *The reader enclosure is designed for office, indoor warehouse, and light manufacturing areas. If a sealed reader is required for wet or hazardous environments, contact your SAMSys representative.*

The digital board contains four LED indicators to provide the operational status of the reader. The LEDs are visible on the front panel of the reader.

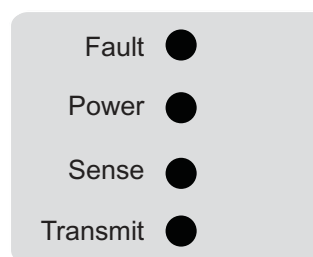


Figure 3–MP9320 LED Status Indicators

Indicator	Color	Description
Fault	Red	Error condition exists
Power	Green	Power is applied to the reader and processor initialization complete
Sense	Green	Reader has tag data to report. This LED also flashes when the reader software is being loaded.
Transmit	Green	Transmitter is operating and RF power is applied to one of the antennas

In addition to the status LEDs, four Active Antenna LEDs provide indication that RF power is being applied to one of the four antennas. Two LEDs (not shown) are also provided on the Ethernet LAN connector to indicate network communication status.

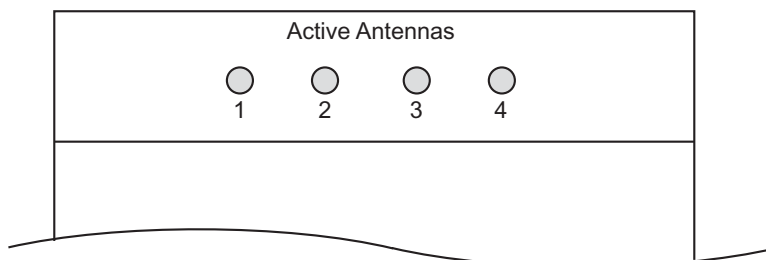


Figure 4–MP9320 Active Antenna LED Indicators

Four SMA type antenna ports are provided on the end panel. The reader also has one power and four communication interface connectors on the opposite end panel.

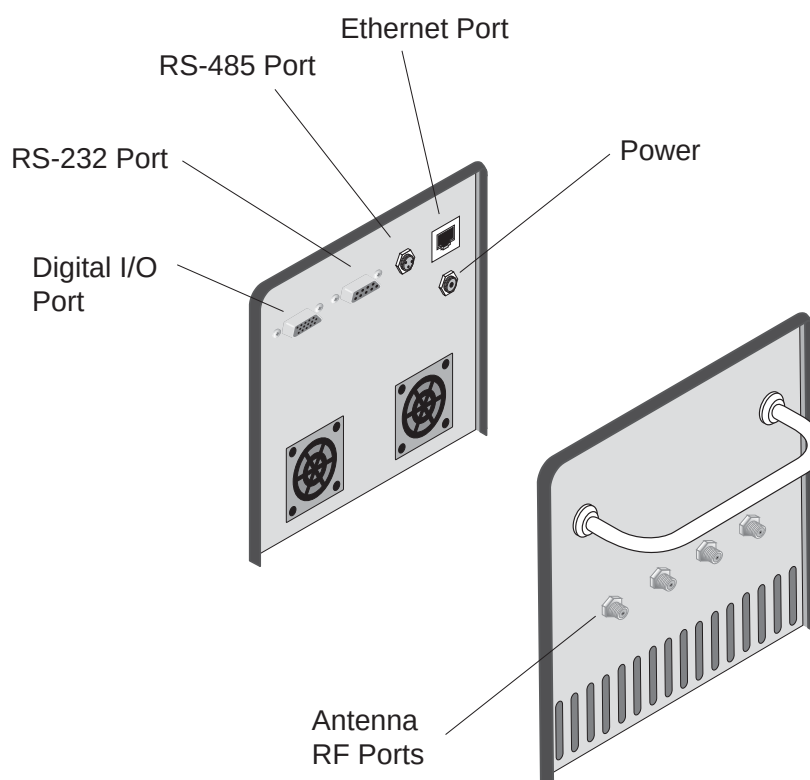


Figure 5–MP9320 V2.8 End-Panel Connectors

Installation

This chapter provides information for installing the MP9320 V2.8 Reader. Topics discussed in this chapter include the following:

- Antenna Installation
- Reader Mechanical Installation
- RS-485/Ethernet Communication Selection
- Serial (RS-232) Communication Setup
- Ethernet LAN Communication Setup
- Configuring the IP Address
- Digital Input/Output Setup
- Transmit Power Calibration
- Connecting to an ICCM

Antenna Installation

The MP9320 V2.8 supports from one to four external antennas in a variety of configurations. One- and two-antenna configurations are typical for most conveyor and container tracking. Four-antenna configurations are used for portals and loading dock doorways.

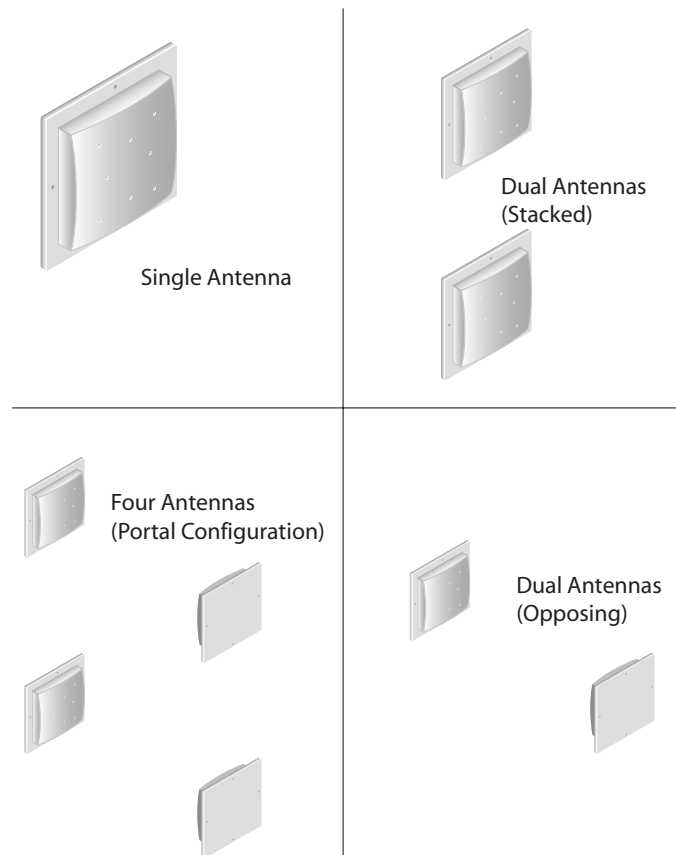


Figure 6–MP9320 V2.8 Antenna Configurations



Warning

The SAMSys MP9320 V2.8 EPC UHF Reader is equipped with four (4) RF ports. To prevent reader damage, active RF ports must be properly terminated with a 50 ohm load or a functional UHF RFID antenna before power up. UHF Readers are factory configured to operate on RF port 1. As a result, port 1 must be properly terminated before initially powering on the reader. Before activating any additional RF ports, they must also be properly terminated. Never power up the reader unless the appropriate loads or antennas are connected. Always power down the reader before removing an antenna or load from an RF port.

Activation of these RF ports is controlled by the internal MCW and MSW registers as described in the MP9320 V2.8 User's Guide, the MP9320 Field Installation Guide, and the Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide.

The MP9320 V2.8 is factory calibrated for operation with the following type of antenna and cable:

Antenna Parameter	FCC	ETSI
Frequency	902-928 MHz	865-870 MHz
Polarization	Circular	Circular
Gain, dBic	9, max	6, max
VSWR, maximum	1.5:1	1.5:1

Cable Parameter	Value
Type	RG58C/U
Length	2 Meters
Connector	SMA type plug, reader side

It is highly recommended that the antenna mounting be adjustable in order to obtain the best performance from the system. However, the antennas must be installed on a solid surface or frame to prevent damage or later misalignment. Perform the following to install the antennas.

NOTE: Use the existing mounting holes on the antenna flange. Drilling new holes in the flange is not recommended.

1. Determine the location of each antenna. Ensure the antenna(s) will not be vulnerable to damage by moving inventory or equipment.
2. Use the antenna as a template and mark the mounting holes.
3. Drill and tap (if necessary) mounting holes for #10 or 1/4 inch mounting screws. For drywall mounting, use drywall anchors or toggle screws.
4. Mount each antenna and install the mounting screws. Do not overtighten the screws. Damage to the antenna case may result.
5. Route each antenna cable back to the reader location. For dual-opposing or portal configurations, route the opposing cables so they can not be damaged by equipment or personnel.
6. Secure each antenna cable with wire ties or other restraint.

Reader Mechanical Installation

The MP9320 V2.8 is designed for easy installation. The following instructions provide the information to install your UHF reader.

As shown in Figure 7, the reader is designed for horizontal or vertical installation. Mounting keyholes are provided on each side of the base plate for easy, non-permanent, installation and removal.



Caution

To ensure proper cooling of the reader, verify that the fan intakes and vents are free of obstructions.

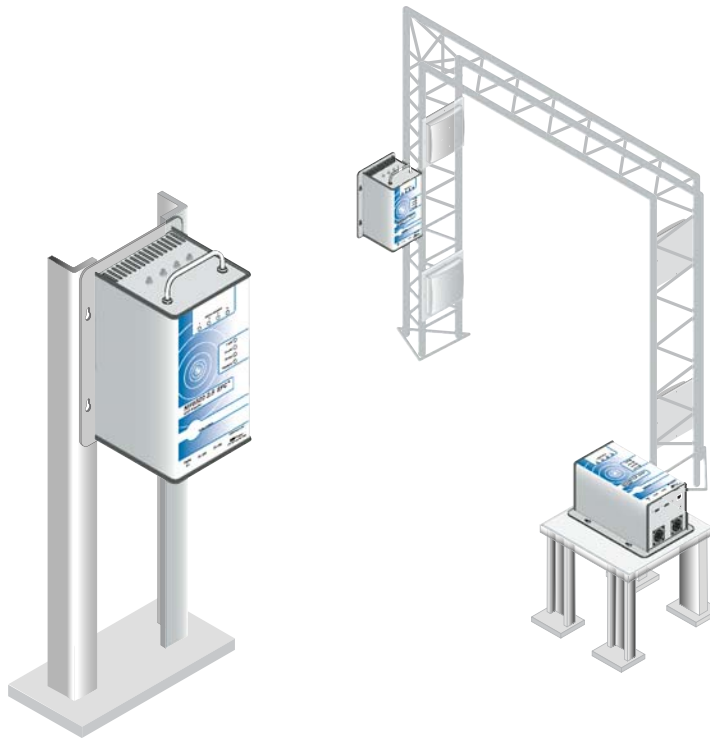


Figure 7—MP9320 V2.8 Reader Installations

For horizontal or table mounting, ensure the reader and all cabling is secured to the surface or frame.

SAMSys recommends that the MP9320 V2.8 be mounted on a horizontal surface. However, if vertical surface installation is required, refer to the following sections for the appropriate mounting. As shown in Figure 8, keyhole slots are provided for easy installation and removal.

