User's
Guide

MP9310
Low-Power UHF Reader Module

SAMSYS
THE POWER TO CHOOSE

SAMSys

MP9310 Low-Power UHF Reader Module
User's Guide

Second Edition (February 2005)

Disclaimer and Limitation of Liability

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 Toroto Stock Exchange under the symbol SMY.

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Federal Communications Commission (FCC) Notice

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.The authority to operate this product is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by SAMSys Technologies.

In order to comply with FCC radiated emissions requirements, the MP9310 with the optional Ethernet port must use a Category 5 shielded cable.

FCC Radiation Exposure Statement

The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

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Introduction

This chapter provides a general description of the MP9310 Low Power UHF Reader Module. Topics discussed in this chapter include the following:

- Unpacking the Reader

- About the MP9310

- 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:

   • MP9310 Low-Power UHF Reader Module
   • Ribbon cable
   • System documentation CD
   • Antenna (optional)
   • Antenna cable (optional)
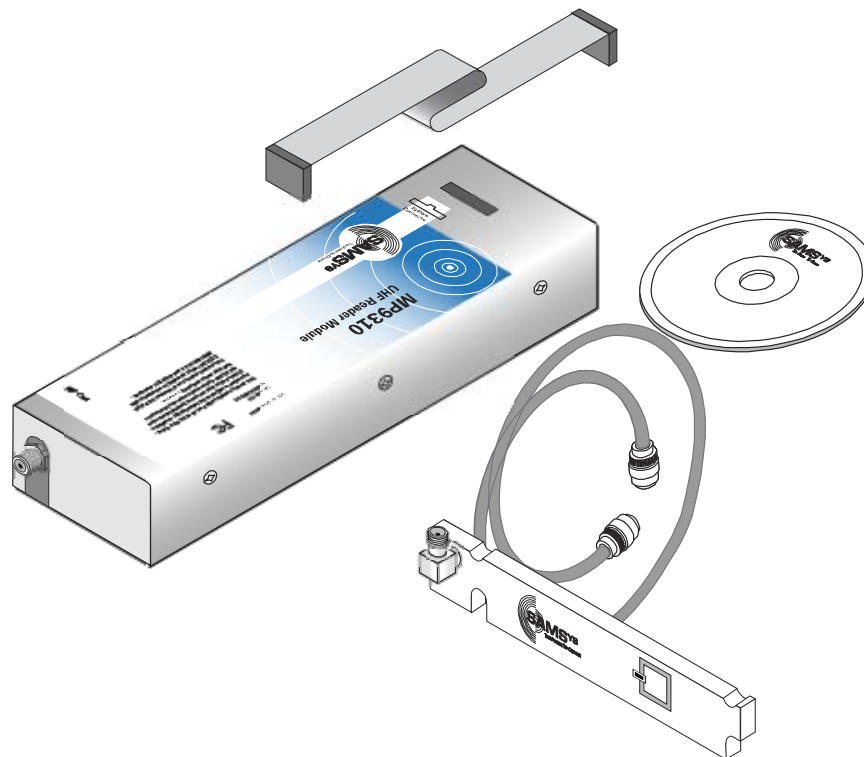
Figure 1–*MP9310 Reader and Accessories*

About the MP9310

The MP9310 is an integral UHF RFID module designed for use in transponder printer/programmers and other tag manufacturing equipment. This compact, low-power module is capable of operating at 902 to 926 MHz for the North American version and 865 to 869 MHz for the European Version.

The MP9310 currently supports the following UHF protocols:

- ISO 18000-6A
- ISO 18000-6B
- EM Marin 4022, 4222, and 4223
- Intermec Intellitag
- Philips UCODE EPC 1.19
- EPC Class 1
- EPC Class 0 including Impinj 0+ and Matrics 0+

In addition to the multi-protocol architecture, the MP9310 includes the following features:

- RS-232 Serial Port
- Digital input and output lines
- Ethernet LAN connection (optional)
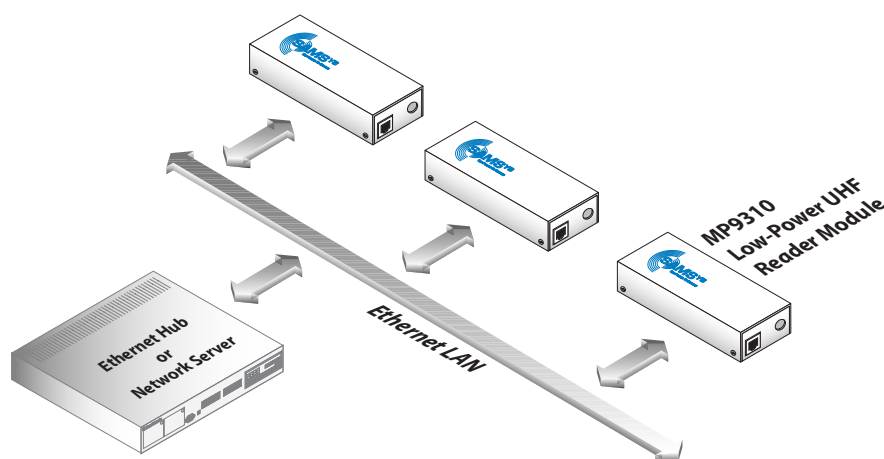
Figure 2–*MP9310 Reader Network (Optional Ethernet shown)*

