

User Manual

MARS-24AT

Multiple Antenna Reader System



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To our valued customers

We constantly strive to improve the quality of all our products and documentation. We have spent time to ensure that this document is correct. However, we realise that we may have missed a few things. If you find any information that is missing or appears in error, please use the contact section at the end of this document to inform us. We appreciate your assistance to constantly improve this document.

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ABOUT THIS MANUAL

This manual is designed for use by engineers experienced with Radio Frequency Identification (RFID) devices. Regulatory, safety and warranty notices that must be followed are given in chapter 7.5 and 7.8.

MEANING OF ALERT SYMBOLS AND SIGNAL WORDS



Notes and Tips. Application Notes.



Requires your attention.



Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Can cause significant property damage.

IMPORTANT INFORMATION

Installation Environment

- For indoor use only unless otherwise specified.
- Install Magellan's readers within the temperature and humidity range according to the product specification. For standard readers the temperature range is from +10°C to +45°C. The humidity range is from 10% to 80% (non-condensing humidity).



The environment must not contain corrosive, flammable or explosive agents or be subject to rapid changes in temperature, to direct vibration or shock.

Installation

- PJM RFID reader-writers communicate with data carriers (RFID inlets, labels and tags) using the 13.56 MHz High Frequency (HF) band. Some industrial machines and electronic devices can generate unwanted noise which may degrade communication. Make sure that other equipment is properly installed, grounded and at a reasonable distance from the reader and/or reader antennas.
- Wireless communication can be degraded by high-voltage and high-current lines and other sources of strong electric and magnetic fields. Installation in such locations should be avoided.



PJM RFID reader-writers are to be professionally installed by authorised, qualified and service-trained installation personnel only.

Maintenance

All PJM RFID readers-writers are low maintenance equipment. Except for externally accessible fuses there are no user-serviceable parts in any reader. There is no requirement to remove the cover of the reader.



Removal of the reader cover by unauthorised personnel will void the product warranty.

Do not attempt to clean internally. Periodic cleaning of external case parts with a damp cloth is advisable. Turn off the reader before cleaning. Do not use a solvent of any kind.

Electrical Safety



In order to avoid electric shock do not remove the reader cover or attempt to repair. The reader must be maintained by authorised, qualified and service-trained personnel only.

Environmental



For disposal readers should be treated as industrial waste.

This symbol on the product or on its packaging indicates that this product shall not be treated as household waste. Instead it shall be handed over to an appropriate collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. The recycling of materials will help to conserve natural resources. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the Magellan Technology regional sales office.

1. INTRODUCTION

Thank you for your recent purchase of a PJM RFID reader-writer.

This User Manual will provide you with information to rapidly adopt PJM technology for your needs, to install the reader hardware and ReaderManager software and get the reader running.

Refer to the 66V10 PJM Confidential Data Book (36-10-006-SPC) for the description of the PJM ItemTag® and PJM StackTag® products of Magellan Technology.

Refer to the ReaderManager Guide (40-01-006-DOC) for a description of the various tools and advanced options available in the ReaderManager software.

Programming is covered in the Application Programmer's Guide (40-01-000-DOC).

Refer to Appendix 7.4 of this manual for details of the Regulations and Standards to which this product complies.

For details of product Warranty refer to Appendix 7.7 of this manual.

For a Glossary of Terms and Abbreviations used in this manual, refer to Appendix 7.5

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2. BEFORE YOU BEGIN

2.1 UNPACKING AND INSPECTION

When you receive your system, inspect it for any obvious damage that may have occurred during shipment. If there is damage, notify the shipping carrier and the supplier of the equipment.



Until you have checked the system, save the shipping carton and packaging materials in the event the unit has to be returned.

The standard MARS-24AT package includes the following components:

- Reader/writer
- Manufacturing test report
- Power adaptor (Optional)
- USB data communication cable (Optional)

2.1.1 POWER PACK

The reader is connected to the power source via a low voltage power pack (12VDC output).



A power cable is not included. End-users should purchase a power cable suitable for the country in which the equipment is being used.



Only power cables and adapters that are compliant with the regulations in the country of use may be connected to Magellan's equipment.

2.1.2 DATA COMMUNICATION CABLES

As shielded cables are generally required in order to comply with EMC emissions limits, the shielded cables are recommended to be used. Unshielded cables may be used where explicitly allowed in the Installation Requirements section of this User Manual.



USB cable should not be longer than 3m



Ethernet cable is not included with the supply.
CAT5 STP (shielded twisted pair) Ethernet cable is recommended

2.2 RECOMMENDED SYSTEM REQUIREMENTS

Recommended minimum host computer requirements:

- Operating System: Windows XP SP2
- Memory: 128MB RAM
- Hard Drive: 20 GB
- CPU: Intel Celeron 500
- Interface: USB or Ethernet (Ethernet cable must be CAT 5 and shielded)

Power supply requirements:

- Mains input: 110 - 240 VAC @ 50/60 Hz
- Low voltage input (MARS-24AT): 12 VDC
- Mains connector: IEC 320/C14

2.3 READER MOUNTING REQUIREMENTS

Surface	Screws recommended
Metal surface	Phillips/Pozidrive Pan Head Self Drilling Zinc Plated Steel Screw No 6/12.7mm equivalent to RS 546-59 5

Timber surface	Phillips/Pozidrive Pan Head Self Drilling Zinc Plated Steel Screw No 6/19.1mm equivalent to RS 278-02
Dry wall	Phillips/Pozidrive Pan Head Self Drilling Steel Screw No 6/25.4mm equivalent to RS 278-051 plus Plasterboard Anchor or equivalent to RS 546-6477

3. PRODUCT OVERVIEW

PJM RFID readers are intended to read and write information to individual ISO 18000-3 Mode 2 Tags.

The communication protocol used by the reader is compliant with ISO/IEC 18000 - 3 Mode 2 (Air Interface at 13.56 MHz).