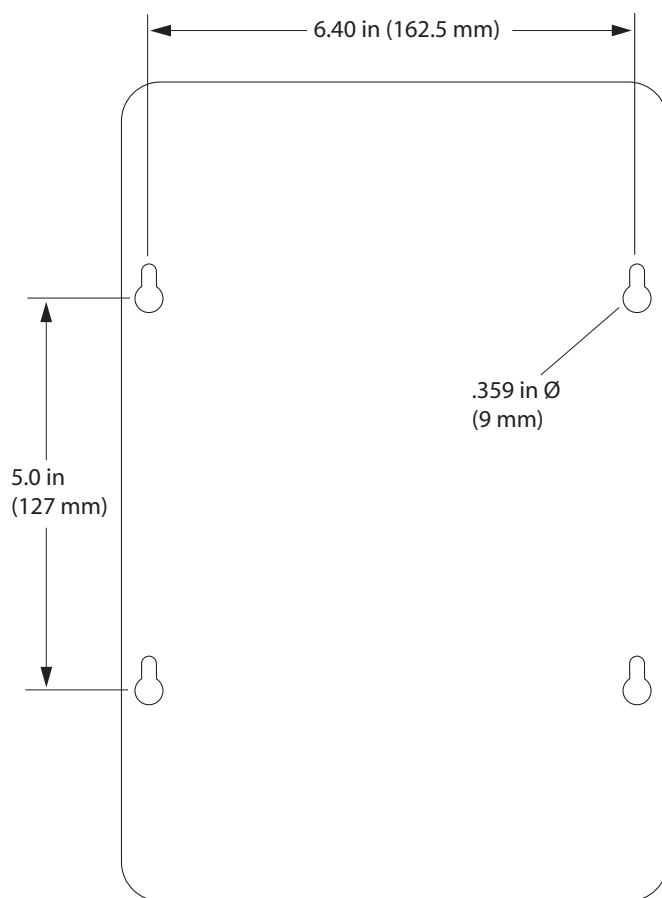


Figure 8–MP9320 V2.8 Base Plate with Mounting Keyholes

Hollow Concrete Block Wall Mounting

To temporarily mount the MP9320 V2.8 to a hollow concrete block wall, SAMSys recommends metal sleeve type concrete anchors that accept a #10 screw and flat washer. To install the reader on a hollow concrete block wall, perform the following.

1. Refer to Figure 8, and mark the location of the mounting screws. Do not install the anchors into the mortar joint.
2. Drill the appropriate size hole for a metal sleeve type anchor.
3. Install the anchors.
4. Install the washers and insert the screws.
5. Tighten the screws to within .375" of the anchor.
6. Install the reader and finish tightening the screws.

Solid Concrete Wall Mounting

To temporarily mount the MP9320 V2.8 to a solid concrete wall, SAMSys recommends one-piece expansion type concrete anchors that accept a #10 screw and flat washer. To install the reader on a concrete wall, perform the following.

1. Refer to Figure 8, and mark the location of the mounting screws.
2. Drill the appropriate size hole for a expansion type anchor and install the anchors.
3. Install the washers and insert the screws.
4. Tighten the screws to within .375" of the anchor.
5. Install the reader and finish tightening the screws.

Wood or Metal Wall Mounting

To temporarily mount the MP9320 V2.8 to a wood or sheet metal wall, SAMSys recommends either #10 x 1 inch wood screws or #10 x 3/4 inch sheet metal screws and washers. To install the reader on a wood or metal wall, perform the following.

1. Refer to Figure 8, and mark the location of the mounting screws.
2. Drill the appropriate size hole for screws.
3. Install the washers and insert the screws.
4. Tighten the screws to within .375" of the surface.
5. Install the reader and finish tightening the screws.

Drywall Mounting

To temporarily mount the MP9320 V2.8 to drywall or sheetrock, SAMSys recommends either #10 toggle bolts or #10 drywall anchors.

NOTE: *There are many types of screw-in, hammer-in, and predrill drywall anchors. Each one is designed for specific applications and pull-out ratings. Ensure that the anchor you select has a pull-out rating of at least 12 lbs.*

To install the reader on drywall or sheetrock, perform the following.

1. Refer to Figure 8, and mark the location of the mounting screws.
2. Refer to the anchor manufactureres instructions for installing the anchors.
3. Install the washers and insert the screws.
4. Tighten the screws to within .375" of the surface.
5. Install the reader and finish tightening the screws.

RS-485/Ethernet Communication Selection

The MP9320 V2.8 is equipped with both RS-485 and Ethernet communication ports. However, only one can be selected at a time. The reader is typically shipped with Ethernet enabled. To enable RS-485 communication, perform the following:



Caution - ESD

The following procedures involve electrostatic discharge sensitive components. ESD protection is required. Damage to the reader can occur if proper ESD equipment such as grounded wrist straps and ESD protected work surfaces are not used.

1. Disconnect all power and communication cables from the reader.
2. Remove the outer reader cover by removing the 8 screws on each side and carefully lifting the cover straight up.
3. Locate Jumper J4 on the connector end of the digital board (top board).
4. Move the jumper to Pins 1-2 (Pin 1 is closest to the end of the board).
5. To re-enable Ethernet communication, move the jumper to Pins 2-3.
6. Replace the cover and the 16 screws.

Serial (RS-232) Communication Setup

The MP9320 V2.8 is equipped with a 9-pin RS-232 communication port for communication directly with a PC or other serial device. Refer to the *Specifications* chapter for information on the port.

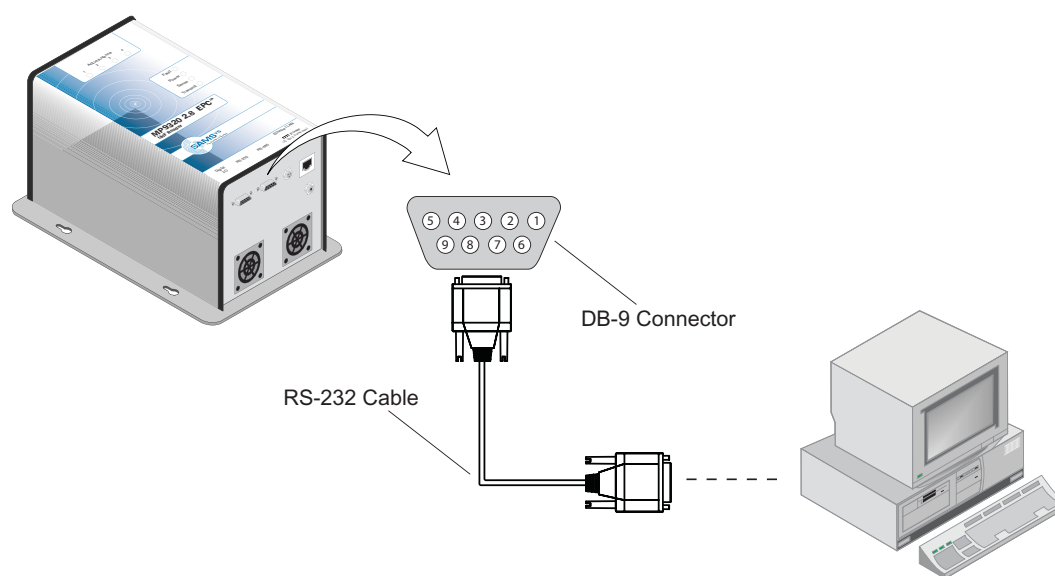


Figure 9—MP9320 V2.8 Standalone RS-232 Communication Setup

NOTE: A serial port adapter may be required if the device has a different connector type. For example, some PCs may have 25-pin serial connectors.

Every effort has been made to ensure the MP9320 V2.8 is configured to match your application. However, it is recommended that the reader configuration be verified before placing the reader into service. If the system is to be used as a local, standalone reader connected to a terminal or PC, perform the following:

1. Verify all antennas, cabling and power supplies are secure.
2. Verify the operator terminal or PC is connected to the reader and operational.
3. Power up the reader.
4. Launch RF Command Suite.
5. Set the terminal serial port parameters to default values (57600, 8, 1, none).
6. Introduce a test tag into the RF field.
7. Verify the tag was read correctly.
8. If the tag did not read correctly, use RF Command Suite to verify the reader operating mode matches the application requirements (refer to Appendix A). If necessary, reconfigure the reader operating modes.

NOTE: Refer to the RF Command Suite User's Guide and the Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide for detailed information on configuring the reader.

Ethernet LAN Communication Setup

The MP9320 V2.8 can be networked with other readers on an enterprise 10/100 BaseT Ethernet LAN. Each reader is equipped with an embedded IP device server that allows the unit to be assigned an IP address. This address can then be accessed by your network server or host computer.

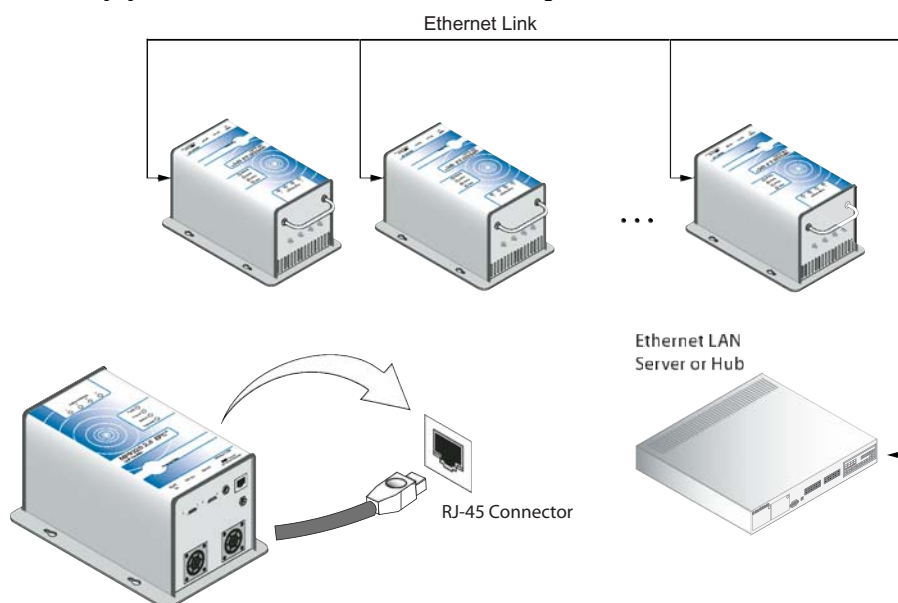


Figure 10–MP9320 V2.8 Ethernet LAN Communication Setup

Installing the RF Command Suite Application

The SAMSys RF Command Suite is a Microsoft Windows application that provides a Graphical User Interface (GUI) for SAMSys RFID Reader Products. The application allows you to easily view tag data, configure the reader, and perform other tag data functions. In addition, the RF Command Suite is the preferred method for sending CHUMP commands to a reader. The RF Command Suite application is provided on the CD shipped with your reader and can be installed on a personal computer. To install RF Command Suite, refer to Chapter 1 - *Introduction* in the RF Command Suite User's Guide.

Configuring the IP Address

The MP9320 V2.8 is equipped with a TCP/IP Ethernet port and embedded IP device server. This reader is configured for automatic IP address allocation using the Dynamic Host Configuration Protocol (DHCP) Mode and the reader automatically extracts the IP address from the DHCP server. This is the default mode for the reader as it is shipped from the factory.

In the event that you need to manually configure the IP address and Baud rate, refer to Appendix C for detailed instructions.

Digital Input/Output Setup

The MP9320 V2.8 is equipped with a digital input/output (I/O) port that provides four logic-level (TTL) input signals and four output signals. Refer to the *SAMSys Forth Programming Language Reference Guide* for programming information. The digital inputs are optically isolated. The outputs are open collector.

