OMRON

V740-series
UHF RFID System

Operation Manual

> **Reader/Writer**
> **Antenna**

V740-BA50C22A-US (Bi-static Reader/Writer)
V740-HS02CA (Circular Antenna)
V740-HS02C (Circular Antenna)

OMRON Corporation

Cat.No. RFM – XXX – XX

PRECAUTIONS

Please read and understand this manual before using the products. Please consult your OMRON representative if you have any question or comments.

Warranty, Limitations of Liability

WARRANTY: OMRON'S EXCLUSIVE WARRANTY IS THAT THE PRODUCTS ARE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP FOR A PERIOD OF ONE YEAR (OR OTHER PERIOD IF SPECIFIED) FROM DATE OF SALE BY OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE PREQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

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IN NO EVENT SHALL THE RESPONSIBILITY OF OMRON FOR ANY ACT EXCEED THE INDIVIDUAL PRICE OF THE PRODUCT ON WHICH LIABILITY IS ASSERTED.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Precautions, Change in Specifications

SUITABLITY FOR USE : OMRON SHALL NOT BE RESPONSIBLE FOR CONFORMITY WITH ANY STANDARDS, CODES, OR REGULATIONS THAT APPLY TO THE COMBINATION OF THE PRODUCTS IN THE CUSTOMER'S APPLICATION OR USE OF THE PRODUCT.
TAKE ALL NECESSARY STEPS TO DETERMINE THE SUITABILITY OF THE PRODUCT FOR THE SYSTEMS, MACHINES, AND EQUIPMENT WITH WHICH IT WILL BE USED.
KNOW AND OBSERVE ALL PROHIBITIONS OF USE APPLICABLE TO THIS PRODUCT.
NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.
CHANGE IN SPECIFICATIONS : PRODUCT SPECIFICATIONS AND ACCESSORIES MAY BE CHANGED AT ANY TIME BASED ON IMPROVEMENTS AND OTHER REASONS. CONSULT WITH YOUR OMORN REPRESENTATIVE AT ANY TIME TO CONFIRM ACTUAL SPECIFICATIONS OF PURCHASED PRODUCT.

Declarations

Regulatory Compliance

EMC .... 47 CFR, Part 15
.... RSS210
Safety .... UL 60950
.... Can/CSA C22.2 No 60950

FCC COMPLIANCE: This equipment complies with Part 15 of the FCC rules for intentional radiators and Class A digital devices when installed and used in accordance with the operation manual. Following these rules provides reasonable protection against harmful interference from equipment operated in a commercial area. This equipment should not be installed in a residential area as it can radiate radio frequency energy that could interfere with radio communications, a situation the user would have to fix at their own expense.

EQUIPMENT MODIFICATION CAUTION: Equipment changes or modifications not expressly approved by OMRON Corporation, the party responsible for FCC compliance, could void the user's authority to operate the equipment and could create a hazardous condition.

IMPORTANT USER INFORMATION: In order to comply with FCC/IC requirements for RF exposure safety, a separation distance of at least 23 cm (9.1in) needs to be maintained between the radiating elements of the antenna and the bodies of nearby persons. This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

Safety Precautions

This chapter provides important information for the safe use of this product.
Ensure to read the information carefully before use.

IN THE SAFETY PRECAUTIONS BELOW, SEVERITY IS CATEGORIZED AS EITHER "WARNING" OR "CAUTION".

⚠ Warning	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.
⚠ Caution	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage. Property damage refers to extended damage caused to house/household goods or livestock/pets.

●Description of Symbols

Prohibition
 Indicates an action or activity not permitted.

Observe strictly
 Indicates the need to ensure the safe use of the product.

Ensure to establish a solid grounding
 A label indicating that a device with a grounding terminal should always be grounded.

Electric shock hazard
 A notification that alerts the possibility of electric shock under certain conditions.

Do not disassemble
 A notification that prohibits disassembly when injuries caused by electric shocks may result.

Please ensure that all cautions and prohibitions are adhered to, since non-compliance may lead to serious injury or damage, in certain circumstances.

⚠ WARNING

Never disassemble, repair, or modify the main unit and cables.
- Do not disassemble, repair, or modify this product. Doing so may result in electric shock, fire, or personal injury.

Do not handle the device with wet hands. Do not touch the terminals while the device is connected to the power supply.
- Electric shock hazard.

Do not allow the cables to be in contact with heaters.
- The cable sheaths may melt and the exposed wire may cause electric shock or fire.

Be sure a solid grounding is established for the device.
- Electric shock hazard.

Do not use the power cords and power adapters not supplied with the products.
- Failure to do so may results in electric shock, fire, or personal injury.

Connect and disconnect cables as described in the following procedures when installing, moving, on this product or attached devices.

To connect:	To disconnect:
1. Turn everything OFF.	1. Turn everything OFF.
2. Attached all cables to devices.	2. Remove power cords from outlet.
3. Attached power cords to outlet.	3. Remove all cables from devices.

Failure to do so may result In spark or deform or damage the device.

⚠ Caution

Do not drop the device you may receive major shocks.
- Doing so may result in personal injury or device damage.

Do not apply strong force to, or place heavy items on the device or cables.
- Doing so may deform or damage the device, resulting in electric shock or fire.

Use and store the product in an environment that is specified in the catalog or operation manual.
- Failure to do so may cause failure of the device, electric shock, or fire. Do not use or store the device in the following locations:

  Locations that do not satisfy the specified operating conditions (0 to +40 , 35%RH to 85%RH,non-condensing).

  Locations that do not satisfy the specified storage conditions (-25 to +65 , 35%RH to 85%RH,non-condensing).

  Locations where the Reader/Writer is exposed to direct sunlight.

	Locations where the Reader/Writer is exposed to dust, corrosive gas, saline, or flammable gas. Locations where the Reader/Writer is exposed to direct heat. Locations subject to condensation due to high humidity. Locations subject to vibration or impact that exceed the limits outlined in the specifications. Locations where the device may be exposed to water, oil, or chemical agents. (This applies to the models other than waterproof types.) Outdoor
❗	**Be sure to tighten the devices screws securely.** ● Failure to do so may result in personal injury or device damage.
❗	**Cables with screw attachments must be secured before use.** ● Failure to do so may damage the device.
❗	**To avoid interferences with other systems, adhere to the following items and check them before using the product.** ● The product uses a publicly available ISM frequency band of 902-928MHz to communicate with Tags. Some transceivers, motors, monitoring devices, power supplies (power supply ICs), and other similar RFID systems may generate noise, which cause radio interference and may affect communication with Tags. If the product is required in the vicinity of these items, check for any interferences prior to use. ● On the contrary, the system itself may affect radio station transmissions or medical devices. Be cautious when using the system in the environments where such effects might occur. ● To minimize noise effects, adhere to the following: Establish a Class D grounding (former Class 3 grounding) for metal objects placed in the vicinity of the system. Keep cables away from those with high voltages or heavy currents.
🚫	**Do not allow the device or cables to be exposed to water.** ● Doing so may result in electric shock, fire or failure of non-waterproof devices or cables.
❗	**If the device fails or is exposed to water (non-waterproof devices or parts), or an unusual smell, smoke, or sparks are detected, immediately refrain from using the device and contact OMRON or a sales representative for service and repair.** ● Continued use of the failed device may result in electric shock or fire.
🚫	**Do not use damaged cables.** ● Continued use of the damaged cables may result in electric shock or fire.

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V740 Series RFID system Reader/Writer Antenna

Operation Manual

V740-BA50C22A-US **Bi-static Reader/Writer(8ports)**
V740-HS02CA **Bi-static Antenna(Circular)**
V740-HS02C **Bi-static Antenna(Circular)**

The OMRON V740 RFID Reader (herein after denoted as the V740 Reader) uses RFID (radio frequency identification) technology to read data stored on RFID tags. The V740 reader operates analogous to an SQL (structured query language) server, providing tag data in response to requests from another application. A separate software application may be used to direct its operation and provide a user interface.

The reader supports UHF (ultra high frequency) antennas, which are available separately. The reader supports multiple configurations of UHF antenna ports and transfers data to a remote computer over a network connection.

The V740 Reader is powered by ThingMagic LLC Mercury4® technologies.

1. Installation and Usage Guide

About this Guide

This installation and usage guide explains how to install the V740 Reader, how to use the browser-based interface, and how to control the reader remotely.

1.1 Before You Begin

1.1.1 Installation Requirements

- The reader is shipped with a power source with a cable length of 1.8m (6ft).

- Use only authorized antennas and cables to maintain FCC approval .

- Properly shielded a grounded cables and connectors must be used for connection to host computer and / or peripherals in order to meet FCC emission limits.

  AC adaptor   with ferrite core must be used for RF interference suppression.

- Provide strain relief for all reader connections.

- The minimum screw size for mounting the reader is #12 (M5). Use suitable wall anchors when mounting to drywall or masonry.

- A Shielded Ethernet cable must be used to communicate with other devices.

- Multiple readers and antennas can be used in combination to enhance detection at specific locations provided the software application is able to synchronize antenna operation.

- Recommended minimum configuration for a computer running an application that interfaces with the V740 Reader:

  – Pentium® 400 MHz processor
  – 128MB memory
  – 10 GB hard disk drive
  – Base-T-10/100 Ethernet® port

1.1.2 Performance Considerations

Reader performance may be affected by external factors including tag variables and environment.

Performance tests conducted under typical operating conditions at your site are recommended to help you optimize system performance.

Tag Variables

There are several variables associated with tags that can affect reader performance:

- Application surface — Some materials interfere with tag performance including metal and moisture. Tags applied to items made from or containing these materials may not perform as expected.

- Tag orientation — Reader performance is affected by the orientation of the tag in the antenna field.

- Tag model — many tag models are available. Each model has its own performance characteristics(refer to Chapter 3).

Environment

Reader performance may be affected by the following:

- Metal surfaces such as desks, filing cabinets, bookshelves, and wastebaskets may enhance or degrade reader performance.

  Mount antennas as far as possible from metal surfaces that are adversely affecting system performance.

- Devices that operate at 900 MHz, such as cordless phones and wireless LANs, can interfere with reader performance.

  These devices may degrade performance of the reader. The reader may also adversely affect performance of 900 MHz devices.

- Antennas operating in close proximity may interfere with one another, thus degrading reader performance.

- Interference from other antennas may be eliminated or reduced by using either one or both of the following strategies:

  – Affected antennas may be synchronized by a separate user application using a time-multiplexing strategy.

  – Antenna power can be reduced by reconfiguring the RF Transmit Power setting for the reader.

1.2 Authorized Antennas

The antenna authorized by the FCC for use with the V740 Reader is described below.

IMPORTANT: No other antennas may be used with the V740 Reader without violating FCC regulations. It is the responsibility of the user to comply with this requirement.

1.2.1 Antennas

Bi-static Circular Antenna(Options)

Model: V740-HS02CA, V740-HS02C
Polarization: Circular
Gain: 6dBi max.
Connector: N-Female
Cable length : 0.3m(0.98')

1.2.2 Antenna Cables(Options)

The only cables authorized by the FCC for use with the V740 Reader are listed below:

Short cable

Model: V740-A01-3.0M
Length: 3.0m(9.8')
Insertion Loss: 1.5 dB min.
Cable Type: 3D-2V
Connector: Reverse TNC to Type N
Cable Diameter : 5.5mm(0.22'')

Long cable

Model: V740-A01-10M
Length: 10m(32.8')
Insertion Loss: 1.5 dB min.
Cable Type:5D-SFA
Connector: Reverse TNC to Type N
Cable Diameter : 7.6mm(0.30'')

1.2.3 Setting the Reader RF Power

During initial installation, the reader must be properly configured to use the correct RF power to comply with FCC regulations. DO NOT increase the power beyond the recommended power setting as calculated below.

The maximum RF power is determined from antenna gain and antenna cable loss using the formula:

Pmax = 36 dBm - Antenna Gain + Cable Loss

For example, if the antenna has a maximum gain of 6 dBi, and the cable has a minimum loss of 1.5 dB, the maximum RF power that may be set is (36- 6 + 1.5) = 31.5 dBm.

The Reader RF Power is set through the **Settings Page** as described on Page18.

Note that in no case may the power be set higher than 31.5 dBm.

Recommended Power Settings

Antenna Type	Short Cable/Long Cable
V740-HS02CA V740-HS02C	31.5 dBm

1.3 Reader Installation

The following parts are provided with the reader:

Part	Qty.	Part Number
V740-Reader/Writer	1	V740-BA50C22A-US
Power Supply	1	-

1.3.1 Install the Reader

You can place the reader on a shelf or mount it to a wall. Mounting shelf and wall should be flat to fix the reader securely.

