User's
Guide

MP9320
UHF Long-Range Reader

SAMSYS

THE POWER TO CHOOSE

SAMSys

MP9320 UHF Long-Range Reader
Owner's Manual

Disclaimer and Limitation of Liability

About SAMSys

SAMSys is the world leader in the design and supply of radio frequency identification (RFID) hardware solutions for high volume pallet and reusable container tracking applications in global logistics management, materials handling, and supply chain industries. SAMSys is a public company listed on the Canadian Venture Exchange under the symbol SMY.

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.

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.

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Introduction

This chapter provides a general description of the MP9320. Topics discussed in this chapter include the following:

- Unpacking the Reader

- About the MP9320

- 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 UHF Long-Range Reader
    •   Power and RS-485 communication cable
    •   15 Vdc power supply
    •   Communication cables (optional)
    •   Antennas (optional)

Figure 1–*MP9320 Reader and Accessories*

About the MP9320

The MP9320 is one of the most advanced UHF long-range readers in the industry. This multi-protocol device currently supports many of today's most popular UHF tags.

The MP9320 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 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 SAMSys Interrogator Control and Concentrator Module (ICCM).

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 include the following:

- Warehouse Logistics

- Inventory Management

- Asset Management

- Pallet Tracking

- Parking Lot Access

- Aggregated Container Tracking

- Loading Dock Portals
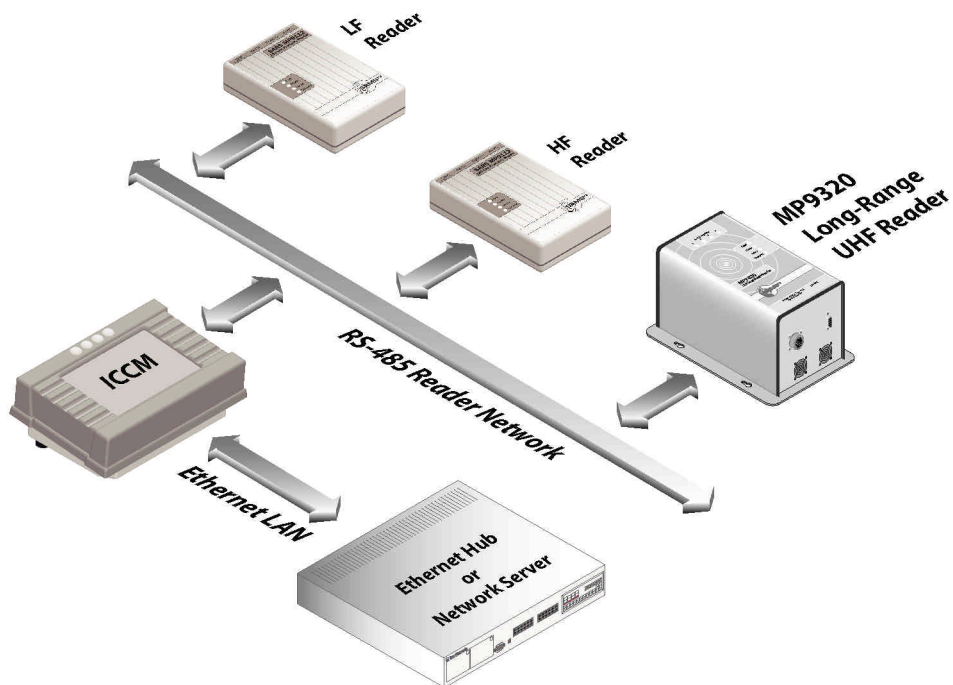
Figure 2–*SAMSys Reader Network*

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

- LED indicators

- (4) antenna ports

- Multiple interface connection options (RS-232, RS-485)

- 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.
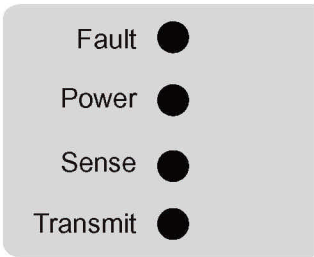
Figure 3–MP9320 LED Status Indicators

