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Mantis™ II Reader

User Manual

Revision 05

RF CODE

User Manual

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1 – Introduction

The **Mantis™ II System** by **RF Code** is an RFID monitoring system designed to report Tags within defined Reader operating ranges. The system utilizes "beacon" Tags that periodically report their presence with an encoded radio transmission. The **Mantis™ II Reader** is a dual-channel radio receiver tuned to the **Mantis™ Tag** transmission frequency of 303.825 MHz.

This manual provides the instructions for the **Mantis™ II Reader** setup and operation. This Reader has different modes of operation and optional functions that are user-selected depending on the system's operational requirements.

The instructions in this manual show how to install, configure, and upgrade the **Mantis™ II Reader** as well as tips on **Mantis™ Tag** placement and antenna optimization. Operational instructions for the **Mantis™ II System** using the **TAVIS™ Concentrator** software by **RF Code** are found in the **TAVIS™ Concentrator** user manual.

2 – Hardware

The **Mantis™ II Reader** is housed in a 5 x 5 x 1.5 inch (12.7 x 12.7 x 3.81 cm) metal chassis and contains the internal components of a RFID Reader combined with connections to allow for both Ethernet and serial port connectivity.

Front View – LED Indicators

Figure 2.1 – Mantis™ II Reader (front view)
shown with standard ¼-wave helical antennas.

Three LEDs are mounted on the front of the **Mantis™ II Reader**.

- **Unlabeled LED** – This LED is used for a feature that is not implemented in this version of the Reader.
- **On-Ready LED** – This LED indicates that the Reader has power applied through an external power adapter.
- **Tag Activity LED** – This LED is used for two purposes: (1) to show the status of the Reader while in standby mode and (2) to show Tag detections while in operation.

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Tag Activity LED

- **While Operating** – The Tag Activity LED flashes intermittently, indicating the Reader has read one or more Tags each time it flashes. Because the Reader can decode Tags faster than the light can be turned on and off, a single flash may indicate more than one Tag being decoded.
- **While in Standby Mode** – The Tag Activity LED turns on and off at a distinctive rate that indicates the Reader is in standby mode.

Rear View – Data Connections

2 – Hardware

Figure 2.2 – Mantis™ II Reader (rear view) showing connections for Network/Ethernet (RJ-45), Power, and Serial/COM (RS-232).

Several connections are housed on the back of the **Mantis™ II Reader**.

- **Ethernet** – RJ-45 Ethernet jack. The Ethernet connection has a link-state "LINK" LED and collision "COL" LED such as those found on common Ethernet network connections. The LINK light stays solid when there is no network activity and flashes when activity is present.
- **Power** – A plug allows for connection to both AC and DC power sources. Power requirements are 12 to 28 VDC and 9 to 20 VAC.
- **Serial** – DB-9 RS-232 serial port.