To mount the reader on a wall:

1. Hold the reader in its four mounting location and mark the position of the mounting screws

Mounting holes

2. Drill holes for the screws and install wall anchors if required. Be sure anchors must have enough strength to fixed the reader against vibration.

3. Insert the M5x16 screws with spring washers and flat washers and tighten until almost flush with the wall.

4. Slip the reader over the screws and slide down to lock the screws in the keyhole openings.

5. Tighten the screws securely.

6. Fix the AC adaptor so that not to move by vibration and tense DC plug cables. Do not bundle the adaptor cable with other signal or power lines.

Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

1.3.2 Install the Antennas

The antennas can be mounted directly to a variety of surfaces. Mounting surfaces should be flat to fix the antenna securely.

To mount the reader on a wall :

1. Hold the antenna in its mounting location and mark the position of the mounting screws with minimum (4) points. The antenna has several mounting holes for each side. Choose 4 of those with diagonal position according to the mounting location.

Drill holes for the screws and install wall anchors if required.

Mounting holes
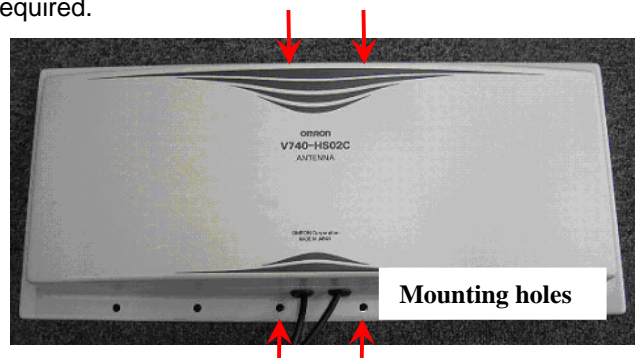
2. Insert the M4x20 screws with spring washers and flat washers and tighten until almost flush with the wall.

3. Tighten the screws securely.

Note: For best performance, mount the antenna in the horizontal orientation as pictured above.

1.3.3 Connect the Reader

A = RJ-45 Ethernet port   10/100Base-T
B = Safe Mode button
C = RS232C   (Do not use)
D = I/O port   (Non LPS)
E = DC power input

Note: MAC Address is displayed on the lower part of RJ-45 Ethernet port.

One to four OMRON Bi-static antennas(V740-HS02CA,02C) can be connected to the reader, depending on the application requirements. The lower row of silk-screen markings on the reader identifies the port number and antenna connections.

Note: Upper row of silk-screen marking on the reader is reserved for future use.
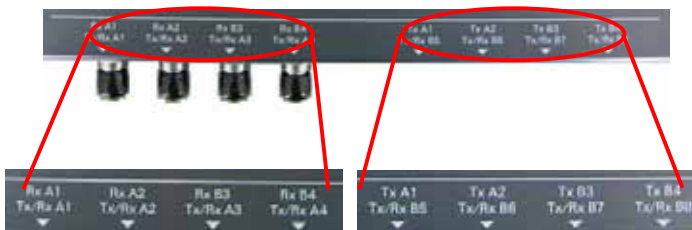
1. Connect required UHF antennas to the antenna ports on the reader .

    IMPORTANT: Connect antennas to the antenna ports before applying power to the reader. Any antenna port not having an antenna connected to it will be disabled when the reader is powered on.

Antenna Connection : V740-BA50C22A-US

Antenna x2
(V740-HS02CA)

Antenna Cable x4
(V740-A01)

Note: With the two antenna configuration, there is a possibility that a tag may be read by an inactive antenna if the tag is located with in approximately 20 cm of the inactive antenna.

2. Verify that all antennas are securely connected.

3. Connect the reader to the network by plugging a Shielded Ethernet cable into the Ethernet port.

    or

    Connect the reader to a PC (personal computer) by plugging a crossover Shielded Ethernet cable into the Ethernet port.

    Note: If DHCP is to be used, then the network and server must be connected **before** powering up the reader. If a DHCP server is not found the reader will fall back to the IP address: "10.0.0.101".

    Note: If NTP is to be used, then the network must be connected and the server must be available **before** powering up the reader. If a NTP server is not found. The reader will not set the current time.

4. Plug the power adapter provided with the reader into the DC power input connector. Then connect the AC power cord to a power outlet.

    While the reader is powering up, one green light will be on. After the reader finishes its power-on self-test, approximately 45 seconds, the green light will pulse. The reader is now ready for operation.

1.3.4 I/O Interface

The Reader provides control of and response to the I/O(Input/Output) lines.

Name	Pin No.	IN/OUT	Interface
I/O_0	6	OUT	Open-collector output 24VDC maximum, 20mA maximum
I/O_1	1	OUT	
I/O_2	9	OUT	
I/O_3	4	IN	Photo-coupler input Control capacity 20mA maximum 5~10mA typical Internal resistance 360ohm
I/O_4	7	IN	

I/O connector is D-sub(9pin) Male connector.
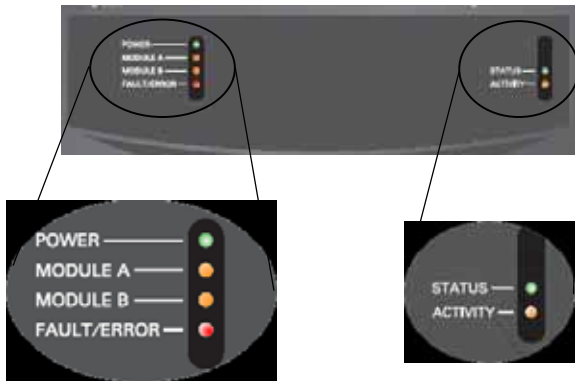
LED Indicators

Name	Meaning
POWER	Lights while booting. Blinks when the reader is running.
MODULE A	Lights when communicating with tags via MODULE A(Antenna port 1 and 2)
MODULE B	Lights when communicating with tags via MODULE B(Antenna port 3 and 4)
FAULT/ERROR	Lights when system error occurs.
STATUS	Reserved for Future Use
ACTIVITY	Reserved for Future Use

IMPORTANT: DO NOT disconnect power during startup. Disconnecting power while booting the V740 reader may result in improper startup.

V740 Reader

Open-collector output 24VDC max. 20mA max.

360

Photo-coupler input Control capacity 20mA max. 5~10mA typ. Internal resistance 360ohm

1.4 Reader Configuration

In some cases, the application software may provide support for reader configuration. If so, follow the instructions provided with the application.

The following procedure describes how to configure the reader directly from a network PC using the browser-based interface.

The reader is shipped to use DHCP by default but will fall back to the following static network configuration if it does not get a DHCP lease:

IP Address: 10.0.0.101
Subnet Mask: 255.255.255.0
Gateway: 10.0.0.1

If you are not using DHCP, you must know the IP address and subnet mask settings for the network environment in which the reader will be running. If you are using DHCP, you must have a means of finding the reader, typically by having a DHCP server update a DNS server. Another way of finding readers on a network is to use the Zeroconf protocol, which Apple calls Bonjour™. (formerly called Rendezvous. Apple provides a downloadable Bonjour plug-in for Windows Internet Explorer at their web site:

http://www.apple.com/macosx/features/bonjour/).

Note: Please contact Apple about operating the Bonjour ™ technology.

1. Exit any reader applications that are running on the network.

    IMPORTANT: Running another reader application while using the browser-based interface may cause a reader error. If this happens, reboot the reader or restart the system using the browser-based interface.

2. Verify that the reader is operational. All LED's should be out except for the green power LED which should be pulsing.

3. Start a Java-enabled web browser from any network-enabled PC. This PC must be configured with an IP address and subnet mask compatible with the reader's settings. For example:

    IP address 10.0.0.10
    Subnet mask 255.255.255.0

4. Browse to…

    http://v740 (dhcp name) or

    http://10.0.0.101

    The V740 reader browser-based interface to the reader is displayed.

5. Click the **Settings** link in the navigation menu. The Modify Settings page appears.

6. If you wish to use DHCP, modify the "Use DHCP?" setting by selecting the "Yes" radio button; otherwise, enter the required network settings in the IP Address, Subnet Mask, and Gateway fields. The fields will turn red if the gateway is not on the same subnet as the IP address. Then, click the [Save Changes] button.

    IMPORTANT: Do not disconnect power until the save process is completed.

7. Set the reader RF power per instructions on page to correspond to antenna and cable types.

8. Verify that the settings shown are correct. Then, restart the reader by disconnecting the power cable and then reconnecting it.

    It may take about 60 seconds for the reader to restart. If the reader IP address was changed, you must type the new address into the PC browser address field to communicate with the reader.

    IMPORTANT: Do not disconnect and connect power cable at the DC cord. Always disconnect and connect power cable at the AC cord.

9. Once the system restarts, click **Settings**. You are taken to the **Modify Settings** page. Your changes will be saved and then applied. After the reader reconfigures its network interfaces, it will automatically redirect you to its status page. There is no need to restart the reader.

    IMPORTANT: Do not disconnect power while the reader is saving its new configuration.

    The reader is now ready to receive commands from the network.

10. Use the **Query** page of the browser-based interface to verify the reader and antenna operation by reading tags.

11. Close the browser window. Start an application to control the reader on the network.

1.5 Reader Service

1.5.1 Using the Browser-Based Interface

The browser-based interface communicates directly with the V740 reader. It includes several tools that enable you to monitor reader performance, change reader settings, and upgrade reader firmware.

A navigation menu provides access to the following pages:

- **Status**—Displays current operational settings.

- **Query**—Allows the user to set timing of operation, set antennas, set RF air interface protocols, and read tags.

- **Write**—Allows the user to write tags; this is only applicable to tags that are writeable.

- **Settings**—Allows the user to modify radio and network settings.

- **Firmware**—Allows the user to upgrade the V740 reader with new firmware images supplied by OMRON.

- **Restart**—Allows the user to restart the reader.

- **Diagnostics**—Provides the current operating settings of the reader.

- **Help**—Provides information that is helpful in operating the reader.

The browser-based interface can be run from any PC on the network. Care must be taken to configure the PC with an IP address and subnet mask compatible with the current operational settings of the reader.

To start the browser-based interface:

1. Exit all reader applications on the network.

   IMPORTANT: Running another reader application while using the browser-based interface may cause a reader error. If this happens, reboot the reader or restart it using the browser-based interface.

2. Start a Java-enabled web browser from any network-enabled PC.

3. Type the IP address of the reader to which you want to communicate in the address field of the browser or use Apple's Bonjour™ protocol to browse to it.

4. A log-dialog appears. Enter the factory-installed name: "web" and the password: "radio"(all lower case)

5. A navigation menu and the V740 reader **"Mercury4" Status** page appear in the browser.

Navigation menu
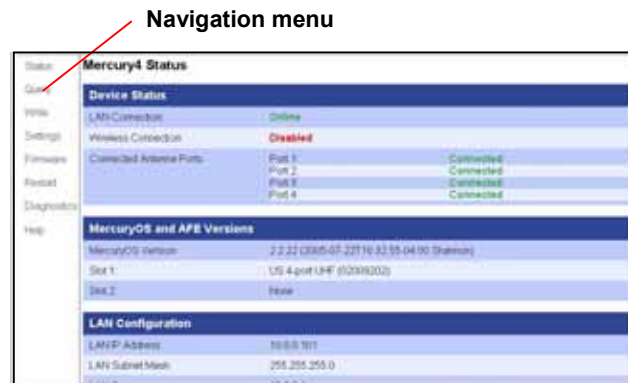
Descriptions for each page are the following:

Status Page

The **Status** page indicates the connected antennas, software version and LAN configuration of the reader.

IMPORTANT: Check to see that at least one antenna port is connected before performing any tag queries or tag write operations.

1. Click the **Status** link in the navigation menu to display the **Status** page.

2. Close the browser window if you are finished using the browser-based interface.

   Note: The status of 'Connected Antenna Ports' is displayed as 'Connected' only for the antennas connected to the V740 reader when it starts up.

Query Page

The **Query** page is mainly used to set up and run anti-collision searches quickly and gives you immediate feedback, which can be useful for verifying performance when installation is complete and for debugging.

At the bottom of the screen is the Query field in which RQL search statements can be entered or selected from the stock queries found in the drop-down list to the right of the Query field. The RQL search statement in the Query field specifies which tag protocols will be read, which antenna ports are to be used, how long the query is to be run, and other read operation parameters. The query can be run once or continuously.