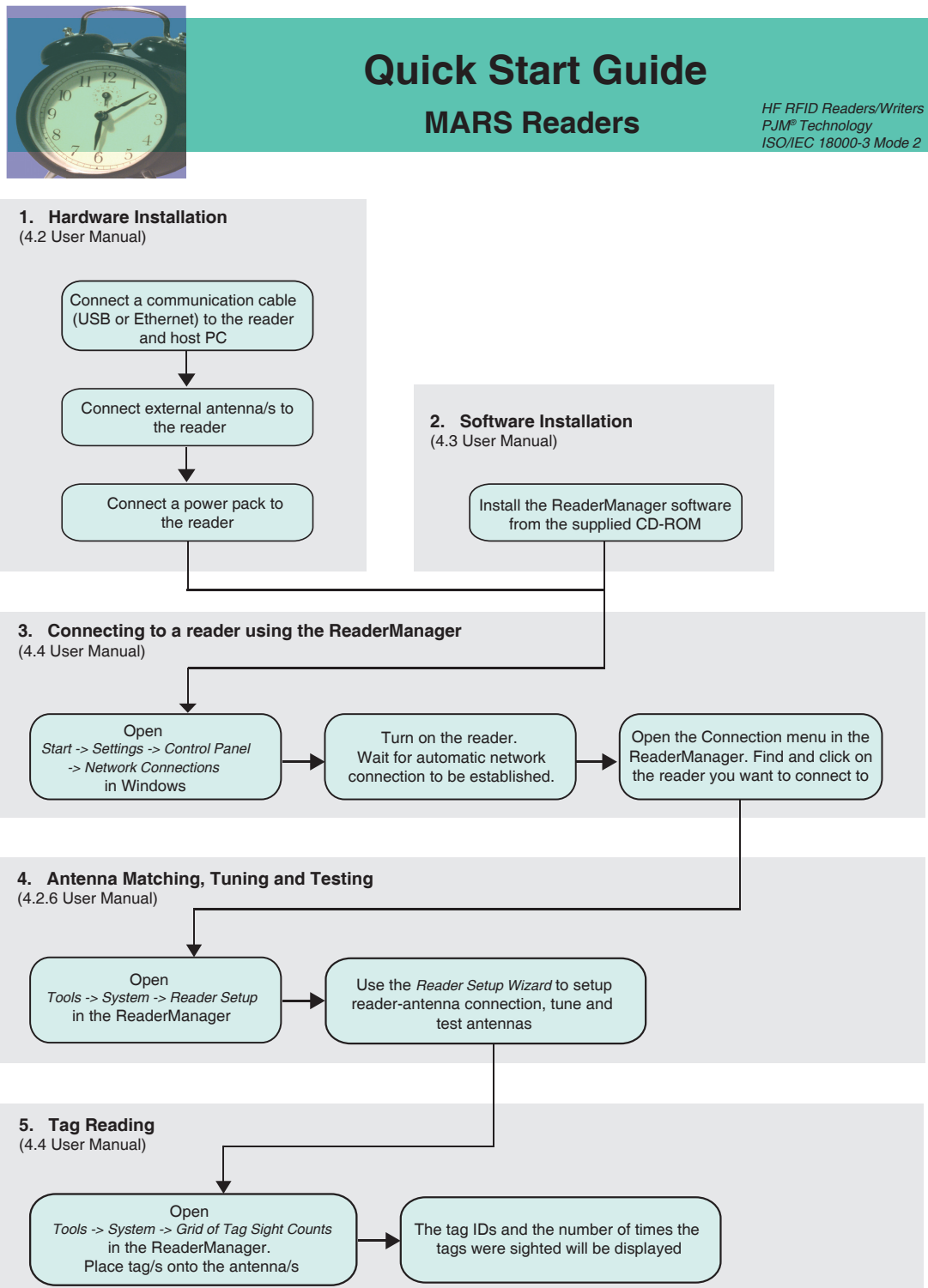
3.1 MARS-24AT

Multiple Antenna Reader System – 24AT
Operates with up to 24 antennas
8 PJM reply channels
General purpose digital I/O interface

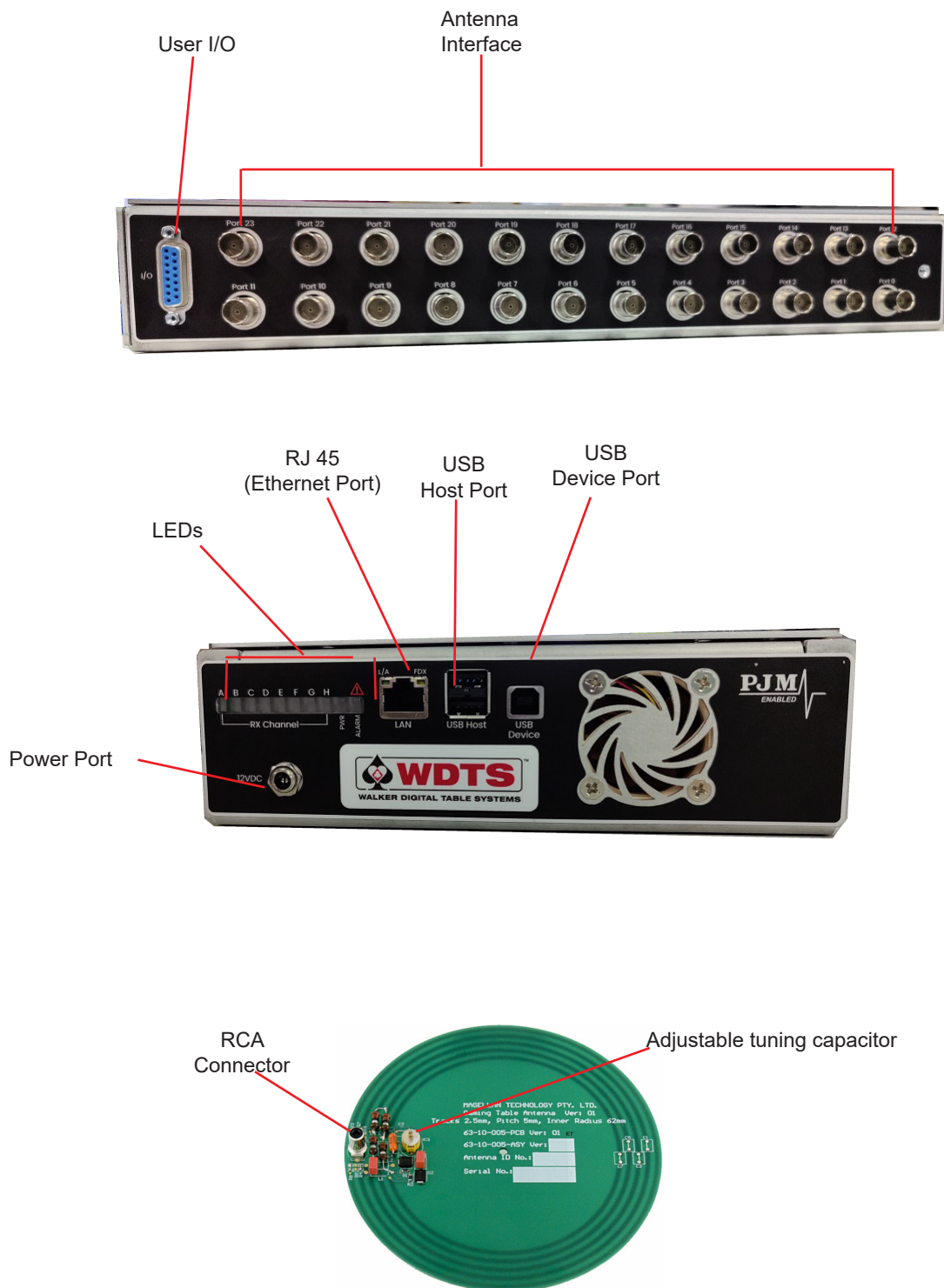


4. INSTALLATION

4.1 QUICK START GUIDE



4.2 HARDWARE INSTALLATION



4.2.1 USER I/O INTERFACE CONNECTOR

The MARS-24AT has an external interface connector called the USER I/O. This provides a number of digital input and output points. These can be used under application control to connect to external devices such as buttons and lights.