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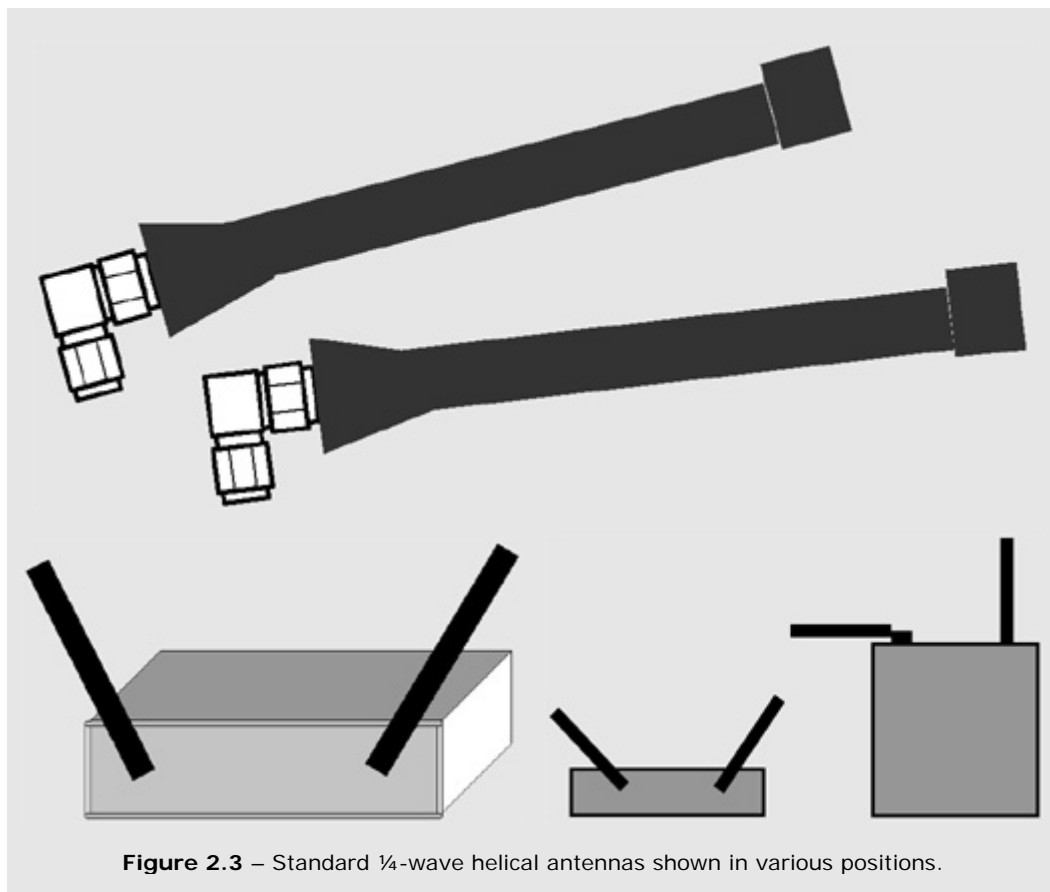
Antennas — Positioning

Figure 2.3 — Standard ¼-wave helical antennas shown in various positions.

Each antenna post supplies an RF signal to the two parallel radio receivers in the **Mantis™ II Reader**. Antenna input impedance is 50 ohms nominal.

Both the type of antennas used and the Reader range setting determine the effective read range. The normal Reader-range features are defined using **¼-wave helical** antennas.

These antennas are appropriate for most Reader applications. Optional antennas that offer diverse receiving properties or extend the range of the Reader are available for the **Mantis™ II Reader**. Contact your **Mantis™ II Reader** distributor for more information.

The **Mantis™ II Reader** has two receiver channels that can operate independently or jointly to provide Tag signal diversity reception. The Reader can operate with one antenna on either antenna post, but the benefit of receiver diversity reception is obtained with both antennas attached.

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Depending on the location and orientation of the Tags, the signal path from each Tag to the Reader may vary. Consequently, this may allow only one antenna to receive the signal.

To achieve the best receiver diversity:

- **Antenna Angle from Reader** – It is desirable to have the antennas positioned at different angles from the Reader.

- **Antenna Angle from Each Other** – Antennas should be at 90-degree angles relative to each other. It may be necessary to experiment with antenna positions to achieve optimum coverage.

- **Height** – As a rule, the higher a Reader is positioned above the ground or floor, the better the Reader's detection range.

⚠ **WARNING – Do not allow antennas to overlap. Keep the antennas separated. Allowing the antennas to overlap reduces the effectiveness of each antenna.**

To minimize RF interference:

- **Separation** – Maintain a 4-to-6-foot separation between the Reader antennas and potential RF radiators such as computers, monitors, printers and electronic office equipment. The local radio environment can limit the Reader's effective range.

- **Height** – Do not operate the Reader on or close to the floor or ground. Grounded and reflective metallic structures around the Reader and/or Tags affect the system performance. For best results, the Reader should be mounted as high as reasonably possible.

⚠ **WARNING – Readers should not be positioned close to ceilings as they act as ground planes.**

✕ **TOOLS – Low loss SMA coaxial extension cables may be used to separate the antennas from the Reader.**

ⓘ **NOTE – Optional antennas that offer diverse receiving properties or extend the range of the Reader are available for the Mantis™ II Reader. Contact your Mantis™ II Reader distributor.**

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Environmental Limits

The **Mantis™ II Reader** is approved for use within the temperature ranges set forth below.

- **Operation:** -20 to +70 degrees Celsius.
- **Storage:** -40 to +80 degrees Celsius.