Note: The selected settings DO NOT affect reader performance associated with other applications.
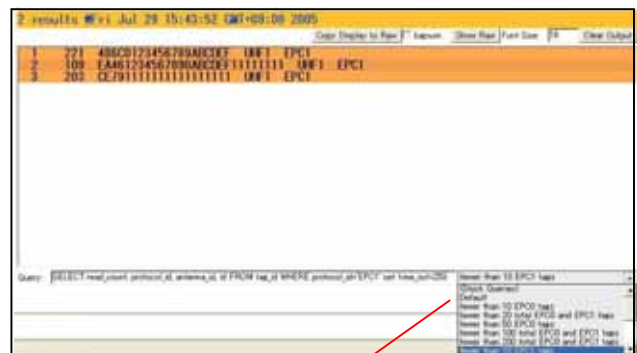
The following stock queries are available from the drop-down list:

Each mode provides the most suitable time out value for the protocols and the number of tags to be read.

- **fewer than 10 EPC1 tags**

- **fewer than 50 EPC1 tags**

- **fewer than 100 EPC1 tags**

   Note: Only the modes that contain EPC1are available on this type of V740 reader.

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To perform a read operation from the **Query** page:

1. Position one or more tags a few feet in front of one of the antennas connected to the reader.

2. Select a stock query from the pull-down list.

3. Click the Start button to begin continuously reading tags.

Tag data is displayed. Each row in this example shows sequential tag number, number of times tag was read, tag data, antenna, and protocol.
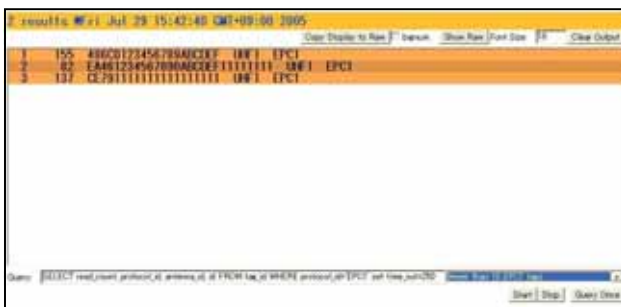
4. Click Stop to stop the tag search.

IMPORTANT: You MUST stop the query before changing the operating mode or RQL command. If you do not click STOP before exiting the browser-based interface, the reader will continue to poll antennas.

Note: The SELECT clause may be modified. However changing the SELECT clause may cause incorrect display of data.

The **Query** page provides additional options that enable you to control the data that is gathered and how it is displayed:

- **Copy Display to Raw** button enables to copy data from the colored list screen to raw data mode that displays raw tag data. This function is available only when the colored tag list screen is displayed.

- **Bignum** checkbox (when checked) displays the total number of unique tags read. The total is displayed in large red numbers directly over the tags read. This function is not available when Show Raw screen is displayed.
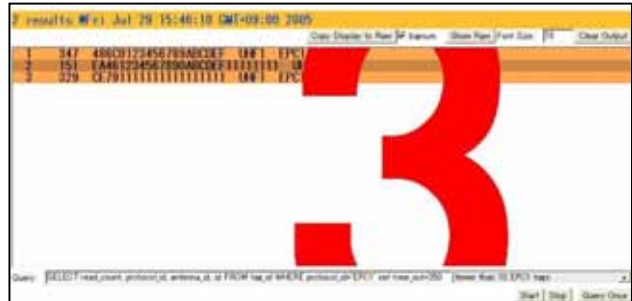
- **Show Raw** button displays raw tag data on the Query page. Each row in this example shows read count, protocol, antenna, and tag data.
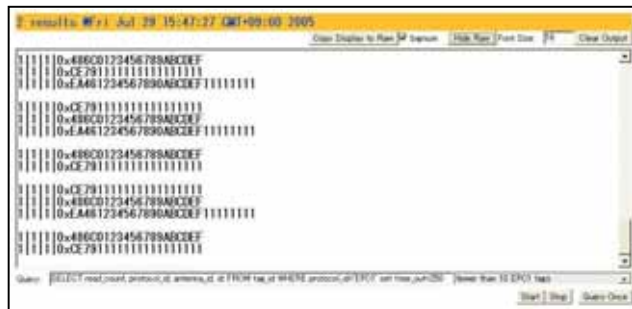
- **Hide Raw** button stops the display of raw tag data.

- **Font Size** text box decides the character size of tags read list. It can be applied from 1 to 128.

- **Clear Output** button clears the tags read list displayed.

- **Query Once** button initiates a single search cycle.

Write Page

Use the **Write** page to replace the id or data that is encoded on a tag.

Consider the following guidelines when writing to tags:

- Always place a tag 0.3–0.6m (1–2ft) from the antenna when writing data. The tag may be damaged if it is too close to the antenna.

- Only unlocked tags can be written.

- The id or data to be written must match exactly the number of hexadecimal characters (numerals from 0-9 and letters from A-F) specified by the tag's protocol. For example: 64-bit EPC1 tag ids are 16 hexadecimal characters long.

- To write one tag, place the tag in the antenna field. If multiple tags are present, they will all be encoded with the same EPC data.

- Use the antenna connected to port 1 of the reader

To write ids or data to a tag:

1. Click the **Write** link on the navigation menu. The **Write** page appears.

2. In the middle pane, type or paste a hexadecimal tag id to be written to the tag in the RQL statement after tag_id=0x. (For example: 16 hex characters for 64-bit tags, 24 characters for 96-bit tags, etc.)

3. Select the checkbox for **EPC1**.

4. Click the **Make Update** button. A query designed to write the highlighted data to the tag appears in the center pane.

5. Place the tag 0.3–0.6m (1–2ft) from the antenna connected to the port 1.

   Verify that no other tags are in the antenna's field.

6. Click the **Submit Query** button to write the data. If the write was successful, the new tag id appears in the bottom pane.

If the write is not successful, the response will include an error message.

To read data from a tag:

1. Display the **Write** page (click the **Write** link on the navigation menu).

2. Click the **Make Select** button. A query designed to read data from the antenna connected to the port 1 appears in the center pane.

3. Place the tag to be read within the detection zone of the antenna.

4. Click the **Submit Query** button to read tag data. Query results appear in the bottom pane.

Settings Page

Use the Modify **Settings** page to change RFID protocol, network and reader security settings. The page is divided into five sections: RFID Protocol Settings; Network Settings: All Interfaces; Network Settings: Ethernet Interface; Boot Options and Security Settings.Instructions for Modifying the Settings.

1. Click the **Settings** link on the navigation menu. The **Modify Settings** page appears.

2. Enter the required settings.

3. Click the **Save Changes** button to save the new settings.

   IMPORTANT: Do not disconnect power until the save process is complete.

   (see 1.5.2 Restarting the Reader on page 25).

Instructions for Modifying the Settings

Changing these parameters changes the reader's settings used on startup. RFID protocol settings, boot options and network settings can be modified. Care must be taken to use correct values or you might be unable to connect the reader without restarting into safe mode.

IMPORTANT: Do not disconnect power until the save process is complete.

Static network settings are ignored when in DHCP mode, and DHCP related settings are ignored when in static IP mode. Please note that your network needs to have properly configured DNS servers if you wish to connect to the reader via its hostname. Usually when using DHCP, the DHCP server will add the hostname to the DNS server's database.

The reader adjusts time by NTP only once when it starts up. You should confirm if the time is correct using **Get information** command (Ref. Section 2.2.4.4).

Note that new RFID, network and security settings take effect after saving. Boot-related options are saved but DO NOT take effect until the reader is restarted. Therefore, to ensure that all new settings take effect, it is recommended that you restart the reader whenever reconfiguring and after saving the new settings.

Note: Please ask the network administrator about the network settings in your environment.

RFID Protocol Settings

The RFID protocol settings take effect immediately on the reader upon saving them. A restart is not required. The Default RQL Query runs continuously at startup and thus a change to this setting requires a restart of the reader.

Item	Describe	Setting Requirement	Default
UHF Power (dBm)	UHF Output power in dBm. This setting must be adjusted carefully to comply with FCC regulations.	Mandatory	30.0
EPC1 Tag ID length	Radio buttons that enable combined 96- and 64-bit tag support or single tag id lengths. If the reader will only be reading 96- or 64-bit tags, select that radio button to optimize read rates.	Optional	64-bit/96-bit
EPC0 Search Depth	Maximum number of EPC0 tags to be singulated on each query. (This function is not available as this type of the V740 reader does not support EPC0 protocol.)	Optional	80
Default RQL Query	Initial query to be run continuously when reader starts up. The most recent command entered is performed automatically and continuously every second after rebooting the reader. Once a user program has connected to port 8080, the results of the command will be available.	Optional	(none)

Network Settings: All Interfaces

Static network settings are ignored when in DHCP mode, and DHCP related settings are ignored when in static IP mode. Please note that your network needs to have properly configured DNS servers if you wish to connect to the reader via its hostname. Usually when using DHCP, the DHCP server will add the hostname to the DNS server's database.

Item	Describe	Setting Requirement	Default
Automatic Hostname	Turning on automatic hostname will append the last six numbers (3 bytes) of the reader's MAC address to the text in the hostname field. With the unique hostname, avoid the same hostname existing in the network, which may occur while some readers are operating simultaneously in DHCP mode.	Optional	No
Hostname	Specify a name that is unique on the network for the reader.	Mandatory	v740
NTP Server	Specify the IP address (or machine name) of the server to get current time from the network (either LAN or WAN). The reader obtains the correct time from another device since it doesn't have a hardware clock. Example) 129.6.15.8(NIST, Gaithersburg, Maryland)	Optional	(none)
Domain Name	Specify the group name when using devices on the network as a group. Omit unless using devices as a group.	Optional	(none)
Primary DNS Server	Specify the IP address (or machine name) of the server that replaces a domain name with an IP address on the network. It is used first, the secondary DNS server is used next. Omit if you access by the static IP address.	Optional	10.0.0.1
Secondary DNS Server	Specify the IP address (or machine name) of the server that replaces a domain name with an ID address. The server is used only when the primary DNS server can not find the domain name. Omit if you access by the static IP address.	Optional	(none)
Default Gateway	Select whether the reader uses LAN wired or air interface.	-	LAN(fixed)

Network Settings: Ethernet Interfaces

Item	Describe	Setting Requirement	Default
Use DHCP	Select whether the reader gets an IP address on the network automatically by DHCP or manual setting. You must not check the item if you use a manually set IP address.	Optional	Yes
Vendor Class Identifier	Specify an extra DHCP parameter for integration and customization. It is not supported on the firmware version 2.2.22.	Optional	mercury4
Use DHCP Server Supplied Hostname	Set this to **yes** to allow the DHCP server to assign the reader a hostname.	-	No
LAN IP Address	Specify a unique IP address on the network when manually set. It is given automatically by the DHCP server, if using DHCP.	Mandatory (in the case of not using DHCP)	10.0.0.101
LAN Netmask	Specify the mask value to determine the network address of the subnet from the IP address. It is not used if using DHCP.	Mandatory (in the case of not using DHCP)	255.255.255.0
LAN Gateway	Specify a unique IP address for the gateway machine only when communicating with the device on another LAN. You don't have to set the item when communicating with the device on the same LAN. Also It is not used if using DHCP.	Optional (in the case of not using DHCP)	10.0.0.1
Fallback IP Address	IP address to be used If any DHCP server can't be found when in DHCP mode.	Optional (in the case of using DHCP)	(none)
Fallback Netmask	Subnet mask to be used if any DHCP server can't be found when in DHCP mode.	Optional (in the case of using DHCP)	(none)
Fallback Gateway	Default gateway to be used If DHCP server can't be found when in DHCP mode.	Optional (in the case of using DHCP)	(none)

OMRON

Boot Options

The boot option settings specify the location of downloadable firmware and configuration files and their optional parameters, and the location of a syslog server to which all reader events may be sent.

Item	Describe	Setting Requirement	Default
Boot Config Options	Optional parameters used when downloading a new configuration file to the reader. It is not supported on the firmware version 2.2.22.	Optional	(none)
Boot Config	URI to the tm.conf file to be downloaded on startup. Specify local:default for local tm.config file. It is not supported on the firmware version 2.2.22.	Optional	(none)
Boot Firmware Options	Same as Boot Config Options used when downloading new firmware to the reader. Following four parameters are available as a user specifiable option. -f / --force Force a downgrade if config file version is lower than that currently running on the reader. -w / --wipe Wipe flash memory and settings -p / --preserve Preserve configuration settings under a wipe. -a / --auto Add the reader's MAC address to download filename.	Optional	(none)
Boot Firmware	URI to the firmware file to be downloaded at startup.	Optional	(none)
Syslog Host	Name of host for remote logging. All log levels in syslog will be sent to this host. Syslog message includes information of events occurring in V740 reader as below. (a) Boot message (b) Query page display and query performance (c) Log-in by telnet, SSH (d) Change of setting values (e) Firmware upgrade	Optional	(none)

Security Settings

These settings control secure access to the reader using a combination of SSH, HTTPS and secure RQL calls.