Physical Description

The MP9310 is a single board reader that provides the OEM with a low-power, UHF solution for integrated RFID systems. The reader board is enclosed in a shielded aluminum enclosure and contains all digital, analog, and RF components along with power and I/O connections. One SMA type antenna port and integral power and I/O connector is also provided. An optional

Installation and Setup

This chapter provides information for installing the MP9310 Low-Power Reader Module. Topics discussed in this chapter include the following:

- Low-Power UHF Antenna Installation

- Reader Mechanical Installation

- Reader Electrical Installation

- Installing the RF Command Suite Application

- Ethernet LAN Communication Setup (MP9310-NE/EE only)

- Setting Transmit Power

- Digital Input/Output Setup

Low-Power UHF Antenna Installation

The MP9310 is designed to operate with the SAMSys Label Printer Antenna. This antenna has an expected read range of 1-12 inches and only requires a power output of approximately 17 dBm for optimal performance.
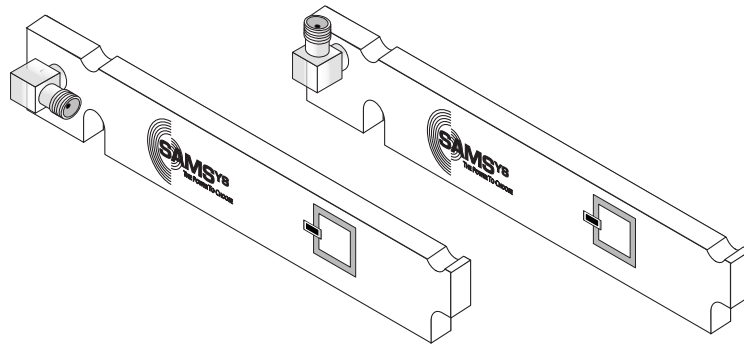
Figure 3–Low-Power UHF Antennas

As shown in Figure 4, mounting slots/cutouts are provided. Do not attempt to drill new mounting holes in the antenna.
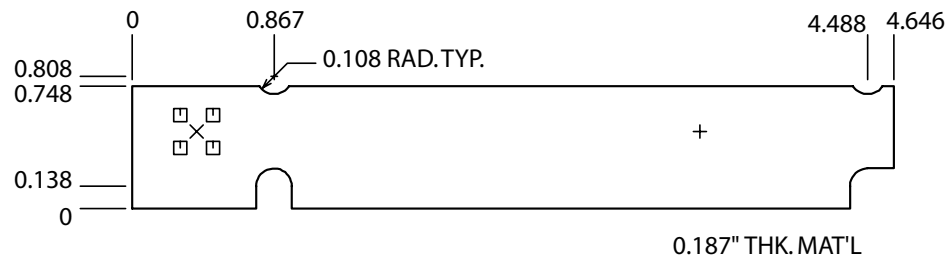
Figure 4–Label Programmer Antenna Dimensions

Caution

To prevent reader damage, the RF port must be properly terminated with a 50 Ohm load or a functional UHF RFID antenna before power up. Never power up the reader unless the loads or antennas are connected. Always power down the reader before removing an antenna or load from an RF port.

FCC Radiation Exposure Statement

The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. The spacing between users and the antenna must be a minimum of 20 cm. The spacing between users and the antenna must be a minimum of 23 cm.

Reader Mechanical Installation

The MP9310 is designed for installation with the enclosure. The following instructions provide the information to install your UHF reader.

As shown in Figure 5, enclosure is provided with four M3-6 threaded inserts for horizontal or vertical installation. If the threaded inserts are not used, mounting brackets may be required. Contact SAMSys for additional mounting instructions.
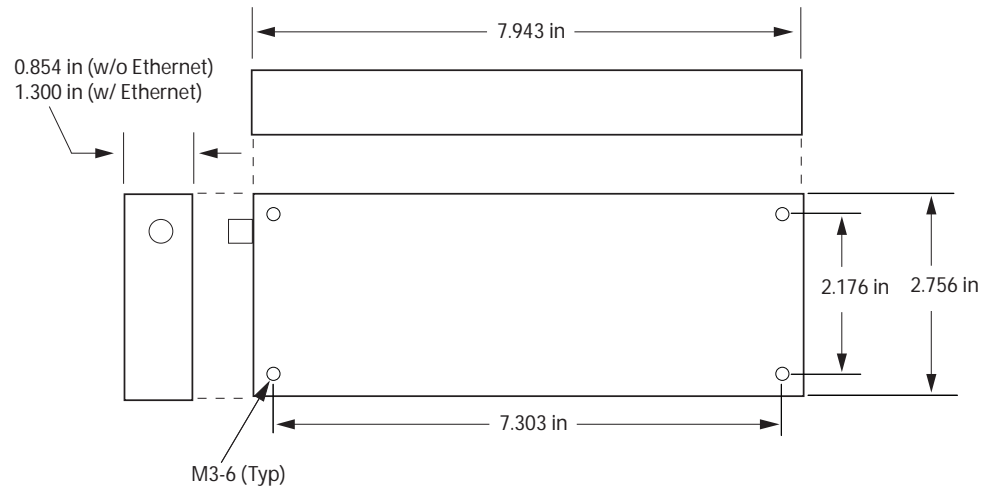
Figure 5–*MP9310 Enclosure Dimensions*