Tag Positioning

Figure 2.4 – Mantis™ Tag.
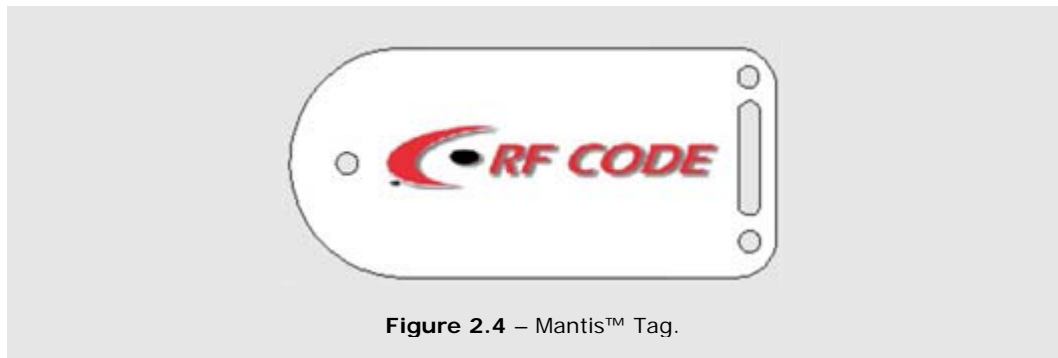
Wherever possible, Mantis™ Tags should be placed in the same orientation (plane) in order to optimize the Reader's ability to receive transmissions from the Tag. The Tags should not be placed closer than ½ inch in proximity to one another.

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> ⓘ **NOTE – The Mantis™ II Reader can only be configured through an Ethernet connection via the RJ-45 jack on the rear of the Reader.**

> ⚠ **WARNING – When an Ethernet connection is made directly between the Reader and a PC, a cross-over network cable is required.**

File System

All embedded operating systems, signal processing software, and configuration options of the **Mantis™ II Reader** are stored in a flash-based file system internal to the Reader. If any changes or updates are required, the files are collected in a directory on the PC, packaged into a new file system, and then transferred to the Reader by **TFTP** (Trivial File Transfer Protocol).

Upgradeable Firmware

The **Mantis™ II Reader** has the ability to be updated as new firmware is released. It is vital that these updates be obtained directly from **RF Code** or its authorized source, since these files define the operation of the Reader and if defective, the files will render the Reader inoperable.

> ⚠ **WARNING – Firmware updates should be obtained directly from RF Code or its authorized source. If defective, these files will render the Mantis™ II Reader inoperable.**
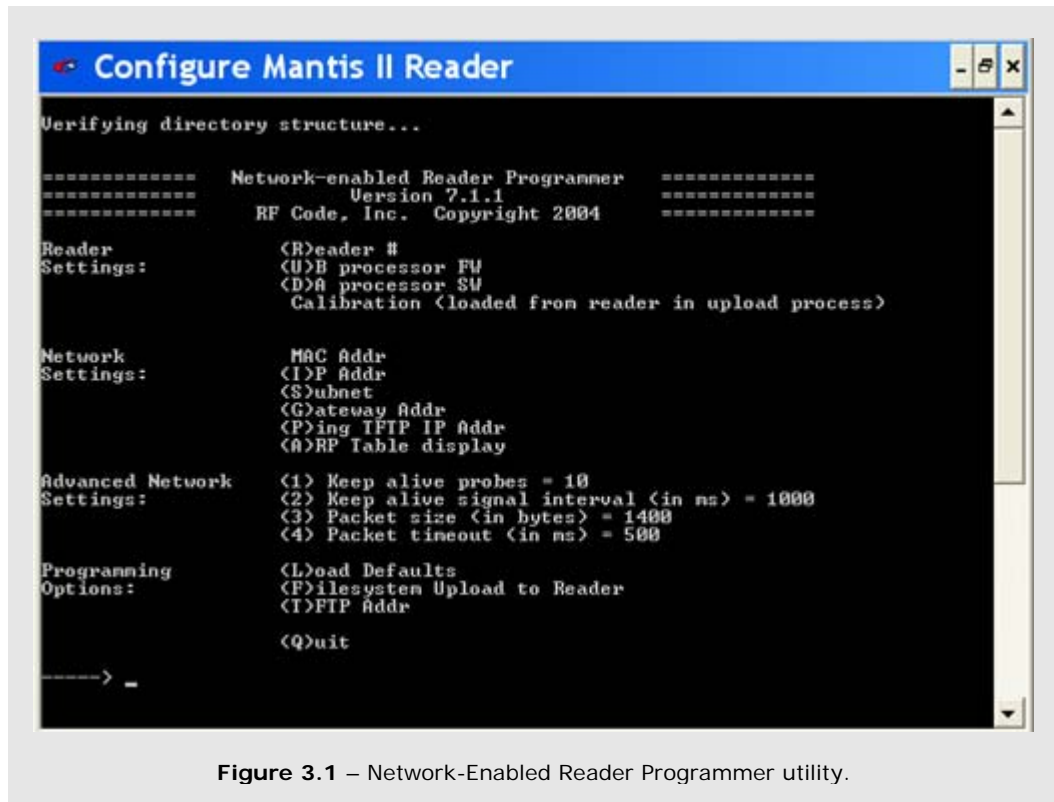
Reader Setup