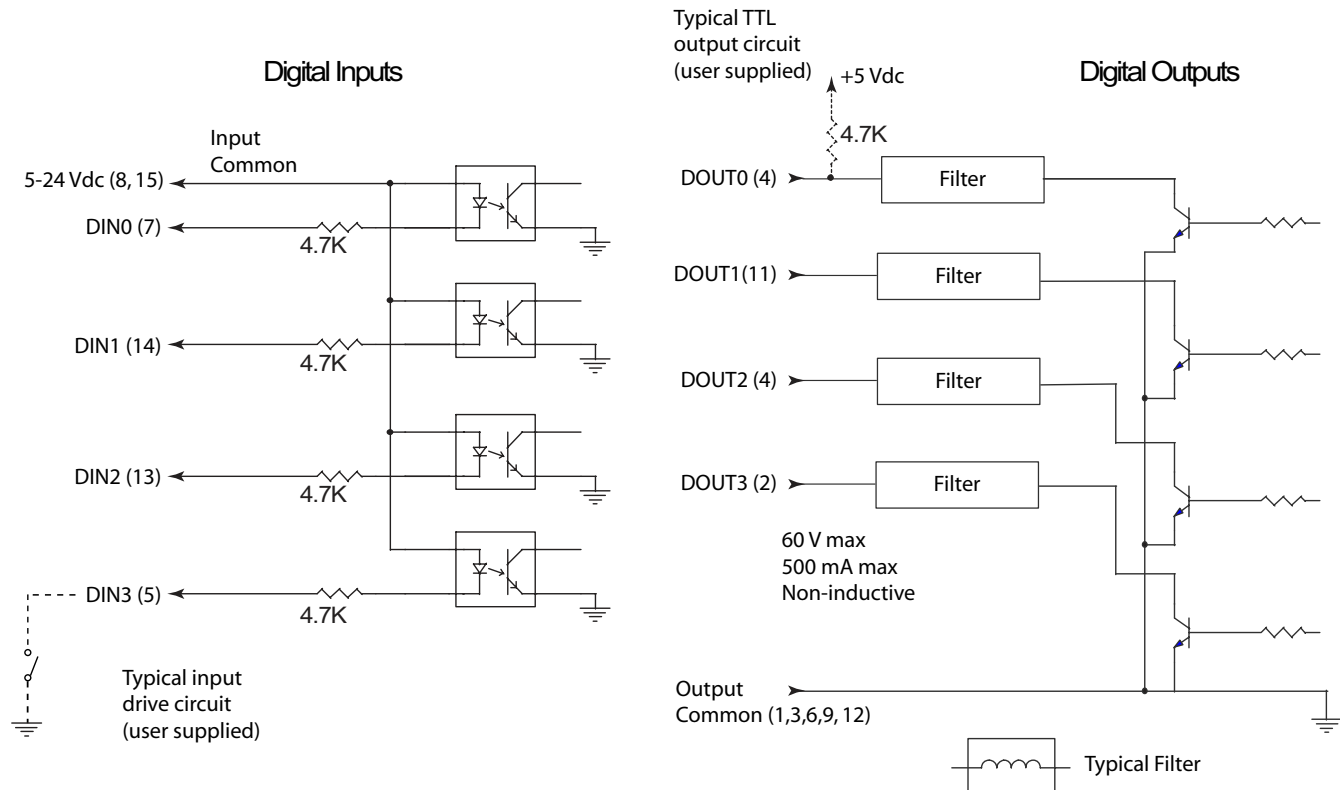


Figure 11–Digital Input/Output Port Configuration

Signal Name	Pin No.	Description
DIN0	7	Digital Input 0 - optically isolated
DIN1	14	Digital Input 1 - optically isolated
DIN2	13	Digital Input 2 - optically isolated
DIN3	5	Digital Input 3 - optically isolated
Digital input common	8, 15	Input common
DOUT0	4	Digital Output 0 - open collector
DOUT1	11	Digital Output 1 - open collector
DOUT2	10	Digital Output 2 - open collector
DOUT3	2	Digital Output 3 - open collector
Digital output common	1,9,3,6,12	Output common

Transmit Power Calibration

The MP9320 V2.8 can be operated with a variety of commercially available antennas and coaxial cables. As a result, the output RF power of the reader must be configured to optimize the read range for a given antenna configuration, while not violating FCC or CE regulations.

Calibration of the reader transmit RF power must only be performed by SAMSys authorized installation personnel or certified resellers.

Operation

This chapter provides general information to operate the MP9320 V2.8 Reader. Topics discussed in this chapter include the following:

- MP9320 V2.8 Power Up and Initialization
- Setting the RF Mode
- Selecting the Number of Antennas
- Selecting Tag Protocols
- Enabling or Disabling Tag Protocols
- Reading Tags
- Writing Blank Tags
- Modifying Tags
- Operation with the ICCM

MP9320 V2.8 Power Up and Initialization

When the power supply is connected, the reader starts an internal initialization sequence. This sequence momentarily lights the LEDs as follows:

1. **Transmit** and **Sense** on momentarily, then off
2. **Sense** flashes
3. **Power** flashes
4. **Fault** flashes
5. All four flash
6. **Transmit** and **Power** flash
7. Beeper on

If the **Fault** LED illuminates during the initialization sequence, the reader has detected a software load fault. Restart the reader to clear the fault.

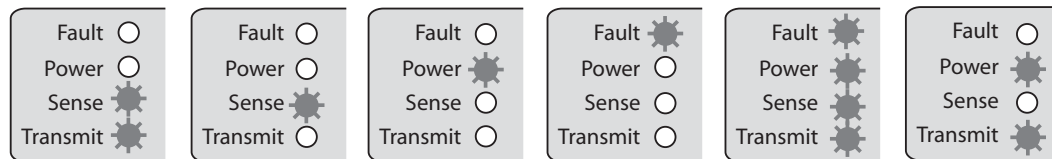


Figure 12–LED Startup Sequence

The reader is operational when the **Power** LED remains on.

After the startup sequence, the RF multiplexer in the MP9320 V2.8, alternately provides RF power to each of the four antennas. The **Active Antenna** LEDs indicate which antenna is transmitting.

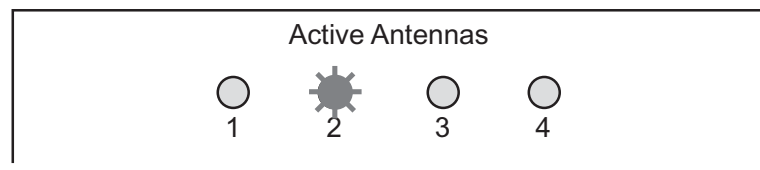


Figure 13–Active Antenna LED Indicators - Antenna 2 Transmitting

NOTE: The number of antennas and the antenna transmit sequence is user configurable depending on the application. Refer to the following sections and Appendix A for more information on reader configuration.

Starting RF Command Suite

In order to verify your installation, start RF Command Suite. This application provides the ability to view your reader configuration and make any needed adjustments. You can also use the application to view tag data. For information on installing and operating RF Command Suite, refer to the RF Command Suite User's Guide.

Setting the RF Mode

The MP9320 V2.8 is factory configured for continuous RF scanning or “auto-read” mode. This mode is equivalent to mode selected by the **Auto Read** function key on the RF Command Suite **Command** interface window.

If desired, you can reconfigure the reader for Polled RF mode (reader activates the transmit carrier and waits for host to send a read command). Select the **Polled Read** function key to activate Polled RF mode.

To halt the Auto Read or Polled Read mode, press the **RF Off** function key.

Selecting the Number of Antennas

The MP9320 V2.8 is factory configured to operate with one antenna connected to Port 1. However, the reader can operate with up to four (4) antennas. If additional antennas are to be installed, use RF Command Suite to select the number of antennas:

From the RF Command Suite **Command** interface window, select function set four (4) and then select one of the following function keys:

F1	1 Antenna (0)	Sets the reader to use antenna 0.
F2	1 Antenna (1)	Sets the reader to use antenna 1
F3	1 Antenna (2)	Sets the reader to use antenna 2.
F4	1 Antenna (3)	Sets the reader to use antenna 3.
F5	2 Antennas (0,1)	Sets the reader to use antennas 0, 1.
F6	3 Antennas (0,1,2)	Sets the reader to use antennas 0, 1, and 2.
F7	4 Antennas	Sets the reader to use all four antennas.



Warning

The SAMSys MP9320 V2.8 UHF Reader is equipped with four (4) RF ports. To prevent reader damage, active RF ports must be properly terminated with a 50 ohm load or a functional UHF antenna before power up. UHF Readers are factory configured to operate on RF port 1. As a result, port 1 must be properly terminated before initially powering on the reader. Before activating any additional RF ports, they must also be properly terminated. Never power up the reader unless the appropriate loads or antennas are connected. Always power down the reader before removing an antenna or load from an RF port.

Selecting Tag Protocols

The MP9320 V2.8 is factory configured with only those protocols selected by the user. Once protocols are activated, the **Command** tab function keys can be used to select the protocol. These function keys are programmed with specific command sequences required by the reader to select a particular protocol. To select a protocol, perform the following:

1. Select the **Command** interface window.
2. Select **Function Set 2** or **3** and locate the required protocol.
3. Press the function key to select the protocol.
4. To view the commands performed by this function, hold the mouse pointer over the key or right click while holding the mouse pointer over the key and select **Edit Macro**.
5. Do not change the command sequence unless you are experienced using SAMSys CHUMP commands to configure readers.

Enabling or Disabling Tag Protocols

If you are experienced with SAMSys reader configuration, you can enable, disable, or modify protocols to match specific requirements. To verify which protocols are activated for your reader, navigate to the **Reader Config** interface window and select:

Reader Configuration ⇒ General Configuration ⇒ Operating Mode ⇒ Protocol Select Mask

Activated protocols will be listed and whether they are enabled or disabled. To enable or disable a different protocol, perform the following:

1. Select the **Protocol Select Word (PSW)** parameters as shown in the following:

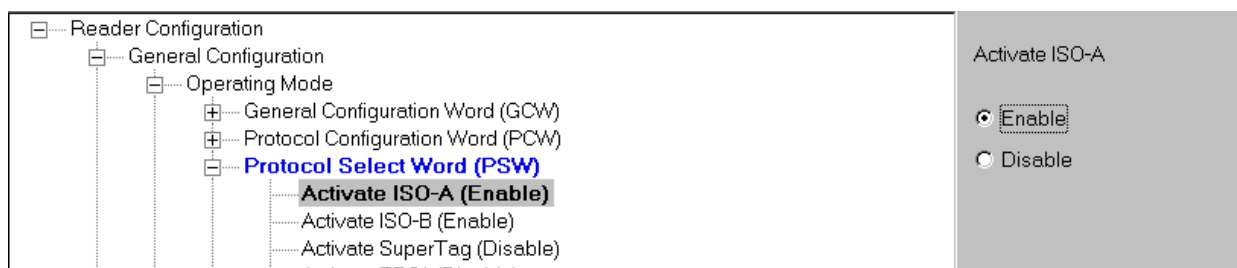


Figure 14 – Protocol Selection

2. Enable or disable a protocol by using the selectors on the right side of the display and press **Send Changes to Reader** . See the following note.
3. To modify the selected protocol, select the **Protocol Configuration Word** and make any required changes.

NOTE: Only enable one protocol at a time. Enabling multiple protocols can result in reduced tag reading performance.

For detailed information on reader configuration using RF Command Suite, refer to the *RF Command Suite Users Guide*.

Reading Tags

Tag Reading Overview

When the reader completes the initialization sequence, the reader activates the RF field and, depending on the configuration, begins transmitting read detect (Rd) commands at the specified frequency. When a tag is placed within range, the reader activates the tag and reads the data. The following example shows a typical Rd return message with ASCII tag data that was returned by the reader:

```
{Rd, d:E0160000000000D53, t: IS186A; C4
```

Reading Tags Using RF Command Suite

RF Command Suite is automatically configured to display tag data as the data is received from the reader. However, tool settings can be changed to match your requirements. Refer to the following sections and the *RF Command Suite User's Guide* to configure the application.

To read tags, perform the following:

1. Select the **Reader Config** Interface and verify the function keys are programmed correctly for your reader.
2. Verify your reader is enabled for the correct tag protocol. Select:
 - Reader Configuration ⇒ General Configuration ⇒ Operating Mode ⇒ Protocol Select Word**
 - Reader Configuration ⇒ General Configuration ⇒ Operating Mode ⇒ Protocol Select Mask**
3. Verify the reader is configured for the correct operating mode. Select:
 - Reader Configuration ⇒ General Configuration ⇒ Operating Mode ⇒ General Configuration Word**
4. To configure the reader to actively scan for tags, set the following General Configuration Word parameters:
 - Serial Mode = Continuous**
 - RF Mode = Continuous**
 - RF Idle RF On when Idle**

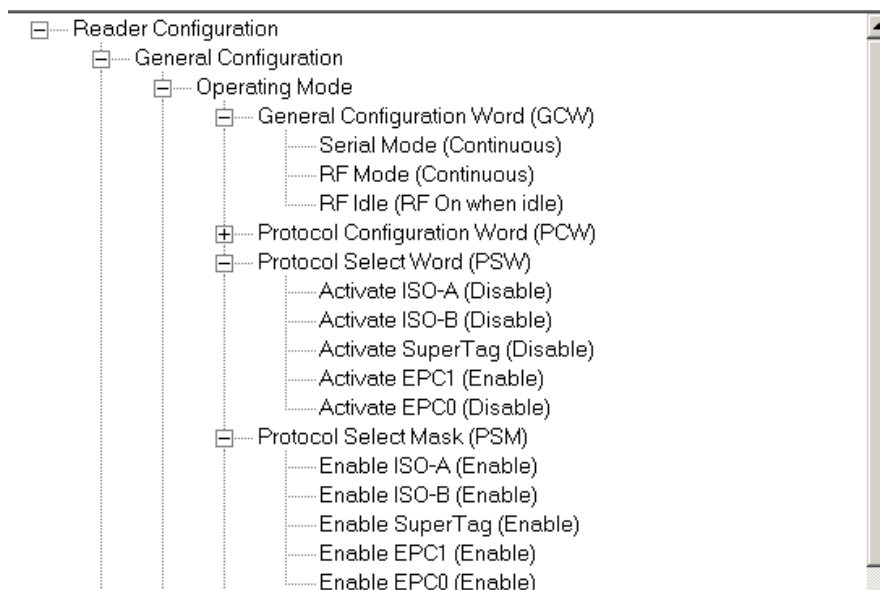


Figure 15–Reader Configuration Parameters

5. Select the **Tag Summary** interface. When tags are read, they are displayed in the window and the statistics are updated.