Item	Describe	Setting Requirement	Default
Secure Shell Only **(disable telnet)**	If Yes, the telnet server is disabled, and reader access can only be performed via a secure shell (SSH). It is recommended to set 'No' in ordinary use.	Optional	No
Secure Web Only **(disable standard http)**	If Yes, reader will only respond to requests using https URLs. Access via http URLs is disallowed. It is recommended to set 'No' in ordinary use.	Optional	No
Secure RQL Only **(disable non-tunneled RQL)**	If Yes, RQL no longer listens on Port 8080 for remote access. RQL is still accessible via an SSH tunnel. It is recommended to set 'No' in ordinary use.	Optional	No

Firmware Upgrade Page

Use the **Firmware upgrade** page to update firmware. Only the update firmware file provided by OMRON can be used.

Firmware update

File upload: [_____] [Browse]

or, specify a download URI (tftp, ftp, http):

[_____]

Erase contents before installing ☐

   Revert to factory settings ☐

[Update]

1. Click the **Firmware** link on the navigation menu. The **Firmware upgrade** page appears.

2. Place the cursor in the **Filename** field and type the complete URL network pathname of the firmware or click the **Browse** button to locate the new firmware file.

3. Be sure to click both check boxes if you want the reader to revert to safe-mode settings (Ref. section 1.5.3.).

   The lower check box becomes enabled after clicking the check box above.

4. Click the Update button to download the new firmware to the reader. The status frame at the bottom of the page displays the progress of the update.

5. To activate the new firmware, restart the reader. Until the reader is restarted, the old firmware will still be active.

In the unlikely event that a firmware update fails, perhaps due to a power failure, the device will restart in Safe Mode.

Note: You should not check the check box of 'Erase contents before installing'. Or the V740 Reader loses the function of I/O control(See section 3).

If the V740 Reader loses the I/O function, you should query OMRON to tell the way of recovering the function.

Restart Page

Use the **Restart** page to restart the reader.

1. Click the **Restart** link on the navigation menu. The **Restart Reader** page appears.

Restart Reader
Click the **Restart System** button to restart the reader.
[Restart System]

2. To restart the reader, click the **Restart System** button. The following dialog box appears.

Microsoft Internet Explorer
? Are you sure you want to reboot the M4 Reader?
[OK] [Cancel]
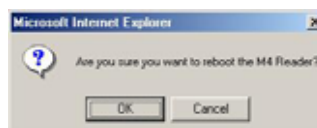
3. Click **OK**. The following message appears and remains on the screen until the reader restarts. Then the **Status** page appears.

Restarting reader
The reader is being restarted. Once it has finished, it will show the status page.
Please do not manually refresh this page. The status page will display automatically once the reader has finished booting.
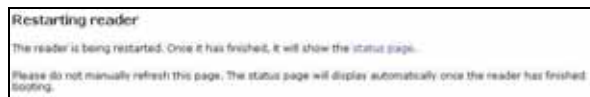
Diagnostics Page

The **Diagnostics** page provides a wealth of information, including the current settings of the reader, comprehensive version information, and current status of network interfaces.

- **View Log** is used for maintenance of the reader. For use by OMRON only.

Help Page

Use the **Help** page to view descriptions of system operations.

1.5.2 Restarting the Reader

Use this procedure to recover from a reader error.

1. Click the **restart** link on the navigation menu.

2. Click the **restart** button and the **OK** button on the confirmation dialog.

Wait for at least 60 seconds for the reader to boot up. The Power/Heartbeat LED is solid green while the reader boots. When the LED begins blinking, the boot process is complete.

1.5.3 Using Safe Mode

Use the recessed Safe Mode button on the reader connector panel to recover from errors which prevent the reader from operating in normal mode. In Safe Mode the reader is configured with a static IP address of 10.0.0.101. Safe mode operation restores factory default settings as follows:

Firmware Version:	factory installed version
IP Address:	10.0.0.101
Host Name:	Mercury4

Although the browser-based interface pages are displayed in red when operating in safe mode, the reader is still functional, although it cannot read or write tags. In most cases, the reader will need to be reconfigured for operation with the reader application after starting in Safe Mode.

1. 1. With the reader running, hold down the recessed reset button for 4 seconds, using a non-conductive object.

2. Release the button
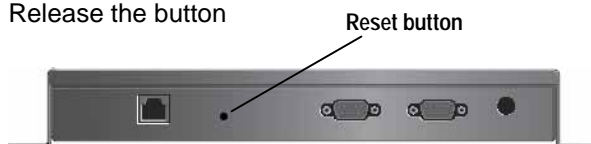
3. The green LED should turn solid as soon as the button is released, indicating the reader is rebooting. It should take approximately 30 seconds to boot into Safe Mode. The web server, telnet server and SSH server run in Safe Mode, however none of the RFID features are activated. To communicate with the reader in Safe Mode, a PC must have an IP address and subnet mask that are compatible with the reader settings, for example:

   IP address 10.0.0.10

   netmask 255.255.255.0

   There are two main reasons to enter Safe Mode. One is to perform a firmware update to repair a corrupted file system. The second is to change settings that are preventing the reader from operating normally.

   Both of these tasks can be performed via the web interface.

4. Once the maintenance has been performed, restart the reader to activate the changes. Disconnect power from the reader.

1.6 Tag Fundamentals

Tag Memory Structure

Protocols and the tag memory structures supported by the V740 reader are described below. For additional information regarding tag operation, refer to each tag specification.

Class 1 Tags

Class 1 tags contain 96 bits of programmable memory. It consists of EPC Code, Check Code data. 64 bits of them are EPC Code, and the first 16 bits of them are Check Code for the EPC Code.

Byte	Bit	Contents
1	0-7	Check Code (CRC)
2	8-15	
3	16-23	
4	24-31	
5	32-39	EPC Code 8bytes (64bits)
6	40-47	
7	48-55	
8	56-63	
9	64-71	
10	72-79	

Class 1B Tags

Class 1B tags contain 128 bits of programmable memory. The format is almost the same as the Class 1 tags. Bit count of EPC code is 96.

Byte	Bit	Contents
1	0-7	Check Code (CRC)
2	8-15	
3	16-23	
4	24-31	
5	32-39	
6	40-47	
7	48-55	
8	56-63	EPC Code 12bytes (96bits)
9	64-71	
10	72-79	
11	80-87	
12	88-95	
13	96-103	
14	104-111	

1.7 Specifications

Electrical

Reader

UHF operating frequency 902–928MHz
Input voltage..24Vdc, 2.0A
RF connector type .... Reverse-TNC

Separate Power Supply

Input voltage.......... Nominal 100–240Vac, 50/60Hz
AC line current...................... Nominal 0.5A at 120V
Output voltage ....Nominal 24Vdc, 2.5A peak

Antenna

Operating frequency...........................902–928MHz
V.S.W.R.. < 1.5 :1
Polarization.. Circular
Impedance..50ohm
Cable length .... 30cm(11.8')
RF connector type ....N-Female

Environmental

Reader

Operating temperature: ... 0° to 40°C (32° to 104°F)
Storage temperature: ....-20° to 65°C (-4° to 149°F)
Relative humidity: .... 25 to 85%RH non-condensing

Antenna

Operating temperature: -10° to 55°C (14° to 122°F)
Storage temperature: ..-25° to 65°C (-13° to 149°F)
Relative humidity: .... 25 to 85%RH non-condensing

Mechanical

Reader

Dimension ....308 X 286 X 40mm
                                             (12.1 X 11.3 X 1.6 in)
Weight ....1.5kg (3.4 lbs)
Protection IP40

Antenna

Dimension ....496X 221 X 70mm
Weight 2.0kg
Protection IP50

Outline Drawings

Supported Tag Protocols
915 MHz... EPC Class 1/1B

2. Query Protocol

Reference Guide

This chapter lays the groundwork for the communication protocol between client software running on a remote computer and the V740 reader. The client software may be a database system, enterprise software, or user software.

In this chapter, we discuss the underlying transport protocol used and present the initial communication protocol RQL. This protocol is loosely based on the SQL language with extensions for a better notion of time. This protocol was designed for rapid prototyping of applications, where a full query to the reader can be encapsulated in a single line of ASCII text. A simple polling mechanism exists for automatically receiving tag event.

2.1 Transport Protocol

In the current implementation, TCP/IP is used as the transport protocol. TCP is a connection-oriented protocol that provides a reliable, in-order data transport layer with end-to-end checksums and flow control.

2.1.1 TCP Connection Setup and Teardown

A session between client software and the reader consists of connection setup, data transactions, and connection teardown.

At present, all connections are initiated only by the client software. If, for example, the reader is configured to automatically forward events and/or data to the client software but the client software has not established a connection, then no attempt is made by the reader to contact the client software to establish a connection. Furthermore, if an extant connection terminates unexpectedly, the reader will not attempt to contact the client software to re-establish a connection. All responsibility for opening, maintaining, and closing the connection during a session rests with client software.

The client software sets up a TCP socket connection on reader port 8080. After connecting successfully, communication between the client software and the reader can proceed as described below. Once the client software has determined that communication has concluded, the connection must be terminated at the TCP level. In order to prevent synchronization issues, each reader will support only one TCP connection.

Other transport protocols may be used to communicate between the client software and its subjugate readers. The application-level protocol discussed below is neutral with respect to the transport layer.

2.2 Event/Query Protocol

The client software can control the reader using RQL via TCP connection and can acquire data from the readers in two modes: 1) by requesting specific data or 2) by automatically receiving events. The two modes are discussed in further detail in the following subsections.

In order to keep the protocol comprehensive and easy to use, we specify a small set of commands that allow the client software to fully configure the readers and exploit their capabilities.

This minimal set of commands includes the ability to request reads based on several relevant criteria (for example, group reads, range reads, reads by prefix, and so on). The ability to reset the reader database and other control capabilities are also provided for.
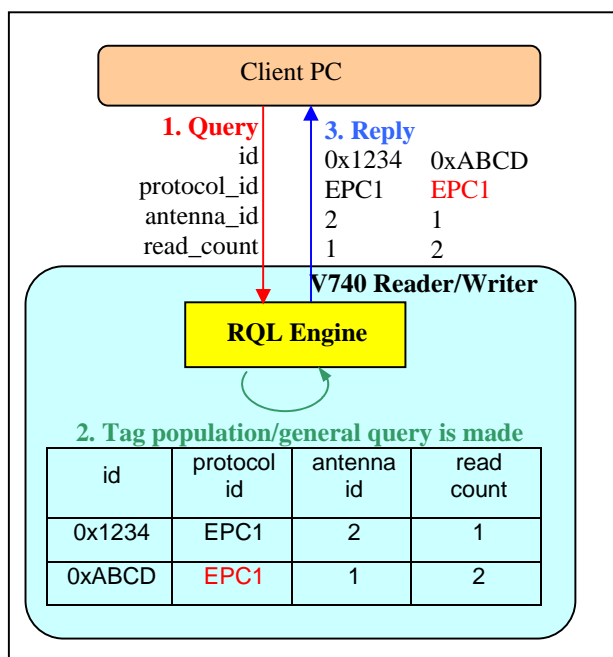
2.2.1 Client Software Requests/Functionality

The client software is able to make the following requests of a reader:

- Read IDs of all tags within range of all antennas.
- Read IDs of all tags within range of a given antenna.
- Read IDs of all tags within a certain subset of tag IDs within range of all antennas.
- Read IDs of all tags within a certain subset of tag IDs within range of a specific antenna.
- Read Individual tag IDs within range of a certain antenna or all antennas.
- Read only the IDs of tags communicating a given RF communication protocol.
- Return the number of times a given tag was read per query.
- Write IDs to a tag.
- Register any commands as aliases (cursor) to the V740 reader.
- Execute any aliases (cursor) one time
- Execute any aliases (cursor) repeatedly at the indicated interval.
- Execute any aliases (cursor) repeatedly in the specified term.

1. Query

	3. Reply	
id	0x1234	0xABCD
protocol_id	EPC1	EPC1
antenna_id	2	1
read_count	1	2

V740 Reader/Writer

RQL Engine

2. Tag population/general query is made

id	protocol id	antenna id	read count
0x1234	EPC1	2	1
0xABCD	EPC1	1	2

Figure 1 : Conceptual diagram of control flow

2.2.2 General Observations, Commands, and Syntax

We note that a reader behaves very much like database wherein each individual tag represents an entry in the database with a given set of attributes. Due to memory constraints of the reader, the system will remove entries from the database as they are queried.

