Universal Reader Assistant User Guide

Supported Hardware :

- Sargas (firmware v5.1.5 and later)
- M6 and Astra-EX (firmware v4.19.2 and later)
- M6e (firmware v1.21.2 and later)
- Micro (firmware v1.9.1 and later)
- Nano (firmware v1.7.2 and later)
- M5e, Compact, USB and Vega (firmware v1.7.2 and later)

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09 Revision B March, 2016

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Introduction Navigation Path: Introduction

This document explains how to use the Universal Reader Assistant (URA) application, version 3.4 and later, for testing and performance tuning ThingMagic reader products. This User Guide was written for version 3.4.32, which is distributed with MercuryAPI version 1.29.4.

URA is written using the high level MercuryAPI in C# .NET. All the source code for URA is available as part of the MercuryAPI SDK. The MercuryAPI supports Java, .NET and C programming environments. The MercuryAPI Software Development Kit (SDK) contains additional sample applications and source code to help developers get started demoing and developing functionality. For more information on the MercuryAPI see the *MercuryAPI Programmers Guide* and the *MercuryAPI SDK*, available on the ThingMagic website.

This document assume you have read the corresponding Hardware Guide for the specific ThingMagic reader being connected to and understand how the reader is connected.

Note: Many features in URA v3.4 and beyond will not work with Astra. For use with Astra it is recommended you request an older version of URA from ThingMagic.

Note: Many of the early screen captures shown in this manual do not show all the tab options that were added later. As of this writing, the complete list of tabs are: "Tag Results", "Write EPC", "Tag Inspector", "User Memory", "Lock Tag", "Untraceable", and "Authenticate". Although not shown in every screen capture, they are fully explained in the appropriate section.

Usage Workflow

Navigation Path: Workflow

Once URA is installed, see Installing URA section for details, this document will step through the required steps in order to start reading tags and optimizing the reader?s performance for a specific usecase. At a high level the steps required, and corresponding document sections, are as following:

- 1. <u>Starting URA</u> This section provides an overview of the main components of the URA application displayed immediately upon startup.
- 2. <u>Connect</u> In order to control a reader and have it read tags the reader must first be connected to. This section provides details on connecting to the various types of readers URA can control.
- 3. <u>Basic Reading</u> Once a reader connection has been established the Read button can be clicked to start reading tags. As soon as a read is initiated tag data will be displayed in the main Tag Results Grid. This section provides details on display options and saving data.
- 4. <u>Settings/Status</u> If tags are being displayed, the next step is optimizing the performance for a particular usecase. This section describes the performance tuning parameters that are available and what they mean, along with status information available.
- 5. <u>Tag Operations</u> Once an inventory has been performed tag entries (EPC or Data cells) can be right-clicked on, presenting a variety of individual operations (writing, inspecting, etc.) that can be performed on a specific tag.
- 6. <u>Troubleshooting</u> The any of the previously defined steps don?t work this section will help diagnose and resolve the issue.

CAUTION !

If disconnecting from one reader and connecting to another (or connecting to the same, rebooted reader) it is recommended you restart URA. If URA isn't restarted the settings may become inconsistent between what is active on the reader and what is displayed in the URA <u>Settings/Status section</u> section.

Installing URA

Navigation Path: Installing URA

The Universal Reader Assistant application is available in two different packages:

- 1. Standalone Application
- 2. Source adn Executable from MercuryAPI SDK

Standalone Application

Navigation Path: <u>Installing URA</u> > <u>Standalone Application</u>

URA is available as a standalone application, installed using a Windows installer. Follow these steps to download and install URA:

- 1. Use a web browser to navigate to http://rfid.thingmagic.com/devkit.
- 2. Find the Universal Reader Assistant link under MercuryAPI | Software and click on it. This will begin download URABonjourSetup32.exe (for 32-bit Windows platforms, please contact ThingMagic support for 64-bit Windows)
- 3. Once downloaded, double-click on URABonjourSetup32.exe and follow the installation instructions.
- 4. Once complete there will be an entry in the Windows Start menu for *ThingMagic* | *UniversalReaderAssistant*

Note: The standalone version maybe newer than the version included in the SDK.

Note: The URABonjourSetup32.exe will also install <u>Apple Bonjour mDNS</u> <u>Discovery Service</u>.

Source and Executable from MercuryAPI SDK

Navigation Path: <u>Installing URA</u> > <u>Source and Executable from MercuryAPI SDK</u>

In addition to being available as a standalone application URA, along with all of its source code, is part of the MercuryAPI SDK. URA can be accessed via the SDK as follows:

- 1. Use a web browser to navigate to http://rfid.thingmagic.com/devkit
- 2. Find the MercuryAPI SDK link under MercuryAPI | Software and click on it. This will begin download SDK Zip package.
- 3. Once downloaded, double-click on the zip file to extract its contents.

Once the contents have been extracted the URA Visual Studio project can be found in:

[INSTALLDIR]/cs/Samples/UniversalReaderAssistant2.0

and the pre-built executable, along with the installer can be found in:

[INSTALLDIR]/cs/Samples/exe

Apple Bonjour mDNS Discovery Service

Navigation Path: <u>Installing URA</u> > <u>Apple Bonjour mDNS Discovery Service</u>

URA2 uses Apple's Bonjour service to discover Bonjour enabled <u>Network</u> <u>Readers</u>. If you do not want Bonjour to be installed simply Cancel out of Bonjour installer once its appears during the URA install and it will not be installed. URA2 will continue to be installed even if Bonjour is cancelled.

If not installed the <u>Network Readers</u> list will be empty during Connect and you will need to manually enter the hostname or IP address.

Starting URA

Navigation Path: <u>Starting URA</u>

Universal Reader Assitant Connection Wizard

Upon starting up URA, you will see the Connection Wizard as shown in Figure 1a. Connection Wizard is a three step proedure which helps users to connect to their correspoding module.

The three steps are:-

- Select Reader
- Connection Settings
- Connect/Read

Select Reader

In Select Reader Wizard page, user will be prompted to select a reader type and reader name. User needs to select one of the three reader types i.e Serail Reader, Network Reader (Fixed Reader) or Custom Transport Reader. Once the user selects the reader types, the user will have to select the specific Reader Name. If the reader name is not visible in the list, user can manually type in the reader name. Once the reader selects the reader, Next button will be enabled and on clicking Next Button, user will be taken to next step.



Figure 1a: Connection Wizard : Select Reader Connection Settings

Once user selects a specific reader, a Connection Settings Wizard page will come up. User will need to select basic settings which are required to connect to module. These settings are Reader region, Antenna connected to the reader and tag protocol which user wants to reads. Once the reader selects the reader settomgs, Next button will be enabled and on clicking Next Button, user will be taken to next step.



Figure 1b: Connection Wizard : Connection Settings Connect/Read

In Connec/Read Wizard page, user will have the option to either connect to reader or directly start reading. On this page, user can also see the details of the selected and the reader settings.



Figure 1c: Connection Wizard : Connect/Read

At any moment if the user wishes to change the reader or change any of the reader settings, Back button will help the user to go back and make changes. Back Button is available on every page of Connection Wizard.

If the user wants to directly move to Main Window of Universal Reader Assitant, click on Cancel Button.

Main Window

After Connection Wizard, user will be navigated to the main Tag Results screen as shown in Figure 1d.

🚳 Universal Reader Assistant					X
Reader URI : COM35	Connected	Read Disconn	nect 📐 📄 🥼 a	32°C	
Tag Results Write EPC T	ag Inspector User Memory	Lock Tag Untracea	able Authenticate	😹 Settings/Status	д
🖾 # EPC	TimeStamp(msec)	RSSI(dBm)	ReadCount	Connect	*
				Reader Type : Serial O Network O Custom Transport Reader Name : Micro (COM35) Transport Logs Refresh Disconnect Region : NA • Baud Rate : 115200 • Refresh Disconnect Region : NA • Baud Rate : 115200 • Load/Save Profile Load Save Performance Tuning Performance Metrics Display Options Reader Diagnostics Regulatory Testing Firmware Update Data Extensions 	
		© ThingMagic, a Divis	ion of Trimble. All Rights R	Reserved.	Ŧ

Figure 1d: Startup Tag Result Screen

This screen contains the basic controls for reading, viewing and handling the Tag Results.