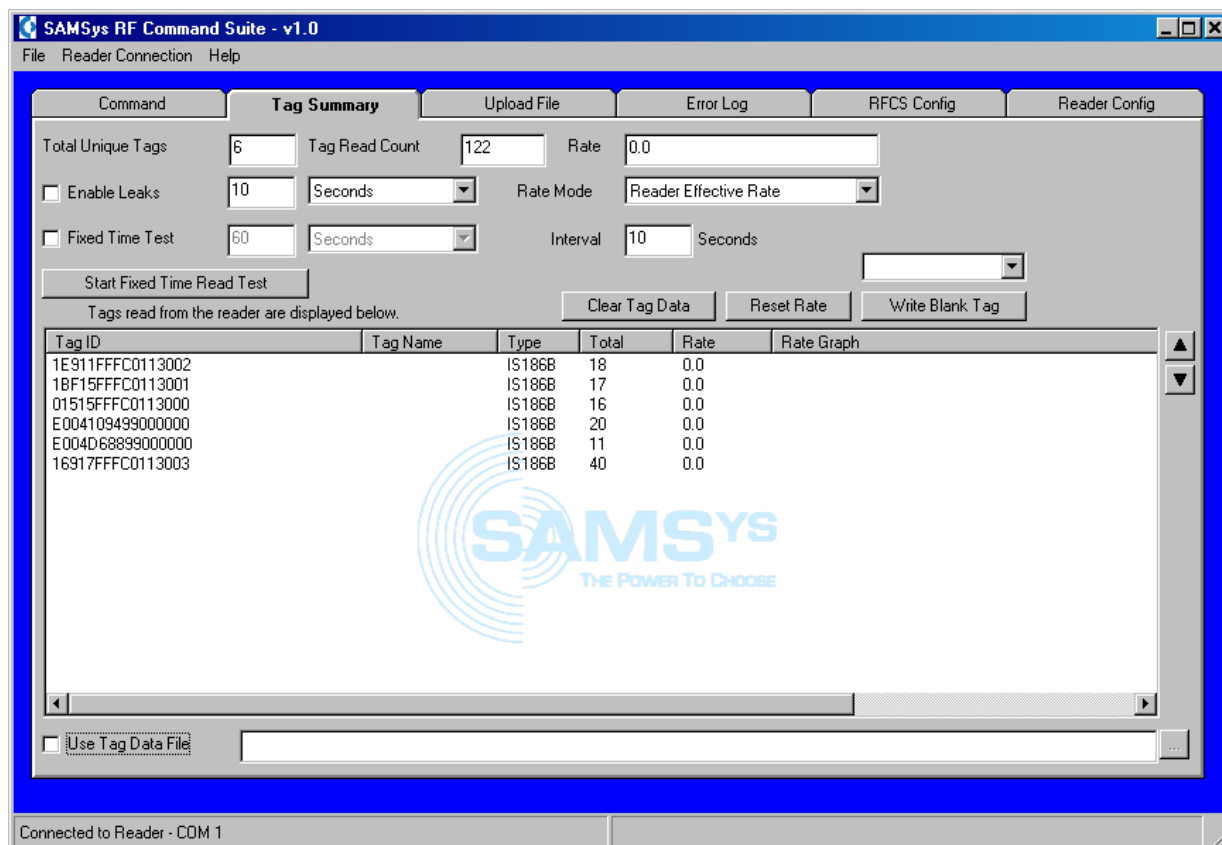


Figure 16–RF Command Suite Tag Summary

Writing Blank Tags

RF Command Suite can be used to write unprogrammed or blank tags. To write blank tags, perform the following:

1. Select the **Command** Interface and verify the reader is connected and the correct protocol is selected.
2. Place the reader in **Polled Read** mode.
3. Verify a single tag is in the RF field of the reader.
4. Select the **Tag Summary** Interface.
5. Select the protocol from the pull-down above the **Write Blank Tag** button.

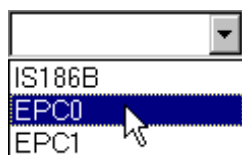


Figure 17–Select Tag Protocol

6. Press the **Write Blank Tag** button to begin the operation and display the tag data box.

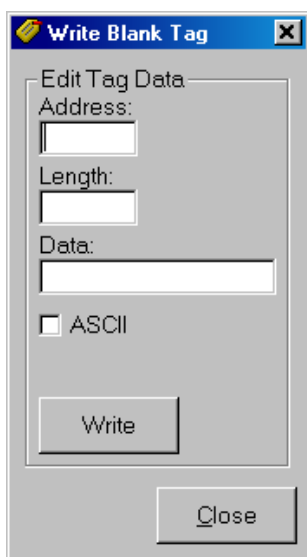


Figure 18–Write Blank Tag

7. Fill in the appropriate data (in Hex) and press the **Write** button to write the data to the tag.

NOTE: For detailed information on the various tag protocols and how each protocol is programmed, refer to Appendix A –Tag Programming.

Modifying Tags

RF Command Suite can be used to modify previously programmed tag data. To modify tags, perform the following:

1. Select the **Tag Summary** Interface and right-click on the tag.

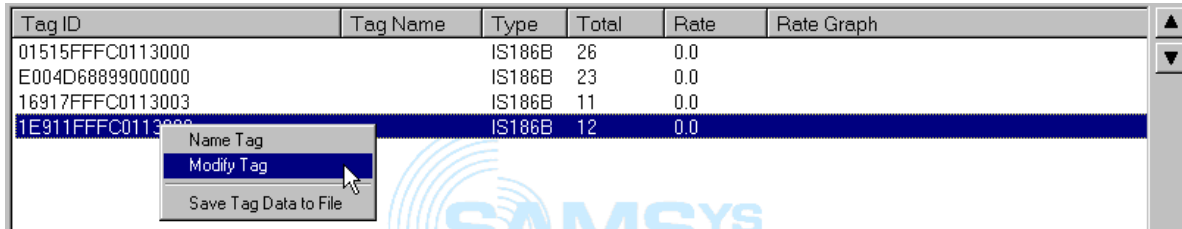


Figure 19–Select Tag to Modify

2. Select **Modify Tag**. The tag data window is displayed.

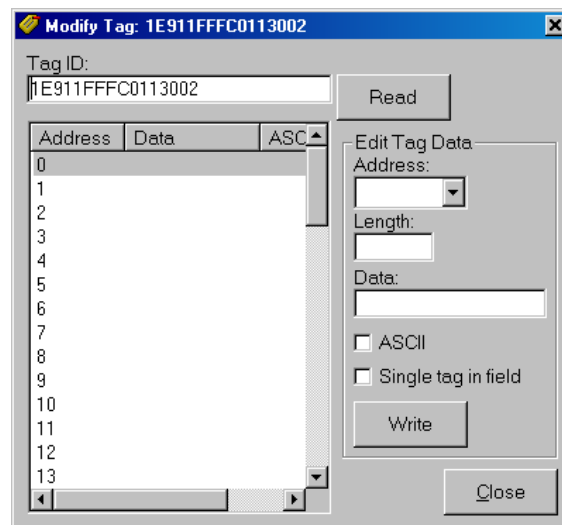
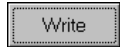


Figure 20–Modify Tag Option

3. Select the **Address** from the pull-down.
4. Enter the data **Length** and actual **Data** for the specific address
5. Select if **ASCII** data and whether or not there is a **Single tag in field**.
6. After all data and parameters are entered, press **Write** .
7. Repeat for each address.

Troubleshooting

This chapter provides general information to troubleshoot the MP9320 V2.8 Reader. Topics discussed in this chapter include the following:

- General Troubleshooting
- Contact Us

General Troubleshooting

SAMSys readers are designed, manufactured, and tested to provide many years of trouble-free service. However, in the event of a reader malfunction or failure, refer to the following troubleshooting instructions to help identify and correct the problem.



Warning - Electric Shock Hazard

The following procedures may involve AC voltage. Use extreme caution when measuring voltage or installing cables and power supplies. Serious injury or death may occur if proper precautions are not observed.



Caution - ESD

The following procedures involve electrostatic discharge sensitive components. ESD protection is required. Damage to the reader can occur if proper ESD equipment such as grounded wrist straps and ESD protected work surfaces are not used.

Symptom	Probable Cause	Corrective Action
No LEDs or buzzer during power up.	Power supply malfunction.	Ensure power supply is inserted into wall outlet. Verify correct operating voltage at outlet. Replace Power Supply.
	Reader software is corrupt.	Replace reader.
Reader appears to lock up.	Readers are vulnerable to high ESD pulses. As a result, the reader can lock up.	Disconnect the power from the reader and reconnect. The reader should reset. If the reader does not function normally after reset, replace the reader.
Any LED fails and buzzer alarms during power up.	Suspect LED bad.	Reader may operate normally with one or more bad LEDs, but the reader should be replaced as soon as possible.
	Reader board failure.	If reader does not read or write, replace the reader.
No buzzer on power up.	Buzzer malfunction.	Reader may operate normally without buzzer, but the reader should be replaced as soon as possible.
	Reader board failure.	If reader does not read or write, replace the reader.
	Reader software is corrupt.	Replace reader.

Symptom	Probable Cause	Corrective Action
No buzzer when reading a tag.	Buzzer malfunction.	Reader may operate normally without buzzer, but the reader should be replaced as soon as possible.
	Reader board failure.	If the reader does not read or write, replace the reader.
	Reader software is corrupt.	Replace reader.
No RS-232 Communication.	External RS-232 cable malfunction	Check cable connectors for bent or broken pins. Replace external RS-485 cable if necessary.
	Reader board failure.	Replace reader.
No RS-485 Communication.	External RS-485 cable malfunction.	Check cable connectors for bent or broken pins. Replace external RS-485 cable if necessary.
	Wrong jumper setting.	Ensure RS-485/Ethernet Jumper J4 is across Pins 1-2.
	Reader board failure.	Replace reader.
No Digital I/O signals present.	Reader board failure.	Replace reader.
Tag ID/data is different from expected value.	Reader software version.	Program reader with latest software version release.
	Electromagnetic interference.	Shield or reposition reader
Tag read failure.	Read range exceeded.	Reposition reader or tag.
	Tag speed exceeded.	Slow tag when within range of reader.
	Faulty tag.	Verify reader operation with a known good tag.
No Ethernet connectivity	External Ethernet cable faulty.	Check cable and replace if necessary.
	Wrong jumper setting.	Ensure RS-485/Ethernet Jumper J4 is across Pins 2-3.
	Wrong Ethernet IP address.	Use the Digi Device Discovery application to reverify IP address.
	Reader board failure.	Replace reader.