Launch Utility

Figure 3.1 – Network-Enabled Reader Programmer utility.

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> ⚠ **WARNING – Computer administrative privileges are recommended when using the Network-Enabled Reader Programmer utility. In the event of IP resolution conflicts, the Utility will attempt to modify the Address Resolution Protocol (ARP) table. On some systems, this can only be achieved with sufficient privileges.**

To launch the utility and perform a Reader setup or update:

Step 1 – From the Windows® desktop, go to the **Start** button > **Programs** > **RF Code** > **Mantis II Reader** program group. Click the **Configure Mantis II Reader** option to launch the utility.

Step 2 – The **Network-Enabled Reader Programmer** utility appears in a DOS screen (see **Figure 3.1** above). Refer to the settings below:

- **Reader Settings** – Refer to page 14.
- **Network Settings** – Refer to page 15.
- **Advanced Network Settings** – Refer to page 16.
- **Programming Options** – Refer to page 17.
- **Network Installation** – Refer to the example on page 18.

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Reader Settings

(R)eader #   **R**

R - Select a new Reader to program.

- Reads and displays a Reader's saved calibration and settings from its configuration file (**SSI_info\AXnnnnnn.txt** where **AXnnnnnn** is the serial number). Any undefined settings will remain blank.

- Errors are displayed if the info file is missing or contains bad calibration data.

- The **Reader #** is the **s/n** (serial number) on the silver label on the underside of the Reader. When entering this number, ignore the space between the two sets of 4 numbers and input it as a single 8-digit alpha-numeric serial number.

- **Note** – The utility checks for reader compatibility, and does not allow specific readers to be uploaded with conflicting code.

(U)B processor FW   **U**

U – Choose firmware revision for the network processor.

- Prints list of available files.

- Type the desired filename (case-sensitive).

- An error message is displayed if the firmware file cannot be found.

(D)A processor SW   **D**

D – Choose firmware revision for the DSP processor.

- Prints list of available files.

- Type the desired filename (case-sensitive).

- An error message is displayed if the firmware file cannot be found.

Calibration (loaded from reader in upload process)

Display Reader calibration data.

- Displays only the calibration data for the Reader at the time of the upload process, when the data is retrieved from the Reader. This field is informational only and cannot be modified.

- **Note** - The calibration string is read strictly from the Reader and sent back during the upload process; the calibration string in the file cannot be uploaded to the Reader. This prohibits users from modifying the calibration string in this file and de-calibrating the Reader during the upload process.

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Network Settings

> ⚠ **WARNING – Microsoft Windows®-based PCs have restrictions on certain IP address ranges (e.g. 127.x.x.x and 224.x.x.x through 254.x.x.x). Since addresses fitting these parameters cannot be configured on a Windows-based PC, it will not be possible to use the utility to reconfigure a Reader assigned with such an IP address.**

MAC Addr

Display Reader MAC address.

- Displays the MAC address of the Reader. This field is informational only and cannot be modified.

(I)P Addr   I

I – Change network IP address.

- Enter in normal dotted decimal format, e.g. **192.168.1.129**

- An error message is displayed if the format is unintelligible or the numbers are out of range.

- This entry represents the new IP address that will be assigned to the Reader during an upload.

(S)ubnet   S

S – Change subnet mask.

- Enter in normal dotted decimal format, e.g. **255.255.255.0**

- An error message is displayed if the format is unintelligible or the numbers are out of range.

(G)ateway Addr   G

G – Change gateway address.

- Enter in normal dotted decimal format, e.g. **192.168.1.1**

- An error message is displayed if the format is unintelligible or the numbers are out of range.

(P)ing TFTP IP Addr   P

P – Ping the TFTP IP address.