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 operational status LEDs, four Active Antenna LEDs provide indication that RF power is being applied to one of the four antennas.
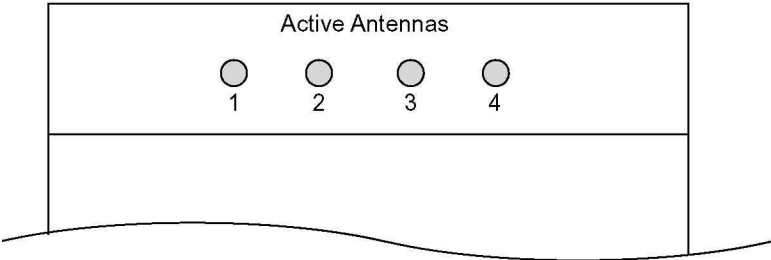
Figure 4–MP9320 Active Antenna LED Indicators

Four SMA type antenna ports are provided on the end panel. The reader also has two power and communication interface connectors on the opposite end panel.
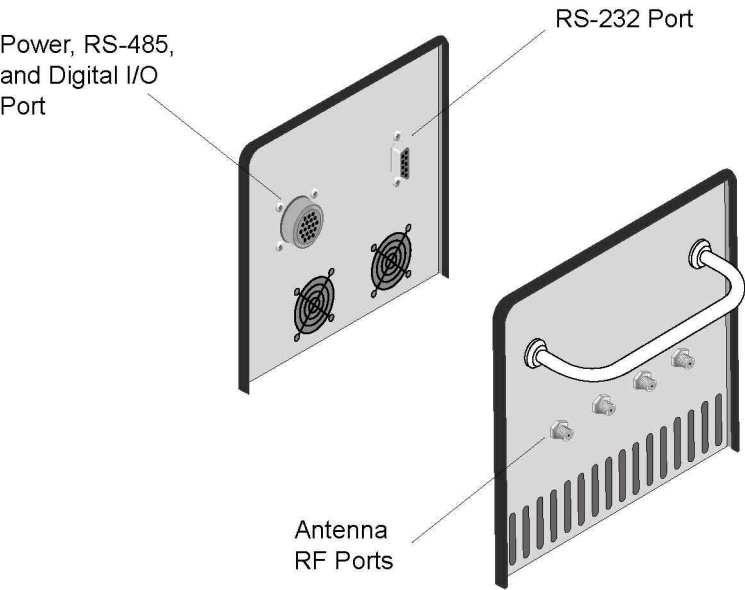
Figure 5–MP9320 End-Panel Connectors

Installation

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

- Antenna Installation

- Reader Mechanical Installation

- Standalone Reader Communication Setup

- Standalone Reader Verification

- Networked Reader Communication Setup

- Digital (TTL) Input/Output Setup

- Transmit Power Calibration

Antenna Installation

The MP9320 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.

Single Antenna

Dual Antennas
(Stacked)

Four Antennas
(Portal Configuration)

Dual Antennas
(Opposing)
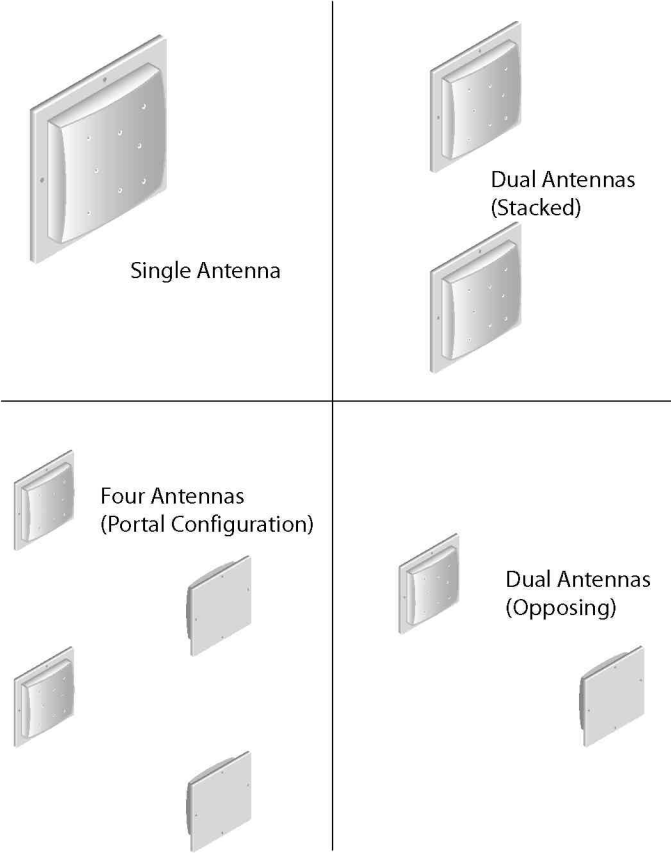
Figure 6–*MP9320 Antenna Configurations*

The MP9320 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	8, max	8, max
Power, minimum	1 W	1 W
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.