Reader Electrical Installation

As shown in Figure 6, the MP9310 is equipped with a 26-post header (2x13, 0.05" center, 0.016"sq post) for power, ground, and communication connections. The antenna connection is provided by a right-angle, bulk-head mount SMA connector. An optional Ethernet connector provides TCP/IP connectivity.
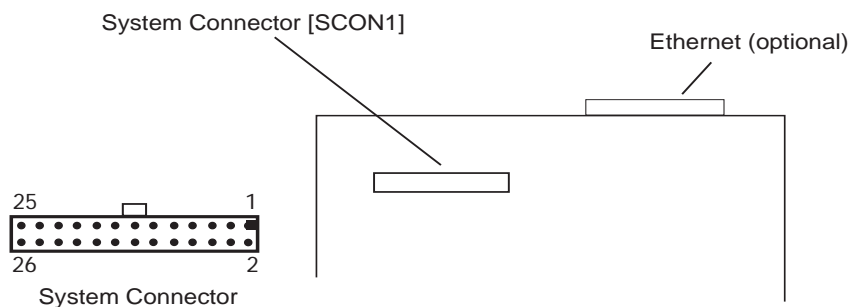
Figure 6–*MP9310 System Connector and Optional Ethernet Port*

Refer to Chapter 6 - *Specifications* for detailed information on the DC Power, RS-232, Digital I/O, and optional Ethernet connections.

Installing the System Connector Ribbon Cable

The System Connector ribbon cable is installed with the key way towards the end of the enclosure. See Figure 6 for proper orientation of the ribbon cable connector.

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.

Ethernet LAN Communication Setup (MP9310-NE/EE Only)

The MP9310-NE/EE is equipped with an optional 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 B for detailed instructions.

Caution

In order to comply with FCC radiated emissions requirements, MP9310 models with the optional Ethernet connector must use Category 5 shielded cables.

Setting Transmit Power - TD0

Output power on the MP9310 is set by configuring the Transmit Power (**TD0**) register. The output power is entered in tenths (1/10) of dBm with steps of 1/2 dBm. All values are in decimal. Therefore, entering a value of 121 equates to 12.0 dBm. Values not entered as 1/2 dBm steps are rounded down to the nearest valid 1/2 dBm step when the reader updates transmit power.

For example, to set the MP9310 output power to 17.5 dBm, send the following CHUMP command to the module:

```
}Cw,d:TD0,b:175!
```

The valid range of values for TD0 is from 0 (0 dBm) to 270 (27 dBm).

Setting Antenna Gain - TG0 (MP9310-E/EE only)

In order to comply with ERP and threshold limits according to EN 302 208, the MP9310-E must be configured with the proper antenna gain. The TG0 register is provided for these purposes. Before operation, the installer must know the actual antenna gain used in the installation, G_A.

Program the TG0 register in the following manner:

```
}Cw,d:TG0,b:xxx,f:1!
```

Where:

xxx is computed as follows: $xxx = (G_A \text{ (db)} + 13.0) * 10$

The range of allowable xxx is 000 through 230 which gives an allowable antenna gain range of -13dB to +10dB. Proper LBT operation according to EN 302 208 is not guaranteed with antennas outside of this range.

Digital Input/Output Setup

The MP9310 is equipped with two logic-level input signals (DIN1/DIN2) and two open-collector output signals (DOUT1/DOUT2). To activate the digital inputs apply a minimum 1.5 Volt differential across the DINn+ and DINn-. The outputs require a 4.7K Ohm pull-up to 5V.

Refer to the *SAMSys Forth Programming Language Reference Guide* for programming information.To set up the I/Os to trigger tag reading and indicated tag sensing, refer to the CHUMP Reference Guide and the Protocol Configuration Word (PCW) register.
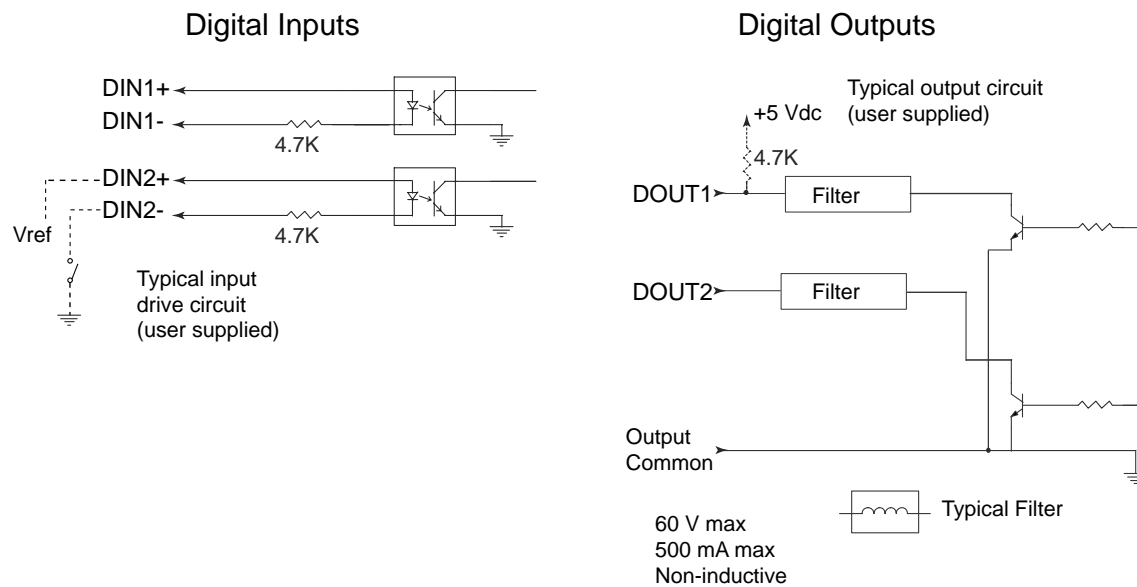
Figure 7–Digital Input and Output Port Configuration