The connector is a 15 way D-Sub.



The pins are used as follows:

Pin Number	Direction	Function
1	Pwr	5V at up to 200mA
2	Pwr	3V3
3	IO	GND
4	Dig	SDA
5	IO	IO1
6	IO	IO3
7	IO	IO5
8	IO	IO7
9	IO	Vsw
10	GND	GND
11	Dig	SCK
12	IO	IO0
13	IO	IO2
14	IO	Debug Port
15	IO	Debug Port

All the External output line pins can be controlled using the `ExternalOutputState()` and `ExternalOutputPulse()` API commands using the number specified in the table. For example, `ExternalOutputState(3,1)` would turn on the output on pin 9. Note that the outputs are intended to drive a simple LED indicator or provide a control signal to a more powerful external buffer. All outputs are 3V.

All the External input line pins will generate log messages when the state of a pin changes, for example `Info,External:Input 4 changed state to 0`. The `External input()` API function can also be called to read the state of all inputs as a number. The inputs allow connection to either switches or any external sensor which provides a contact closure or TTL compatible signal.

When designing external hardware, we strongly advise checking the design with Magellan beforehand to verify that it will be electrically compatible.

This connector also includes the debug serial port of the CPU, which is used as the system console. These pins are 3V levels only, so a proper RS-232 driver must be used externally if this connection is required. Refer to Application Programmer's Guide (40-01-000-DOC) for more information.

4.3 READERMANAGER SOFTWARE INSTALLATION

The ReaderManager application software allows tag data to be viewed and programmed.

The ReaderManager can only connect to one Reader at a time. The Connections menu allows the user to connect to other Readers by disconnecting from the currently connected Reader and then establishing a connection to a new Reader.

It is possible to run many ReaderManagers on the same computer at the same time. Simply double click on the ReaderManager icon to open up multiple instances of the ReaderManager.

Refer to the ReaderManager Guide (40-01-006-DOC) for various tools and advanced options available in the ReaderManager.

4.3.1 INSTALLATION AND FUNCTIONALITY TEST

Step 1: Insert the CD supplied with the reader into the CD-ROM.

Step 2: Open Windows Explorer, double click on *ReaderManager-Install*.

Step 3: Ensure all items in the Install dialog are ticked, and then click the *Install* button.

If Python is not installed on your computer, the installation program will prompt you if you would like to install Python. Click the *Yes* button and accept all the default options during installation.

When the ReaderManager and all the required libraries are installed the dialog box will be displayed. Ensure the dialog box shows *Completed* and no problems are reported.



There is an option to install only an Ethernet-over-USB driver. Tick only the *PJM Reader USB driver (RNDIS Ethernet)* box in *Install* dialog and press *Install*.

Step 4: Click the *Close* button to continue.

If the ReaderManager is already installed, double click *ReaderManager-Upgrade*. Follow steps 3 to 4 above.

If Python and PyQt are already installed, the installation program will not re-install them. To force the installation program to re-install these libraries, click the relevant check boxes.

Step 5: To start the ReaderManager double click the *ReaderManager* icon or select *ReaderManager* from the Programs Start menu.



Step 6: Functionality test.

Select *Help>About ReaderManager* from menu to see the version of the ReaderManager software and its status.

4.3.2 UPGRADING SOFTWARE



Recommended to upgrade the ReaderManager software at least once a month and ReaderServer software on network based readers every 3-4 months.

Refer to the ReaderManager Guide (Upgrading Reader Software) for more information about how to upgrade the ReaderServer from the ReaderManager *File* menu.

4.4 CONNECTING TO A READER USING READERMANAGER



Magellan's readers are complex and powerful network devices. As most network devices they should be handled by well trained network administrators.

A reader provides Ethernet and USB device interfaces to allow for user connection.

Before you open the ReaderManager and connect to a reader using the ReaderManager you must obtain an Ethernet IP address if you are using a normal Ethernet cable or an Ethernet cross over cable, or acquire a USB IP address if you are using the USB cable.

These are the networking rules:

- USB will always choose a subnet different to Ethernet.
- Both interfaces will try to obtain the 169.254.0.0 range, but Ethernet has priority.
- 172.16.0.0/16 is USB's fallover subnet if Ethernet has already taken it by either: DHCP, fixed, or link-local IP acquisition.

To change the reader's network settings:

From the Tools menu in the ReaderManager select *System* then *Configuration System*. Click the *Network Configuration* tab.

The screenshot shows a window titled "Configuration System" with two tabs: "System Configuration" and "Network Configuration". The "Network Configuration" tab is active. It contains a text box with the following text: "You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings." Below this text is a checkbox labeled "Obtain an IP address automatically" which is currently unchecked. To the right of the checkbox is a text box labeled "Use the following IP address:". Below this text box are three text boxes: "IP Address:" with the value "192.168.65.129", "Subnet mask:" with the value "255.255.255.0", and "Default Gateway:" with the value "192.168.0.1". On the right side of the window, there are six buttons: "Unlock", "Save", "Refresh", "Delete", "Add", and "Generate Report".

If the reader is to be assigned an IP address from a DHCP server click the *Obtain an IP address automatically* check box.

To assign a static IP address, uncheck the check box and enter the IP address in the *IP address* text box. The box will turn red if the IP address is not valid.



Care should be taken not to duplicate IP addresses on your network. If you are unsure what IP address to use consult your system administrator.

Enter the network *Subnet mask* and *Default gateway* addresses in the text boxes provided.

Click the *Save* button to save these changes to the reader, or click the *Refresh* button to restore the last saved values.

Restart the reader for these changes to take effect.

4.4.1 GETTING AN IP ADDRESS USING ETHERNET

Here is a general guide to the way Reader network address assignment works:

The Ethernet interface is either served an IP address via DHCP or is assigned a static IP address by the user. If the Reader is set to use a DHCP assigned address and no DHCP server is available it will automatically use a link local address of 169.254.0.0/16.

The Reader must be powered up with the Ethernet connected to get a DHCP assigned IP address.

By default, the Readers are set to *Obtain an IP address automatically*, which means they look for a DHCP server. If one isn't present, for example when a crossover cable is used to connect to a single PC, the Reader will choose a Link Local address.

A link local address (also known as Automatic Private IP Addressing - APIPA) is one chosen at random in the range 169.254.0.1 to 169.254.255.254 with a netmask of 255.255.0.0.

Windows PCs and most other computers by default will use the same system, which allows an ad-hoc network of computers and Readers to automatically pick unique addresses. This can work for a crossover cable between a single Reader and a computer or a more complex setup involving multiple Readers and multiple PCs using a normal Ethernet cable and Ethernet hub/switch.

This system is very good to use because it requires no expertise or intervention from users.

The below process refers to automatic address negotiation only.