Across the top of the window are the following controls and status:

- **Connect** button when clicked this will open the settings panel to the connect section. Once in the connect section the reader to connect to, including Networked Readers and Serial Readers can be specified and connected.
- **Reader URI** Once connected this will display the URI of the active connection.
- **LED and Status Message** show the status of the reader connection:
 - RED no connection to any readers
 - YELLOW Connection established to [Reader URI] and reader idle

- GREEN [Reader URI] actively reading
- **[Read]** Once connected a Read button will appear.
- Broom Icon Clears the Tag Results display
- **Disk Icon** Saves the tags shown in the Tag Results displayed to a file. Ifspecific tags are checked it will only save those tags.
- Antenna Icon Indicates when tag information is being streamed to a server
- **Thermometer Icon** Indicates the temperature when a M6e, Micro, Nano, or USBPro reader is continuously reading (AsyncOffTime=0)

Connect

Navigation Path: Connect

Once the Connect button on the Tag Results screen is clicked the connection options will be displayed. The radio button should be clicked to specify the type of reader being connected to. Please reference the specific product's Hardware Guide for details on how to establish a connection to each reader and how to identify the correct URI (hostname, IP Address, COM port, etc.) to identify it.

Network Reader

Navigation Path: <u>Connect</u> > <u>Network Reader</u>

Universal Read	ler Assistant	Apple Acres 4	and a later				x
Reader URI	: 10.2.0.111	<u> </u>	onnected Read	Disconnect 💊 📄 🌡	35°C Å		JIC ABLE
Tag Results	Write EPC	Tag Inspector	User Memory Lock Tag	Untraceable Authenticate		🔉 Settings/Status	Ļ
#	EPC		TimeStamp(msec)	RSSI(dBm)	ReadCount	 ✓ Connect 	-
						Reader Type : O Serial Network O Custom Transport Reader Name : Sargas123 (10.2.0.11) Transport Logs Refresh Web UI Disconnect Region : NA Load/Save Profile Load Save	

Figure 2: Connect to a Network Reader

Finding a reader on the network

If <u>Apple Bonjour mDNS Discovery Service</u> has been installed the Network Readers dropdown will contain a list of readers discovered on your network, select one and click Connect to continue.

If Bonjour has not been installed, in order to connect to a networked reader (Astra-EX, M6) the correct reader URI must be entered in the text box next to the Connect button. The specific value depends on the network configuration. The following are typical values for three common configurations, see the Hardware Guide for more details on figuring out the readers address.

• **Direct to PC connection** - if the reader is configured with an ethernet cable going from the host PC directly to the reader the reader's IP address is likely either using the fallback static address of 10.0.0.101 or using a link local address and can be contacted using the automatic hostname such as M6-XXXXXX or astra-ex-XXXXXX (where XXXXXX is the last 6 digits of the MAC/LAN address, seen on the barcode label)

Note: On some systems, especially when using the Direct to PC connection, the hostname must end in ".local" for the connection to succeed. i.e. *m6-21071f.local*

- **DHCP on the LAN** the reader should be identifiable using the automatic hostname such as M6-XXXXX (where XXXXXX is the last 6 digits of the MAC/ LAN address, seen on the barcode label).
- **Static IP on the LAN** the assigned IP address should be used. Although the reader name display is a pull-down menu, it can also be manually edited to enter an IP address.

Once the connection is established the Status LED should change to YELLOW and the Region selection in the Connect section will change to the region of the connected reader as shown in Figure 3. On networked readers the region of operation cannot be changed.

🚳 Universal Rea	ader Assistant	nar Anale II.		Contraction of the local division of the loc		×
Reader UR	I: 10.2.0.111	Connected Read	Disconnect 📐 📄 🌡	35°C Å	ThingMa	AGIC
Tag Results	Write EPC Tag Inspe	ctor User Memory Lock Tag	Untraceable Authenticate		🔉 Settings/Status	 р
#	EPC	TimeStamp(msec)	RSSI(dBm)	ReadCount	Connect	^
					Reader Type : O Serial @ Network O Custom Transport Reader Name : Sargas123 (10.2.0.11) Transport Logs Refresh Web UI Disconnec Region : NA • Load/Save Profile Load Save	

Figure 3: Connected to a Network Reader

Once connected go to WebUI for persistent settings

Once a connection to a networked reader is established the WebUI button will become active. Clicking on it will open up a browser to the reader's Web Interface which supports modifying the network configuration and making persistent changes to the Performance Settings of the reader. See the reader's Hardware Guide for details on using the WebUI.

Serial Readers

Navigation Path: <u>Connect</u> > <u>Serial Readers</u>

🎒 Uni	versal Reader Assistant	Apple Acoust	hate II				
Re	ader URI :	e c	Disconnected	Connect 💊 📑 🌡	35°C Å		A DIVISION OF TRIMBLE
Tag	Results Write EPC	Tag Inspector	User Memory Lock Tag	Untraceable Authenticate		🔉 Settings/Status	Ф
= #	EPC		TimeStamp(msec)	RSSI(dBm)	ReadCount	Connect	·
						Reader Type : © Serial © Network © Reader Name : Micro (COM35) © Transport Logs Region : NA → Baud Rate : Select → Load/Save Profile Load Save) Custom Transport

Figure 4: Connecting to a Serial Reader

Finding the assigned COM port

In order to connect to a serial reader (USB Reader, Vega, M5e/M6e devkits) the correct COM port must be selected from the drop down next to the Connect button. In order for the associated COM port to be displayed the reader must have been connected to the host prior to starting URA. If not, you can click Refresh to try and re-detect COM ports in use. The specific value depends on what the host system has assigned the new connection, typically it will be the last value in the list.

Baud Rate

If the reader is using a TTL/RS232 connection and you know the baud rate of reader being connected to you can select it prior to connecting. If you don't URA will attempt to figure it out. Once connected you can change the baud rate for faster communications, if supported.

For native USB connections the baud rate setting does not apply.

Region

Once the connection is established the Status LED should change to YELLOW and the Region selection in the Connect section will change to the default region of the connected reader, similar to Figure 3. For Serial Readers, the region will indicate "Select" if the reader is in its default configuration. A region will be displayed if one has been previously selected, saved, and restored automatically on reboot. Reading is not permitted until a region has been selected.

Transport Logging

Navigation Path: <u>Connect</u> > <u>Transport Logging</u>

For both connection types if *Transport Logging* is checked a logfile will be created containing all of the low level communication between URA and the reader. This can be very important to diagnosing a support problem.

When gathering logs for support it is recommended the following process be followed:

- 1. Prior to connect, check *Transport Logging*.
- 2. Click *Connect*.
- 3. Navigate to a filesystem location to save the log file and provide a name.
- 4. Perform the operations to reproduce the problem being debugged.
- 5. Once the problem has been reproduced, *Disconnect*.
- 6. Send the log to support.

Load and Save Profiles

Navigation Path: <u>Connect</u> > <u>Load and Save Profiles</u>

🕉 Settings/Status	ф
Connect	*
Reader Type : Serial Network Custom Transport	
Reader Name : Micro (COM35)	
Transport Logs	
Refresh Connect	
Region : NA 👻	
Baud Rate : Select 🔹	
Load/Save Profile Load Save	

Full settings and display options profiles can be saved, for the current running configuration, and loaded using the Save and Load buttons of the Connect section. Loading and saving profiles supports three different workflows, one for saving and two for loading, as follows:

Save Profile

Once connected to a reader, with it working as desired, the full configuration of the reader, including the reader connected to, all read options, performance settings and display settings can be saved to a URAC (URA Config) file by following these simple steps:

- 1. Click "Save"
- 2. File manager pops up in URA.exe directory. The default filename field populated with [reader type]_[readername].urac. This maybe changed as desired.
- 3. Click "Save" in the file manager to save to the specified file.

Load Profile - Before Reader Connect

If you have not yet connected to a reader and want to load a previously saved profile and connect to the same reader the profile was saved from the Load operation will both connect to the reader and load the saved profile:

- 1. With URA Status indicator showing [Red] Disconnected, click "Load".
- 2. Select desired *.urac file and "Load".
- 3. Load attempts to connect to the Reader URI saved as part of the profile.
- 4. If the connect fails an error will be displayed and the Load Profile After Reader is already connected workflow should be followed.
- 5. If connect succeeds the full saved profile and display options are loaded.