Contact Us

For any questions regarding products and services, including returns, repairs, technical support, training, and all other available services, contact your distributor or SAMSys Customer Service at the following:

E-mail	support@samsys.com
Telephone	1-877-367-4342 (toll free) 8:00am-6:00pm EST, Mon-Fri
Fax	1-919-281-1551

Specifications

This chapter describes the specifications for the MP9320 V2.8 Reader. Information provided includes the following:

- Reader Specifications
- Environmental Specifications
- Battery Specifications
- Power Supply Specifications
- RS-232 Connector Specifications
- RS-485 Connector Specifications
- Ethernet LAN Connector Specifications
- Digital I/O Connector Specifications
- Optional Communication Cable Specifications
- Antenna Specifications
- Regulatory Standards

Reader Specifications

Frequency	865-870 MHz (25 KHz steps) 902-928 MHz (200 KHz steps) 869.525 MHz single frequency
RF Power	16 mW - 3 W
Connections	RS-232, RS-485, Digital I/O (TTL), or Ethernet LAN
Input Voltage	15 Vdc +/-5%
Input Current	3A maximum

Environmental Specifications

Operating Temperature	-4° F to 158° F (-20° C to 70° C)
Storage Temperature	-40° F to 185° F (-40° C to 85° C)
Maximum Shock	1 foot (0.3 meter) drop to any corner
Relative Humidity	5% to 95% non-condensing
Case Material	Aluminum
Case Dimensions	5.25 x 7.0 x 11.5 in (133 x 178 x 286 mm)
Weight	4 lbs (1.8 kg)

Battery Specifications (Optional)

Battery (optional)	Lithium/Manganese Dioxide
Designation	ANSI/NEDA 5012LC / IEC-CR1220
Voltage	3.0 volts
Average capacity	40 mAh to 2.0 volts



Caution - Risk of Explosion

Only replace battery with a battery of the same type and designation. There is a risk of explosion if the battery is replaced with incorrect type. Dispose of old battery according to manufacturers instructions and local regulations.

Power Supply Specifications

Input Voltage	100 – 240 VAC
Input Consumption	0.3 A, 31 – 45 VA
Input Frequency	50 – 60 Hz
Output Voltage	15 VDC
Output Current	3 A

RS-232 Connector Specifications

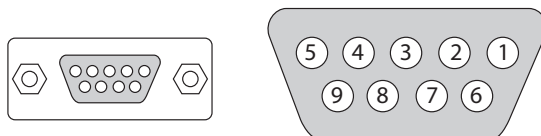


Figure 21–RS-232 Connector

Baud rate	9600 - 38400 (Default = 57600)
Parity	None
Data bits	8
Stop bits	1
Pin 1	CNVSS (Normally low. High puts reader in programming mode.)
Pin 2	TXD
Pin 3	RXD
Pin 4	DTR (shorted to pin 6)
Pin 5	GND
Pin 6	DSR (shorted to pin 4)
Pin 7	CTS
Pin 8	RTS
Pin 9	+3.3 Vdc

RS-485 Connector Specifications

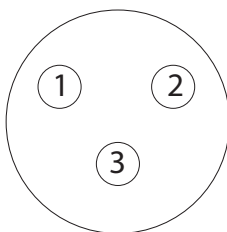


Figure 22–RS-485 Connector

Baud rate	9600 - 38400
Parity	None
Data bits	8
Stop bits	1
Pin 1	RS-485 C (common)
Pin 2	RS-485 B
Pin 3	RS-485 A

RS-485/Ethernet Jumper Setting

Jumper	Pins	Action
J4	1-2	RS-485 enabled.
	2-3	Ethernet enabled.
J1	1-2	High side termination active.
J2	1-2	Low side termination active.

Ethernet LAN Connector Specifications

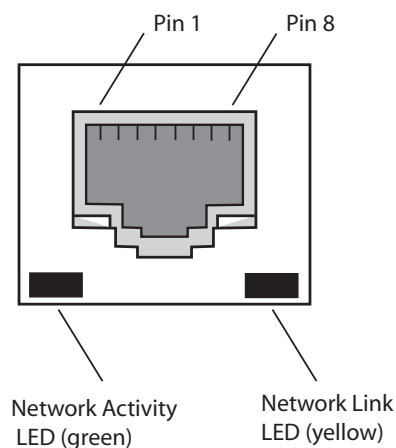


Figure 23–Ethernet LAN Connector

Pin 1	TXD+ (Transmit Data +)
Pin 2	TXD- (Transmit Data -)
Pin 3	RXD+ (Receive Data +)
Pin 4	EPWR+ (Power from switch +)
Pin 5	EPWR+ (Power from switch +)
Pin 6	RXD- (Receive Data -)
Pin 7	EPWR- (Power from switch -)
Pin 8	EPWR- (Power from switch -)
Network Link LED	Yellow LED indicates network link is operational. On continuously indicates Ethernet connection made.
Network Activity LED	Green LED indicates network traffic detected.

Digital I/O Connector Specifications

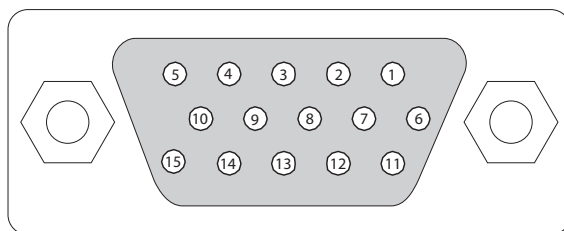


Figure 24–Digital I/O Connector

Signal Name	Pin No.	Description
DIN0	7	Digital Input 0 - optically isolated
DIN1	14	Digital Input 1 - optically isolated
DIN2	13	Digital Input 2 - optically isolated
DIN3	5	Digital Input 3 - optically isolated
Digital input common	8, 15	Input common
DOUT0	4	Digital Output 0 - open collector
DOUT1	11	Digital Output 1 - open collector
DOUT2	10	Digital Output 2 - open collector
DOUT3	2	Digital Output 3 - open collector
Digital output common	1,9,3,6,12	Output common

Optional Communication Cable Specifications

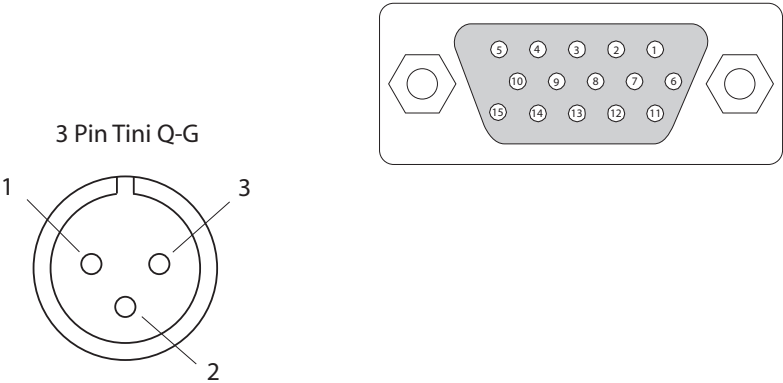


Figure 25–Optional Communication Cable Pinouts

15 Pin D Sub (Digital Input/Output)

Pin No.	Description
1	Output common
2	Output 3 - open collector
3	Output common
4	Output 0 - open collector
5	Input 3 - optically isolated
6	Output common
7	Input 0 - optically isolated
8	Input common
9	Output common
10	Output 2 - open collector
11	Output 1 - open collector
12	Output common
13	Input 2 - optically isolated
14	Input 1 - optically isolated
15	Input common

3 Pin Tini Q-G (RS-485)

Pin No.	Description
1	Common
2	B
3	A

Suitable Antenna Specifications

Antenna Parameter	FCC	ETSI
Frequency	902-928 MHz	865-870 MHz
Polarization	Circular	Circular
Gain, dBic	8, max	6, max
VSWR, maximum	1.3:1	1.3:1



Caution

This device has been designed to operate with no more than 1 Watt into the antenna and an antenna gain of no more than 9 dBic. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada, unless power into the antenna is decreased to compensate for the increased antenna gain. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit an RF field in excess of Health Canada limits for the general population; consult Sagfety Code 6, obtainable from Health Canada's website at www.hc-sc.gc.ca/rpb

Regulatory Standards

Emissions

Radiated Emissions (enclosure)	EN 55022 Class B FCC Part 15
Conducted Emissions (AC port)	EN 55022 FCC Part 15
Harmonic Distortion (AC port)	EN 61000-3-2: 1999
Voltage Fluctuation (AC port)	EN 61000-3-3
RF Spectrum	EN 300 220-1 EN 300 220-2 FCC Part 15 Canada RSS-210

Immunity

Electrostatic Discharge Immunity (all ports)	EN 61000-4-2
Radiated Immunity (enclosure)	EN 61000-4-3
Magnetic Immunity (enclosure)	EN 61000-4-8
Electrical Fast Transient Immunity (all ports)	EN 61000-4-4
Lightning Surge Immunity (all ports)	EN 61000-4-5
Conducted Immunity (all ports)	EN 61000-4-6
Voltage Dips and Short Interruptions (AC port)	EN 61000-4-11
EMC	EN 301 489-1 EN 301 489-3

Safety

Electrical Safety	EN 60950
RFID Human Safety	EN 50364



SAMSys Technologies, Inc.

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Reader Configuration

This appendix describes how to change or update the MP9320 V2.8 Reader configuration using the RF Command Suite. Refer to the *RF Command Suite User's Guide* for additional information.

Information provided in this appendix includes the following:

- Operating Modes
- Default Configuration
- Configuring the Reader with RF Command Suite
 - Changing the RS-232 Configuration
 - Changing Reader Operation Modes
 - Configuring Specific Protocols
- Updating Reader Firmware with RF Command Suite
- Updating the Reader Firmware using the ICCM
- Using CHUMP Commands to Configure the Reader

Operating Modes

SAMSys reader software is configurable to verify configuration parameters. Typical reader parameters include the following:

- RF communication mode (polled or continuous)
- Serial communication mode (polled or continuous)
- Multiplexer Configuration (# antennas, inventory rounds, and antenna hopping)
- Serial multidrop addressing
- Protocol configuration
- Protocol selection

For detailed information on checking reader configuration, refer to the following sections and the *RF Command Suite User's Guide*.

Default Configuration

The factory default configuration is as follows:

- General Configuration
 - RF Continuous
 - Serial Continuous
- Serial Configuration
 - 57600 Baud
 - 8 Data Bits
 - 1 Stop Bit
 - No Parity
- Multiplexer Configuration
 - 1 antenna
 - Antenna hopping enabled
 - 1 inventory round per antenna

Configuring the Reader with RF Command Suite

RF Command Suite can be used to easily configure your reader. The **Reader Config** interface provides control over the reader configuration registers that set communication parameters, change operating modes, and control the transmitter and receiver. These configuration registers are located under **General Configuration**.

In addition, individual protocol configurations can be modified. The protocol configuration registers are located under **Protocol Configuration**.

NOTE: If reader configuration commands have been recently sent from the command line or by pressing the function keys, the Reader Configuration window may not reflect the updated settings. Refresh the Reader Configuration window by collapsing and re-expanding the directories (see Figure 26). The updated settings should be displayed.

1. To configure the reader, select the **Reader Config** tab.

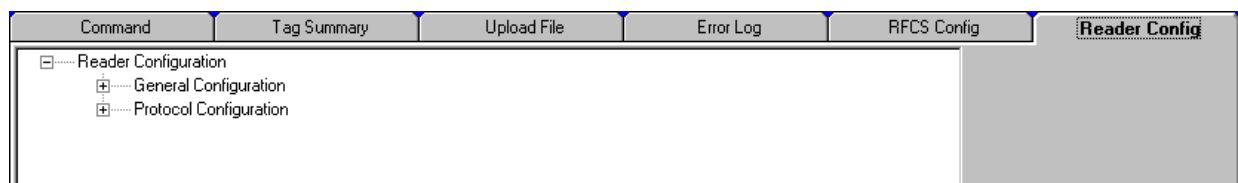


Figure 26 – Reader Configuration

2. To modify the general configuration registers expand the directory under **General Configuration**.
3. To modify the protocol configuration registers expand the directory under **Protocol Configuration**.



Caution

SAMSys readers use internal registers to provide a high degree of flexibility in setting operational parameters. However, improper setting of these registers can result in reader inoperability or permanent damage. For detailed information on reader and protocol configuration registers, refer to the Comprehensive Heuristic Uniform Messaging Protocol (CHUMP) Reference Guide and the Field Installation Guide.

NOTE: To make any reader changes permanent, the changes must be written to non-volatile memory (NVM). To make changes permanent, select the Persistence Flag option ☐ **Add Persistence Flag** before sending the change to the reader.