In order to successfully connect a Reader via a crossover cable follow these steps:

Step 1: In Windows, open the *Start -> Settings -> Control Panel -> Network Connections* window

The PC's Ethernet connection should be marked as disconnected

Step 2: Plug in the cross over cable. Turn the reader on. The user should instantly see the state of Ethernet change to *Looking For An Address*.

This process may take up to a minute.

Step 3: Eventually the state should change to *Limited Or No Connectivity*. In the desktop icon tray, the Ethernet will be marked with a yellow triangle.

This means that Windows was looking for a DHCP server, but was unable to find one, so it used a Link Local address (169.254.X.X) instead. Although it may look like an error, this is what you should expect to see.

Step 4: Left click on the Ethernet connection and look in the *Details* box on the bottom of the left hand side panel of the *Network Connections* window. You should see the IP address in here.

If the address showing is **not** 169.254 followed by 2 other numbers, then the user needs to check the following:

1. Right click on the Ethernet connection in the *Network Connections* window.
2. Select the *Properties* menu option.
3. In the properties window, look in the list of items for *Internet Protocol (TCP/IP)*.
4. Double click on this item
5. In the *Internet Properties* window, click on the *Alternate Configuration* tab
6. Make sure that the *Automatic private IP address* radio button is the selected one.
7. If it is not, then select it and click *OK*.

In some PCs this setting could be on a manual address, which would prevent Link Local addressing from functioning.



Note that older versions of Reader OS software used a different system. It is important that all Readers are upgraded to 2.03 or above in order to use this functionality.

Step 5: Go to the section 4.4.3

4.4.2 GETTING AN IP ADDRESS USING USB

The USB interface uses TCP/IP networking over USB as the protocol. This allows you to connect to a reader as if it were a normal network, so all the usual services, such as telnet and FTP, are available.

Any device hardware when it's first connected to a PC via USB requires a device driver. The device driver is provided by Microsoft (Windows XP SP2). No USB device drivers are available instantly. They have to be installed and require a certain amount of configuration. The driver must be installed on the PC before Windows can use the connection. The device driver requires a configuration file for the reader which is installed on the PC via the ReaderManager.



When you install a new reader for the first time it can take from 1 to 5 minutes to create a network connection before the ReaderManager is able to recognize a new reader.

Since every reader has a unique serial number, Windows treats it as a new device and you will have to install the device driver again for each new reader that you connect to the same PC. After the first installation, Windows can search for the driver automatically as the device driver files are already on the PC.

In order to connect to a reader via USB for the first time follow the steps below:

Step 1: Open *Network Connections* in Windows (Windows XP SP2) to view the network connection process.

You can verify that the reader is connected by looking at the *Network Connections* window. You can open this window from several places: *Start -> Settings -> Control Panel -> Network Connections* or *My Computer -> Other Places -> My Network Places -> View Network Connections*.

Step 2: Make sure that the USB and power cables are plugged in. Turn on the reader. The *Found New Hardware* dialog box will be displayed.

When a reader is connected to a host computer for the first time using a USB, there are a few steps to go through before the ReaderManager is able to identify the new reader:

1. In *Found New Hardware Wizard* tick *Yes, this time only to search for software* and press *Next*.
2. In *What do you want wizard to do?* tick *Install the software automatically* and press *Next*.
3. Wait while the wizard installs the *Linux USB Ethernet/RNDIS Gadget* device driver. Ignore any other message and press *Continue* anyway.
4. Press *Finish*.

Step 3: Wait until a new entry appears in the *Network Connections* list called "Linux USB Ethernet/RNDIS Gadget". This is the reader.

If it says *Acquiring IP address* then you must wait until it says *Connected*. The reader's network connection will say:

1. *Local Area Connection X*
2. *Connected*

3. Linux USB Ethernet/RNDIS Gadget

Once it says *Connected* in the *Network Connections* window (Windows) you can go to Step 4.

If it says *Disabled* or *Broken*, then click right and select *Repair* or *Enable* to try and fix the connection. If this fails, disconnect the reader, reboot your PC and repeat from Step 1.

The reader can disconnect in situations where it has been repeatedly plugged and unplugged before Windows has had a chance to properly and completely process the network connection. In this situation it is possible for the reader to appear on the network for about a minute before it is disconnected by the Windows networking system.

The solution is:

1. Unplug the reader.
2. Wait for the reader's network connection to be removed from the *Network Connections* window.

Once the network connection has been removed:

1. Plug the reader back in.
2. Wait for the network connection to re-appear and become *Connected*.
3. Connect to the reader via the ReaderManager.

Another solution is to try another USB port as USB ports can fail on PCs. As with the previous case:

1. Unplug the reader.
2. Wait for the network connection to be removed.
3. Plug the reader into another USB port.

Windows networking can take some time (a few minutes) to create the network connection if the reader has been rapidly plugged and unplugged. If the reader network device does not disappear within 5 minutes of being disconnected, reboot your PC as then there is a problem with Windows Networking or the USB port has locked up.



You should NEVER power cycle a reader because you are having problems with your PC or with Windows. Power cycling can cause more problems with Windows and Windows networking.

Most USB problems are usually caused by Windows networking delays and Windows networking problems. Frequent unplugging of the USB cable will create even more problems.

Step 4: Go to the section 4.4.3.

4.4.3 GETTING A READER CONNECTED USING THE READERMANAGER

Step 1: Open the ReaderManager.

ReaderManager will automatically detect all readers on the local network. When a reader is connected for the first time to a network using an Ethernet cable or a host computer using a USB cable, the reader is identified by its Model Name-Serial Number (It is recommended that these be kept).

Users can replace or add additional information to the Model Name-Serial Number such as a physical location or customer ID number.

Subsequently when a user starts using the reader the new name will appear on the list of readers in the *Connection* menu.



Tip: If you want to use the new name immediately, simply power cycle the reader to view the new name on the *Connection* menu list.

To change a reader network name:

From the Tools menu, select *System* then *Configuration System*. The window shown below will be displayed.

Field Name	Field Value
Reader	
Model	MDR-1109
Name	Desktop
Part Number	60-70-003
MLC	1
Version	1
Date Code	05/06
Serial Number	100108
Customer ID	Type something here...
Digital	
Part Number	56-10-004-ASY
Version	4
Date Code	05/06
Serial Number	20794

Click the column on the right of *Customer ID* and enter the name you would like the Reader to be identified as. This is the name that will appear on the *Connection* menu.

Click the *Save* button on the right to save your changes to the reader, or click the *Refresh* button to restore the previously saved name.

Step 2: Click the *Connection* menu item to view readers found on the local network.

The ReaderManager will use network broadcasts to look for active readers via USB and Ethernet. If you click on the *Connection* menu, you can see readers defined in there automatically.

A list of readers will be displayed. The IP address and MAC address will be shown on the status bar as you move the mouse over each reader entry.

Step 3: To connect to a reader, select the reader you would like to connect to from the *Connection* menu, then click the left mouse button.

The status bar will change from a red to a green background to indicate that the ReaderManager was able to connect to a reader. The tag type and IP address are also shown on the status bar.