Load Profile - After Reader is already connected

If you want to load a previously saved profile onto a different reader than it was saved from you must first connect to the reader then load:

- 1. With URA Status indicator showing [Yellow] Connected, click "Load".
- 2. Select desired *.urac file and "Load".
- 3. Since already connected Load ignores reader URI and only loads the profile.
- 4. The full saved profile and display options are loaded.

Basic Reading

Navigation Path: Basic Reading

Once connected to a reader you can quickly start reading and obtain immediate feedback using default settings. Simply position one or more tags in front of one of the antennas connected to the reader and:

- Click *Read* This will start a continuous read on all connected antennas in the default configuration. The resulting tags will be displayed in the <u>Tag</u> <u>Results Grid as shown in</u> *Figure 5*. While reading is active the Status LED will be GREEN.
- 2. Click *Stop Reading* to end the search.

In order to change the reading behavior and improve performance for a particular usecase see the <u>Settings/Status</u> section.

۵, U	nive	ersal Reader Assistant 2.0					x
	7	A DIVISION OF TRIMBLE	m6-21071f	Reading Stop Reading			
Tag	g Re	esults		C			22
	#	EPC	TimeStamp (msec)	RSSI (dBm)	ReadCount		Settin
	01	1000E28011042000248CF	12:04:33.301	0	430	*	/s6i
	02	1000000000002000228DF	12:04:33.161	0	458		Sta
	03	1000000000002000218DF	12:04:33.270	0	453		atus
	04	1000000000002000288DF	12:04:33.091	0	478		Ľ
	05	1000E200341103B800000	12:04:33.231	0	434		
	06	1000E28011042000264CF	12:04:33.180	0	431		
	07	1000E28011042000258CF	12:04:33.291	0	394		
	08	100000000000000E2001	12:04:33.091	0	465		
	09	1000E28011042000248DF	12:04:33.020	0	339		
	10	1000E2801104200028CCF	12:04:33.290	0	401		
	11	1000E28011042000244CF	12:04:33.180	0	327	=	
	12	1000E28011042000218CF	12:04:33.190	0	350		
	13	1000E280110420002A4CF	12:04:33.301	0	419		
	14	1000E2801104200026CCF	12:04:33.061	0	378		
	15	300833B2DDD901403505(12:04:33.100	0	503		
	16	1000E28011042000238CF	12:04:33.231	0	150		
	17	1000E28011042000244DF	12:04:33.190	0	266		
	18	1000E28011042000288CF	12:04:33.231	0	352		
	19	1000E28011042000278CF	12:04:33.121	0	248		
	20	1000E2801104200024CCF	12:04:33.091	0	366		
	21	1000E280110420002A8DF	12:04:32.830	0	138		
	20	400050004404000000005	40-04-00 004	0	000		

Figure 5: Default Tag Results Display

Tag Results Grid

Navigation Path: <u>Basic Reading</u> > <u>Tag Results Grid</u>

As shown in Figure 5, the default displayed tag results show the following columns of data:

- *#* The order each tag was read.
- **EPC** The EPC ID of the tag, typically 96-bits of data shown in Hex.
- **Timestamp** The timestamp when the tag was last seen during this query.
- **RSSI** The receive signal strength of the tag response, in dBm.
- **ReadCount** The number of times the tag was read on [Antenna].

In addition to the above fields, additional fields can be displayed using the Display Options settings. These include:

- Antenna the number of the antenna over which the tag was read.
- **Frequency** the channel the reader was on when the tag was read, displayed in kHz (e.g. "915750").
- **Phase** The phase, from 0 to 180 degrees, between the outgoing carrier and the signal reflected back by the tag.
- **Protocol** Protocol used when the tag was read. (e.g. "Gen2", "ISO18000-6B", "IPX64", ATA etc). (Protocols are selected in the "Read/Write Options" panel. If only "Gen2" is displayed, then you have not applied the appropriate license to the module to read additional protocols.)

If "Antenna" or "Frequency" are chosen, each combination of EPC, Antenna, and Frequency will be displayed on a separate line in the Tag Results Grid.

Clicking on a column header will reorder the displayed tags based on that field.

Save Data Navigation Path: <u>Basic Reading</u> > <u>Save Data</u>

Once reading is stopped and tags are displayed in the Tag Results Grid, the displayed data can be saved to a file by checking the check-box in the far left column for each tag to save; or leave them all unchecked to save all. Select the file to save the data to and click *Save*.

Settings/Status

Navigation Path: Settings/Status

Upon Connect the Settings/Status slide-out panel, as shown in Figure 6, will be displayed and opened to the Connect section. This panel contains configuration settings for the Ta Results Grid, read behavior and performance tuning, along with status information and a Firmware Upgrade utility. Each section can be independently expanded/collapsed and the entire panel can be pinned in placed or left to open and auto-collapse based on mouse position using the pin icon in the upper right corner of the panel.



Figure 6: Settings/Status Panel

Read Option

Navigation Path: <u>Settings/Status</u> > <u>Read Option</u>

This sections allows the basic behavior of a Read operation to be defined (relates to the read method and ReadPlan configuration as defined in the MercuryAPI) for when the *Read* button is clicked. It contains the following options

Table 1: Read Options

Setting	Description
Read Behavior	 Read Continuously - Clicking Read causes a continuous read to be run until <i>Stop Reading</i> is clicked. Will read using the RF On/RF Off duty cycle as defined by those settings. Read Once - Each click of Read causes a single query for the time specified. Optionally select/deselect Fast Search which optimizes performance for maximum re-reads of a few tags
Protocols	The protocols supported by the connected reader will be displayed. Check those to be queried for. When Read is clicked the selected protocols will be cycled through.
Antennas	 Antennas - The antennas supported by the connected reader will be displayed. Check those to be queried for. When Read is clicked the selected antennas will be cycled through. Antenna Detection - Will make only antennas with a detected antenna connection available. Uncheck to make all ports available. Switching Method - Specifies how the reader will switch between antennas during a read operation if multiple antennas are selected: Equal Time - The RF On or Timeout value specified in the Read Behavior will be divided equally among

	 Dynamic - The read cycles through the antennas, moving to the next antenna when no more tags are found on the current antenna. The cycle resets to the first antenna every RF On/Timeout period.
Embedded ReadData	 For every tag read the specified memory bank location will also be read for that tag and displayed in the <i>Data</i> column in <i>Tag Results</i>. Enable - Displays the embedded read data options to be added to the read operation and adds the Data column. Membank - The memory bank to read from. Start - The starting WORD address to read from. (0 based) Length - The number of WORDs of data to read. Specifying 0 will result in the entire memory bank starting at address Start to be read, up to 128 words. UniqueByData - Causes the data read to be used as a unique identifier of the tag. Useful if many tags in the field have the same EPC, read the TID UID and they will be distinguishable.
Filter	 This will apply a Gen2 Select filter so only tags matching the specified criteria will be read. Membank - Memory bank to apply filter on. Start - Starting BIT address to apply filter against. Filter Data - The value (in Hex) to compare with the data in <i>Membank</i> at <i>Start</i> address. Invert - invert the selection, deselect tags that match the filter criteria and return the ones which don't.

Performance Metrics

Navigation Path: <u>Settings/Status</u> > <u>Performance Metrics</u>

This section displays performance metrics of the active or just performed *Read* operation:

Setting	Description
Unique Tag Count	Total number of unique tags found.
Total Tag Count	Total number of tags read, including re-reads of the same tag. Also displays the time during which those tags were read.
ReadRate/Sec	Using the Total Tag Count metric, displays the average tags per second.

Table 2: Performance Metrics
Performance Metrics

Navigation Path: <u>Settings/Status</u> > <u>Performance Tuning Option</u>

This section provides a set of options, based on high-level usecase characteristics, allowing the reader performance to be optimized.

Setting	Description
Read Power	Control the amount of RF Power transmitted by the reader, to the antenna, when reading. The RF power directly relates to the range at which the reader can "see" tags, the higher the power, the longer the range.
Tag Population Size	 Automatically adjust settings as tag population changes - Reader dynamically adjusts optimization setting depending on the tag population it detects in the field. Optimize for estimated number of tags in the field - If the tag population size is relatively well known and consistent, performance can be increased by optimizing for that size. In this case enter the approximate population size for increased performance.
	• Maximum tag read rate - Performance is optimized for maximizing the speed of tag to/from reader communications, which results in more tags being read faster.
Read Distance vs Read	ORMaximum Tag read distance - Performance is optimized
Rate	for reading weaker, harder to read tags.