- An error message is displayed if the TFTP IP address is blank.

- A status message is displayed which reflects the results of the pinging operation.

- If a ping is unsuccessful, the utility will attempt to remove the TFTP IP address from the ARP table and perform another ping.

(A)RP Table Display   **A**

A — Display ARP Table.

- When two or more Readers initially share the same IP address, it is likely that the ARP will need to be either modified or flushed before sequential accesses to the same IP address can be performed (due to physical addressing). This feature provides a method of querying the ARP table to assess IP resolution issues.

Advanced Network Settings

(1) Keep Alive Probes (default = 10)   **1**

1 — Change number of keep-alive probes.

- Defines the maximum number of keep-alive probes to send.

- An error message is displayed if an invalid number is entered (and the field will be cleared).

(2) Keep Alive Signal Interval (default = 1000 ms)   **2**

2 — Change keep-alive signal interval.

- Defines the signal interval (in milliseconds) for how often the keep-alive probes are sent on a connection.

- An error message is displayed if an invalid number is entered (and the field will be cleared).

(3) Packet Size (default = 1400 bytes)   **3**

3 — Change packet size.

- Defines the maximum packet size (in bytes).

- An error message is displayed if an invalid number is entered (and the field will be cleared).

(4) Packet Timeout (default = 500 ms)   **4**

4 — Change packet timeout setting.

- Defines the packet timeout (in milliseconds).

- An error message is displayed if an invalid number is entered (and the field will be cleared).

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Programming Options

⚠️ **WARNING – If the IP address to be assigned to the Reader is out of scope with regard to the subnet mask, the utility will upload the file system to the Reader but will NOT attempt to retrieve this file system back from the Reader for verification.**

(L)oad Defaults   **L**

L – Load default firmware and network settings.

- These are settings as defined in the **SSI_info\defaults.txt** file.
- This command is useful after a **(R)eader #** command to update to a standard network configuration before programming.
- Errors are displayed if any settings are invalid.

(F)ilesystem Upload to Reader   **F**

F – Create file system and upload to the Reader.

- Prior to the upload, the Reader parameters are verified and the TFTP IP address is pinged. The process will only continue if these are successful.
- Creates file system (**A.bin**, **Bcom.bin**, **caltable.txt**, **network.txt**) using currently displayed settings, uploads to the Reader, then initiates self-programming.
- If applicable, after re-initialization of the Reader, the file system is retrieved from the Reader and verified against the original.
- Errors are displayed if any vital components are missing, if the settings are not properly defined, or if there are problems communicating with the Reader over the network.
- Saves the Reader configuration data upon a successful upload.

(T)FTP Addr   **T**

T – Set TFTP address for the file system upload.

- This address must reflect the current IP address of the Reader, which likely differs from the new IP address to which it is being set with the **(I)P Addr** command.
- Under normal circumstances, this should not have to be changed. The **TFTP** (Trivial File Transfer Protocol) address is automatically updated when the **IP** address of the Reader is changed and a successful upload is performed.

(Q)uit   **Q**

Q – Quit the Network-Enabled Reader Programmer Utility.

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Configuration Files & Default Settings

Each Reader has a configuration file under **SSI_info\AXnnnnnn.txt** (where **AXnnnnnn** is the serial number) reflecting its last programmed state. After a successful program upload to a Reader, the configuration file for that Reader is updated with the current settings.

The next time the Reader is selected for configuration, these saved settings are imported and displayed as a baseline configuration. The Reader configuration file is therefore purposely similar to the interactive commands.

⚠ **WARNING – Do not use [CTRL]+[C] to exit, or the last settings of the Mantis™ II Reader will be lost!**

Example – Network Installation

Step 1 – Select the **(R)** command, then enter the Reader's serial number when prompted.

Step 2 – Select the **(I)** command, then enter the new IP address for the Reader (e.g. 192.168.4.34).

Step 3 – Select the **(S)** command, then enter the new subnet mask for the Reader (e.g. 255.255.0.0).

Step 4 – Select the **(F)** command to upload the new file system and update the Reader settings.

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Serial Settings

The **Mantis™ II Reader** supports operation via a standard RS-232 serial port, which may be used instead of, or in conjunction with the Ethernet jack. The Reader will accept commands from either source, or output results to both. In additional, the serial port doubles as a diagnostic port, providing valuable feedback about Reader functionality and configuration during power-up and programming.