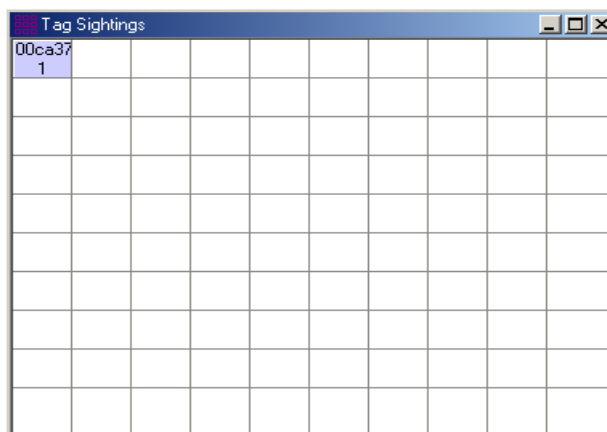
To get more information how to setup static connections to readers please refer to the ReaderManager Guide (40-01-006-DOC).

4.5 COMMUNICATION TEST

Perform the tag reading test by selecting *Tools -> System -> Grid of tags sight count*.

Use one of the fully powered tags, place the tag on the reader antenna.

The first square in the grid should turn from white to blue and display the tag's ID number and the number of times the tag was sighted (should be one). An example of this is shown below.



5. WORKING WITH ANTENNAS

The MARS-24AT requires special installation and tuning of external antennas. Refer to the ReaderManager User Guide (40-01-006-DOC) for the antenna matching, tuning and testing instructions using the *Reader Setup Wizard* tool.

MARS' external antennas are suitable for applications where one or many reading points are required. They are designed to be used as free standing antennas, integrated into non-metallic (preferably plastic) housings, or even embedded into desk tops or shelves.



Once antennas are placed in the position they are to be used, it is essential that they are fixed in place and tuned. The tuning is to be done only once at installation. All antennas (except the small round antenna 30 mm radius) have an adjustable capacitor that allows for tuning.

5.1 MATERIALS

The material upon which an antenna is mounted and the positioning of the antenna itself can have a significant effect on antenna performance.

The effect of materials and antenna position on antenna operation may be determined as follows:

- Place an antenna on a styrofoam block and tune for maximum voltage at the antenna center using an Antenna Tuning Probe, digital voltmeter and a trimming tool. Then place the antenna on/into the installation position, retune and measure the maximum voltage again. Compare the voltage values.
- A difference of 10% or less is acceptable. If the voltage reduces by more than 10%, this indicates that the material is adversely affecting the antenna. The user should determine if the reduction in operation is acceptable by measuring read range and stacking operation. If the reduction is not acceptable the antenna must be relocated.
- Alternatively the use of a plastic spacer of 5 mm minimum thickness between the mounting material and the antenna is recommended where the mounting material is adversely affecting the antenna.

Antenna performance may be affected by conductive and metallic materials in the immediate vicinity of the antenna.

Metal, metallic or metallized objects placed next to the reader antenna may change the characteristics of the antenna affecting the tuning operation and reducing the read range.

It is recommended that the antenna should not be placed closer than 35 cm to any metallic object that is of a similar or larger size to the antenna.

Small metallic objects such as jewelry or coins put on the antenna will have almost no affect on the antenna performance.

If metallic conveyor rollers are a part of an application it is recommended that they be replaced with plastic parts if possible or apply shielding techniques as required.

Materials such as wood, laminated MDF, HDF or plywood have a limited conductivity. If an antenna is mounted into these materials some reduction in the read range can be expected.

Plastics are the best materials on which to mount an antenna provided that they are graphite/carbon free.



Try to avoid using black plastics as they may be conductive due to carbon/graphite based colouring agents.

Clear glass is generally not conductive and can be used as a desk top material (for desktop applications). Smoked and tinted glass may be conductive and any affect on antenna operation should be determined by measurement.

5.2 ANTENNA SEPARATION

Antennas mounted in a close proximity may cause mutual interference.

For antennas connected to the same MARS reader the safe distance between the antenna edges is antenna size dependent and varies from 5 cm (radius 30 mm round antenna) to 15 cm (202x352 mm antenna).

For antennas connected to two different MARS readers the safe distance between the antenna edges is also antenna size dependent and varies from 30 cm (radius 30 mm round antenna) to 60 cm (202x352 mm antenna).

Do not mount an antenna on a desktop surface if there is a MARS reader immediately below and under the antenna. The distance between the antenna and the MARS reader should be no less than 20 cm. Use extended brackets to increase the distance if required. Alternatively the MARS can be screened from the antenna by a purpose built ferrite shield.



In general no electronic devices or power adaptors should be placed within 20 cm of an antenna in any direction. Before such installations are attempted Magellan must be consulted.

5.3 CABLES

Do not run any cables under or near an antenna. Maintain a minimum distance of 15 cm.



The cables that connect external antennas with the reader are provided by Magellan. The MARS readers should only be operated with antenna cables supplied by Magellan. Any changes or modifications to the equipment that are not expressly approved by the party responsible for compliance will void the product warranty.

5.4 HOW TO SHIELD ANTENNAS

Antennas may be shielded by a purpose built ferrite sheet only. In special circumstances, devices such as keyboards and computers may be placed under antennas where a purpose built ferrite antenna shield (64-50-001) is provided to protect the antenna.

A ferrite shield consists of a sheet of aluminium with ferrite tiles, minimum thickness 5 mm.

Contact Magellan for further information on shielding antennas for your specific applications and for the specification of the Ferrite Antenna Shield (64-50-001) when planning your installation.

5.5 ANTENNA MAINTENANCE (TUNING)

Antennas may require periodic re-tuning and testing. Detuning of an antenna may occur if the physical environment around the antenna is changed. This can occur, for example, when large metal objects are located near the antenna or electronic devices or cables are placed in close proximity with the antenna. The severity of detuning is dependent upon the size of the metal object and can only be determined by measurement.

Before tuning make sure that metal objects, electronic devices and cables are not closer than the recommended distances in any direction from the antenna.

The purpose of the tuning procedure is to maintain an antenna at its correct operating point. Tuning the antenna means to trim it to its highest possible field strength which corresponds to the highest voltage as measured by a voltmeter with an Antenna Tuning Probe.

If in doubt, contact Magellan for further instructions for your specific application.

5.5.1 EQUIPMENT AND SOFTWARE REQUIRED FOR ANTENNA TUNING AND TESTING

- 1 x Antenna Tuning Probe with cable (Magellan Antenna Tuning Kit)
- 1 x RF Trimming Tool (Magellan Antenna Tuning Kit)
- 1 x Universal Digital Voltmeter (to measure DC voltages between 1 and 15 volts)
- Magellan ReaderManager software– V2.05 or better
- 1 x Tag (fully powered tag)



Antenna Tuning Kit: Antenna Tuning Probe with a cable and RF Trimming Tool

5.5.2 TUNING INSTRUCTIONS

1. Connect the Antenna Tuning Probe terminals to the voltage and input terminals of the digital voltmeter.
2. Set the voltmeter to measure a DC voltage range greater than 10 volts.