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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 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.
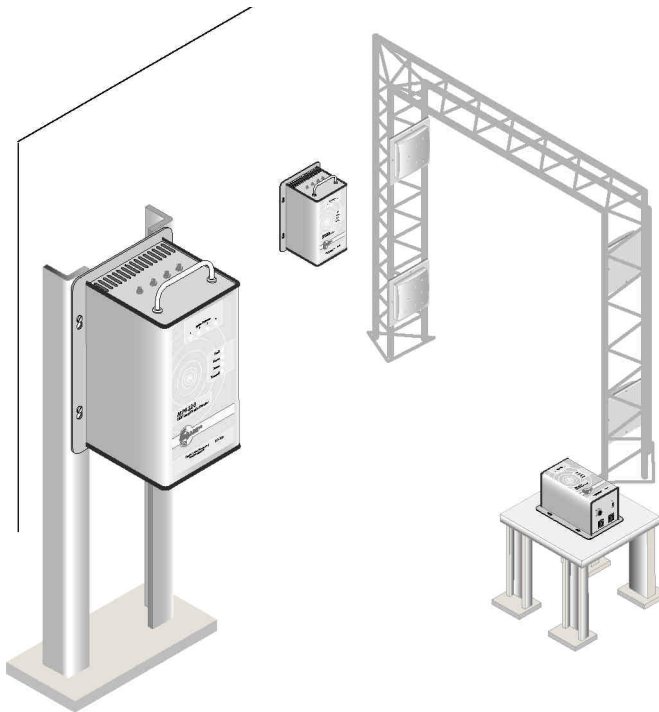
Figure 7–*MP9320 Reader Installations*

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

For non-permanent vertical or wall mounting, install the appropriate wall anchors (drywall, wood, or concrete) to secure the reader. Keyhole slots are provided for easy installation and removal. Refer to Figure 8 for the location of the keyholes.
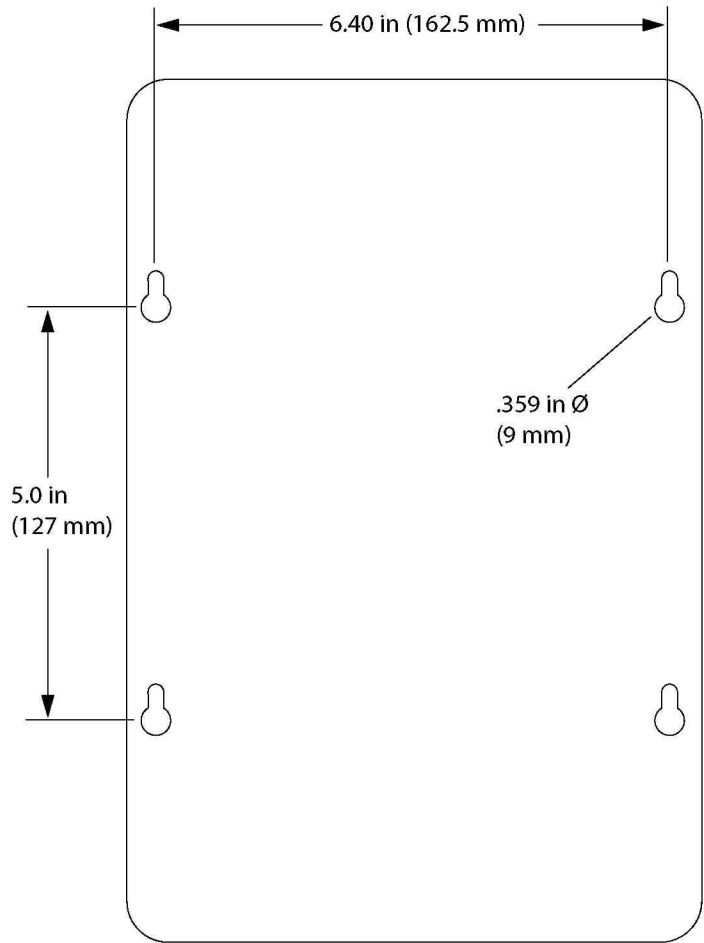
Figure 8–MP9320 Base Plate with Mounting Keyholes