Having selected the appropriate serial port (COM port) on your system, use the following settings in your communications package:

Bits Per Second: **115200**
Data Bits: **8**
Parity: **None**
Stop bits: **1**
Flow Control: **None**

ASCII Setup
      ASCII Sending
            Send Line Ends with Line Feeds: **NO**
            Echo Typed Characters Locally: **NO**
            Line Delay: **10 ms**
            Character Delay: **0**
      ASCII Receiving
            Append Line Feeds to Incoming Line Ends: **YES**
            Force income data to 7 bit ASCII: **NO**
            Wrap Lines: **NO**

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Ethernet Settings

As shipped, the default network settings for the **Mantis™ II Reader** are:

IP address:	**192.168.1.129**
Subnet mask:	**255.255.255.0**
Gateway:	**192.168.1.5**

⚠ **WARNING – These settings must be changed to match the subnet of the network on which the Mantis™ II Reader is to be used.**

These Ethernet settings are stored in the **network.txt** file, which is read by the Reader at boot time. Each setting is represented as a string of hexadecimal characters. For IP addresses, a pair of hexadecimal characters (00 to FF) represents each decimal component (0 to 255) of the address. For example:

IP address:	**192.168.1.239 =>**	**C0A801EF**
Subnet mask:	**255.255.0.0 =>**	**FFFF0000**
Gateway:	**192.168.1.1 =>**	**C0A80101**

The **network.txt file** consists of the following default hexadecimal strings that are concatenated on a single line. For example:

C0A80181	FFFFF000	C0A80105	0A	3E8	578	1F4
IP Address	Subnet Mask	Gateway	Keep-Alive Probes	Keep-Alive Interval (ms)	Packet Size (bytes)	Packet Timeout (ms)

⚠ **WARNING – This network.txt file should not be altered. Instead, the Network-Enabled Reader Programmer Utility allows the user to change these settings using dotted decimal notation for IP addresses, the subnet mask, and other advanced settings.**

4 — Troubleshooting

This is a brief list of potential problems, with possible solutions, that may be encountered while using the **Mantis™ II Reader** or the **Network-Enabled Reader Programmer** utility. If the problem cannot be resolved using this list, please call the distributor from which you obtained the **Mantis™ II System** for help in resolving the problem.

PROBLEM — There are no Tags being read at the Reader.

- **CONDITION** – The Reader power light is off.
- **REMEDY** – Plug in the Reader power supply.
- **REMEDY** – Turn on the Reader power switch.

PROBLEM — There are no Tags being read at the Reader.

- **CONDITION** – The Reader power light is on.
- **CONDITION** – The Reader detect light is turning on and off at a regular interval.
- **REMEDY** – The Reader is in standby mode and needs to be configured and enabled for operation.

PROBLEM — There are no Tags being read at the Reader.

- **CONDITION** – The Reader has power but is unresponsive to system communications or remote restart commands.
- **REMEDY** – Verify the LAN is connected and the Client Bridge can be "Pinged".
- **REMEDY** – Verify that the Reader is connected to the LAN by a wired cable or by wireless but not by both. If connected by a wired LAN, remove the wireless card from the Reader.

PROBLEM — There are no Tags being read at the Reader. The Reader has been configured, enabled and is communicating.

- **CONDITION** – The Reader power light is on.
- **CONDITION** – The Reader detect light is not flashing.
- **CONDITION** – The system is receiving the "status" message from the Reader.
- **REMEDY** – Verify the antennas are attached to the Reader and/or move the Tags closer to the Reader.
- **REMEDY** – Change the range setting on the Reader to a longer range to see the available Tags.
- **REMEDY** – Verify the communication medium between the Reader and the computer is operational.
- **REMEDY** – Verify that the configured group code is the same as the Tags being read.
- **REMEDY** – Verify the computer program is set up correctly to receive TagIDs.

PROBLEM – TagIDs do not drop off the computer display when the Tags are moved away from the Reader.

- **CONDITION** – The antenna(s) are installed on the Reader.

- **REMEDY** – Verify that the data communication path from the Reader to the computer is functional.

- **REMEDY** – Change the Reader's range setting to a shorter range.

PROBLEM – All the indicator lights on the Reader turn off and back on again.

- **REMEDY** – If the Reader is not in operation or off-line, the watchdog timer inside the Reader periodically power-cycles the whole Reader. This is normal operation.