Table 3: Performance Tuning Option

	Note : Mostly applicable to using Battery Assisted Passive Tags. Most Passive Tag applications are range limited by the power output from the antenna, not the reader's ability to "hear" a tag's response.
Tag Response Rate	 Select best choice for population size - used the Tag Population size setting to determine best settings. Only recommended to be used if setting an estimated tag population size. Customize tag response rate - adjust between: Tags respond more often - tags will re-respond to an ongoing inventory as quickly as possible. Not recommended for large populations of tags. Tags respond less often - Tags will sleep for their "flag persistence" period, (duration depends on exact setting and tag specifics). This is preferred when trying to inventory large populations of tags as it allows "weaker" tags a chance to respond.
Configure Gen2 Settings	Switches the setting options from the high-level use-case characteristics to low level Gen2 Protocol Settings. See Advanced Performance Tuning

Advanced Performance Tuning

Navigation Path: <u>Settings/Status</u> > <u>Advanced Performance Tuning</u>

When the Configure Gen2 Settings button is clicked in the Performance Tuning Options section the high-level use-case settings are disabled and the Gen2 Protocol settings can be set directly. See the *MercuryAPI Programmers Guide Performance Tuning* section for more details on these settings.

Note : Once the high-level settings have been configured to maximize performance for a usecase the *Configure Gen2 Settings* button can be clicked and the corresponding low level settings will be displayed. These settings can then be used in a MercuryAPI application to maintain the performance tunings.

Display Option

Navigation Path: <u>Settings/Status</u> > <u>Display Option</u>

This sections allows the content and behavior of the Tag Results Grid to be configured. It contains the following options:

Setting	Description
Font Size	Set the font size used in the Tag Results Grid. Smaller fonts enable more rows to be visible.
Tag Aging	When enabled (checked) the row of a tag will progress through multiple shades of gray as it "ages", i.e. hasn?t been re-read in subsequent inventory rounds.
Refresh Rate	For most applications, leave this at its default value of 100 ms. If URA is used to read a large tag population (greater than 150 tags) over a very long period of time, the URA refresh rate should be changed to 999 msec. This gives the "garbage collection" routine enough time to prevent memory leakage.
Tag Results Column	 Additional Columns of tag read meta data can be selected (click check-box in drop-down menu) to be displayed: Antenna - The antenna on with the tag was read. If the same tag is read on more than one antenna there will be a tag entry for each antenna on which the tag was read. Protocol - The protocol of the tag. Frequency - The frequency on which the tag was read, in kHz. Phase - Average phase of tag response in degrees (0°-180°)i> TagReadData - The data read when the Tag Data Settings Read Data option is selected. If the tag doesn?t have the requested data "Read Data failed" will be

Table 4: Display Option

	returned.
TimeStamp Format	Select timestamp format to be displayed.
Big Num Selection	Settings to optionally display various summary information, while querying, in a big number format.

Reader Diagnositcs

Navigation Path: <u>Settings/Status</u> > <u>Reader Diagnostics</u>

This section displays version information about URA and the connected reader. When contacting ThingMagic support for issues found while using URA it is recommended this information be provided.

- **RFID Engine** type of reader connected to.
- Firmware Version firmware running on the connected reader.
- **Hardware Version** version of hardware (can be useful to support when issues arise).
- Universal Reader Assistant running version of URA
- **MercuryAPI Version** version of the MercuryAPI SDK this URA was built with.

Regulatory Testing

Navigation Path: <u>Settings/Status</u> > <u>Regulatory Testing</u>

This section is used to create test signals and customize the hop table to adhere to local regulations that limit the channel frequency range beyond limitations imposed by the region setting.

Note : These settings do not apply to M6 or Astra-EX readers. Their hop table can only be limited by editing a configuration file on the reader.

Three tabbed choices are available:

- CW will send an unmodulated carrier for a configurable amount of time (in msec). The channel used will be the first one in the hop table.
- PRBS Will send a signal modulated with random data for a configurable amount of time (in msec). The channel used will be the first one in the hop table.
- Hop Table Comma-separated (no spaces) list of all the channels in the hop table, in the order they will be used. Selecting a new region always refreshes the list to the default hop table for that region. ThingMagic modules support up to 62 entries in their hop table (no pre-defined regions currently have a hop table larger than 51 entries).

Firmware Upgrade

Navigation Path: <u>Settings/Status</u> > <u>Firmware Upgrade</u>

The section provides a means to upgrade the firmware of the connected reader.

To upgrade

- Click *Choose Firmware* and navigate to the filesystem location where the firmware file is located.
- Select the firmware file and click *Open*.
- Click *Upgrade*.
- Upon completion the Status message will change to indicate it has completed.

Note : The latest firmware is always available on

http://www.thingmagic.com/index.php/manuals-firmware. It requires a password which can be obtained from ThingMagic Support if you have an active support contract.

Note : This utility can be used to downgrade firmware also.

Data Extensions(Demo Functionality)

Navigation Path: <u>Settings/Status</u> > <u>Data Extensions(Demo Functionality)</u>

The section provides demo functionality to stream data, as a server, to a network port where client applications can listen and recieve tag read data.

When enabled tag read data will be sent to the specified network port in a tabdelimited format containing "[EPC ID] [Timestamp] [RSSI] [Antenna ID]", for example:

123422223333444455556666 6/24/2014 1:55:03 PM -22 1

AAAABBBBCCCCDDDDEEEEFFFF 6/24/2014 1:55:03 PM -81 1

Any client that can connect to the specified network port can connect and receive the data.

Note : Current functionality is limited to a single client connection.

Note : Current tag read data is not buffered. If no client is connected tag reads will be not be sent. Once connected tag read data will be seen from the time of connection forward.

Testing Data Extensions

To enable data extensions simply select Enable Data Extensions:

 Data Extensions 		
Data Extensions		
EnableDataExtensions		
Stream to TCP port	9055	
HTTP POST		

Figure 7: Enable Data Extensions

Once enabled clients can connect to the specified port. A simple test client to use is a telnet client. On Linux this can be invoked by simply entering:

\$ telnet [IP address of URA host] 9055

Note : On Windows a telnet client applications such as putty or teraterm (both can be found by running a websearch on their name). Follow each applications instructions for connect a telnet client to

```
host: [URA host IP address]
```

port: 9055

With a client connected read output is now pending "Start Reading" being clicked. Starts and stops of reading do not affect the port. Port is closed upon disconnecting from reader or unchecking "Enable Data Extensions".

When reading the Status bar will indicate a client is connected and data is streaming, example above.



Figure 8: Data Extension Client Connected and Data Streaming Status



Figure 9: Data Extension Client Connected and Data Streaming Icon

Tag Operations

Navigation Path: <u>Tag Operations</u>

Universal Reader Assistant 2 currently supports the following individual Tag Operations:

- <u>Write EPC</u>
- <u>Tag Inspector</u>
- <u>User Memory Editor</u>
- Lock Tag
- <u>Untraceable</u>
- <u>Authenticate</u>

All Tag Operations Tabs support two main workflows which define what tag will be operated on.

Workflows

Navigation Path: <u>Tag Operations</u> > <u>Workflows</u>

1. User Clicks on one of the tag operation tabs. This causes the following behavior:

First tag to respond is selected. This means when an operation is performed it will be performed on the first tag to respond. If more than one tag is in the field the tag to be operated on is non-deterministic. Clicking Read/Refresh buttons will often provide a warning indicating that more than one tag was found.

The first detected/selected antenna will be used for the operation.

2. User right-clicks on EPC ID or Data (from enabling an Embedded ReadData) cell in the Tag Results Grid and selects a tag operation. This causes the following behavior:

A Select filter will be applied when the selected tag operation is invoked. The select filter to be applied will be shown in the top section of the operation tab.

The antenna the tag was read on (add the Antenna column in Display Options to the Tag Results Grid to see which) will be used for the tag operation.

Note : Following workflow #2 does not guarantee the operation will be isolated to a specific tag. If you are not certain if the select critieria only applies to a single tag the Read/Refresh button can be used to check. Clicking it a few times should always show the same data and should not result in any warnings.

Note : The best way to guarantee the select identifies a single tag is to add an EmbeddedReadData on TID memory?s Unique Identifier portion (use length =0) to your Read operation and right-click on the resulting Data cell in the Tag Results Grid.