Standalone Reader Communication Setup

The reader 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.
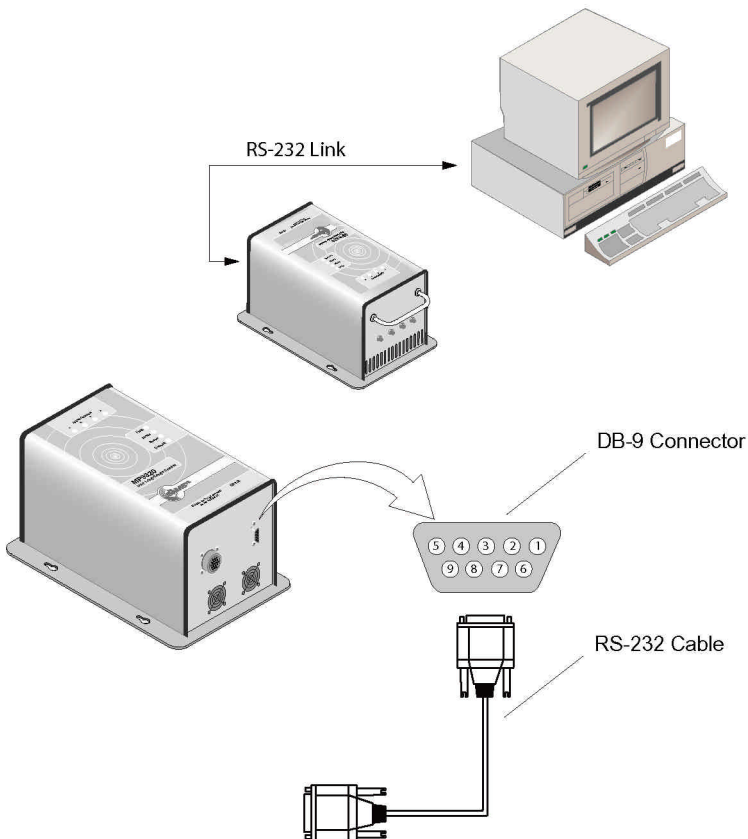
Figure 9–*MP9320 Standalone RS-232 Communication Setup*

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.*

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Standalone Reader Verification

Every effort has been made to ensure the MP9320 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. Launch a terminal emulation program such as HyperTerminal®.

4. Set the terminal serial port parameters to the reader default values (9600, 8, 1, none).

5. Power up the reader.

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 the Configuration Read (Cr) command to verify the reader operating mode matches the application requirements (refer to Appendix A). If necessary, use the Configuration Write (Cw) command to reconfigure the reader operating modes.

▶ **NOTE:** Refer to the Comprehensive Heuristic Unified Messaging Protocol (CHUMP) Reference Guide for detailed information on the Cr and Cw commands, reader configuration words, and other CHUMP commands.

Networked Reader Communication Setup

The MP9320 can be networked with other readers and to the SAMSys Interrogator Control and Concentrator Module (ICCM) using an RS-485 interface (see Figure 10). Refer to the *Specifications* chapter for detailed information on the RS-485, Power, and Digital I/O Port.

Figure 10–MP9320 RS-485 Communication Setup

Networked Reader Verification

Similar to standalone reader verification, networked readers should also be verified before entering service.