Operation

This chapter provides general information to operate the MP9310 Low-Power UHF Reader Module. Topics discussed in this chapter include the following:

- MP9310 Power Up and Initialization
- Setting the RF Mode
- Selecting Tag Protocols
- Enabling or Disabling Tag Protocols
- Reading Tags
- Writing Blank Tags
- Modifying Tags
- Resetting the MP9310

MP9310 Power Up and Initialization

When the power supply is connected, the MP9310 starts an internal initialization sequence.

After the initialization sequence, the reader activates the RF field and, depending on the configuration, begins transmitting read detect (Rd) commands at the specified frequency.

Setting the RF Mode

The MP9310 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 Tag Protocols

The MP9310 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 specific 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 command sequence 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 sequnce unless you are experienced using SAMSys CHUMP commands to configure readers.

Enabling Protocols

SAMSys readers can be configured with different tag protocols. If your reader was loaded with specific protocols at the time of purchase, these protocols can be enabled or disabled as required. To verify which protocols are enabled for your reader, select:

> **Reader Configuration** ⇨ **General Configuration** ⇨ **Operating Mode** ⇨ **Protocol Select Mask**

To configure the reader for a specific protocol, perform the following:

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

Figure 8 – 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** [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.

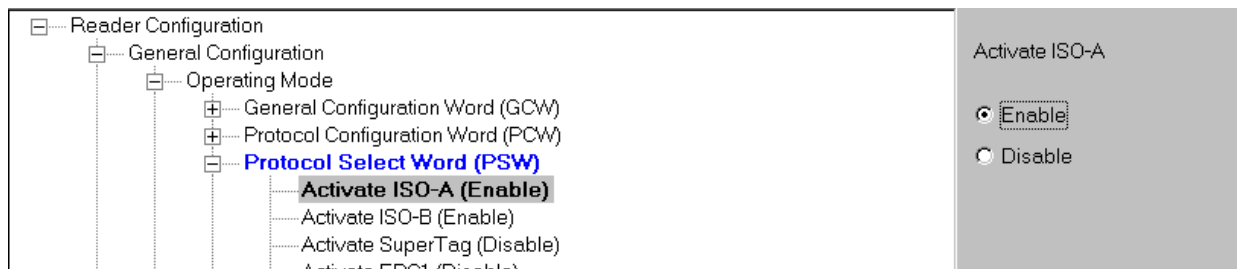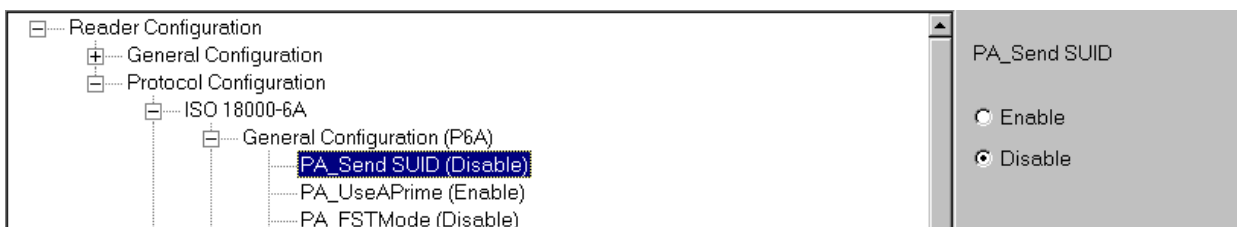
Figure 9 – Protocol Parameter Configuration

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** [Send Changes to Reader].