Once in a tag operations tab most of the Settings/Status options do not apply and will be disabled.

Write EPC

Navigation Path: <u>Tag Operations</u> > <u>Write EPC</u>

The Write EPC tag operation tab allows the EPC of specific tags to be updated. The tag the operation will be applied to follows the rules defined in the two Tag Operations Workflows.

Once the tag to operate on has been set the WriteEPC tab supports the following workflow:

- 1. The EPC ID read and written can be represented in several formats. The format used to display the data in the Current and New EPC sections will both be in the selected format:
 - **Hexidecimal** direct hexidecimal representation of the raw data on the tag. This will match the cell value shown in the Tag Results Grid.
 - **ASCII** interprets the data on the tag as ASCII characters. See the http://www.asciitable.com/ for a chart showing the corresponding hexidecimal value an ASCII character represents. Control characters may not be displayable.
 - **Reverse Base 36** A method to represent an EPC with the fewer characters (19 characters for an EPC that would need 24 characters in hexadecimal). It contains all the uppercase letters of the alphabet plus numbers 0-9.

Note : Perform a Read then switch between the representations to better understand different representations of the same raw data.

- 2. The **Current EPC** section will display the EPC of the tag that will be operated on based on the Write to selection. If clicking on Read results in a warning then the tag written to cannot be guaranteed.
- 3. Once confident the desired tag is setup to be written to, clicking the Write button will cause the **New EPC** to be written to the tag.

Example

The following shows a typical scenario of writing a tag?s EPC ID using Workflows 2, selecting a specific tag:

1. A Read operation was performed with an Embedded ReadData on the TID memory bank resulting in the tags as shown in *Figure 10*.

Tag	g Re	sults Write EPC						
	#	EPC	Data	TimeStamp (msec)	RSSI (dBm)	Read Count	Antenna	
	49	4D696B657354616731323334	21 1B E6 DD 00 00	03:19:42.885	-54	170	3	
	6	100000000000000000000000000000000000000	24 4C FC DF 00 00	03:19:42.347	-46	19	1	
	1	100000000000000000000000000000000000000	21 8C FC 99 00 00	03:19:42.328	-35	25	1	
	2	100000000000000000000000000000000000000	27 4C FC 81 00 00	03:19:42.291	-29	26	1	
	14	100000000000000000000000000000000000000	26 4C FD 15 00 00	03:19:42.286	-39	28	1	

Figure 10: Tag Results - Tag Operation Workflow 2

- 2. Right-click on the TID value and select WriteEPC. The tab will switch to the WriteEPC tab with the Select criteria as shown in *Figure 11*. Since this tag was read on Antenna 3, the write operation will be attempted on antenna 3.
- 3. This tag's EPC ID was previously written with ASCII data so switching to ASCII Text shows the ASCII interpretation of the raw data as shown in Figure 11.

First tag to respond	
Tag selected in Tag Results page	
Select Filter for WriteEPC: TID Memory, Address = 3 and Data	a = 211BE6DD0000
How to represent EPC	47.0
Hexadecimal	
ASCII Text	
C / WOUL ICAL	
© Reverse Base 36	
© Reverse Base 36	
© Reverse Base 36 Current EPC	
© Reverse Base 36 Current EPC MikesTag1234	Read
© Reverse Base 36 Current EPC MikesTag1234	Read
© Reverse Base 36 Current EPC MikesTag1234	Read
© Reverse Base 36 Current EPC MikesTag1234	Read
© Reverse Base 36 Current EPC MikesTag1234 New EPC	Read

Figure 11: Write EPC Workflow 2

4. Once a New EPC is entered and Write clicked, if successful, a follow-up Read should show the newly written EPC, as shown in *Figure 12*.

Read
Write

Figure 12: WriteEPC Successful Write and Read

Note : If the EPC ID is used for Select (right-click on the EPC cell) the Read operation will not work following a successful write. In general, using the current EPC ID as a select criteria for a write EPC is a bad idea since the operation cannot be easily reried in the event of a partial write.

Tag Inspector

Navigation Path: <u>Tag Operations</u> > <u>Tag Inspector</u>

The Tag Inpector tab allows the full contents of a tag's memory banks to be displayed in context.

Once the tag to operate on has been set the Tag Inspector will read the full contens of all the memory banks of the tag, as long as they exist and are not read-locked and display them as shown in *Figure 13*.

The Tag Inspector is a useful tool to learn about the varied contents of a Gen2 RFID tagand the meaning of data in specific memory locations. It can also be used as a debugging tool to verify expected contents on specific tags that might be behaving inconsistently. For example, checking to make sure the tag is of the same type (TID Vendor and Model) as other tags in use or verifying expected memory banks exist, are readable and have the expected contents.

Note : In general the most reliable way to select a tag for inspection is by performing a Read with an Embedded Read TID on full TID contents, then right-clicking on theData cell for the desired tag to Select on its TID value.

Tag Results Write EF	C Tag Inspector				
Tag to Inspect					
 First tag to respon Tag selected in Ta Showing tag: EPC 	d g Results page	Refresh			
Reserved Memory Bank	c (0)				
Purpose:	Kill Password	Access Passwo	rd		
Value (Hex):	FF 11 22 33	00 00 00 01			
Address (Word):	O	2			
EPC Memory Bank (1)					
Purpose:	CRC PC	EPC ID		Additional Memory	
Value (Hex):	8F 21 30 00	53 71 75 69 67 67 6C	65 54 61 67 31		
Value ASCII Reverse	Base 36	SquiggleTag1			
Address (word):	0 1	2			
TID Memory Bank (2)					
Purpose:	CIsID Vendor ID	D Model ID	Unique ID		
∀alue (Hex):	E2 003	412	01 68 10 00 08 B0 56 09 09 13 01 7F	70 01 5F FB FF FF DC 10	
Meaning	Alien	Higgs 3			
Address (word):	0		2		
User Memory Bank (3)					
Purpose:	User Data				
∀alue (Hex):	00 00 00 00 00 00 00	00 00 00 00 00 00 00 11 1	1 22 22 33 33 44 44 00 00 00 00 00 00 00 0	0 00 00 00 00 00 00 00 00 00 00 00	0 00 00 00 00 00 00 00 00 00 🔵
Value(ASCII)		20""33DD00000000			

Figure 13: Tag Inspector

User Memory Editor

Navigation Path: <u>Tag Operations</u> > <u>User Memory Editor</u>

The User Memory Editor tag operation tab allows the contents of User Memory of specific tags to be viewed and updated. The tag the operation will be applied to follows the rules defined in the two Tag Operations Workflows.

Once the tag to operate on has been set the User Memory Editor tab supports the following workflow:

- 1. The contents of User Memory to be read and written can be represented in two ways:
 - Addressible Hexidecimal direct hexidecimal representation of the raw data on the tag. In this mode the data is displayed as individual bytes in a grid showing the specific address within the User Memory bank. Modified, but not yet written, data will be shown in red.