3. Place the Antenna Tuning Probe in the center of the antenna.
4. Using an RF trimming tool adjust the tuning capacitor on the antenna for maximum voltage as measured by the tuning probe.

5.5.3 OPTIMISATION OF ANTENNA PERFORMANCE



If maximum read distance is important for your application then the antennas have to be protected/shielded from interference using appropriate mounting material, and then tuned to maximum voltage.

If maximum read distance is not an issue the antennas can still work effectively even if not tuned to maximum voltage, but the effect will be reduced read range.

The 8.8 m cable will provide a range reduction of between 15% to 20 % in comparison to the 1.5 m standard cable (Refer Appendix 7.3 Maximum Read-Write Distance).

Refer section 4.2.7 "Antenna Matching, Tuning and Testing" for detailed procedures..

6. WORKING WITH TAGS

Single-axis antennas are tag orientation sensitive. Refer to the Tag-to-Reader/Tag-to-Antenna section of this document.

Reading and writing speeds depend on reader-tag communication speeds, the number of receiver channels, the amount of information to be read and/or written and the number of tags presented at a the same time. The number of tags and the amount of information to be read and especially written, slows down the read-write communication speed.



Be aware that tags and readers can be incompatible with each other. Larger tags can work with all types of readers and antennas. Smaller tags require higher field strengths and as a result they may not operate with some reader/antenna combinations or have to be closer to a reader antenna to operate. Refer to the Reader-Tag Compatibility section of this manual.

PJM StackTags delivered on a roll are always fully powered (ST normal power mode or 6000 mode). Fully or normal powered tags are ON all the time and reply to each reader command providing they are in the field of the reader antenna.

To reduce the risk of tag replies clashing and to increase anti-collision and stackability for some applications the tags can be reconfigured by end-users to a ¼ low power mode (ST ¼ normal power mode or 2000 mode). This means that tags in the ¼ low power mode are muted ¾ of the time and do not reply to the reader commands instantly.

Tags can be reconfigured individually (one by one) or en masse (many at once). Before reconfiguring tags make sure the ReaderManager software has been installed and upgraded to the latest version, the reader is running and the reader is *Connected* to the ReaderManager software.

6.1 HOW TO RECONFIGURE TAGS INDIVIDUALLY OR EN MASSE

1. In the ReaderManager go to *Tools -> System -> Console*. Click with the right mouse button and tick *Show Tag Replies*.
2. Then go to *Reader Configuration* and choose *Config_Normal_Powered_Tag* or *Config_Quarter_Powered_Tag* (for the ReaderManager version 2.12 or higher).
3. Place a single tag or multiple tags into the reader antenna field.
4. Remove the tag(s) from the field.
5. Follow the step 3 to 4 for a new batch of tags.
6. Once completed go to *Reader Configuration* and click on *Clear All*.

6.2 HOW TO CHECK A TAG CONFIGURATION MODE

The tag configuration mode can be checked with the ReaderManager:

1. Go to *Tools -> System -> Interrogate Command*.
2. In *Reply* select *Normal* and click *Send*.
3. Then go to *Tools -> System -> Table of Tag Messages* to see the tag configuration in the *Config* column. The messages of all the tags currently in the reader antenna field can be seen. 2000 means that the tag has been reconfigured to *ST ¼ normal power mode* configuration. 6000 means that a tag is in *ST normal power mode*.

6.3 HOW TO CHECK A TAG CHIP TYPE (IT OR ST)

The tag chip type can be checked with the ReaderManager:

1. Go to *Tools > System > Tag Memory Map*
2. Place a tag on the antenna. The tag ID# will appear below "Current tags"
3. Left mouse click on the ID#
4. The chip type can be seen in the "Value" column of the System Memory in line "0":

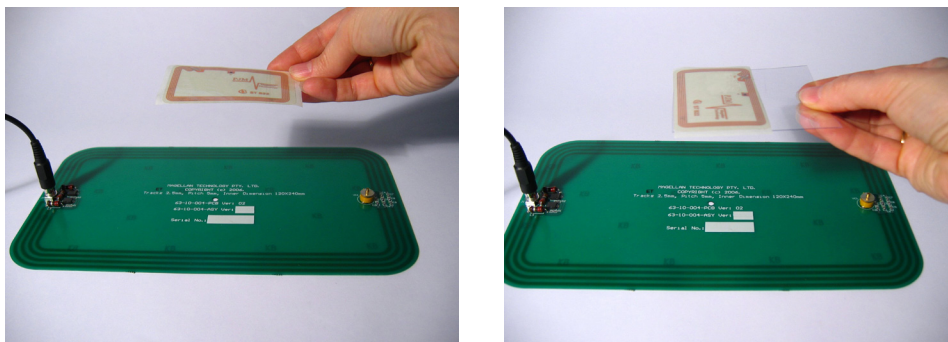
Value for ItemTag chip is XXX0

Value for StackTag chip is XXX1

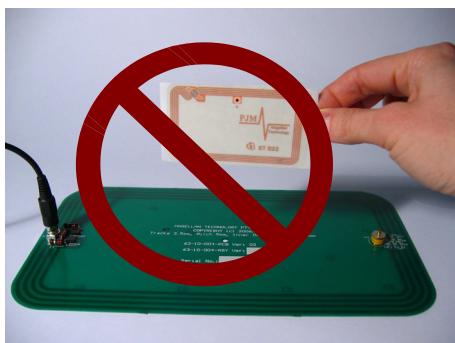
Note X means "do not care"

6.4 TAG-TO-ANTENNA ORIENTATION

Tags should always be presented face on to the external antenna surface (i.e. with the coils of the reader antenna and the tag parallel). This is the position for optimum coupling (power transfer) between the antenna and the tag, and hence gives maximum read range. Tags may still work at an angle depending upon the distance between the tag and the external antenna.



Correct orientation



Incorrect orientation (90° angle)

7. APPENDIX

7.1 EXTERNAL ANTENNA TYPES

External antennas have been designed to operate with Sato's MARS readers. The antenna operating volume is inside the antenna turns. Each antenna is connected to a reader via a supplied RCA cable. The RCA cable length: 1.5 m (standard cable), 8.8 m (on request).

7.2 READER-TAG COMPATIBILITY

Refer to the Tag Comparison Chart on our website: www.magellan-technology.com/products/tags_and_chips.