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 tag data that was returned by the reader:

```
{Rd,d:E016000000000D53,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 **Command** interface and verify the function keys are programmed correctly for your reader.

2.   Select the **Reader Config** interface and verify the 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**
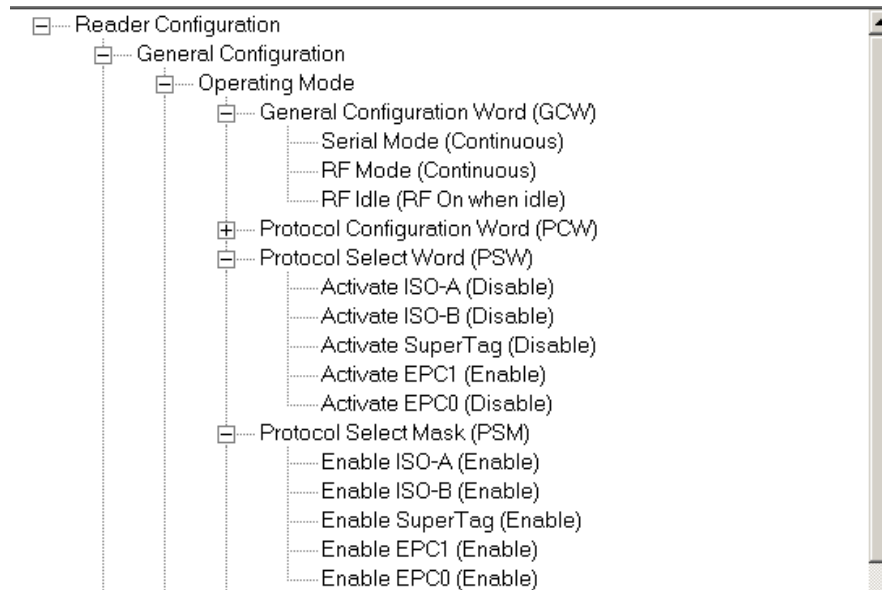
Figure 10–Reader Configuration Parameters

5. Select the **Tag Summary** interface. When tags are read, they are displayed in the window and the statistics are updated.
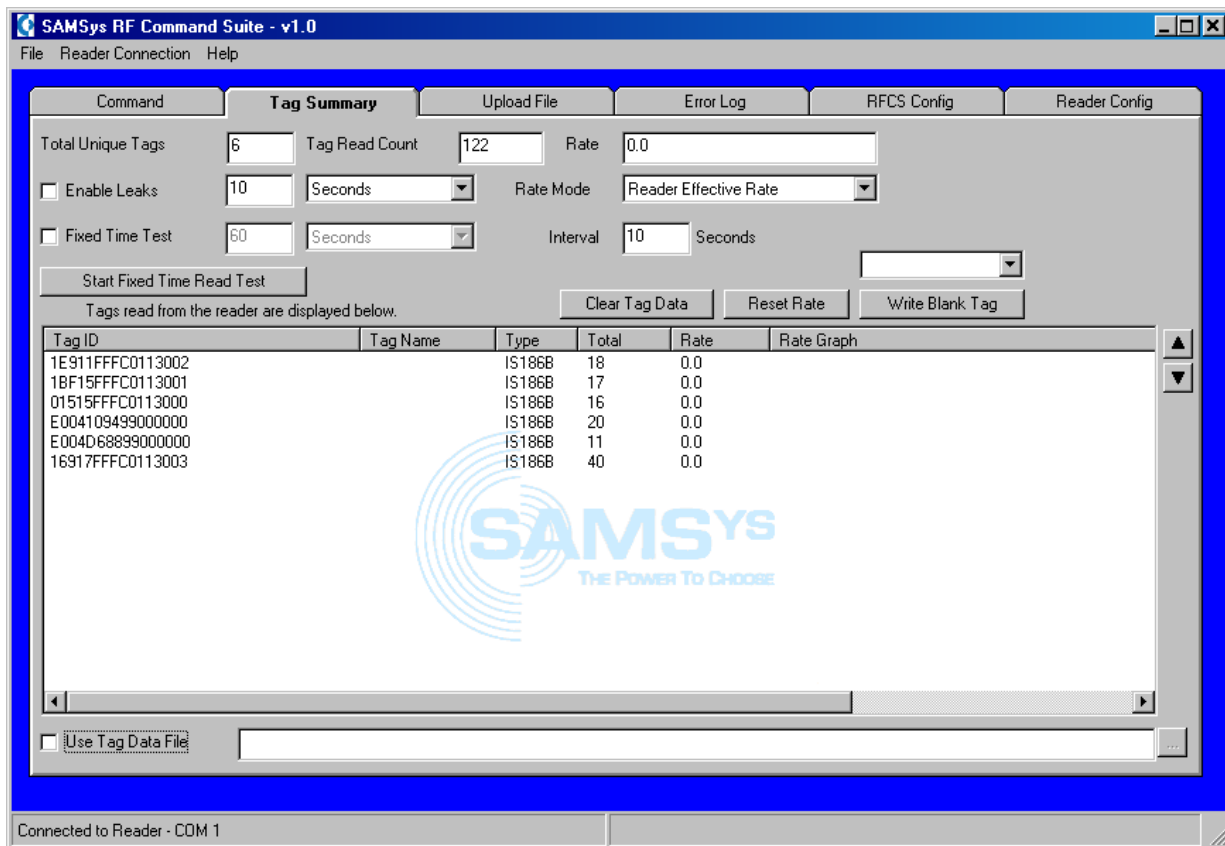
Figure 11–RF Command Suite Tag Summary

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.
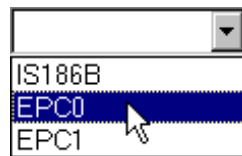
***Figure 12**–Select Tag Protocol*

6. Press the **Write Blank Tag** [Write Blank Tag] button to begin the operation and display the tag data box.
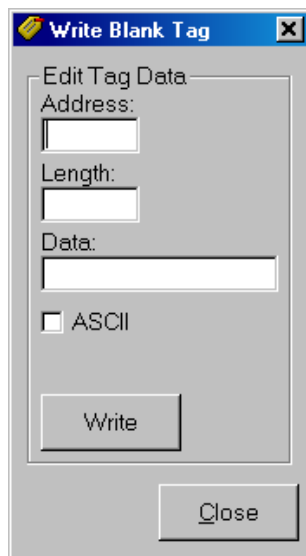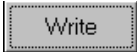
***Figure 13**–Write Blank Tag*
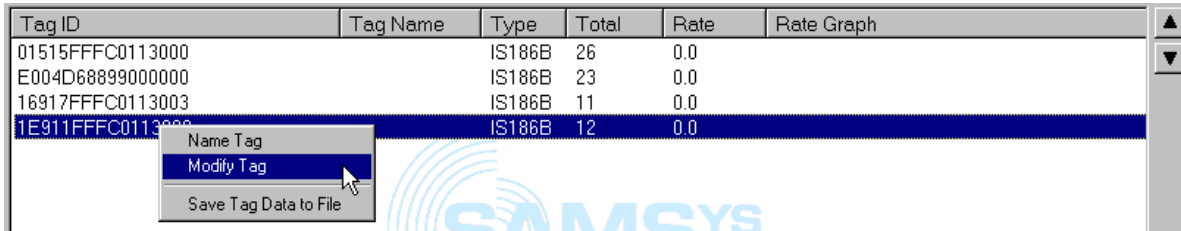
7. Fill in the appropriate data (in Hex) and press the **Write** [Write] button to write the data to the tag.

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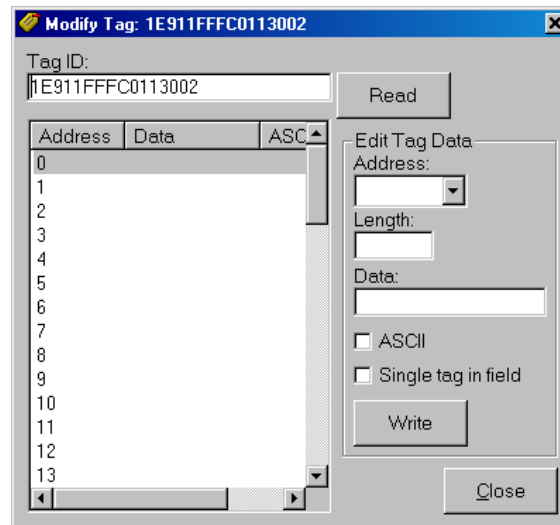
1. Select the **Tag Summary** interface and right-click on the tag.

Figure 14–Select Tag to Modify

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

Figure 15–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** ▢ Write ▢.

7. Repeat for each address.

Resetting the MP9310

To reset the MP9310, drive the reset line low for 3 ms. Refer to Chapter 5 - *Specifications* for detailed information for location of the reset pins on the system connector (SCON1).

Troubleshooting

This chapter provides general information to troubleshoot the MP9310 Low-Power UHF Printer Module. 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
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.
No RS-232 Communication.	External RS-232 cable malfunction	Check cable connectors for bent or broken pins. Replace external RS-232 cable if necessary.