If the system is an RS-485 networked configuration using the ICCM, perform the following:
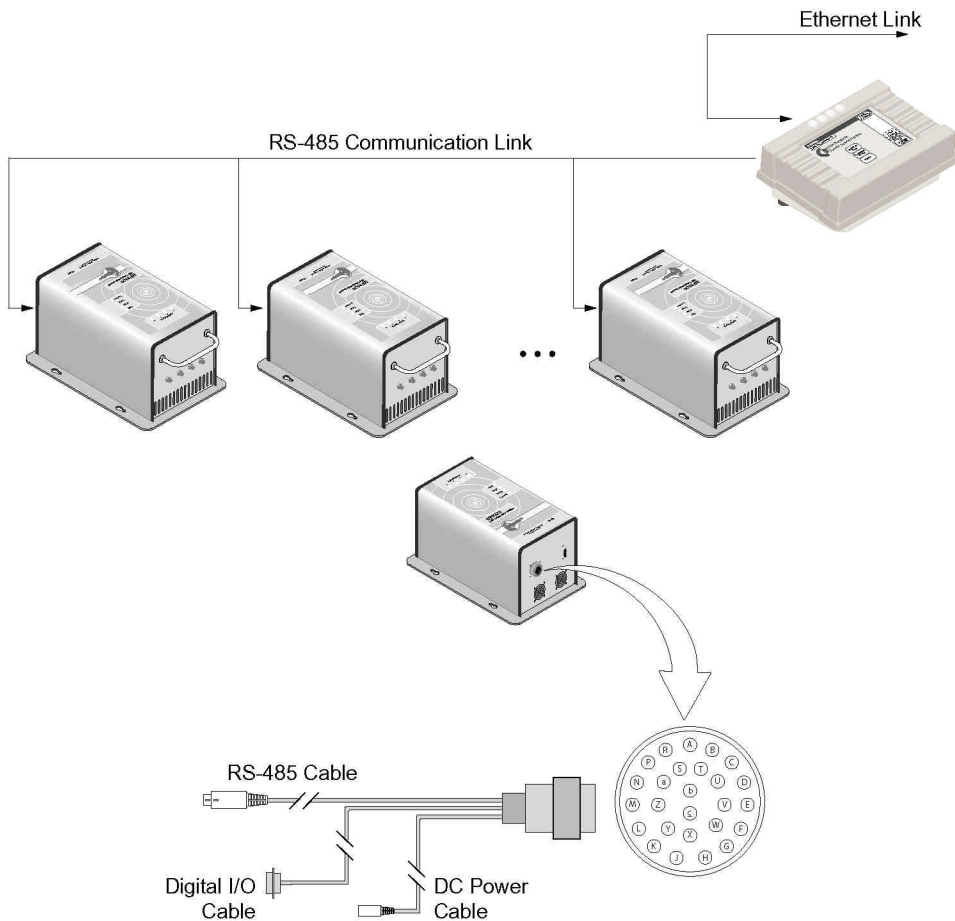
1. Verify all antennas, cabling and power supplies are secure.

2. Verify the ICCM is connected to the RS-485 network and operational.

3. Power up the readers.

4. Follow the instructions in the *Interrogator Control and Concentrator Module User's Guide* to **Auto-Find** all readers on the network.

5. Introduce a test tag into the RF field.

6. Verify the tag was read correctly.

7. If the tag did not read correctly, use the ICCM **Configure Readers** function to verify the reader operating mode matches the application requirements.

Digital (TTL) Input/Output Setup

The MP9320 is equipped with a digital I/O port that provides four logic-level (TTL) input signals and four output signals. This port can be programmed for specific applications. Refer to the *SAMSys Forth Programming Language Reference Guide* for more information. As shown in Figure 11, the digital inputs are optically isolated. The outputs are open collector.
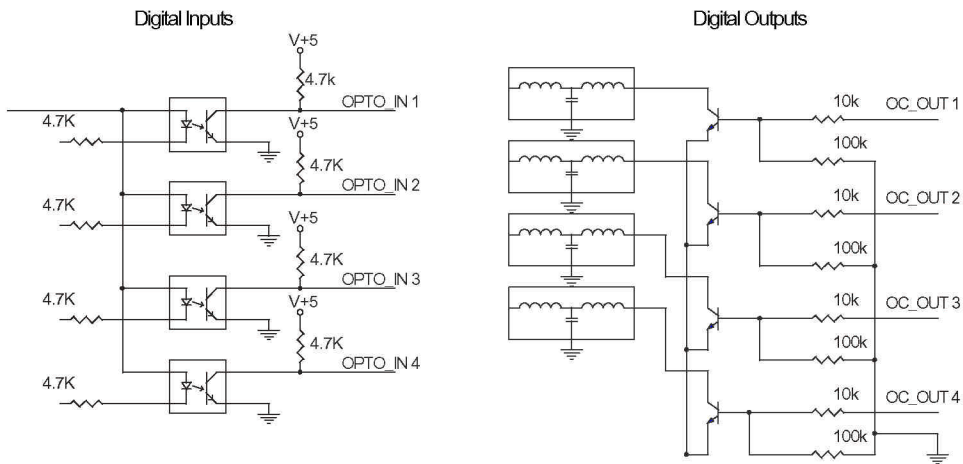
Figure 11–*Digital Input and Output Port Configuration*