Tag to Read/W	Vrite																
First tag	to respond		_														
OTes esta	ated in Ten 1	Desulte nee	Re	fresh													
I ag sele	cted in Tag i	Results pag															
Showing	tag: EPC ID	= 8888															
How To Repre	sent User N	lemory Dat	а														
Addresse	d Hexadecin	nal															
ASCII No	tepad																
<u> </u>																	
ddroneod Ho	* Editor																
Addressed He	x Editor																
Addressed He Write To	Tag																
Addressed He Write To Word	Tag												Space	for 64 bytes	s available		
Addressed He Write To Word Address (He	Tag												Space	for 64 bytes	s available		
Addressed He Write To Word Address (He	ex Editor Tag ex) 0x0000	0×0001	0×0002	0x0003	0x0004	0×0005	0×0006	0×0007	0×0008	0×0009	0x000a	0х000ь	Space 0x000c	for 64 bytes 0x000d	s available 0x000e	0×000f	
Addressed He Write To Word Address (He 0x0000	ex Editor Tag (x) (x) (x) (x) (x) (x) (x) (x) (x) (x)	0x0001	0×0002 00	0x0003 44	0×0004 00	0x0005 00	0×0006 00	0×0007 00	0×0008	0x0009	0x000a	0×000b	Space 0x000c 00	for 64 bytes 0x000d 00	s available 0x000e 00	0×000f	
Addressed He Write To Word Address (He	ex Editor Tag 0x0000 00	0x0001	0×0002	0×0003 44	0×0004	0×0005	0×0006 00	0×0007	0000×0	0x0009	0x000a	0x000b	Space 0x000c	0x000d	s available 0x000e 00	0x000f	
Addressed He Write To Word Address (He 0x0000 0x0010	EX Editor Tag 0x0000 00 00	0x0001 00	0×0002 00 00	0x0003 44 00	0x0004 00 00	0×0005 00 00	0×0006 00 00	0×0007 00 00	0×0008 00 00	0×0009 00 00	0x000a 00	0×000b 00	Space 0x000c 00 00	0x000d 00 00	s available 0x000e 00 00	0×000f 00	
Addressed He Write To Word Address (He 0x0000 0x0010 0x0010	Ex Editor Tag 0x0000 00 00 00	0×0001 00 00	0×0002 00 00	0x0003 44 00	0×0004 00 00	0×0005 00 00	0×0006 00 00	0×0007 00 00	0×0008 00 00	0×0009 00 00	0x000a 00 00	0x000b 00 00	Space 0x000c 00 00 00	e for 64 bytes 0x000d 00 00 00	s available 0x000e 00 00 00	0×000f 00 00	
Addressed He Write To Word Address (He 0x0000 0x0010 0x0010	Ex Editor Tag 0x0000 00 00 00 00	0×0001 00 00	0×0002 00 00 00	0x0003 44 00 00	0×0004 00 00 00	0×0005 00 00 00	0×0006 00 00 00	0×0007 00 00 00	0×0008 00 00 00	0x0009 00 00 00	0x000a 00 00 00	0x000b 00 00	Space 0x000c 00 00 00	0x000d 00 00 00 00	s available 0x000e 00 00 00 00 00	0x000f 00 00	

Figure 14: Addressible Hex Editor

• **ASCII Notepad** - interprets the data on the tag as ASCII characters. In this mode the data can be displayed and edited as if it were a text file in a text editor. Modified, but not yet written, data will be shown in red.

Tag to Dead Write	
Tag to Read/write	
First tag to respond Tag selected in Tag Results page Showing tag: EPC ID = BBBB	
How To Represent User Memory Data	
Addressed Hexadecimal	
ASCII Notepad	
ASCII Text Editor Write To Tag	
	Space for 64 characters available: 14 characters remaining
Any text can be writted here and saved to the tag.	

Figure 15: ASCII Notepad Editor

Note: While typing in ASCII Notepad Editor the total space and remaining space available will be shown in red.

2. Once confident the desired data is setup to be written to, clicking the Write to Tag button will cause the data to be written to the tag?s User Memory Bank.

Warning :

In URA, when a Write to Tag is clicked, whether in the ASCII Editor or Hex Editor the entire contents of the User Memory will be written as shown in the editor. It WILL NOT only write modified data. This can result in long write times for large memory tags. In URA v2.4 this has been fixed so only the edited bytes will be written. The Lock Tag operation tab allows the contents of specific tags to be locked and unlocked and the Access Password of the tag to be written. The tag the operations will be applied to follows the rules defined in the two Tag Operations Workflows.

Once the tag to operate on has been set the Lock Tag tab supports the following workflow:

- 1. Upon tag selection the Access Password is read (if not read-locked) and displayed. In order to lock the contents of a tag first the Access Password should be set to a non-zero value. Contents can be locked with a zero access password but it will not be secure since no password is required to operate on the contents of unlock them.
- 2. If Access Password Write is clicked the password is written to the tag. From this point on, for locking to work, the Access Password field in URA must match the value written to the Access Password section of Reserved Memory (see the Tag Inspector to see the memory structure)
- 3. Select the locking operations to be performed and click Apply. The successful, or failed, locks will be indicated in the Apply Locks section.
 - If Access Password is selected to be Read/Write Locked when Apply is clicked you will first be prompted to save the value being written to a file so it will be remembered. The saved file will contain the tag?s EPC ID, full TID and the password written. Once the file is saved the locks will be attempted.

Tag Results Write EPC	Tag Inspector	User Memory Lock	тад	
Tag to Read/Write				
 First tag to respond Tag selected in Tag Res Showing tag: TID data at 	ults page address 0 = E280110	esh 042000228DFC990000)	
Access Password				
Enter the Access Passworr must match the value store Memory. If it doesn't, Write	d to use for locking. It ed in Reserved • it.	11 11 22 22		Write
Lock Actions				
	UnLock	Write Lock	Read/Write Lock	Permanent?
User Memory				
EPC Memory		\checkmark		
Access Password			~	
Kill Password				
Apply Locks				
The following MercuryAPI	LockActions will be a	applied:		Apply
Gen2.LockAction.EPC_LC Gen2.LockAction.ACCES	DCK S_LOCK			

Figure 16: Lock Tag Operation

Note :

It is not possible to request the current lock status from a Gen2 tag. For this reason the Lock Tag tab cannot show the current lock state. It can only be used to request new locking states be applied.

Untraceable

Navigation Path: <u>Tag Operations</u> > <u>Untraceable</u>

Introduction to Gen2V2

These instructions describe how to use a Micro module with firmware version 1.07.01 or greater with Universal Reader Assistant 2.6.18.18 or greater (distributed with API version 1.27.1) to demonstrate the EPCglobal Gen2V2 properties of NXP "UCODE DNA" tags.

These capabilities are:

- 1. Enabling the "Untraceable" feature which permits obscuring all or part of the EPC; all, part, or none of the TID; and all or none of the User memory
- 2. Inserting and activating key0 and key1 (both keys can be used for authentication of the tag, but only key1 can be used to read data securely)
- 3. Ability to read data securely, either by obtaining the data over the air, or asking the tag to store the data in buffer memory, where it is obtained securely.

Note that as with all function tabs, you may either go to the tag and act on the first tag to respond, or you may select a tag in the Tag Results page, left-click on its EPC field, then use the right mouse button to select a tab category. The EPC of that tag will automatically be used to communicate with that tag selectively:



Figure 17: Tag Selection for Advanced Operations

Note : If you are going to vary the tag's reported EPC length using the Untraceable function, it is best to read the first tag to respond as the selective search for the tag does not automatically adjust to the changing EPC value.

Confirming Tag Type

After you get URA connected to the Micro, make sure that the tag is readable and it is an NXP AES (also called "DNA") tag:

Tag Results Write E	PC Ta	ag Inspect	or User Memory	Lock Tag Unt	traceable Authenticate	
Tag to Inspect						
 First tag to respond Tag selected in Tag 	nd ag Result	s page	Read			
Showing tag: EPC	ID = E20	JU6F92000	JUUUJAUUZEA8CU			
Reserved Memory Bar	nk (0)					
Purpose:	Kill Pas	sword	Access Pass	sword		
Value (Hex):	00 00	00 00	00 00 00 00)		
Word Address (Dec): 0		2			
EPC Memory Bank (1)						
Purpose:	CRC	PC	EPC ID		Extended EPC Memory	
Value (Hex):	8F 4D	34 00	E2 C0 6F 92 00 00	0 00 3A 00 2E A8 C0	00 00 00 00 00 00 0	
Value ASCII	Base 38		âÀo :."À			E
Word Address (De	ec):0	1	2		8	
TID Memory Bank (2)						
Purpose:	CISID	Vendor I	D Model ID	Unique ID		
Value (Hex):	E2	C06	F92	20 00 00 02 00 2	2E A8 C0	
Meaning	<	NXP	AES			
Word Address (De	ec):0			2		
User Memory Bank (3))					
Purpose:	User D	ata				
Value (Hex):	00 00	00 00 00 00	0 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00	0 00 00 00 00 00 00 00 00 00 00 00 00 0	00
Value(ASCII)		•••••				
4						-

Figure 18: Confirming Tag Type

If you wish to assign an Access Password to the tag for additional security, do so through the Lock Tag tab.

Note : Although the current value of the Access Password is shown with spaces between the bytes, if you enter a desired value, you must remove these spaces.

Note : The NXP "UCODE DNA" tags currently require that the Access Password be nonzero in order for the Untraceable command to configure the tag

properly. Once the Untraceable value is set, however, the value of the Access Password can be zero or non-zero when obtaining the EPC, TID or User memory values.