	Reader board failure.	Replace reader.
No Digital I/O signals present.	Reader board failure.	Replace reader.
	Incorrect wiring	Recheck digital I/O circuit as shown in Chapter 2 - *Installation*.
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 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 MP9310. Information provided includes the following:

- Reader Specifications

- Antenna Specifications

- Environmental Specifications

- Power and Input/Output Connectors

   – System Connector Specifications
   – Ethernet LAN Connector Specifications

Reader Specifications

Parameter	Value
Frequency (North American)	902 to 926 MHz (Model MP9310-N and MP9310-NE)
Frequency (European Union)	865 to 869 MHz (Model MP9310-E and MP9310-EE)
Frequency Step Size	25 kHz programmable
Frequency Accuracy	+/- 10 ppm
RF Power	0.002 to 0.5 Watt (conducted)
RF Impedance	50 Ohms, nominal
Connections	RS-232, Digital I/O (TTL), Ethernet LAN
Input Voltage	5.0 Vdc +/-10%
Input Current	2.5 Amp maximum
Enclosure Material	Aluminum
Case Dimensions (w/o Ethernet)	.854 in x 2.756 in x 7.943 in (21.7 mm x 70.0 mm x 201.7 mm)
Case Dimensions (with Ethernet)	1.300 in x 2.756 in x 7.943 in (30.0 mm x 70.0 mm x 201.7 mm)
Mounting holes	M3-6 inserts on 2.176 in x 7.303 in spacing (55.3 mm x 185.5 mm)
Weight (approx)	11.1 oz (316 g)

Antenna Requirements

The antennas used with this transmitter must be professionally installed in a manner which guarantees compliance with all local laws and regulations.

Antenna Parameter	North American (FCC)	European Union (ETSI)	
		302-208	**300-220**
Frequency	902 to 926 MHz	865 to 868 MHz	869.525 MHz
Polarization	Circular or Polarized	Circular or Polarized	Circular or Polarized
Impedance	50 Ohms	50 Ohms	50 Ohms
VSWR, maximum	1.25:1	1.25:1	1.25:1
Antenna gain	9 dBi, Max	See Note 1	See Note 2

Note 1: *To comply with EN 302 208, the installer must use an antenna whose beamwidth shall be less than or equal to 90 degrees for transmit ERP levels less than or equal to 500 mW. For transmissions above 500mW and less than or equal to 2W, a minimum antenna beamwidth of 70 degrees is required.*