Changing the RS-232 Configuration

To configure the reader's serial port parameters, perform the following:

1. Select the RS-232 UART parameters as shown in the following:

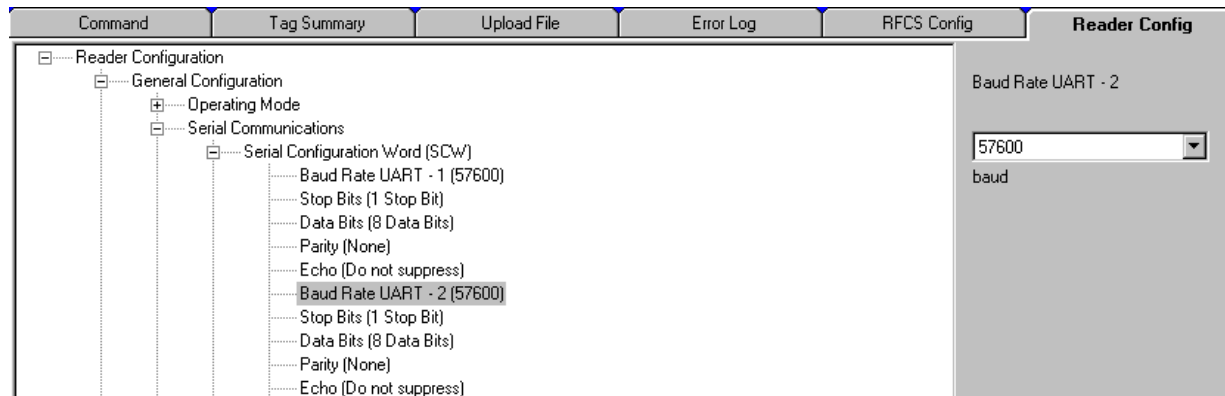
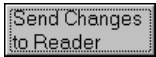


Figure 27 – RS-232 Serial Port Configuration

2. Make any changes using the pull-down menus and selectors on the right side of the display and press **Send Changes to Reader** .

Changing Reader Operation Modes

The reader's serial and RF modes can be configured for polled or continuous operation. In addition, the RF On when Idle mode can be set. To change any of the operating modes, perform the following:

1. Select the specific General Configuration Word (GCW) parameters as shown in the following:



Figure 28 – Serial and RF Mode Configuration

2. Make any changes using the selectors on the right side of the display and press **Send Changes to Reader** .

Configuring Specific Protocols

Individual Protocol Configuration registers can be modified for specific tag types and read modes. For specific protocol configuration register information, refer to the *Comprehensive Heuristic Uniform Messaging Protocol (CHUMP) Reference Guide*. To configure individual protocol registers, perform the following:

1. Select the individual protocol configuration word parameters.

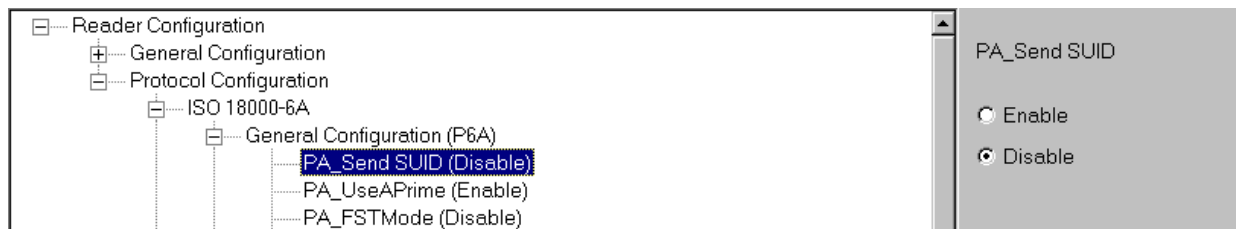
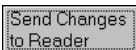


Figure 29 – Protocol Parameter Configuration

2. Enable or disable a specific protocol parameter by using the selectors on the right side of the display and press **Send Changes to Reader** .

Updating Reader Firmware with RF Command Suite

Periodically, SAMSys releases updated reader firmware that incorporates new protocols, enhanced features, and updated FlashROM images. SAMSys readers can be updated with new firmware using RF Command Suite. Refer to the *RF Command Suite Users Guide* for detailed information on this application.

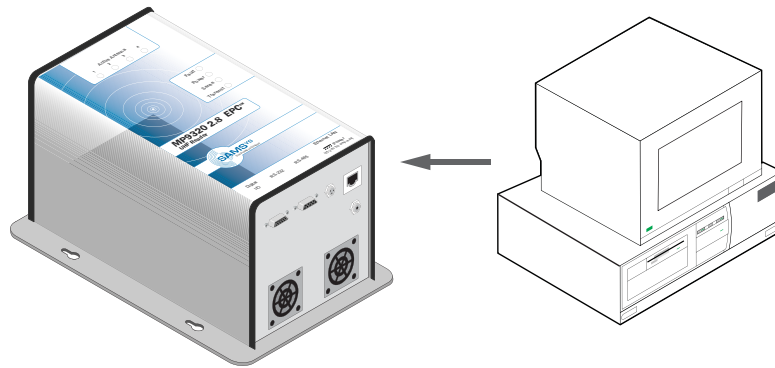


Figure 30—Firmware Upload System Configuration

Receiving Updated Firmware from SAMSys

Updated firmware is available by contacting SAMSys customer support. The firmware file has a **.chp** extension and is typically included in a zipped release file such as “**EPCReader_1.36.10.zip**”

Copy the files to a PC or other host computer connected to the reader.

Uploading Firmware with RF Command Suite

When uploading a file, RF Command Suite sends one line at a time and waits for the **{a}** response from the reader before sending the next line. If an **e:** is received, indicating an error, the upload aborts.

To upload firmware to a reader, perform the following:

1. Connect the reader to the PC using the RS-232 or Ethernet port as required.
2. Start RF Command Suite.
3. Select the **Command** interface window and turn off the RF output by pressing the **RF Off** function key.
4. Select the **Upload File** tab.
5. Browse to the file to upload. To use the directory navigator, press the Browse button .

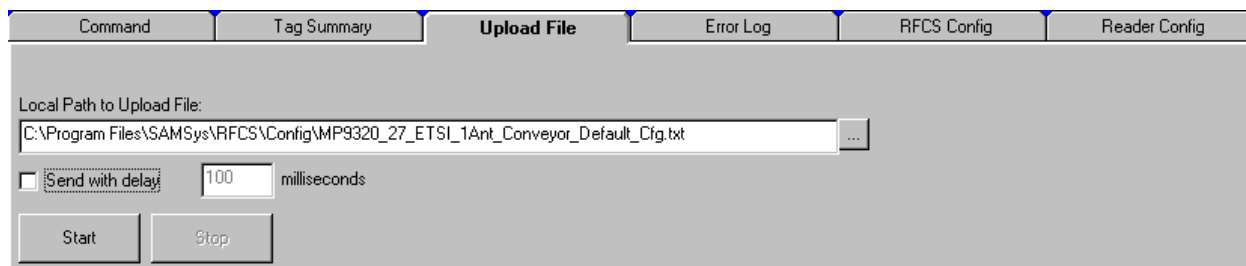


Figure 31 – Upload File Controls

6. When uploading FORTH files, insert a time delay between each line of the file. Select the **Send with delay** option and enter a time delay in milliseconds. A time delay is not necessary with **.chp** files.
7. When you are ready to upload the file, press **Start** .
8. The file will be uploaded to the reader. During upload, a bar graph indicates what percentage of the file has been sent.
9. If the file cannot be sent, a File Transfer Timeout error is displayed.

Updating Reader Firmware using the ICCM

To upgrade the reader firmware using the ICCM, verify that the ICCM is connected to the reader via the RS-232 or RS-485 communication port and that a PC or other host computer is connected to the ICCM via the RS-232 port. See Figure 30.

Receiving Updated Firmware from SAMSys

Updated reader firmware is available on CD or via download from the SAMSys website at www.samsys.com. The upgrade includes the reader application code which has a **.mot** extension such as **UHFrd_r_1.30d.mot**.

Copy the files to a PC or host computer connected to the ICCM.

Transferring the Files to the ICCM

Once the upgrade files are loaded to your PC, use the **Transfer Files** function on the ICCM to transfer the files to the ICCM. For detailed information on the Transfer Files function, refer to the *Interrogator Control and Concentrator Module User's Guide*.

Uploading the File to the Reader

After transferring the files to the ICCM, use the **Upload Reader Firmware** function to upload the reader application file to the reader. Use the **Upload Reader FlashROM** function to upload the Forth word definitions file to the reader. For detailed information on the Upload Reader functions, refer to the *Interrogator Control and Concentrator Module User's Guide*.

Using CHUMP Commands to Configure the Reader

In addition to using RF Command Suite to reconfigure a reader, individual CHUMP commands can be sent to the reader from RF Command Suite or a terminal/command console. To setup a SAMSys reader, the Configuration Write (Cw) command is used to write a three-letter configuration variable name and a 32-bit word to the reader. This word contains the individual setup parameters required by the reader.

For specific syntax information on the Cw command, refer to Chapter 2 in the *Comprehensive Heuristic Unified Messaging Protocol Reference Guide*.

Commonly used configuration variables include the following:

- GCW – General Configuration Word
- SCW – Serial Configuration Word (CHUMP 1.31 and above)
- MCW – Multiplexer Configuration Word
- SMA – Serial Multidrop Address
- PCW – Protocol Configuration Word
- PSW – Protocol Select Word
- Pxx – Specific Protocol Configurations
- CNR - Self Training Control

The following example shows the Cw command used to write the MCW to the reader.

```
}Cw,d:MCW,b:00040200! <CRLF>
```

where:

00040200 = 4 antennas, 2 inventory round operations per antenna.

If the Cw command was successful, the reader responds with:

```
{A7; <FCS><CRLF>
```



Warning

The SAMSys MP9320 Reader uses internal registers to provide a high degree of flexibility in setting operational parameters. The use of these registers is described in the MP9320 User's Guide, the MP9320 Field Installation Guide, and the *Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide*. However, improper setting of these registers can result in reader inoperability or permanent damage.

In particular, the TPC, TP0, TP1, TP2 and TP3 registers control the transmit power of the reader. The user should not modify these registers unless specifically directed by SAMSys personnel. Trained, professional installers should only modify them as part of the transmit calibration procedure described in the *Field Installation Guide*.

Tag Programming

This appendix describes how to program tags of varying protocols using CHUMP commands sent from a terminal or console.

Information provided in this appendix includes the following:

- Overview of the Tag Writing Command
- Programming the EPC1 Tag
- Programming the ISO 18000-6A Tag
- Programming the ISO 18000-6B Tag
- Programming the Impinj EPC0 Tag
- Programming the Matrics Class 0+ Tag

Overview of the Tag Writing Commands

Tag writing with SAMSys readers is performed using the Write Any (**Wa**) command and the Write Tag (**Wt**) command. **Wa** must be used when writing to blank tags. **Wt** is used when the tag already has a tag ID.

Typically, **Wa** is used whenever the write operation affects the tag ID. **Wa** can also be used for write operations to any data on a tag. This command is executed with a single tag in the RF field.

Wt can only be used for write operations to a specific tag where the tag ID has already been assigned. This command can be used for write operations to any data on the tag, except the tag ID itself.

Both **Wa** and **Wt** have several different command parameters that can occur in any order in the command string. In some cases, the parameters are optional. The parameters include the following:

- **a**: address block (in hex)
- **l**: length
- **b**: write data
- **f**: control flags

Where:

a: address block refers to the particular piece of writeable memory in the tag. The concept of a block size can vary from one tag type to another. The address block may be optional if the specific tag type only contains a single piece of writeable memory. This value is in hexadecimal.

l: length refers to the length of the data to be written. For some tags this length is in bytes and for others this is in blocks.

b: write data is the data to write to the tag.

f: control flags dictate certain optional protocol specific behavior with the write operation.

Some tags support the ability to have a portion or all of their internal memory locked against further modification. Write operations to locked memory will not be successful. The locked status of a piece of memory can be queried via the **Yl** command. The **Yl** response is **f:0** for unlocked or **f:1** for locked.

Details of the syntax for any command found in this document can be obtained in the CHUMP Reference Guide.

Programming the EPC1 Tag

SAMSys MP9320 and MP9310 readers can be used to program 64-bit and 96-bit EPC1 tags.

Use the **Wa** command to write EPC1 (Alien) tags. Do not use **Wt** since the tag does not support singulated write operations. In addition, before writing to a 96-bit EPC ID tag, you must send a Tag Reset (**Tr**) command prior to issuing the write operation.