Signal Name	Pin No.	Description
Input 1	a	TTL input - optically isolated
Input 2	b	TTL input - optically isolated
Input 3	U	TTL input - optically isolated
Input 4	D	TTL input - optically isolated
Digital input common	N	input commmon
Output 1	Z	TTL output - open collector
Output 2	c	TTL output - open collector
Output 3	V	TTL utput - open collector
Output 4	E	TTL output - open collector
Digital output common	M	output common

Transmit Power Calibration

The MP9320 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. Topics discussed in this chapter include the following:

- Reader Power Up

- Reading Tags

- Operation with the ICCM

Reader Power Up

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

1. **Transmit** on

2. **Sense** on

3. **Power** on

4. **Fault** on

5. All four on

6. Beeper on

If the **Fault** LED flashes on at the beginning of the sequence, the reader has detected a software load fault. Restart the reader to clear the fault.
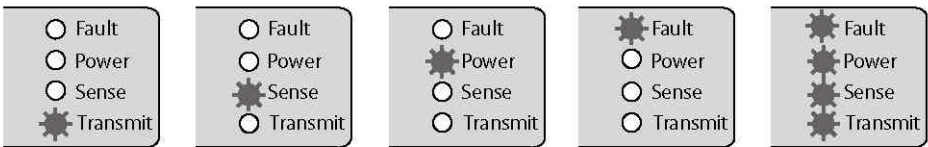
Figure 12– LED Startup Sequence

The reader is operational when the **Power** LED remains on.
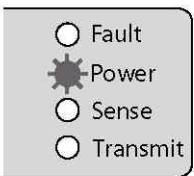
Figure 13– Power LED On – Reader Operational

After the startup sequence, the RF multiplexer in the MP9320, alternately provides RF power to each of the four antennas. The **Active Antenna** LEDs indicate which antenna is transmitting.
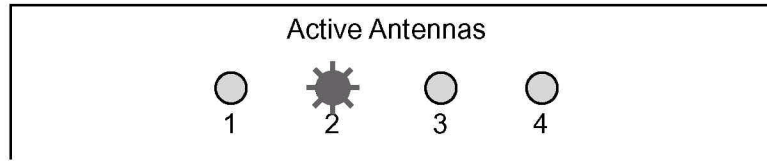
Figure 14– Active Antenna LED Indicators - Antenna 2 Transmitting

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

Reading Tags

When the reader completes the intialization 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 **Sense** LED flashes and the beeper sounds when the tag is successfully read.
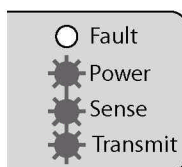
Figure 15– LED Indicators - Tag Successfully Read

The following example shows a typical Rd return message with ASCII tag data that was returned by the reader:

```
{Rd,d:164D7026DB,f:3C00,t:IS186A;62
```

NOTE: *The tag read beeper can be enabled or disabled depending on the application. Refer to Appendix A for more information on reader configuration.*

Operation with the ICCM

The Interrogator Control and Concentrator Module (ICCM)
provides greater flexibility for accessing, configuring, and
manage SAMSys readers. With the ICCM, you can access your
RFID data with your own client/server applications, perform
administrative functions from an easy-to-use Web interface, and
remotely perform debug activities on your readers.

The ICCM also has a 1/4 VGA touch screen LCD. The LCD can
be used to provide an operator interface for applications running
directly on the ICCM. This allows for local access to RFID data
and applications in environments where a remote application
server is not available or required.