The syntax for querying against this database is derived from SQL syntax.

In the simplest case, the client software explicitly requests data by polling the readers. The request protocol is implemented in such a way that the client software specifies:

Required information.

- What subset of tags the reader should consider.

- Which read constraints should be applied.

Example commands:

- ```
  SELECT id FROM tag_id WHERE
  id=0x1234567890ABCDEF AND antenna_id=1 AND
  protocol_id='EPC1';
  ```

  Would return a tag only if its tag ID was `0x1234567890ABCDEF`.

- ```
  SELECT id FROM tag_id WHERE (antenna_id=1
  OR antenna_id=2) AND protocol_id='EPC1'
  SET time_out=1000;
  ```

  Would return a tag only if the antenna ID was 1 or 2 and will search for at least 1000ms.

Note: The RQL command is terminated by a semicolon. When you use sample commands in this manual, you must input a command in one line without line feed characters.

2.2.3 Extended RQL Command Structure supported by the V740 Reader

Extended Command Set for Data and Write, and Lock operations

ID Read : Identify tags, including anti-collision.

ID Write : Change tag ID

ID Lock : Prevent further changes of tag ID

Kill : Initialize tag

Password : Set a pass-code to kill a tag

Table1: Supported Protocols for each function

Function		EPC1	EPC1B
ID	Read		
	Write		
	Lock		
Kill			
Password			

With the exception of the 'ID Read' command, all commands are protocol and antenna specific and can only be used with a single protocol at a time and with a single antenna at a time. Hence all queries with the exception 'ID Read' need to be constrained to one protocol and one antenna, for example

```
WHERE protocol_id='EPC1' and
antenna_id=1
```

A complete example of an 'ID Write' query would be

```
UPDATE tag_id SET
id=0x0123456789ABCDEF WHERE
protocol_id='EPC1' AND antenna_id=1.
```

 'ID Read' (enumerate tags) is, by definition, a multi-target command, since it determines what the individual targets are in the first place.

There are some special cases to the single-target rule. For example, ID Write is semantically tricky – what does it mean to target a tag if its target ID is going to be changing? In the current state of the art, most protocols do not support addressed ID writes (ID write targets all tag IDs) or disallow tag ID changes entirely.

2.2.4 Detailed Command Structure

2.2.4.1 ID Read

The client software would use the SELECT command to read IDs of tags. The SELECT command is for querying the tag population of the reader as well as static variables such as firmware version. The structure of a SELECT command is as follows:

SELECT *entry_list* FROM
table_expression where_specification
[set_specification];

Ref. Table 2 for entry_list details.

A SELECT clause is entered as:

SELECT *entry1*, *entry2*, *entry3*, ...

one or more entries can be specified, for multiple entries, a comma delimiter is required.

A table_expression is specified by only one table name.

FROM *table*

In the function ID Read, you always use 'tag_id' as a table name. And so the table_expression is as follows:

FROM tag_id

A where_specification is entered as:

WHERE *boolean_expression*

boolean_expression can consist of any expression which evaluates to a boolean value. In many cases, this expression will be:

entry binary_operator value

where *binary_operator* can be one of =, <, <=, >, >= , <>, AND, or OR. Parentheses may also be used to create associations of subexpressions. In the presence of a 'where_specification', SELECT will not return any rows for which the WHERE condition does not evaluate to TRUE.

Note: You must specify one protocol in 'where_specification'.

A set_specification is entered as:

SET *expression*

expression consists of entry and the value.

In response, all IDs delimitted by LF code are sent. The format is as follows:

[id1] <LF> [id2] <LF>.....[idn] <LF><LF>

The response includes the check code and ID. The first 4 digits are the check code, and the ID follows for the EPC1/1B protocols.

Below are some examples for reading tag ID:

- To query a tag on a specific antenna and protocol, you can specify a specific antenna and protocol in the 'where_specification':

```
SELECT id FROM tag_id WHERE
antenna_id=1 AND protocol_id='EPC1';

SELECT id FROM tag_id WHERE
antenna_id=2 AND protocol_id='EPC1';
```

The first specifies 1 as an antenna id, and EPC1 as a protocol id. The second specifies 2 as an antenna id, and EPC1 as a protocol id. The reader searches tags that corresponds to the condition, and returns the tag ID if the tag is present followed by LF code, an empty event (only LF code) results if tags matching the 'where_specification' are not present.

- To query a tag on multiple antennas, you can specify multiple antennas by 'OR' operator in the 'where_specification':

```
SELECT id FROM tag_id WHERE
(antenna_id=1 OR antenna_id=2) AND
protocol_id='EPC1';

SELECT id FROM tag_id WHERE
(antenna_id=1 OR antenna_id=2 OR
antenna_id=3 OR antenna_id=4) AND
protocol_id='EPC1';
```

The first specifies 2 antennas, and the second specifies 4 antennas.

- To query a specific tag, given its EPC code, one can specify a specific tag with an ID as a hexadecimal number*:*

```
SELECT id FROM tag_id WHERE
id=0x1234567890ABCDEF AND
antenna_id=1 AND protocol_id='EPC1';
```

When Indicating id in the 'where_specification', the reader searches the ID from the higher order. If the value is shorter than 16 digit for EPC1(24 digit when using EPC1B), it examines only upper bits.

```
SELECT id FROM tag_id WHERE
antenna_id=1 AND protocol_id='EPC1' AND
id=0x1234;
```

- To query a specific sub class of tags, given a range of tag ID values:

```
SELECT id FROM tag_id WHERE
protocol_id='EPC1' AND antenna_id=1
AND (tag_id>=min_tag_id AND
tag_id<=max_tag_id);
```

The reader returns the tag ID values for all the present tags between *min_tag_id* and *max_tag_id*, which are hexadecimal values.

- To query tags by specific or all antennas:

```
SELECT id FROM tag_id WHERE
antenna_id=1 AND protocol_id='EPC1';

SELECT id FROM tag_id WHERE
protocol_id='EPC1';
```

At the first, the reader searches tags only by antenna 1. Second the reader searches tags by all antennas available. Omitting the antenna indication in the 'where_specification' means to search all antennas available.

Note: When specifying multiple antennas even if an antenna that does not exist is specified, the reader obtains the tag ID only using antenna 1 and doesn't return any an error message.

```
SELECT id FROM tag_id WHERE
(antenna_id=1 OR antenna_id=5) AND
protocol_id='EPC1';
```

- The client software can specify multiple entries in the select_list field of the SELECT command:

```
SELECT id, antenna_id FROM tag_id
WHERE antenna_id=1 AND
protocol_id='EPC1';

SELECT protocol_id, timestamp, id,
antenna_id FROM tag_id WHERE
antenna_id=1 AND protocol_id='EPC1';
```

The first example returns the tag IDs and antenna_ids, and the second returns protocol_ids and the time that the tag was read (seconds from the unix epoch, Jan 1, 1970) with the tag IDs and antennas_ids.

Note: To read timestamp, the NTP sever must be set up in advance.

The reader returns protocol_id as an integer value. The value '1' represents 'EPC1'. For example, the query with protocol_id and the response is as follows:

```
[Query] SELECT protocol_id, id FROM
     tag_id WHERE antenna_id=1 AND
     protocol_id='EPC1';

[Res]  1|0xCE791111111111111111<LF><LF>
```

- To query during a specific time:

```
SELECT id FROM tag_id WHERE
antenna_id=1 AND protocol_id='EPC1'
SET time_out=500;
```

The command imposes a time out constraint of 500ms; i.e., the reader stops reading and returns all collected data after 500ms. The order in which specifying arguments are used is irrelevant. The default timeout is 250ms if none is specified.

It is important to always use a timeout in specifying a query to achieve optimal performance for a given application. Detailed information will be discussed in the next section

Timeout

The client software can impose a time limit on a read operation, requesting the reader to search only for a limited time (specified in milliseconds). The reader may fail to detect some tags if insufficient time is allocated to the search operation. The time_out is the parameter used for specifying the time allocated for the read operation.
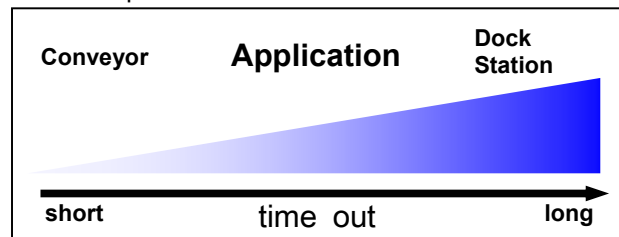

In general, a large time_out should be used for dock stations (>2000ms), and short time_outs should be used for conveyor belts (<100ms).

```
SELECT id FROM tag_id WHERE antenna_id=1
AND protocol_id='EPC1' SET
time_out=1000;
```

(See 3.2 Communications Time)

The constraints on the scheduler in the reader for the time_out are shown below. The reader searches sequentially for each antenna in the time. When the last antenna completes searching, the reader returns to the first antenna again. Following chart shows an example of time schedule given by the model command as below.

```
SELECT id FROM tag_id WHERE
(protocol_id='protocol1') and
(antenna_id=ant1 or antenna_id=ant2 or
antenna_id=ant3 or antenna_id=ant3);
```

time_out						
ant1	ant2	ant3	ant4	ant1	ant2	...
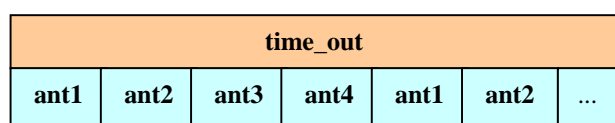
The antenna arbitration algorithm is optimized to maximize the read rate of all the tags in the field. The time division for each antenna is determined automatically by the reader and cannot be specified by the user.

e.g. if 10 EPC1 tags takes 20 ms per tag on average. With two antennas:

minimum time_out =
10 x 20 x 2 x 2 = 800 ms.

Note: It is caused by the following reasons that the difference between the time_out value and actual time required for reading.

It spends 20 ms to switch protocols.

The max of the difference can be calculated by summing up the time caused by the reasons. You need consider time lag to avoid mutual interface due to time sharing.

Table 2:
Reader Internal Tag Data Table Schema -Tag Read

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
SELECT	id	tag_id	Hex String	-	0xFEDCBA0 987654321	Requests the id (tag data) of the tag
	antenna_id	tag_id	Int	-	2	Requests the antenna id used to read the tag
	protocol_id	tag_id	Int	-	1 (EPC1/1B)	Requests the protocol id of the tag
	read_count (*1)	tag_id	Int	-	1	Requests the number of times a tag ID was read
	timestamp	tag_id	String	-	1101973245. 003590	Requests the time M4 read data from the tag. To get the correct time, you need to adjust the clock by setting NTP server.
FROM	tag_id	-	-	-	-	The name of the internal tag data table(fixed)
WHERE	antenna_id	tag_id	Int	[1...4]	1	Specifies the antenna used to read a tag
	protocol_id	tag_id	String	'EPC1'	'EPC1'	Specifies the protocol used to read a tag. Must be uppercase.
	read_count	tag_id	Int	1 and over	2	Specifies the number of times a tag was read
	id	tag_id	Hex String	-	0xFEDCBA0 987654321	Specifies the tag id to be read.
SET	time_out	tag_id	Int	[1...65535]	500	Specifies the amount of time the SELECT command will read tags in milliseconds.

Note(*1)**:** If you specify 'read_count' on 'EPC1' protocol, the reader returns '1' due to the search algorithm.

2.2.4.2 ID Write – Writing data to tag

The UPDATE command is used to write new data to a tag. The structure of an UPDATE command is as follows:

> UPDATE *table_expression* set_specification *where_specification*;

table_expression and entries specified in set_specification are provided in Table 3.

A table_expression is specified by only one table name:

> UPDATE tag_id

A set_specification is entered as:

> SET *entry=value*

A where_specification is entered as:

> WHERE *boolean_expr*

In a where_specification, both protocol_id and antenna_id must be specified.

The tag_id (tag data) is returned with a check code as follows:

> EPC1:[check_code][tag_id]<LF><LF>

The 'where_specification' is specified in the same manner as the SELECT in the previous section.:

- Example : To write tag data(tag_id) to a 64-bit EPC tag:

```
UPDATE tag_id SET id=0x1234567890ABCDEF
WHERE protocol='EPC1' AND antenna_id=1;
```

The reader returns the tag_id if the write operation was successful.For example the response is as follows:

```
0xCE851234567890ABCDEF<LF><LF>
```

In this case, "CE85" is the check code. "1234567890ABCDEF" is tag data(tag id).