Untraceable Function

You use the Untraceable function by selecting the options and then pressing "Write to Tag" to send the desired configuration to the tag and activate it. Note that you need to use a non-zero Access Password to set the Untraceable properties. Thereafter, you may define the access password back to all zeroes when reading the allowed tag information, f you wish.



Figure 19: Changing Untraceable Settings

Note : When the tag is read, this display does NOT show the current state of the settings for the tag except for the Access password. This display always returns to its default choices and there is no way of knowing what the tag is configured to return for each data field.

Changing EPC Options

Select whether you want the tag to report its entire EPC, or a partial EPC. The partial EPC may be adjusted in units of Words (2 bytes). Note that you may not only shorten the EPC, but you may lengthen it as well, to the limits of the extra data in the EPC memory (see results of Tag Inspector).

As you make changes to the EPC length, and repeatedly read from the Tag Results page, you will see that the tag is identified as unique as each change is made. Here is an example of the tag reporting the entire EPC (6 Words), EPC shortened to 4 Words, and EPC lengthened to 8 Words.

Тас) Re	sults Write EPC Tag Inspector User Mem	ory Lock Tag Untra	ceable Authenticate	
	#	EPC	TimeStamp(msec)	RSSI(dBm)	ReadC
	1	E2C06F92000003A002EA8C0	06:31:10.012 PM	-31	68
	2	E2C06F92000003A	06:31:30.115 PM	-32	23
	3	E2C06F92000003A002EA8C00000000	06:31:53.257 PM	-31	31

Figure 20: Results of Changing EPC Untraceable Options

Changing TID Options

The choices for TID is to show all (tag make and model plus serial number), Tag info only, or not to reveal any. To observe these changes, use the Embedded ReadData function with the setting shown here ("UniqueByData" will allow you to see all the changes and not have new reads overwrite the old ones in Tag Results. "Show failed Data Reads" will allow you to see the tag reads when the TID is not reported.

Embedded ReadData	
MemBank TID Start 0 Length 0	
UniqueByData Show Failed Data Reads	
Filter — Apply Filter	

Figure 21: Displaying Results of TID Options

The results are shown here, for TID choices of "Show All", "Show Tag Info Only" and "Show None".

 Tag	Re	sults Write EPC Tag Inspector	User Memory Lock Tag Untraceable	Authenticate)	
	#	EPC	Data	TimeStam p(msec)	RSSI (dBm)	ReadCou nt
	1	E2C06F92000003A002EA94F		09:01:14.2	-37	100
	2	E2C06F92000003A002EA94F	E2 C0 6F 92	09:02:11.4	-36	195
	3	E2C06F92000003A002EA94F	E2 C0 6F 92 20 00 00 02 00 2E A9 4F	09:02:20.0	-31	29

Figure 22: Results of Changing TID Untraceable Options

Note that in order to read the TID when "Show Tag Info Only" is active, you must specify that you want to read two words, as shown here:

Embedded ReadData	
Enable	
MemBank TID Start 0 Length 2	
🗹 UniqueByData 🗷 Show Failed Data Reads	
Filter	$\overline{}$
Apply Filter	

Figure 23: Requesting 2 Words of TID Data

If you specify a length of "0", no TID data will be returned.

Changing User Data Options

The choices for User Data are "Show All" and "Show None".

The settings for Embedded ReadData may be changed to display User data as shown here:

Embedded ReadData	
Enable	
MemBank User Start 0 Length 2	
UniqueByData Show Failed Data Reads	10
Filter	
C Apply Filter	70

Figure 24: Displaying Results of User Data Options

Note that the NXP UCODE DNA tag does not support reading all User memory with a "0" length. You must specify the length of the data to read.

Again, select "Show Failed Data Reads" if you want the tag read results to show when no User data is returned.

 Tag	, Re	sults Write EPC Tag Inspector	User Memory Lock Tag	Untraceable A	uthenticate	
	#	EPC	Data	TimeStamp (msec)	RSSI(dBm)	ReadCount
	1	E2C06F92000003A002EA94F		08:53:00.694 Al	-37	726
	2	E2C06F92000003A002EA94F	00 00 00 00	08:53:21.694 Al	-37	90

Figure 25: Results of Changing User Untraceable Options

Authenticate

Navigation Path: <u>Tag Operations</u> > <u>Authenticate</u>

The "Authenticate" Tab is used to both insert and activate keys, as well as authenticate tags and obtain encrypted data using those keys.

Activating Keys

Two 16-byte keys are inserted into specific User memory locations, and are activated by writing a specific value into two other User memory locations. The keys may be freely read and edited until activated, at which point those memory locations become inaccessible. The two keys are called "Key0" and "Key1". Either may be used for authenticating the tag, but only Key1 may be used to decrypt data that has been encrypted by the tag.

The key insertion and activation is controlled by the top portion of the "Authenticate" tab. These are the expected results for a tag that has never had a key written to it.



Figure 26: Default Unactivated Keys

Note that although the current value is shown with spaces between the bytes, you must enter the desired value without spaces, as shown here:

Tag to Read/Write		
 First tag to respo Tag selected in T 	nd ag Results page	
Showing tag: EPC	D = E2C06F92000003A002EA8C0	
Kay Incortion and Act	ivation	
Key insertion and Act	Ivauon	
Current Key0 =	00 00 00 00 00 00 00 00 00 00 00 00 00	
Current Key0 = Key0 To Write =	00 00 00 00 00 00 00 00 00 00 00 00 00	
Current Key0 = Key0 To Write = Current Key1 =	00 00 00 00 00 00 00 00 00 00 00 00 00	

Figure 27: Entering a Key

When you press "Insert Keys", this pop-up message will be displayed:



Figure 28: Success Message

Note that the Current Key values will remain unchanged until you press "Read" again".

ag to Read/Write		
First tag to respo Tag selected in Tag	nd ag Results page	
Showing tag: EPC	ID = E2C06F92000003A002EA8C0	
(au Incontion and Act		
key insertion and Act	Ivation	
Current Key0 =	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16	
Current Key0 = Key0 To Write =	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16	
Current Key0 = Key0 To Write = Current Key1 =	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 00 00 00 00 00 00 00 00 00 00 00 00 00	

Figure 29: Key Confirmation

Always make sure you read the keys to confirm that the value is what you want before activating them. Once activated, you cannot change the keys nor determine their current value. If you read a tag whose keys have been activated, you will get this result:

Tag to Read/Write	
First tag to respo Tag selected in Tag Showing tag: EPC	nd ag Results page
Key Insertion and Act Current Key0 =	ivation Key0 is inserted and activated
Key0 To Write = Current Kev1 =	Kev1 is inserted and activated
Key1 To Write =	
Inse	Activate Kevs

Figure 30: Obscuring of Keys Following Activation

Note that there is no provision for only activating one of the keys. If you leave any key at its default "0000..." value, it will be activated to that value.

Tag Authentication

Tags are authenticated by having the reader send a random challenge string to the tag, the tag uses its key to encrypt the challenge, and sends the result back. The reader then uses the key to decrypt the message and, if the decrypted message is the one it sent to the tag, it declares the tag authentic.

To authenticate the tag, enter key0 or key1 for the tag and press "Authenticate Key0" or "Authenticate Key1". You will see a success message and the same "Returned Challenge" value as the "Random Challenge" field above, as shown here:
Tag Results Write EPC Tag Inspector User Memor	y Lock Tag Untraceable Authenticate
Tag to Read/Write	
First tag to respond	
Tag selected in Tag Results page	
Showing tag:	
Key Insertion and Activation	
Current Key0 =	Universal Reader Assistant
Key0 To Write =	
Current Key1 =	The Successfully Authenticated
Key1 To Write =	
Insert Keys Activate Keys	ОК
Authenticate and ReadData	
Database Key0 =	
Verification Key0 = 010203040506070809101112131	141516
Database Key1 =	
Verification Key1 =	
Random Challenge = D4 65 3E 1A 37 2B F3 3E 71 3C	Refresh
Enable	
Returned Data =	
Read from Buffer	
Returned Data =	
Authenticate Key0	Authenticate Key1
Returned Challenge = D4 65 3E 1A 37 2B F3 3E 71 3C	

Figure 31: Successful Tag Authentication

Key1 may also be used for tag authentication.

If the key entered into the verification field does not match that in the tag, Universal Reader Assistant will still report that the Authentication Failed, as shown below. Note that the Returned Challenge will not match the Random Challenge value.