The ICCM includes an integrated 10baseT Ethernet LAN
interface. You can use the Ethernet connection to establish
communication between your reader and a LAN-attached
application server.

Contact your SAMSys representative for more information on the
ICCM product or visit the SAMSys web site at *www.samsys.com*.

Troubleshooting

This chapter provides general information to troubleshoot the MP9320. 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.
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.

Symptom	Probable Cause	Corrective Action
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.
	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.

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

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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. Information provided includes the following:

- Reader Specifications

- Environmental Specifications

- Power Supply Specifications

- RS-232 Connector Specifications

- Main I/O Connector Specifications

- Regulatory Standards

Reader Specifications

Range	Up to 10 ft (3 m)
Frequency	864-870 MHz (25 KHz steps) 902-928 MHz (100 KHz steps) 869.525 MHz single frequency
RF Power	10 mW - 4 W 2.5 W ERP to antenna (FCC) 500 mW ERP to antenna (ETSI)
Connections	RS-232, RS-485, or Digital I/O (TTL)
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	5.0 x 7.0 x 9.5 in (127 x 178 x 241 mm)
Weight	4 lbs (1.8 kg)

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
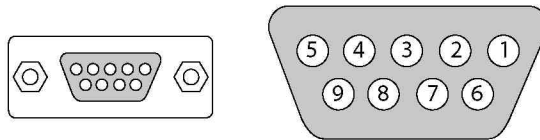
Figure 16–*RS-232 Connector*

Baud rate	9600
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	RST
Pin 9	+5 Vdc

Main I/O Connector Specifications
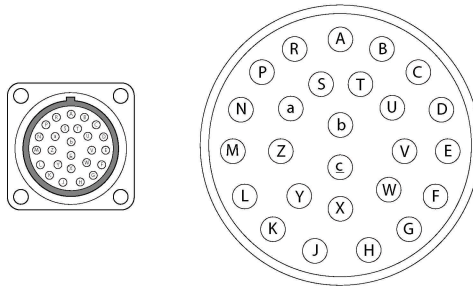
Figure 17–Main I/O Connector

Pin A	Spare
Pin B	Spare
Pin C	Spare
Pin D	Digital input 4
Pin E	Digital output 4
Pin F	Spare
Pin G	Ground
Pin H	Ground
Pin J	Vin (+12 Vdc)
Pin K	Vin (+12 Vdc)
Pin L	Spare
Pin M	Digital output (common)
Pin N	Digital input (common)
Pin P	Spare
Pin R	Spare
Pin S	Spare
Pin T	Spare
Pin U	Digital input 3
Pin V	Digital output 3
Pin W	RS-485 Phase A
Pin X	RS-485 Phase B
Pin Y	RS-485 Phase C (common)
Pin Z	Digital output 1
Pin a	Digital input 1
Pin b	Digital input 2
Pin c	Digital output 2

Antenna Specifications

Antenna Parameter	FCC	ETSI
Frequency	902-928 MHz	865-870 MHz
Polarization	Circular	Circular
Gain, dBic	8, max	8, max
Power, minimum	1 W	1 W
VSWR, maximum	1.5:1	1.5:1

Antenna Cable Specifications

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

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 UL 60950
RFID Human Safety	EN 50364

Reader Configuration

This appendix describes how to change or update the MP9320 configuration. For detailed information on configuration variables, refer to the *Comprehensive Heuristic Unified Messaging Protocol Reference Guide*. Information provided includes the following:

- Operating Modes

- Default Configuration

- Changing Reader Configuration

Operating Modes

SAMSys reader software is configurable for different operating modes and protocols. Use the Configuration Read (Cr) command 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 specific syntax information on the configuration variables, refer to the *Comprehensive Heuristic Unified Messaging Protocol Reference Guide*.

Default Configuration

The factory default configuration is as follows:

- General Configuration
    - RF Continuous
    - Serial Continuous

- Serial Configuration
    - 9600 Baud
    - 8 Data Bits
    - 1 Stop Bit
    - No Parity

- Multiplexer Configuration
    - 4 antennas
    - Antenna hopping enabled
    - 1 inventory round per antenna

- All supported protocols enabled

Changing Reader Configuration

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 Configuration Write 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

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 the following:

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

SAMSys Technologies, Inc.