Note 2: *In accordance with local regulation.*

FCC Radiation Exposure Statement

The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. The spacing between users and the antenna must be a minimum of 20 cm.

Caution

To prevent reader damage, the RF port must be properly terminated with a 50 Ohm load or a functional UHF RFID antenna before power up. Never power up the reader unless the loads or antennas are connected. Always power down the reader before removing an antenna or load from an RF port.

Environmental Specifications

Specification	Value
Operating Temperature	-4° F to 131° F (-20° C to 55° C)
Storage Temperature	-40° F to 176° F (-40° C to 80° C)
Relative Humidity	5% to 80% non-condensing

Power and Input/Output Connectors

System Connector [SCON1]

Ethernet (optional)

25   1

26   2
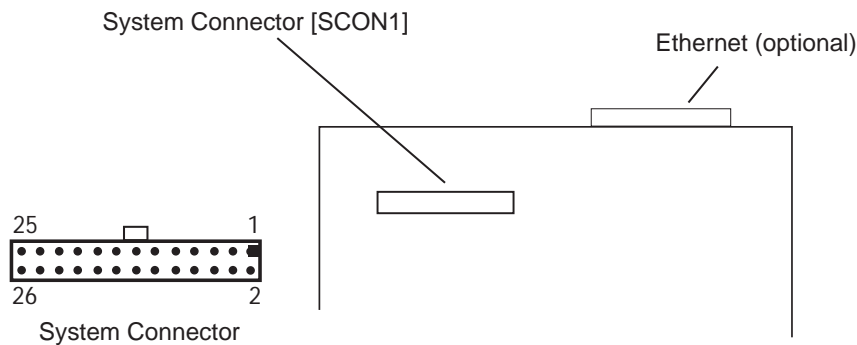
System Connector

System Connector (SCON1) Specifications

Pin No.	Name	Signal/Value
18,20,22,24,26	PWR	System Supply Voltage, 5.0 Vdc +/-10%, 2.3A Max
3,10,12,14,16,17, 19,21,23, 25	GND	Common
Pin 1	V33	3.3 Vdc
Pin 2	PROG	Program Enable
Pin 4	RESET	Active Low Reset
Pin 5	DIN1	Digital Input 1, 3 to 25 Vdc, 1 to 5A, Optically Isolated
Pin 6	DIGND1	Reference for DIN1
Pin 7	DIN2	Digital Input 2, 3 to 25 Vdc, 1 to 5A, Optically Isolated
Pin 8	DIGND2	Reference for DIN2
Pin 9	DOUT1	Digital output 1 50 Vdc, 40 mA, Open Collector to Ground
Pin 11	DOUT2	Digital output 2 50 Vdc, 40 mA, Open Collector to Ground
Pin 13	TXD	Transmit
Pin 15	RXD	Receive

Ethernet LAN Connector (Optional)
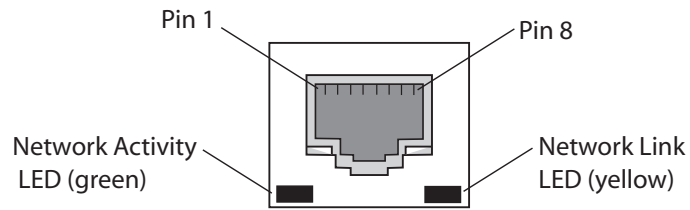
Figure 16–Ethernet LAN Connector

Pin Number	Signal
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
Network Activity LED	Green LED indicates network traffic detected.

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 lock password and must be always 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 AABBCCDD to address 0x20 on a tag with ID E003000011223344455667788, issue the following command:

        }wt,d:E003000011223344455667788,a:20,b:AABBCCDD!