If the operation failed, "Error 0102: Error performing query<LF><LF>" returned.

Note: The format of the tag data in the command must much the selected protocol or an error will result.

For example :

- A 64 bit EPC1 tag requires 16 hexadecimal digits

- A 96 bit EPC1 tag requires 24 hexadecimal digits

(See section 1.6)

If wrong data is written to the tag, the tag may be unreadable. In this case, write correct tag ID again, after that, the tag would turn to be readable.

Table3 : Reader Internal Tag Data
Table Schema -Tag Write

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
UPDATE	tag_id	-	-	-	-	The name of the internal tag data table(fixed)
SET	id	tag_id	Hex String	-	0xFEDCBA0987654321	Specifies the tag id(tag data) to be written
WHERE	antenna_id	tag_id	Int	[1...4]	1	Specifies the antenna used to read a tag
	protocol_id	tag_id	String	'EPC1'	'EPC1'	Specifies the protocol used to read a tag. Must be uppercase.

1. ID Lock

The UPDATE command is also used to lock data of a tag. This can be used to write '1' to 'locked' flag . The structure of an UPDATE command is the same as ID Write.

- Example : To lock tag id of a 64-bit EPC tag:

```
UPDATE tag_id SET locked=1,
id=0x1234567890ABCDEF WHERE
protocol='EPC1' AND antenna_id=1;
```

The reader returns the tag_id if the lock operation was successful. For example the response is as follows:

```
│0xCE851234567890ABCDEF<LF><LF>
```

In this case, "CE85" is the check code. "1234567890ABCDEF" is tag data(tag id).

If the operation is failed, "Error 0102: Error performing query<LF><LF>" returned.

- Example : To lock tag id of a 96-bit EPC tag:

```
UPDATE tag_id SET locked=1,
id=0x1234567890ABCDEF12345678 WHERE
protocol='EPC1' AND antenna_id=1;
```

The reader returns the tag_id the same way as 64-bit tag.

Note: The format of the tag data in the command must much the selected protocol or an error will result. (See section 1.6)

For example :

- A 64 bit EPC1 tag requires 16 hexadecimal digits

- A 96 bit EPC1 tag requires 24 hexadecimal digits

Note: You must send this command to only one tag at one time in the stable communication area.

Note: Response data always contains a separator in front of the tag ID.

Note: If the response of the command is different from the ID of the tag in the communication area, you need to retry it.

Table4 : Table Schema - Tag Lock

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
UPDATE	tag_id	-	-	-	-	Tag id database table (Fixed)
SET	locked	tag_id	Int	1	1	Can be specified with only "1"(Fixed).
	id	tag_id	Hex String	-	0xFEDCBA0987654321	Specifies the tag id to be updated
WHERE	antenna_id	tag_id	Int	[1...4]	1	Specifies the antenna used to update a tag
	protocol_id	tag_id	String	'EPC1'	'EPC1'	Specifies the protocol used to update a tag. Must be uppercase.

2. Kill

The UPDATE command is also used to initialize a tag. 3 parameters must be specified in SET Clause. The first is 'killed' flag, the second is password for the tag and the last is id of the tag. The structure of an UPDATE command is the same as ID Write.

- Example : To lock tag id of a 64-bit EPC tag:

```
UPDATE tag_id SET killed=1,
password=0x88, id=0x1234567890ABCDEF
WHERE protocol='EPC1' AND antenna_id=1;
```

The reader returns the tag_id if the kill operation was successful. For example the response is as follows:

```
||0x00000000000000000000<LF><LF>
```

If succeeded, the response of kill command is all 0.

If the operation is failed, "Error 0102: Error performing query<LF><LF>" returned.

- Example : To lock tag id of a 96-bit EPC tag:

```
UPDATE tag_id SET killed=1,password=0x88,
id=0x1234567890ABCDEF12345678 WHERE
protocol='EPC1' AND antenna_id=1;
```

The reader returns the tag_id the same way as 64-bit tag.

Note: The format of the tag data in the command must much the selected protocol or an error will result. (See section 1.6)

For example :

- A 64 bit EPC1 tag requires 16 hexadecimal digits

- A 96 bit EPC1 tag requires 24 hexadecimal digits

Note: You must send this command to only one tag at one time in the stable communication area.

Note: Response data always contains 2 separators in front of the tag ID.

Note: After sending this command, you must send an ID read command and confirm no ID data is sent as a response.

Table5 : Table Schema - Kill Tag

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
UPDATE	tag_id	-	-	-	-	Tag id database table (Fixed)
SET	killed	tag_id	Int	1	1	Can be specified with only "1" (Fixed).
	password	tag_id	Hex Streing	[0x00...0xFF]	0x88	Specifies the password set to the tag in advance.
	id	tag_id	Hex String	-	0xFEDC BA09876 54321	Specifies the tag id to be updated
WHERE	antenna_id	tag_id	Int	[1...4]	1	Specifies the antenna used to update a tag
	protocol_id	tag_id	String	'EPC1'	'EPC1'	Specifies the protocol used to update a tag. Must be uppercase.

3. Set Password

The UPDATE command is also used to set password of a tag. This can be used to set password. The structure of an UPDATE command is the same as ID Write.

- Example : To set password of a 64-bit EPC tag:

```
UPDATE tag_id SET password=0x88,
id=0x1234567890ABCDEF WHERE
protocol='EPC1' AND antenna_id=1;
```

The reader returns the password if the setting password operation was successful. For example the response is as follows:

```
│0x88<LF><LF>
```

In this case, "0x88" is the password.

If the operation is failed, "Error 0102: Error performing query<LF><LF>" returned.

- Example : To lock tag id of a 96-bit EPC tag:

```
UPDATE tag_id SET password=0x88,
id=0x1234567890ABCDEF12345678 WHERE
protocol='EPC1' AND antenna_id=1;
```

The reader returns the tag_id the same way as 64-bit tag.

Note: The format of the tag data in the command must much the selected protocol or an error will result. (See section 1.6)

For example :

- A 64 bit EPC1 tag requires 16 hexadecimal digits

- A 96 bit EPC1 tag requires 24 hexadecimal digits

Note: You must send this command to only one tag at one time in the stable communication area.

Note: Response data always contains a separator in front of the tag ID.

Table6 : Table Schema - Set Password

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
UPDATE	tag_id	-	-	-	-	Tag data database table (Fixed)
SET	password	tag_id	Hex String	[0x00...0xFF]	0x88	Specifies the password for the tag to kill.
	id	tag_id	Hex String	-	0xFEDCBA0987654321	Specifies the tag id to be updated
WHERE	antenna_id	tag_id	Int	[1...4]	1	Specifies the antenna used to update a tag
	protocol_id	tag_id	String	'EPC1'	'EPC1'	Specifies the protocol used to update a tag. Must be uppercase.

4. Reader Control

The client software can register a command with a cursor name to the reader. This section describes Cursors (Stored Procedures or Aliases) and Reader settings.

i. Cursors

Declare

The client software has the ability to declare cursors (saved queries), which it can then use to request data repeatedly using the FETCH or the AUTO_MODE command. Only one cursor can be executed at one time. A maximum of 16 cursors can be defined.

To create a cursor:

DECLARE *cursorname* CURSOR FOR *query;*

cursorname — an arbitrary string.

query — an RQL query (SELECT/UPDATE statement), as defined above.

If the query is valid in its syntax, an empty event (only LF code) is returned. If invalid, an error message is shown(Ref. Table 9).

Example:

```
DECLARE cursor1 CURSOR FOR SELECT id,
antenna_id FROM tag_id WHERE
protocol_id='EPC1';

DECLARE cursor2 CURSOR FOR UPDATE
tag_data SET id=0xFEDCBA9876543210
WHERE protocol_id='EPC1' and
antenna_id=1;
```

Note: Commands for getting information and setting the separator can not be used as cursors.

Close

Used to close(delete) a cursor and free its resources(only 16 cursors may be defined simultaneously). Only one cursor can be closed at one time. The client software issues the command:

CLOSE *cursorname*;

If the cursorname is valid, following the command, an empty event (only LF code) is returned.

Reset

To reset the reader RQL server, for example, if the RQL state is undefined or questionable, use:

RESET;

Following the command, an empty event (only LF code) is returned. The command returns the RQL

daemon to its initial state; that is, resets the reader, deletes cursors and clears memory.

ii. Execution

Commands stored as cursors can be executed in 3 ways as described below.

Fetch

To execute the stored cursor, a FETCH command is sent by the client software. Only one cursor can be executed at one time.

FETCH *cursorname*;

which performs all actions appropriate to the declared query and sends the result back.

Example:

```
DECLARE cursor3 CURSOR FOR SELECT id,
antenna_id FROM tag_id WHERE id =
0x11111111111111111111 AND
protocol_id='EPC1';

FETCH cursor3;
```
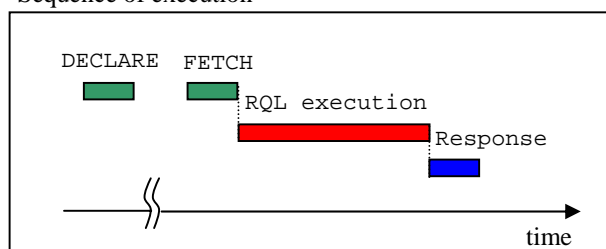
could return:

if the tag was read by antenna 2,

```
0xCE791111111111111111|2<LF><LF>
```

or if the tag was not found.

```
<LF>
```

Sequence of execution

Auto Mode

The client software may switch the reader into Auto Mode, causing the reader to repeatedly execute a cursor indefinitely.

SET auto *cursorname* = ON, repeat = *interval*;

For example,

```
DECLARE cursor4 CURSOR FOR SELECT id,
antenna_id FROM tag_id WHERE
protocol_id='EPC1' SET time_out=250;

SET auto cursor4 = ON, repeat = 500;
```

Every 500 milliseconds, the cursor executes for 250 milliseconds querying for tags. The remaining 250

milliseconds are spent with cursor idle(RF off). This syntax can be used for controlling the duty cycle of the reader. For full reader utilization, ensure that the value of time_out is less than the value of *repeat*, if not the cursor is executed continuously.

Auto Mode can be terminated by sending the command:

    SET auto = OFF;

No other command can be used while Auto Mode is active.

To schedule intermittent reads with off times of 1 second starting at a specific time use:

Example:

```
DECLARE cursor5 CURSOR FOR SELECT id
FROM tag_id WHERE protocol_id='EPC1'
SET time_out=500;

SET auto cursor5 = ON, repeat = 1000;

(get resopnses...)

SET auto = OFF;
```

To turn off Auto Mode, the SET auto = OFF command is sent by the client software.

1. If the SET command executes while the cursor is executing, the cursor will finish before Auto Mode stops.

2. If the SET command executes while the cursor is idle, then Auto Mode stops immediately.
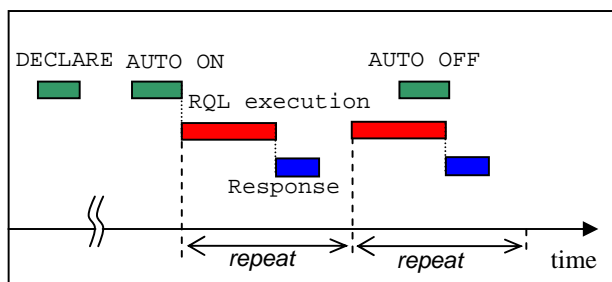
Scheduled Reads

The reader uses the Network Time Protocol as a means to establish absolute time on the reader. With that capability in place the reader is enabled to execute tag operations that have been scheduled relative to absolute time. The reader adjusts UTC time of the NTP server, whatever time zone it works on. Here is how it works.

First the user declares a cursor , in a way similar to how to you use cursors in auto mode.

To run the query once at a specific time you use a command of the form:

    SET trigger_time *cursorname* = '*starttime*';

To run the query in auto mode over a given interval:

    SET auto_time *cursorname* = '*starttime*', repeat=*interval*;

or

    SET auto_time *cursorname* = '*starttime*/*stoptime*', repeat=*interval*;

The first form here starts the auto mode at a given time, and then just continues until you stop it, the same way you would stop normal auto mode.

The second form runs during the specified interval.

The start and stop time are specified in ISO8601 time strings, of the form

    YYYY-MM-DDTHH:mm:SS.DDDDZZZZZ

Where YYYY is the year, MM is the month, DD is the day, HH is the hour, mm is the minute, SS is the second, and DDDD is the fraction of a second, and ZZZZZ is the time zone. The seconds and fractions of a second are both optional (but if you want fractions of a second, you must specify seconds as well). The time zone can either be specified as GMT or Zulu time by using a 'Z' or it can be an offset from GMT using +HH:MM or -HH:MM. For example, in Eastern time, that would be -05:00.