Prior to writing, EPC1 tags must be erased. If the command specified does not erase the tag during the command execution then specify the erase operation separately using the Tag Erase (**Te**) command.

Also, in order to calculate the CRC, the entire tag ID must be presented to the reader in one command. EPC1 tags contain an internal CRC value which covers the EPC ID and the kill passcode. The reader always calculates the CRC and writes the correct value to the tag during the write operation. As a result, the entire tag ID and passcode must be presented to the reader in one command. The last byte is the kill passcode. In the examples that follow, this passcode is set to **00**.

The **Wa** command has several different parameters that can occur in any order in the command string. These parameters include the following:

- **a**: address block (in Hex). This parameter is optional since there is only a single writeable piece of memory. If specified, the parameter should use block address 0x00.
- **l**: length. This parameter reflects the number of bytes being written and must be equal to **9** if writing a 64-bit EPC ID with the kill passcode or equal to **d** if writing a 96-bit EPC ID with the kill passcode.
- **b**: write data. This parameter must contain the entire EPC ID (64- or 96-bit), followed by the one byte kill passcode.
- **f**: control flags. This parameter controls operations related to writing a tag. Set **f:1** to verify the data in the tag following the write operation. Set **f:2** to erase the data prior to the write operation. For most applications, set both of these bits with **f:3**.

The following is a typical command to write a 96-bit EPC1 ID tag:

```
}wa,a:0,b:80020304050607090a0b0c0e00,l:d,f:3!
```

The following is a typical command to write a 64-bit EPC1 ID tag:

```
}wa,a:0,b:800080042504600200,l:9,f:3!
```

In addition to the Wa, Te, and Tr commands, SAMSys readers also support the following EPC1 operations:

- **Lb** Lock Block
- **Yl** Query Lock Status (returns **f:0** for unlocked or **f:1** for locked)
- **Td** Tag Destroy

The Lock Block and Query Lock Status operations can only be performed with a single tag in the RF field and do not require any parameters. The Tag Destroy operation requires the **b:** parameter to specify the particular kill passcode for this tag.

For detailed information on these and other tag commands, refer to the *Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide*.

Programming the ISO18000-6A Tag

Both the **Wa** and **Wt** command can be used with the ISO18000-6A tag. In addition to **Wa** and **Wt**, two additional commands can modify specific data in the tag. The **Wd** command modifies the DSFID and **Wf** modifies the AFI.

Typically, the **Wt** command is used to modify user data in the tag. The **Wt**, **Wd**, and **Wf** commands require the tag ID to be in the **d:** parameter. Also, the tag must first be put in the SELECT state using the **Ts** command with the tag ID specified in the **d:** parameter.

NOTE: Some varieties of ISO18000-6A tags are not writeable. Currently, only Atmel markets a writeable ISO18000-6A tag.

The following parameters are used with the **Wa** or **Wt** commands.

- **a:** address block (in Hex). In ISO18000-6A, only a single block can be written at one time and this parameter represents the specific four byte block.
- **l:** length. This parameter is optional since each write operation must contain exactly four bytes.
- **b:** write data. This parameter must contain four bytes of data.

The following is a typical command to write to an ISO18000-6A tag:

```
}wa, a:0, b:01020304!
```

For example, to write AABCCDD to address 0x20 on a tag with ID E00300001122334455667788, issue the following command:

```
}wt, d:E00300001122334455667788, a:20, b:AABCCDD!
```

In addition to the **Wa**, **Wt**, **Wd**, and **Wf** commands, SAMSys readers also support the following EPC1 operations:

- **Lb** Lock Block
- **Yl** Query Lock Status (returns **f:0** for unlocked or **f:1** for locked)

Each of these operations must specify a particular tag ID using the **d:** parameter or first be put in the SELECT state using the **Ts** command with tag ID specified in the **d:** parameter.

Programming the ISO18000-6B Tag

General ISO18000-6B Programming

In ISO18000-6B, operations are controlled by a state machine within the tag. As a result, the tag must be in the *Data Exchange* state for the write operation to succeed. To guarantee the tag is in that state, the tag must be reset using the Tag Reset **Tr** command followed by a Read Detect **Rd** command prior to performing the first write operation.

The ISO18000-6B protocol does not provide any feedback on the write operation since the reader always provides an Ack (**{A}**) after the tag receives a command. The only way to verify success is to read the data back from the tag.

An ISO18000-6B tag write operation can fail if any byte within the addressed range is locked or if the power setting is not correct. It is not uncommon for Philips and Rafsec ISO18000-6B tags to have some of the first eight bytes locked. Confirm the status of the specific type of tag in use.

Both the **Wa** and **Wt** command can be used with the ISO18000-B tag. The **Wt** command is used to modify data outside of the first 8 bytes in the tag and requires specification of the tag ID using the **d:** parameter.

The following parameters are used with the **Wa** or **Wt** commands.

- **a:** address block. In ISO18000-6B, this parameter provides the address of the writeable memory block. The block size is one byte.
- **l:** length. This parameter reflects the number of blocks being written (which is equal to the number of bytes in this case).
- **b:** write data. This parameter contains the actual data being written.

The following command example command writes AABBCDD to user memory at address 0x20 on a tag with ID EF04001122334455:

```
}wt,d:EF04001122334455,a:20,b:AABBCDD,l:4!
```

In addition to the **Wa** and **Wt** commands, SAMSys readers also support the following ISO18000-6B operations:

- **Lb** Lock Block
- **Yl** Query Lock Status (returns **f:0** for unlocked or **f:1** for locked)

Each of these operations must specify a particular tag ID with the **d:** parameter and block address with the **a:** parameter.

UCODE Programming

Writing multiple bytes anywhere in the first eight bytes of a UCODE tag requires the use of the **Wa** command. Only a single tag should be present in the RF field for a **Wa** operation. The **Wa** command can be used to modify any byte in the tag.

For single byte write operations, use the **Wt** command.

The ISO18000-6B UCODE tag can emulate a 96- or 64-bit EPC ID tag by writing data to multiple locations in the tag and enabling the appropriate mode in the reader. This capability is more fully described in the *Implementation of EPC Tag Data on UCODE EPC 1.19 Application Note* from Philips Semiconductor. For detailed information on reader configuration for this tag, refer to the P6B Configuration Register description in the SAMSys *Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide*.

To configure a UCODE tag for a 96-bit EPC ID of 3114F4DA34B2D05E01010101, send a Tag Reset **Tr** command followed by a Read Detect **Rd** command. Then issue the **Wa** commands:

```
}Tr!  
}Rd!  
}wa, a:2, b:315E01010101, l:6!  
}wa, a:10, b:14F4Da34B2D0, l:6!
```

To configure a UCODE tag for a 64-bit EPC ID of 4066771122334455, send a Tag Reset **Tr** command followed by a Read Detect **Rd** command. Then issue the **Wa** commands:

```
}Tr!  
}Rd!  
}wa, a:2, b:401122334455, l:6!  
}wa, a:10, b:6677, l:2!
```

Programming the Impinj EPC0 Tag

In EPC0, there is no single standard for performing write operations and there are notable differences between manufacturers. Consequently, some varieties of EPC0 tags are not writeable. This section addresses the writable EPC0 tags produces by Impinj.

Both the **Wa** and **Wt** command can be used with the EPC0 tag.

In Impinj EPC0 tags, the following command parameters are used:

- **a**: address block (in Hex). This parameter provides the address of a writeable memory block. The block size is one row which is two bytes.
- **l**: length. Parameter reflects the number of blocks being written.
- **b**: write data. Parameter must contain the data to be written. If the data provided does not match the length specified, zeros are padded to the right of the data.

Typically, the **Wt** command would be used to modify user data in the tag. The **Wt** command requires specification of the tag ID using the **d**: parameter.

For example, to write data AABBCDD to user memory at address 0x8 on a tag with ID E00300001122334455667788, issue the following command:

```
}wt, d:E00300001122334455667788, a:8, b:AABBCDD!
```

In addition to the **Wt** command, the reader also supports the following operations:

- **Lb** Lock Block
- **Yl** Query Lock Status (returns **f:0** for unlocked or **f:1** for locked)
- **Td** Tag Destroy

The Lock Block and Query Lock Status operations must be performed with a single tag in the RF field and do not require any parameters. The Tag Destroy operation requires **d**: parameter to specify a particular tag ID and the **b**: parameter to specify the particular kill passcode for this tag.

For detailed information on these and other tag commands, refer to the *Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide*.

Program a 96-Bit EPC (Impinj Tags)

To write a 96-bit EPC on an Impinj Zuma EPC0 tag, enter the following:

```
}Wa, a:4, l:6, b:306c50fd76d803cf02f47f5f, f:3!
```

where:

a:4 is the start of the EPC

l:6 is the length in rows

b:xxxx is the 96-bit EPC code

f:3 is the command to calculate the CRC

The CRC is calculated and written to the row following the EPC code.

Program a 64-Bit EPC (Impinj Tags)

To write a 64-bit EPC and precalculated 16-bit CRC, enter the following:

```
}Wa, a:4, l:5, b:c80507a8009af9d71021!
```

where:

a:4 is the start of the EPC

l:5 is the length of the EPC and CRC in rows

b:xx is EPC and CRC

Program a 48-Bit Product Code (Impinj Tags)

In the following example, the 48-bit product code is written first and then the 16-bit serial number is written at a later time. To write the 48-bit product code, enter:

```
}Wa, a:4, l:3, b:c80507a8009a!
```

To write the 16-bit serial number, enter the following:

```
}Wa, a:7, l:2, b:fa6e7380!
```

Program the User Data (Impinj Tags)

To program user data on a 96-bit Impinj Zuma Tag, data is written to specific rows. To write user data to User Row 11 (b hex), enter:

```
}Wa, a:b, b:1234!
```

Change the Passcode (Impinj Tags)

To change the Passcode on an Impinj Zuma Tag, enter the following:

```
}Wa, a:2, l:2, b:123456!
```

where:

l must equal 2

b must be 6 digits

Programming the Matrics Class 0+ Tag

Matrics Class 0+ tags utilize a process called Singulation. This is a process of uniquely identifying a tag in a population of tags and retrieving its Electronic Product Code (EPC). For detailed information on EPC Class 0 singulation, refer to the EPC Global Class 0 specification.

When a tag is requested to identify itself, it responds with different data based on its singulation mode. Class 0 and Class 0+ tags allow three modes of singulation:

- **ID2** - This mode responds directly with the EPC. ID2 is the fastest mode (fewest bits transmitted), but requires the reader to echo the bits back to the tag. This echo can create security issues. Also, this mode can not be read when writing the EPC, since the echo will change the EPC as you write it.
- **ID0** - This mode returns packets of 12 random bits that are different every time you singulate. When the reader has what it determine is the correct number, it writes the EPC. This mode is the only reliable method of writing the tag EPC.
- **ID1** - This mode is the same as ID0, but every singulation returns the same bit stream. The bits are random, but they are seeded from the EPC. Writing the EPC changes these bits.

The singulation mode is controlled with the PE0 register and must be set prior to writing tags.

Matrics Class 0+ tags contain three writable pages or memory blocks: These pages are as follows:

- **Page 0** – Kill code (24 bits)
- **Page 2** – EPC code (64 or 96 bits)
- **Page 3** – User data (104 bits)

When Page 2 or Page 3 data is written, a 16-bit CRC is appended.

Both the **Wa** and **Wt** command can be used to write Matrics Class 0+ tags. The following command parameters are used:

- **a:** address block. This represents the memory page of the tag on which the write operation will occur. Values can be 0, 2 or 3, as defined previously. If this parameter is missing, it will default to 0.
- **l:** length. This parameter is required and is the number of bytes being written.
- **b:** write data. This parameter is required and contains the data to write.
- **d:** tag ID. This parameter is required for the **Wt** command (optional for **Wa**) and specifies the EPC code of the tag to which the write operation applies. The 16-bit CRC must be supplied along with the 64 or 96 bit EPC code.

Writing Initial EPC Code to Blank Matrics EPC0+ Tags

To write the EPC code to blank tags, ID0 singulation must be used.

If ID2 traversal is to be inhibited on subsequent tags, set the traversal inhibit bit in PE0 . Once written, those tags will not singulate using ID2 unless the EPC code is erased and then rewritten with traversal inhibit cleared.