7.3 SPECIFICATIONS

ELECTRICAL	
Operating Frequency	13.56 MHz
ISO/IEC Compliance	18000-3 Mode 2
Command Data Rate	424 kbit/s
Reply Data Rate per Channel	106 kbit/s
Number of PJM Reply Channels	8
Number of External Antennas	up to 24
Number of Axes	Antennas available for 1, 2 or 3 dimensional operation
Operating Range	Tag type dependent
Compatible Antennas	Details available on request
Antenna Cable Length	1.5 m, 3 m (optional cable extender required)
Dedicated I/O	15 way D-SUB Connector
I/O Connector	12VDC
Power Supply	2.5 mm DC centre pin positive
DC Power Supply Connector	110 - 240 VAC @ 50/60 Hz
Mains Input	IEC 320/C14
Mains Connector	60 W (minimum)
Power Consumption	
PERFORMANCE	
Tag Type	Antenna dependent refer Tag Reference Table
Identification rate at 100% accuracy	up to 600 tags/s
Identify & read 96 bits data at 100% accuracy	up to 250 tags/s
Identify, write & read back 96 bits data at 100% accuracy	up to 50 tags/s
HOST	
Host Interface	USB and Ethernet (Ethernet Cable must be CAT 5 and shielded)
Minimum Host Computer Requirement"	"Windows XP SP2, 500 MHz CPU, 128MB RAM"
SOFTWARE	
Minimum Firmware Reader Server	Version 3.42.8
ENVIRONMENTAL	
Operation environment	Indoor use
Temperature range	0°C to +45°C
Humidity	10% to 80% (non-condensing)
MECHANICAL	
External Dimensions (L x W x H)	383 x 205 x 62 mm
Internal Aperture	N/A
Net Weight	3.7 kg including power supply
Net Volume	0.0049 m ³
GENERAL	
Read and write operations	Yes
No manual calibration needed	Yes (some antennas)
Automatic tuning	Yes
Readers can be placed in close proximity to one another	Yes, however antennas need minimum separation depending on type

7.4 REGULATION AND STANDARDS

RFID equipment is subject to national and international regulations.

7.4.1 FCC RADIO FREQUENCY INTERFERENCE STATEMENT (USA)

The FCC regards RFID equipment as low-power transmitting devices and, therefore, does not require users of RFID devices to obtain a license to operate them.

NOTE: 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 instruction manual, 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:

- Reorientation or relocation of 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



Any changes or modifications to the equipment that are not expressly approved by the party responsible for compliance could void the user's authority granted under FCC Rules to operate this equipment.

FCC ID: 2BEI3-MARS24AT

7.4.2 IC RADIO FREQUENCY INTERFERENCE STATEMENT (CANADA)

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003
du Canada.

FCC ID: 31874-MARS24AT

7.4.4 ACMA DoC (AU)

This product complies with the Australian Communications and Media Authority (ACMA) Radiocommunications regulations and carries the C-Tick mark accordingly.

7.4.4 ISO/IEC 18000 – 3 MODE 2 (AIR INTERFACE AT 13.56 MHz) COMPLIANCE

Magellan's readers fully comply with the ISO/IEC 18000 Part 3 Mode 2 (Information technology – Radio frequency identification for item management. Part 3: Parameters for air interface communications at 13.56 MHz) published in August, 2004.

7.4.5 HUMAN SAFETY



Customers using the MARS-24AT readers and antennas are responsible for operating their system under implemented power levels and antenna configurations against relevant standards for human safety in electronic field.

7.5 GLOSSARY OF TERMS AND ABBREVIATIONS

Antenna	A reader antenna that emits radio waves and receives reply signals from tags. The reader antenna can be internal where it is integrated into the reader or external where it is connected to the reader via a cable.
Antenna axis	The antenna port on the reader which the antenna is plugged into.
Antenna tuning	Trimming a reader antenna to its highest possible field strength which corresponds to the highest operating voltage.
Create axis group	Create an antenna group. This means combining antennas or antenna ports into one group that serves the same purpose or application.
Configure axis group	Configure group antenna behaviour. This means to set up all antennas in the group to the same behavioural parameters which will be the default parameters for this group.
D/C	Date Code (month/year): Date of device manufacturing
DSB	Digital Support Board: Embedded processor board running the embedded operating system (OS) and the ReaderServer
HF	High Frequency (13.56 MHz)
GUI	Graphical Use Interface
IT	ItemTag (chips, inlets and labels)
LAN	Local Area Network
LED	Light Emitting Diode
MLC	Machine Level Control (System Configuration Control): Reader version number
MRD	Maximum Read-Write Distance
Network Connections window	In Windows open <i>Start-> Control Panel-> Network Connections</i> or open <i>My Computer-> Other Places-> My Network Places-> View Network Connections</i>

OEM label	Original Equipment Manufacture label is located on the back of the equipment. It includes the Model Number, P/N, D/C, S/N and MLC.
PJM	PJM is an RFID communication technology developed and patented by SATO VICINITY Pty Ltd and complies with ISO/IEC 18000-3 Mode 2. PJM technology products include a range of RFID chips, inlets, tags and readers.
P/N	Part Number
Power cycle the PC	Close Windows, switch the PC off, remove the power plug and wait for 30 seconds before powering the PC back up again. For laptops this means removing the battery and waiting for 30 seconds. This ensures that the USB host controller chips on the motherboard have had a chance to be fully reset.
Power cycle the reader	Turn off the power or unplug the power cable (the power port on the reader). Open the <i>Network Connections</i> window in Windows. Wait for the reader network connection to be removed from the <i>Network Connections</i> window. Plug the reader back in and wait for the network connection to re-appear and become <i>Connected</i> in the <i>Network Connections</i> window. Connect to a reader via the ReaderManager's <i>Connection</i> menu.
Reader/s	SATO's RFID reader-writer/s
ReaderManager	Graphical user application for Windows/Linux operating systems which provides a platform for testing, demonstrations and application development
ReaderServer	Embedded application that provides the standard Application Programmer Interface to serve end-user applications. This application runs on the reader.
RFID	Radio Frequency IDentification
RFID inlet	A RFID device comprising a microchip and an antenna (etched copper or aluminium or possibly conductive inks) on a flexible substrate (PET plastic film)
RFID label	RFID inlet often with adhesive backing (sticky label)
RFID tag	1. generic name for RFID inlet and label; 2. RFID inlet or label inserted into a housing (glass, polycarbonate, polyamid, epoxy, ABS, etc.)
RFID reader-writer	Device for reading and writing to RFID tags
RMA	Returned Materials Authorisation (Return Authorisation number)

Setup axis	Setup antenna. To setup an antenna means to match the antenna with its corresponding antenna port by choosing the antenna type from the list in the ReaderManager.
S/N	Serial Number
ST	StackTag (chips, inlets and labels)