Some examples:

```
C6:    DECLARE cursor6 CURSOR FOR SELECT id
       FROM tag_id WHERE antenna_id=1 AND
       protocol_id='EPC1';

C7:    DECLARE cursor7 CURSOR FOR SELECT id
       FROM tag_id WHERE antenna_id=2 AND
       protocol_id='EPC1';
```

To run c6 once on February 14th 2004 at 18:54:50 GMT:

```
SET trigger_time cursor6 = '2004-
02-14T18:54:50Z';
```

To run c7 for 10 seconds starting in intervals of 1000 ms at 2004-01-20 at 15:37 in Eastern Standard Time:

```
SET auto_time cursor7 = '2004-01-
20T15:37-05:00/2004-01-20T15:37:10-
05:00', repeat=2000;
```

Note: If only the start time is specified and the current time has passed the start time, the cursor is executed immediately.

If the current time has passed the start time and the stop time specified in the future, the cursor is executed immediately and finished at the specified stop time.
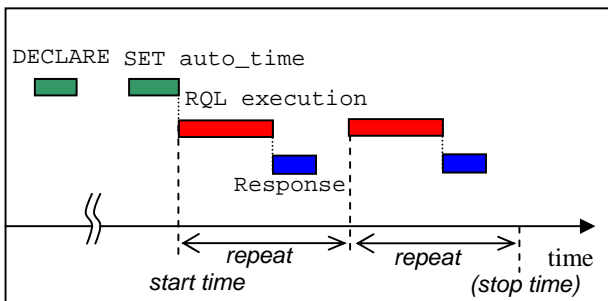
Example:

The following example schedules reads to execute 1 time per second with an off time of 750ms, starting at a specific time:

```
DECLARE cursor8 CURSOR FOR SELECT id
FROM tag_id WHERE protocol_id='EPC1';
```

```
SET auto_time cursor8 = '2004-01-
22T12:43:08-05:00', repeat=1000;
```

Note: Since time_out is not specified, the default time_out of 250ms is used.

iii. Setting of ID Read response format

Separator

The client software can change the separator between the entries of the response for ID reading.(Ref. 2.2.4.1 ID Read).

```
SET separator = 'c';
```

Following the command, an empty event (only LF code) is returned. The default separator is '|'. The separator must be one character. Example is as follows:

```
SET separator='#';
```

```
SELECT id, protocol_id, antenna_id
FROM tag_id WHERE protocol_id='EPC1';
```

The response would be as follows.

```
0xCE85123467890ABCDEF#1#1<LF><LF>
```

Table7 : Table Schema - Reader Control

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
DECLARE	-	n/a	cursorname, query	-	cursor1	Defines the cursor name for the query.
FETCH	-	n/a	cursorname	-	cursor1	Executes a cursor and sends the data
CLOSE	-	n/a	cursorname	-	cursor1	Deletes a defined cursor
RESET	-	n/a	-	-	-	Resets the reader, deletes cursors, clears memory
SET	tirgger_time	n/a	cursorname, time	-	-	Set a cursor to run at the specified time once.
	auto_time	n/a	cursorname, start time, stop time	-	-	Set a cursor to keep running from the start time to the stop time repeatedly.
	auto	n/a	cursorname, ON, OFF	-	cursor1 = ON	Turns auto-mode of cursors on/off.
	repeat	n/a	Integer	-	-	Sets a cursor to keep running
	separator	n/a	character	except ';'	'|'	Changes the separator in the output format of a query.

2.2.4.3 Get Information

The client software can get the information about the
status of the reader. For example, firmware version
and current time of the system. To get firmware
version information, The format is as follows:

SELECT *entry* FROM *table_expression*

Table8 : Table Schema - Get Information

Keyword	Entry	Table	Arguments	Range	Example Value	Comments
SELECT	version	Firmware	String	-	2.2.22 (2005-07-22T16:32:55-04:00 Shannon)	Requests the firmware version of the reader
	current_time	Settings	String	-	2006-01-01T00:01:39.891808	Requests the current time of the reader.
FROM	Firmware	-	-	-	-	Table for the information about the reader's firmware.
	Settings	-	-	-	-	Table for the information about the reader's settings.

2.2.5 Errors

If the reader is unable to execute a command issued by the client software, the reader issues an error message, which has the basic form:

> Error *error_code* : *string*

where error_code is an integer. Error codes and strings are documented in Table 6.

For example:

```
DECLARE cursor9 CURSOR FOR SELECT id
FROM tag_id;

FETCH cursor10;
```

Would result in the error message:

```
Error 0100: Cursor does not
exist<LF><LF>
```

Table 9: Error codes and Strings

Error Codes	Strings	Explanation/Cause
0100 : ERROR_INVALID _ARGUMENTS	No protocol specified	Indicates missing or more than 17 protocol_id are declared (only for UPDATE command)
	Too many protocols specified	Indicates too many protocols are declared (only for UPDATE command)
	No antenna specified	Indicates missing or more than 17 antenna_id are declared (only for UPDATE command)
	Too many antennas specified	Indicates more than 2 antennas specified(only for UPDATE command)
	Unknown table	
	Cursor already exists	Declared cursor name already exists
	Unknown setting	Indicates no entry item in the table
	Cursor does not exist	Fetch non-existent cursor
	Unknown field	Indicates items for GetInfo command (only for UPDATE command)
	Invalid set clause entry	
	DELETE: Cursor does not exist	Indicates a cursor name for CLOSE command that is not defined by DECLARE command
	Start_time not specified correctly	Indicates time format incorrectly for start or finish time.
	time_out value out of range	Set sleep time_out value out of range
	Unknown protocol	Indicates nonexistent protocol
	Syntax Error	Syntax error or spelling mistake etc
	Invalid argument	
0101 : ERROR_INVALID _DATA	Unknown setting	
	Time is invalid	
	Unknown protocol ID	

Error Codes	Strings	Explanation/Cause
	Invalid command in current mode	Execute a command while another command is running on auto mode
0102 : ERROR_REMOTE	Error performing query	Tag is absent. Argument is illegal.(only for UPDATE command)
	Error setting ping threshold	
	Error setting saved ping threshold	
	Error setting saved IP address	
	Error setting saved gateway	
	Error setting saved netmask	
	Error setting firmware version	
	Error setting safemode version	
	Error setting OS version	
	Error setting supported protocols	
	Error getting operation state	
0106 : ERROR_INVALID_ANTENNA	Antenna does not exist in current hardware configuration	Antenna does not exist in current hardware configuration.
0107 : ERROR_UNCONNECTED_ANTENNA	Antenna port exists. But no antenna connected	Antenna port exists. But no antenna connected.
0199: ERROR_UNKNOWN	Tag data access failed	Table name on update command is invalid
	Error getting entry	
	Error getting ip address entry	
	Error getting netmask entry	
	Error getting gateway entry	

2.2.6 Protocol Specific Functionality and Parameter Settings

While the standard ID_read and anti-collision searches are supported by practically all offered protocols, therefore no protocol-specific information is required to issue a RQL search. More specific commands, such as data_read and data_write require protocol specific information when formatting the query and interpreting the results. The tables below provide that information.

2.2.6.1 915 MHz EPC Class 1/1B

		Parameters / Constraints	Return Value (String)	Example
ID	Read	()	Class1: 80 bits (64 bits ID and 16 bits CRC, hex format) Class1B: 112 bits (96 bits ID and 16 bits CRC)	SELECT id FROM tag_id WHERE protocol_id='EPC1';
	Write	**id**: 64 bits or 96 bits (hex)	new_id or error_code with string	UPDATE tag_id SET id=0x1234567890ABCDEF WHERE protocol_id='EPC1' AND antenna_id=1;
	Lock	**id**: 64 bits or 96 bits (hex) **Locked Flag:** 1(Fixed)	id or error_code with string	UPDATE tag_id SET locked=1, id=0x1234567890ABCDEF WHERE protocol_id='EPC1' AND antenna_id=1;
Kill		**id**: 64 bits or 96 bits (hex) **password:** 8bits(hex) **Killed Flag:** 1(Fixed)	all zero id or error_code with string	UPDATE tag_id SET killed=1, password=0x88, id=0x1234567890ABCDEF WHERE protocol_id='EPC1' AND antenna_id=1;
Password		**id**: 64 bits or 96 bits (hex) **password:** 8bits(hex)	password or error_code with string	UPDATE tag_id SET password=0x88, id=0x1234567890ABCDEF WHERE protocol_id='EPC1' AND antenna_id=1;

Note: The state of the tag becomes 'Quiet' after reading by RQL. If you wish to communicate with the tag using a 2nd reader, a 'Talk' command must be sent to change the tag to active mode.(for more detailed information about the status of the tag see 'Communication Interface Specification' for EPC1)

2.3 Examples

Examples given in this chapter are provided as a guide for the user in determining suitability and does not constitute a warranty. Users must verify operation in their specific environment and application.

2.3.1 Example 1

To read tags attached to cases passed through a gate on a conveyer, the client software finds tags using 2 antennas. For the example pictured below, the command is as follows:

```
SELECT id, antenna_id FROM tag_id
WHERE (antenna_id=1 OR antenna_id=2)
AND protocol_id='EPC1' SET
time_out=500;
```

Then the reader continues to read tags through the gate.
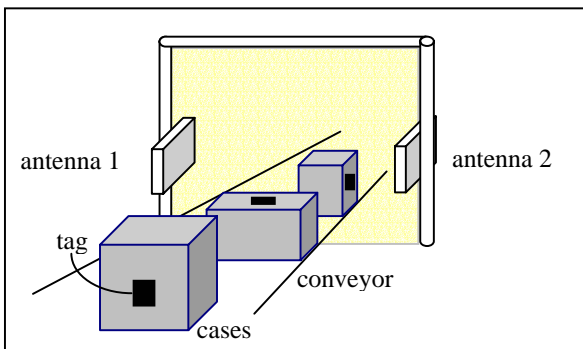
2.3.2 Example 2

To read tags and send a response repeatedly every 1 second using one antenna. For the example pictured below, the command is as follows:

```
DECLARE query1 CURSOR FOR SELECT id
FROM tag_id WHERE antenna_id=1 AND
protocol_id='EPC1' SET time_out=500;

SET AUTO query1=ON, repeat=1000;
```
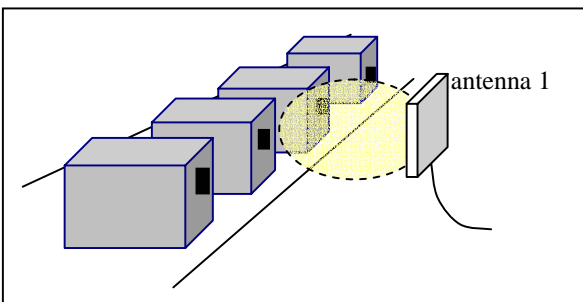

2.3.3 Example 3

To synchronize two readers see the following instructions.

On Reader 1:

```
DECLARE cursor_one CURSOR FOR SELECT
id FROM tag_id WHERE
protocol_id='EPC1' SET time_out=300;

SET auto_time cursor_one = '2005-02-
01T13:00:00Z', repeat=1000;
```

The first reader will start reading for no less than 300 ms at just 13 o'clock, and it will repeat the command 1000ms.

On Reader 2:

```
DECLARE cursor_two CURSOR FOR SELECT
id FROM tag_id WHERE
protocol_id='EPC1' SET time_out=300;

SET auto_time cursor_two = '2005-02-
01T13:00:00.5Z', repeat = 1000;
```

The second reader will start reading for no less than 300ms starting at time 0.5 second after 13 o'clock, and it will repeat the command every 1000ms.

The effect will be that each reader will have a almost 50% duty cycle with each one only active when the other one is off.
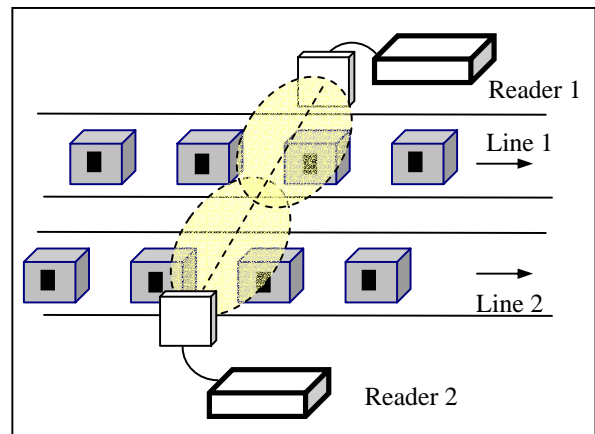
3. I/O

This chapter describes how to use this function a function for external input/output control.
The V740 Reader has an external input/output function on the RS232C connector; two for input and three for output. Following table is a terminal assignment.