Once a valid EPC code is written to Page 2, it cannot be overwritten unless the tag is first erased. Tag write operations using ID0 singulation cannot distinguish if a tag has previously been singulated.

Each ID0 singulation will use a new random number. To prevent a single tag from continually being selected for EPC code writing, an error code is returned if the tag already has a valid EPC code and overwrite is blocked.

As stated earlier, the mode must be set prior to writing tags. A typical value for the PE0 register for writing blank tags is 0x12050180. This value sets PE0 for the following:

- Use ID0 singulation with 2 blocks of random bits
- Retry count set to 5
- Scroll first turned on
- Autolength EPC enabled

To write the PE0 register, enter the following:

}Cw,d:PE0,b:12050180!

If traversal inhibit required, write 0x52050180 to the PE0 register.

To write a 96-bit EPC code to a blank tag, enter the following:

```
}Wa, a:2, b:220000000000000000000000000003, l:c!
```

Writing a Kill Code and User Data

Kill codes and user data can be written to any tag in the field in the same manner as the EPC code method described above, but typically a kill code and user data would be associated with a specific EPC code. Once written, you cannot read back the kill code.

To write a Kill Code, enter the following:

}Wa,a:0,b:112233,l:3!

To write User Data to any tag, enter the following:

}Wa,a:3,b:00112233445566778899aabbcc,l:d!

To write a specific tag, enter the EPC code and the 16-bit CRC. The following write command singulates using ID2, so PE0 singulation bits are ignored:

**}Wt,a:0,d:2200000000000000000000003DCD0,b:112233,l:3!
!**

To write user data to any tag: (singulates using ID2, so PE0 singulation bits ignored)

**}Wt,a:3,d:2200000000000000000000003DCD0,
b:00112233445566778899aabbcc,l:d!**

Tag Erase

To erase a Matrics 0+ tag, use the Tag Erase **Te** command. Only one tag should be in the field when executing this command. All memory pages are filled with 0's and a 16-bit CRC is appended.

After erasing, the EPC code page will be filled with 0's. Also, the user data page will have all 0's with a 16 bit CRC appended at the end. This allows the user data page to be read with the **Ra** command. However, the EPC code page will return an error on **Ra**, since there is no valid CRC. If any page is locked, then the **Te** command will fail and none of the pages will be erased.

To erase a tag, enter the following:

}Te!

Locking Tags

Individual memory pages can be locked with the **Lb** command. Once a page is locked, it cannot be unlocked or written. The following are typical Lock commands.

To lock Page 0 (Kill code of any tag singulated using PE0 bits), enter:

}Lb!

To lock Page 2 (Kill code of any tag singulated using PE0 bits), enter:

}Lb, a:2! (locks page 2, the EPC code of any tag singulated using PE0 bits)

To lock Page 3 (User data with specific EPC code), enter:

}Lb, a:3, d:2200000000000000000000003DCD0!

Configuring the IP Address

This appendix describes how to configure the IP address of the MP9320 V2.8 Reader. Topics discussed in this chapter include the following:

- Ethernet IP Address Overview
- IP Address Setup

Ethernet IP Address Overview

The MP9320 V2.8 can be networked with other readers on an enterprise 10/100 BaseT Ethernet LAN. Each reader is equipped with an embedded IP device server that allows the unit to be assigned an IP address. This address can then be accessed by your network server or host computer.

When the reader is installed on a TCP/IP network connected to the internet, the reader must be assigned a unique IP address. The reader is configured for automatic IP address allocation using the Dynamic Host Configuration Protocol (DHCP) Mode. This is the default mode for the reader as it is shipped from the factory. In this case, the reader automatically extracts the IP address from the DHCP server.

If DHCP is not available or the reader is not setup for automatic IP address allocation, the address can be manually assigned using the Digi Device Discovery application.

IP Address Setup

To set up an MP9320 V2.8 for Ethernet communication, perform the following:

1. Verify all cabling and power supplies are secure and power up the readers.
2. Copy the Digi Discovery application from the UHF Reader system distribution disk to your host system. This application has the filename: **dgdiscvr.zip**.
3. Copy the RF Command Suite application to your host system. This application has the filename **Setup_RFCommandSuite_10.exe**.
4. Unzip the Digi Discovery zip file and extract the **dgdiscvr.exe** application. The application will be copied to your system inside a folder.
5. Open the **dgdiscvr.exe** folder and double-click the **dgdiscvr** application.
6. If any readers are connected, the application will launch and the readers will be displayed as follows:

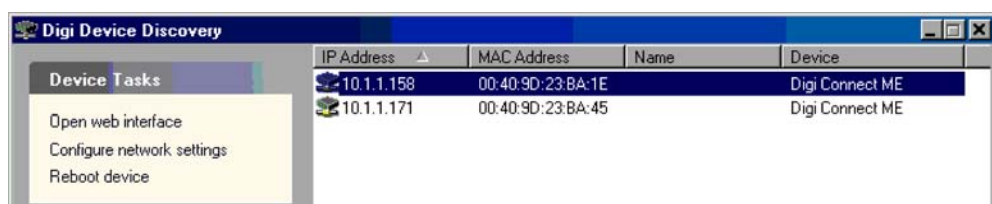


Figure 32–Digi Device Discovery Application Window

7. Select the IP address of the reader to configure.

NOTE: If the IP address returns all zeros (0.0.0.0), configure the reader manually by selecting **Configure network settings**.

8. The following steps require loading a Java applet onto your computer. If your computer will accept applets, follow Step 10 through Step 13.
9. If your system cannot run Java applets, follow Step 14 through Step 17 to complete the setup using a Telnet session to enter commands.
10. (For Java applet) Click on **Open web interface** to load a Java applet and open a web browser window off the reader's device server.
11. (For Java applet) Click **Yes** if you get a security dialog box request when the applet launches.

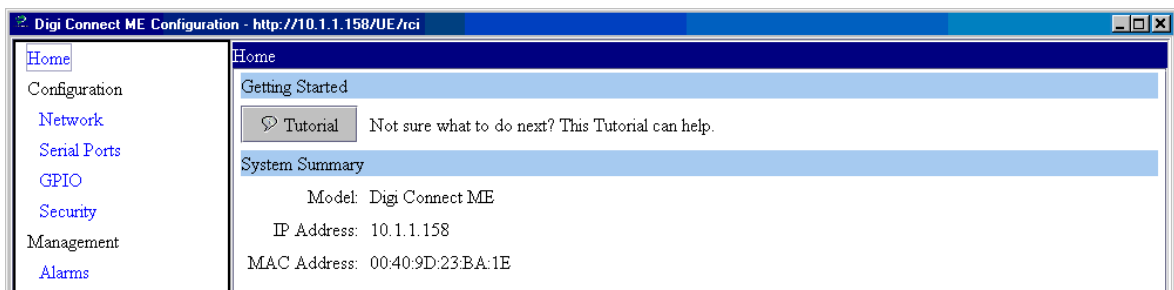


Figure 33–Digi Device Discovery Web Interface Window

12. (For Java applet) Select **Serial Ports** and verify the Baud Rate is set to 57600.

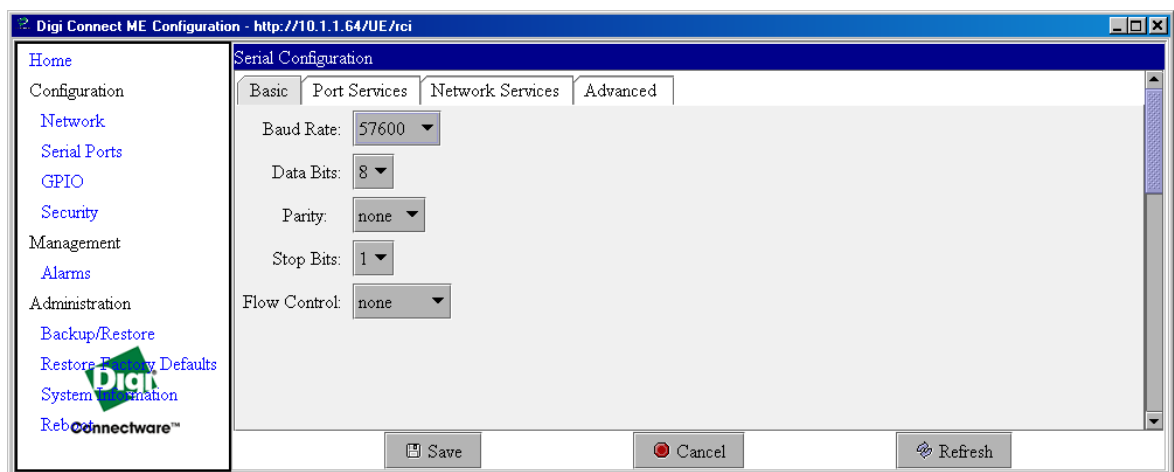


Figure 34–Digi Device Discovery Serial Configuration Window

13. (For Java applet) Press **Save** and go to Step 18.

14. (For Telnet session only) Connect to the reader via a Telnet session. Use the IP address returned by the Digi Discovery application and **Port 23** for the Telnet connection.
15. (For Telnet session only) Enter **show serial** and verify the serial port settings match the settings in the reader's SCW configuration register.
16. (For Telnet session only) To change the baud rate, enter **set serial baudrate = <rate>**. For best performance, a baud rate of 57600 is recommended.
17. Close the Telnet session.
18. Verify the serial port on the reader is connected to the serial port on your PC or host system with a serial cable.
19. At this time, load RF Command Suite. This application is a SAMSys reader management application supplied on your system CD. RF Command Suite will be used to set the serial port speed on the reader to a Baud Rate of 57600.
20. If the reader's serial port Baud Rate is not correct, you can modify the rate by selecting the **Reader Config** interface window.
21. Expand **Reader Configuration** ⇒ **General Configuration** ⇒ **Serial Communications** ⇒ **Serial Configuration Word (SCW)**.

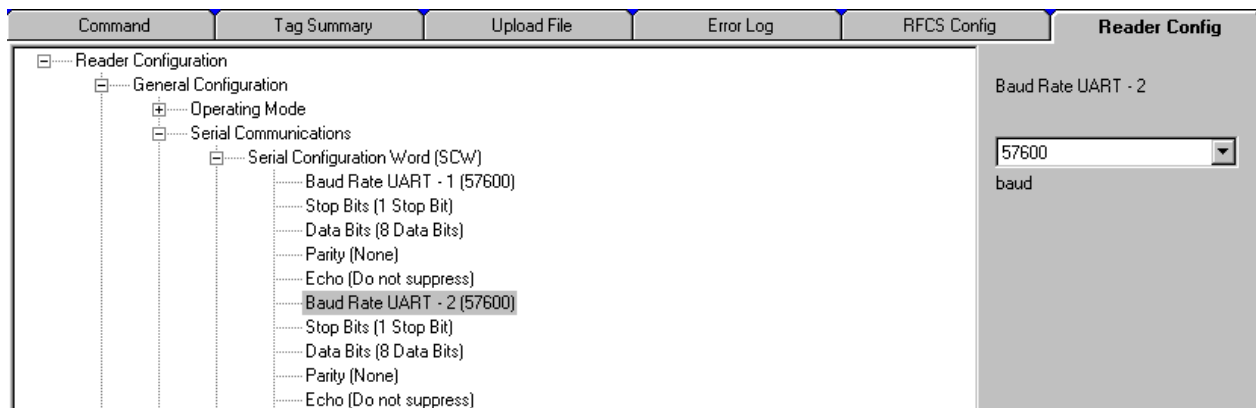


Figure 35–Reader Serial Port Properties

22. Determine which UART is driving the serial port:
 - UART-1 – unused
 - UART-2 – RS-232
 - UART-3 – Ethernet
23. Change any settings and click **Send Changes to Reader** .
24. After setting the Baud Rate, close any ConnectMe and Digi Device Discovery windows.

25. From RF Command Suite, select **Reader Connection** → **Disconnect**. This will disconnect any auto connected sessions.
26. Select **Reader Connection** → **Connect via TCP/IP**.
27. Select **Reader Connection** → **AutoConnect** to establish an Ethernet connection.
28. Select the IP address of the reader from the popup list and press **OK**.
29. Select the **Command** interface tab and press the **Version** function key to verify communication with the reader.