7.6 TROUBLESHOOTING

7.6.1 LEDs

Blue LED is off	Power cable not connected	Ensure the power cable is connected correctly to both the mains power and to the Reader
	Power cable faulty	Replace the cable
	Power adaptor faulty	Replace the power adaptor
	Reader faulty	Send a service report using the Service Form
Absence of the flashing green LED during tag reading	Incorrectly oriented tag/tags	Ensure tag/tags are oriented correctly to the reader antenna (see Tag-to-Reader/Tag-to-Antenna Orientation).
	Faulty tag/tags	Replace tag/tags. Do not use tags with a black dot or black square marking (faulty tags).
	The <i>Powering Field</i> is off	Ensure the powering field is on. Go to <i>Tools>System>Reader Setting</i> . Tick the <i>Powering Field</i> box.
	Antenna was not tuned	Tune the antenna (refer to the Working-with-antennas section)
	Reader faulty	Send a service report using the Service Form.
Green LED flashes but I can not see any tag message in the ReaderManager	USB or Ethernet connection is not functioning The reader is not <i>Connected</i>	Ensure the communication cable is connected correctly. Ensure the reader is turned on and a communication cable is plugged in. The status bar in bottom right corner of the ReaderManager window has to show an indication <i>Connected</i> , the tag type and the IP address.
	The tag type is incompatible with the reader	Use the appropriate tag type according to the chart in the Reader-Tag Compatibility section.
	A communication tool has not been chosen	Choose <i>Grid of tag sight counts</i> or <i>Table of Tag Messages</i> from <i>Tools->System</i> menu to view tag replies.
Red LED remains on	Reader faulty	Send a service report using the Service Form

7.6.2 ANTENNA INSTALLATION AND MAINTENANCE

Antenna test failed	Wrong tag. The tag used for the test is in a low power mode.	Make sure you use a normal/fully powered tag for testing (refer to the Working-with-Tags section in the Reader User Manual). Perform the test again.
	Faulty tag	Replace tag. Do not use a tag with a black dot or black square marking (faulty tag).
Antenna is not on the list of available antenna types	You have purchased new antenna type which is not in your version of the ReaderManager	Download the latest version of the ReaderServer available from Magellan's website. Then upgrade the ReaderServer on your reader using the ReaderManager.
Antenna does not work as good as before (reduced read range, etc.)	The Antenna has been moved recently and was not tuned	Once you change the antenna position, moved the antenna or replaced the mounting material you should understand first whether the antenna is affected by the mounting material, put a plastic spacer if affected and tuned the antenna again.
	Metallic object/s, electronic devices or cables are in the close vicinity of the antenna and affect the antenna performance	Move all metallic objects, electronic devices and cables away from the antenna or shield the antenna by a purpose built ferrite shield. Once you do so the antenna should perform as before. Measure the maximum voltage, compare with the voltage previously recorded and tuned the antenna if it's required.

7.6.3 CONNECTING A READER

Can not find and connect to the reader - reader is not shown on the <i>Connection menu</i> list	The reader was not in the operational mode when you connected a communication cable and/or opened the <i>Connection menu</i>	Plug in the communication and power cables. Wait for about 1 minute after you apply power to the reader. The red LED must be permanently on and the green LEDs off. In the ReaderManager open the <i>Connection menu</i> . Find the reader you want to connect to on the list.
PC does not recognise the reader at all	The USB port on the PC is broken	Use another USB port known to be working.
	USB port has temporarily failed	Power cycle the PC.
	The reader is faulty	Check the reader on two other PCs. If no PC shows any response at all to the USB cable being plugged in then it's faulty. Send a service report on the Service Form.
	USB cable faulty	Change the USB cable.
PC recognises the reader, but claims that it is faulty in the Windows' Device Manager and does not create a network connection	Windows has previously marked the reader as faulty and will not try to connect to it or load the reader driver. Usually caused by rapidly unplugging and plugging of the USB cable.	Make sure that the USB cable is unplugged and the reader is turned off. Remove/Uninstall the faulty device from the Device Manager, then plug the USB in, turn the reader on and wait for a network connection again. Alternatively connect a different reader to the PC as it will have a different serial number and Windows will not flag it as faulty.
The reader is connected, and appears to be working correctly but the network connection drops out after a few seconds	The reader was replugged too quickly before Windows finished processing the previous network connection	Wait at least 30 seconds before replugging any reader into the same PC or wait until the network connection disappears
	USB hub does not work properly	Power cycle the PC. Try a rear USB port on the PC to connect the USB cable. Avoid using an external USB hub.
No network connection can be made to the reader but the Network Connections window shows that the reader is connected and all other network status information indicates that networking should be working	The USB port on the PC has stopped working for an unknown reason.	Use another USB port. If this fails, power cycle the PC.

7.7 REPORTING A PROBLEM

If after following the checks and procedures outlined in the Troubleshooting section, you are still having a problem with a Magellan reader, you will need to send a report to Magellan. To make the diagnosis quicker and easier, please supply your problem report on a Service Form along with the following information:

- What kind of tags are you using and how many are you putting on the reader at one time?
- Have this reader and the tags you are using worked at any time in the past?
- Have you tried connecting to the reader with a different PC?
- Have you successfully installed the ReaderManager application?
- In the ReaderManager, select the Help/About ReaderManager menu item and record on the Service Form what version numbers are shown in the window that appears.
- In the ReaderManager, select the Help/System Report/Get System Information. Get a zip file and then email it to us (for the ReaderManager version V2.18 and higher).

The information required in the Service Form about Model Number, S/N, P/N and D/C is located on the OEM label on the back of the equipment.

7.7.1 WARRANTY REPAIRS

Before shipping any reader a Return Authorisation number (RMA) must be obtained.



End-users should contact the company from whom they purchased the reader for repair, replacement or refund in accordance with Magellan's terms and conditions of sale.

If you purchased the reader directly from Magellan, contact Magellan for a Return Authorization number (RMA) before shipment.

The copy of the Service Form with RMA must be enclosed in the original or equivalent packing with the RMA number clearly marked on the outside of the box.

7.7.2 NON-WARRANTY REPAIRS

If a reader needs repairing after the one year warranty period expires, your support organization or Magellan if you purchased directly from Magellan will first provide an estimate of repair charges. Then upon receiving approval from you the reader can be sent for repair. Refer to above Warranty Repairs information for return procedures.

7.7.3 WARRANTY

Magellan's warranty and liability with respect to products and/or services is for a period of 12 months from date of delivery and is limited to the rectification of faulty workmanship and/or non-compliance

Any liability with respect to components including purchased or free issued items arising in the manufacture of products are covered by, and limited to, any warranty provided by the original manufacturer. Always return a copy of this form along with the product

7.7.4 LIMITATION

Magellan's warranty excludes consumables, and excludes products that have been improperly installed or maintained, modified or misused. Notification of claims must occur within the warranty period.

End-users should contact the company from whom they purchase the products for replacement, repair or refund in accordance with Magellan's terms and conditions of sale.

If you purchased the product directly from Magellan, contact Magellan for a Return Authorization Number (RMA) before shipment.

Contact	Company		Return Authorisation number (RMA)	
	Address		Date	
Product	Country		Technical Contact	
	Sales Order		Telephone	
	PO Number		Fax	
	Purchase Date		Email	
	Describe any hardware modifications made to the unit and modification date:			
Reason for	Describe problems (see Reporting a Problem):			
Return to	If purchased from Magellan: Magellan Technology Pty Limited 65 Johnston St. Annandale NSW 2038 Australia		Tel.: +61 2 9562 9800 Fax: +61 2 9518 7620 Email: info@magtech.com.au Website: www.magtech.com.au	

* End-users should contact the company from whom they purchased the Reader

7.7.5 SERVICE FORM (EDITABLE PDF-FILE ON YOUR CD)