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 AABBCCDD to user memory at address 0x20 on a tag with ID EF04001122334455:

> }wt,d:EF04001122334455,a:20,b:AABBCCDD,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 noteable 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 AABBCCDD to user memory at address 0x8 on a tag with ID E00300001122334455667788, issue the following command:

        }wt,d:E00300001122334455667788,a:8,b:AABBCCDD!

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 the16-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 retieving 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 overwrtite 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:22000000000000000000000003,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:220000000000000000000003DCD0!**

Configuring the IP Address

This appendix describes how to configure the IP address of the MP9310 Reader Module equipped with an Ethernet port.

Information provided in this appendix includes the following:

- Ethernet IP Address Overview

- IP Address Setup

Ethernet IP Address Overview

The MP9310 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 MP9310 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 a reader 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:
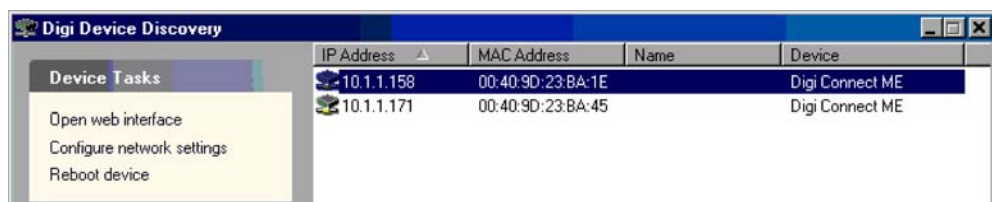

Figure 17–Digi Device Discovery Application Window

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

NOTE: *If the IP adress 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.
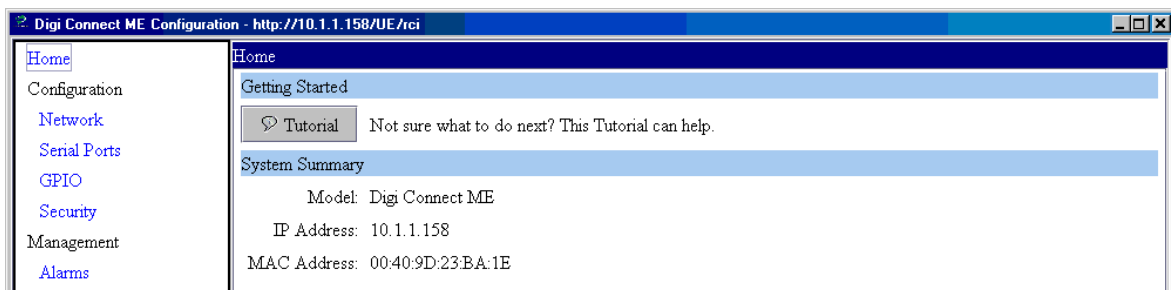

Figure 18–Digi Device Discovery Web Interface Window

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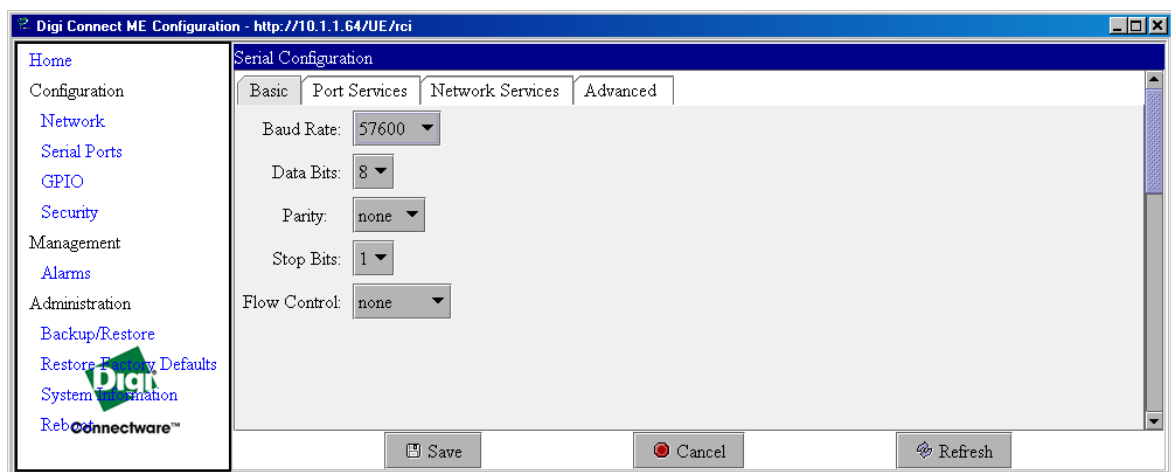

Figure 19–Digi Device Discovery Serial Configuration Window

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 ther 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).**
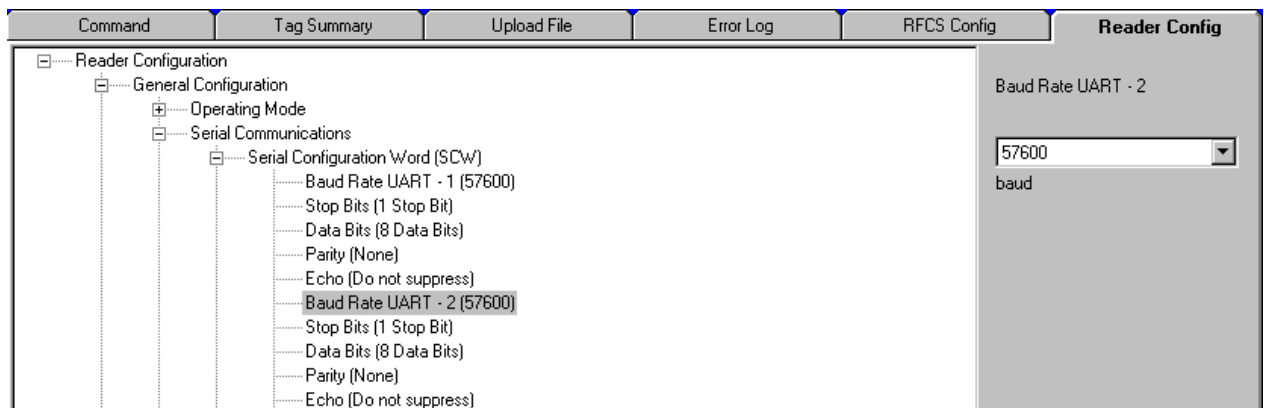

***Figure 20**–Reader Serial Port Properties*

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** 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.

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