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A – List of Acronyms

RFCP – **RF Code** Common Protocol
TAVIS™ – Total Asset VISibility

ADO - ActiveX Data Objects
API - Application Program Interface
ARIN - American Registry for Internet Numbers
ARP – Address Resolution Protocol
ASP - Active Server Page

B2B - Business-to-Business
BGP4 - Border Gateway Protocol
BSA - Business Systems Analyst

CDFS - Compact Disc File System
CGI – Common Gateway Interface
COM - Component Object Model
CPU - Central Processing Unit
CSS - Cascading Style Sheet

DDL – Description Definition Language
DHTML - Dynamic Hyper-Text Markup Language
DLL – Dynamic Link Library
DLT - Digital Linear Tape
DMZ - Demilitarized Zone
DNS - Domain Name Server
DoS - Denial of Service

EDI - Electronic Data Interchange
EJB - Enterprise Java Beans
ERP - Enterprise Resource Planning

FTP - File Transfer Protocol

GIF - Graphics Interchange Format
GPS – Global Positioning System
GRE - Generic Routing Encapsulation

HTML - HyperText Markup Language
HTTP - HyperText Transfer Protocol

I/O - Input/Output
IDE - Integrated Drive Electronics
IE - Internet Explorer
IIS - Internet Information Services
IP - Internet Protocol
IPSec - Internet Protocol Security
ISO – International Organization for Standardization
ISP - Internet Service Provider
IT - Information Technology

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J2EE - Java 2 Platform, Enterprise Edition
JPEG - Joint Photographic Experts Group
JSP - Java Server Pages

L2TP - Layer 2 Tunneling Protocol
LAN – Local Area Network

NNTP – Network News Transport Protocol
NTP – Network Time Protocol

OBI - Open Buying on the Internet Consortium
OC - Optical Carrier
ODBC - Open Database Connectivity
OLTP – Online Transaction Processing
OS - Operating System

PAT - Port Address Translate
PDF - Portable Document Format
POP - Point of Presence

RAID - Redundant Array of Independent Disks
RAM - Random Access Memory
RFID – Radio Frequency Identification
ROM - Read Only Memory
RTLS – Real Time Location System

SAN - Storage Area Network
SAP™ - Systems, Applications, Products, and Data Processing™
SDK - Software Developer's Kit
SGML - Standard Generalized Markup Language
SNMP – Simple Network Management Protocol
SOAP – Simple Object Access Protocol
SQA - Software Quality Assurance
SSL - Secure Sockets Layer
SSI – Signal Strength Indication

TCP/IP - Transmission Control Protocol/Internet Protocol
TOAD - Tool for Oracle Applications Development

UBC - Unified Buffer Cache
UN/SPSC – United Nations Products & Services Classification
UNSPSC – Universal Standard Products & Services Classification
UPS - Uninterruptible Power Supply
URL - Universal Resource Locator

VPN - Virtual Private Network
VSS - Visual SourceSafe

WAN – Wide Area Network
WSC – Windows Script Components

XML - eXtensible Markup Language
XSL - eXtensible Style Language
XSTL - eXtensible Style Language Transformation
XTML - eXtensible Table Markup Language

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C – FCC Compliance

Changes or modifications to this equipment, not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 when the equipment is operated 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 against interference to radio or television reception, which may be determined by turning the equipment off and on; the user must 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.
- Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

The **Mantis™ II System** has two major components which are independently certified and comply with Federal Communications Commission (FCC) rules, part 15.

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

The system operates by using **Mantis™ Tags** which have been certified or are in the certification process. These devices comply with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) these devices may not cause harmful interference, and (2) these devices must accept any interference received, including interference that may cause undesired operation.

a. FCC IDs: N3S2001B03 for:
   i.   2 second Mantis Tag P/N: 05101297-26
   ii.   5 second Mantis Tag P/N: 05101297-27
   iii. 10 second Mantis Tag P/N: 05101297-28
   iv. 15 second Mantis Tag P/N: 05101297-29.

b. FCC IDs: P6F2001C04 for:
   i.   Mantis Tags with motion sensor P/N 05101677-01
        (containing PCB level P/N 02021663-01)
   ii.   Mantis Tags W/O motion sensor P/N 05101677-11
        (containing PCB level P/N 02021663-11)

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D – Copyright Statement

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User Manual
Revision 05

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