	RS232C Connector
Input 1	pin 4
Input 2	pin 7
Output 1	pin 6
Output 2	pin 1
Output 3	pin 9

3.1 Using the input/output function

1. Start the socket communication program created by users. In the open window connect to the IP address of V740 on port 8091.
2. Send the I/O control command ("CC") to the reader.

3.2 Detailed Command structure

1. I/O Control Command (CC)
CC changes statuses of external input/output connectors (OUT1, OUT2, OUT3, IN1 and IN2) and read their statuses.

< Command format>

Command code "CC"	OUT1	OUT2	OUT3
2	1	1	1

OUT1-OUT3	Writing "1" or "0" following CC specifies the status of the output. 1:ON/0:OFF Writing "*" instead of "1" or "0" starts to read the statuses of the connectors.

< Response format >

Coomand "CC"	Response Code "00"	OUT1	OUT2	OUT3	IN1	IN2	LF	LF
2	2	1	1	1	1	1	1	1

Response Code	00 : Normal 14 : Format Error
OUT1 - OUT3	Displays the status of output. 1 : ON / 0 : OFF
IN1, IN2	Displays the status of input. 1 : ON / 0 : OFF

Example (1) To output +5V from OUT1, -5V from OUT2 and +5V from OUT3, enter the below command and the following response will be received.
Command: CC101
Response: CC000101<LF><LF>

Example (2) To read the statuses of each connector; OUT 1-3 and IN 1 and 2, enter the below command and the following response will be received.
Command: CC***
Response: CC0001010<LF><LF>

2. Invalid Command Response
Invalid Command Response is sent whenever the reader receives any invalid or undefined commands.

< Response format>

Command code "IC"	LF	LF
2	1	1

For example, if the invalid command ="AA" is sent, in response to the command, the following data will be received.
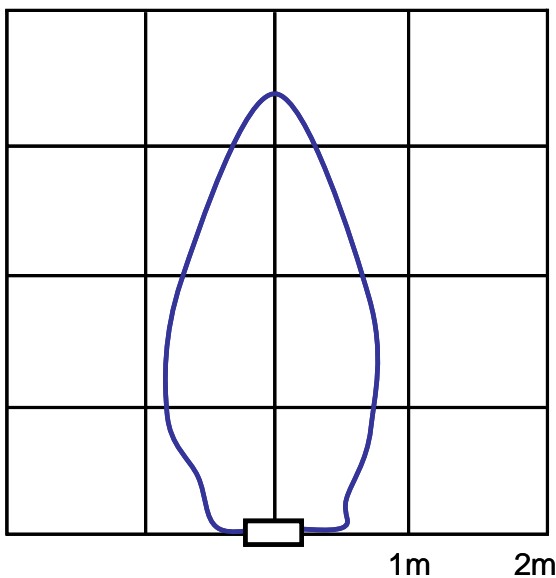Command: AA000
Response: IC<LF><LF>

.

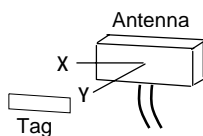# 4. Characteristics(Reference)

Characteristics data given in this chapter is provided as a guide for the user in determining suitability and does not constitute a warranty. Actual performance may vary based on actual user conditions.

4.1 Communications Range

### Circular Antenna(V740-HS02CA,04C) / Class1b Tag

1m   2m

<u>\<Measurement Set-up\></u>

Antenna

X

Y

Tag

*. There are no RF reflection objects around the Antenna and Tag in the measurement environment.
*. There are some areas where communication is possible outside the communications range shown in the graph by the effect of reflection off of the ground.
   For example, an electric wave darkroom.
*. 6dB attenuator is attached at the time of measurement with a Liner polarization antenna.
   3dB attenuator is attached at the time of measurement with a Circular polarization antenna.
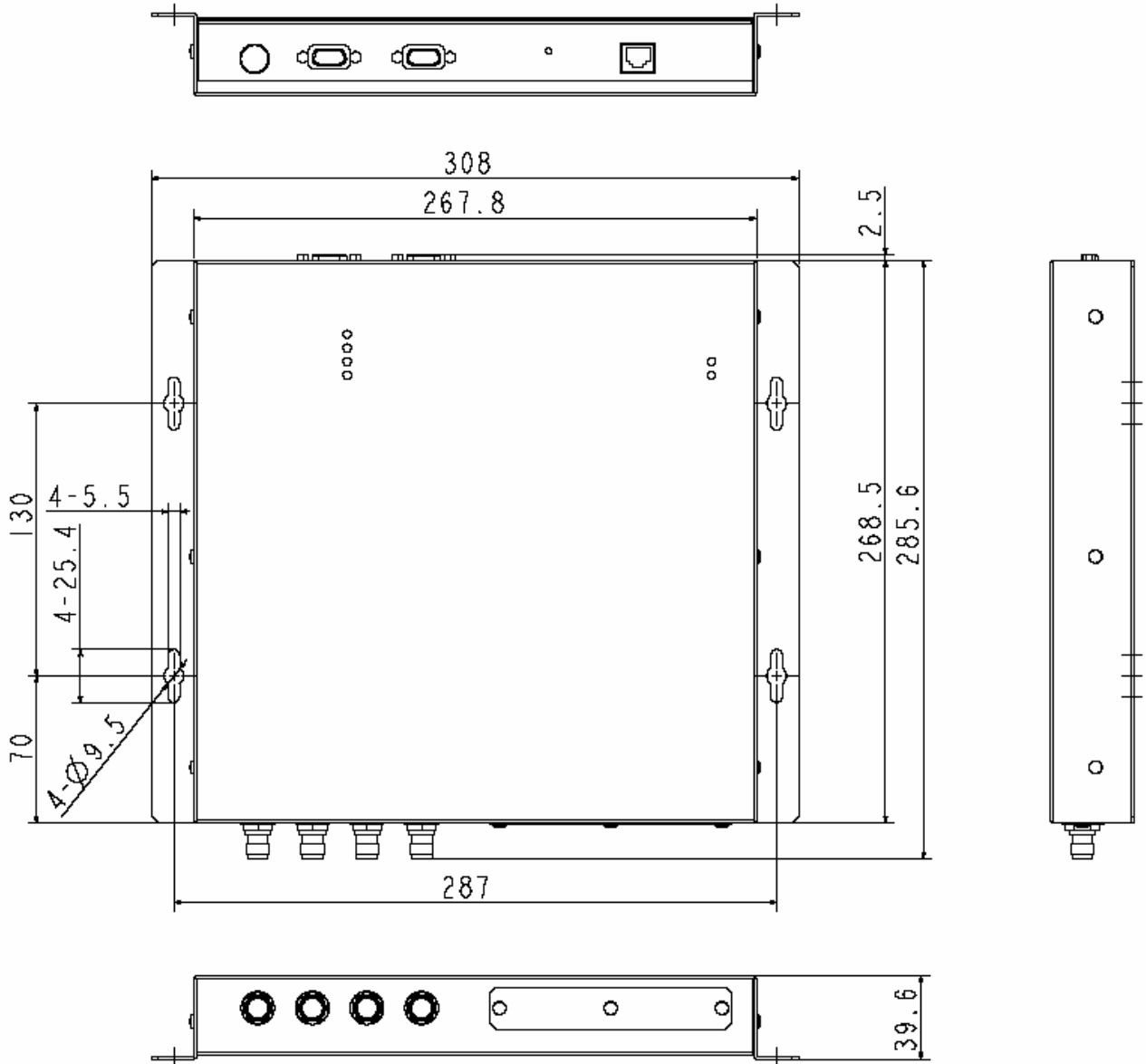
4.2 Communications Time

Communications time varies for several reasons such as the actual noise environment and the distance between tags and antennas. The chart below shows the communication time vs. the number of tags in the antenna read range. One may use the communication time value as a reference when setting time out values in the RQL command.
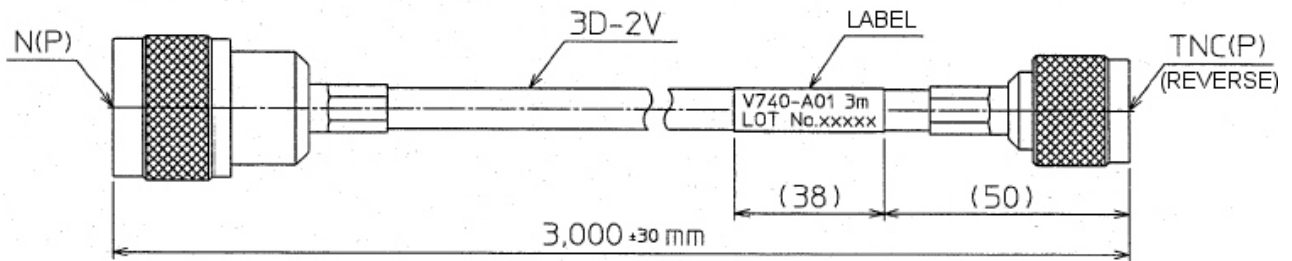
Class1/1b Tags
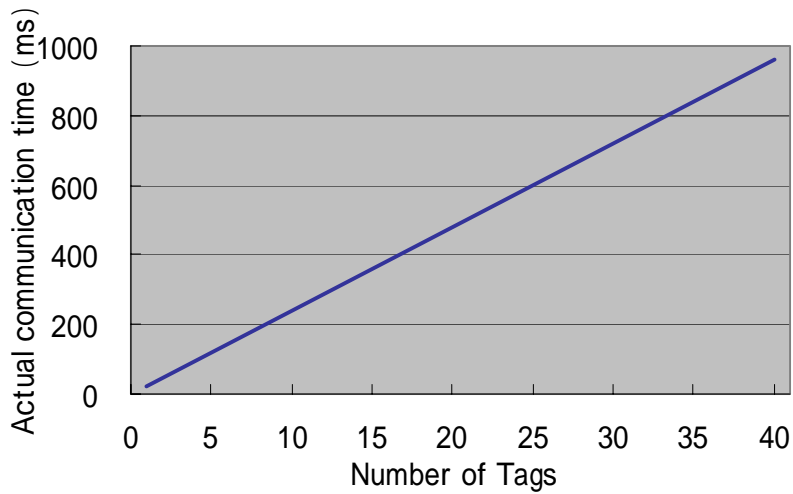
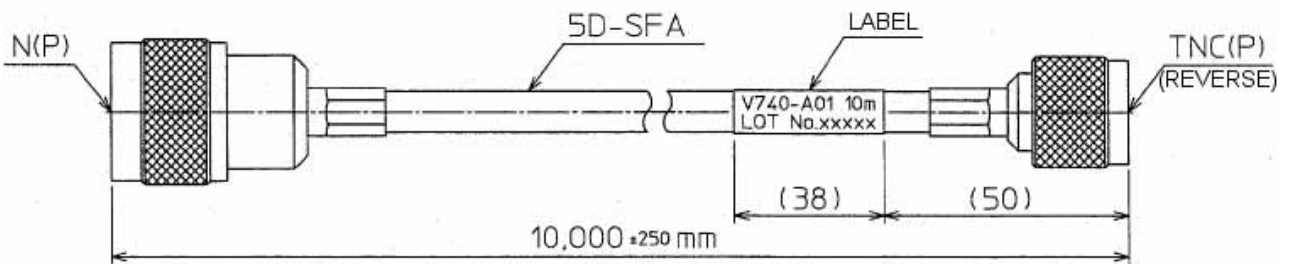# APPENDIX : OUTLINE DRAWINGS

Reader : (V740-BA50C22A-US)

Material : Aluminium

Antenna : (V740-HS02CA   V740-HS02C)

Material : Aluminium

Antenna Cable:

Short cable (V740-A01-3.0M)

N(P) | 3D-2V | LABEL | TNC(P) (REVERSE)

V740-A01 3m
LOT No.xxxxx

(38)   (50)

3,000 ±30 mm

Long cable (V740-A01-10M)

N(P) | 5D-SFA | LABEL | TNC(P) (REVERSE)

V740-A01 10m
LOT No.xxxxx

(38)   (50)

10,000 ±250 mm

Revision History

$$\boxed{\textbf{Catalog No.} \boxed{\textbf{RFM - 002 - } \boxed{\textbf{01}}}}$$

Revision Code

Revision Code	Date	Reason for revision/revised page
01	2005/11	First edition

OMRON

Cat. No. RFM - 002 - 01   Note: Specifications subject to change without notice.   Printed in Japan