Tag Results Write EPC Tag Inspector User Memory Lock Tag Untraceable Authenticate
Key Insertion and Activation Universal Reader Assistant
Current Key0 = Key0 Key0 To Write = Tag Failed Authentication: Confirm Verification Key is Correct.
Current Key1 = Key1
Insert Keys OK
Authenticate and ReadData
Database Key0 =
Verification Key0 = 01020304050607080910111213141515
Database Key1 =
Verification Key1 =
Random Challenge = 95 AB D0 F0 55 86 E7 FB 03 2C Refresh
Enable Returned Data =
Read from Buffer Returned Data =
Authenticate Key0 Authenticate Key1
Returned Challenge = D7 2E FE 92 70 01 8F 8D 2D 00
< >

Figure 32: Failed Tag Authentication

If you want to do repeated trials with different Random Challenge values, press "Refresh" by the Random Challenge value and a new random value will be generated.

Obtaining Encrypted Data With Authentication

You may obtain encrypted data as well as authenticate the tag by selecting "Enable Returned Data" and selecting which memory location you want returned. Note that data is selected in 64 bit (2 Word) increments. As for Authenticate, the value returned is only valid if the Returned Challenge matches the Random Challenge, as shown here:

Tag Results Write EPC	Tag Inspector	User Memory	Lock Tag	Untraceable	Authenticate	
Tag to Read/Write						
First tag to respond	First tag to respond					
Tag selected in Tag Re	sults page	au				
Showing tag:						
Key Insertion and Activatio	n	(Universal Rea	der Assistant		
Current Key0 =						
Key0 To Write =			П	ag Successfully Au	uthenticated	
Current Key1 =				- j , , , , ,		
Key1 To Write =						
Insert Key	/S	Activate Keys			ОК	
Authenticate and ReadData	1					
Database Key0 =						
Verification Key0 =						
Database Key1 =						
Verification Key1 = 16151413121110090807060504030201						
Random Challenge = 1	D4 65 3E 1A 37 2B	F3 3E 71 3C	Refresh			
Enable						
MemBank TID -	Start 0 Len	gth 1				
Returned Data = E2 C	0 6F 92 20 00 00 0	2 00 2E A9 4F 00	00 00 00			
Read from Buffer						
Returned Data =						
	Authenticate K	ey0	Authent	icate Key1		
Returned Challenge =	D4 65 3E 1A 37 26	3 F3 3E 71 3C				
•	1/1				•	

Figure 33: Successful Authentication with Returned Data

If the key used to decrypt the data does not match the one in the tag, the Returned Challenge will not match the Random Challenge and the data returned will not be valid. A message indicating that the authentication failed will be displayed as, shown below, and the Returned Challenge value will not match the Random Challenge value. The returned data will be incorrect, but displayed, so that the user can better understand how data encryption security works for Gen2V2 tags.



Figure 34: Authentication with Data Failure

Note that the Access Password is security is bypassed when encrypted data is

being requested.

Obtaining Encrypted Data from Buffer

NXP tags have two options for obtaining encrypted data. The normal one is for the tag to backscatter the value. The other option is for the tag to put the data in a buffer for the reader to access. This access must be done before the tag is powered down, so cannot be used to obtain the data later. It is simply a different method for obtaining the data immediately.

This method of obtaining the data is activated by selecting "Read from Buffer". The returned data is displayed as shown here. As with the normal encrypted data read function, it is only supported for Key1.

Tag Results Write EPC	Tag Inspector	User Memory	Lock Tag	Untraceable	Authenticate
Tag to Read/Write					
First tag to respond	Ber	ad			
Tag selected in Tag Re	sults page	au			
Showing tag:					
Key Insertion and Activatio	n	(Universal Read	der Assistant	— ×-
Current Key0 =					
Key0 To Write =			Т	- Sugarafully Au	the section to a
Current Key1 =				g successiony Au	Ithenticateu
Key1 To Write =					
Insert Key	/S	Activate Keys			ОК
Authenticate and ReadData	1				
Database Key0 =					
Verification Key0 =					
Database Key1 =					
Verification Key1 =	161514131211100	908070605040302	201		
Random Challenge = [D4 65 3E 1A 37 2B	F3 3E 71 3C	Refresh		
Enable					
MemBank EPC •	Start 0 Leng	gth 1			
Returned Data =					
Read from Buffer					
Returned Data = DC 1	B 34 00 E2 C0 6F 9	92 00 00 00 3A 00	2E A9 4F		
	Authenticate Ke	ey0	Authenti	cate Key1	
Returned Challenge =	D4 65 3E 1A 37 2B	3 F3 3E 71 3C			
4					•

Figure 35: Authenticate with Buffer Data Read Success

If the key does not match the one programmed into the tag, the authentication will fail, and the following error message will be displayed:

Tag Results	Write EPC	Tag Inspector	User Memory	Lock Tag	Untraceable	Authenticate	
Tag to Read/	Write						
First tag Tag sele Showing	g to respond ected in Tag Re g tag:	sults page Re	ad				
Key Insertion	and Activatio	n			Universal Re	ader Assistant	— ו
Current Ke	ey0 =						
Key0 To W	/rite =					Sen? memory overru	n - had PC.
Current Ke	ey1 =				W	tenz memory or and	Dur c.
Key1 To W	/rite =						
	Insert Key	'S	Activate Keys				ОК
Authenticate	and ReadData	I					
Database	e Key0 =						
Verificatio	on Key0 =						
Database	e Key1 =						
Verificatio	on Key1 =	16151413121110	090807060504030	200			
Random	Challenge = [04 65 3E 1A 37 2E	3 F3 3E 71 3C	Refresh			
Enabl	e						
MemBan	k EPC 🔹	Start 0 Len	ngth 1				
Returned	Data =						
Read	from Buffer						
Returned	Data =						
		Authenticate k	(ey0	Authenti	cate Key1		
Returned	Challenge =						
			<u>.</u>				
and the second second second			III				F

Figure 36: Failure of Authentication with Buffer Data Read

Note that the error message is a Gen2-level failure, not a failure detected upon comparison of the Returned Challenge and the Random Challenge, as was the case for non-buffer reads.

Troubleshooting

Navigation Path: Troubleshooting

This section contains following topics:

- 1. <u>Troubleshooting Table</u>
- 2. <u>Collecting Diagnostics Data for ThingMagic</u>

Troubleshooting Table

Navigation Path: <u>Troubleshooting</u> > <u>Troubleshooting Table</u>

Table 5: Common Problems and Solutions

Problem	Path to Solution
Cannot connect to reader	 Verify the hostname, IP address or COM port is correct. See the hardware specific guide for more details on setting up a connection. For the M6 and Astra-EX the reader control communicate uses the LLRP interface which uses network port 5084. Verify 5084 is not being blocked by the network firewall.
Reader is not reading tags	 Verify known good Gen2 tags are near the reader antenna. Try modifying the Performance Tuning Options to force tags to respond more frequently. Check antenna cables on reader Increase the Read Power setting in Performance Tuning Options
Reader error LED stays on	Following Collecting Diagnostic Data for ThingMagic Support and send to support.
	Performance, as it relates to tag reading, is very usecase dependent. Typically, it comes down to whether you are trying to read lots of tags once or a few tags repeatedly. If the reader settings aren?t correct for your usecase the performance will appear poor.

Read "Performance" is slow	 Use the Performance Tuning Options to modify the settings for your usecase. See the <i>MercuryAPI Programmer's Guide</i> <i>Performance</i> <i>Tuning</i> section for details about Gen2 settings and try using the Advanced Performance Tuning options directly.
Errors after a Firmware Upgrade	 If the upgrade was of the M6 from v4.7 to a newer version make sure to read the Release Notes of the newer version. There are special steps that must be taken to make that upgrade. Try reinstalling the firmware and restarting URA.

Collecting Diagnostic Data for ThingMagic Support

Navigation Path: <u>Troubleshooting</u> > <u>Collecting Diagnostic Data for ThingMagic Support</u>

When experience problems connecting to readers or performing RF (reading, writing) operations it will be necessary to gather the following information to help diagnose the problem. This information will often be the first thing requested when reporting a problem to ThingMagic support.

1. Transport Logging: Follow the steps to collect transport logs.

2. Collect the Error Log saved in [Windows Start menu] | Documents | URA | tmrlog_[timestamp].txt

3. *Reader Serial Number:* See the 2d barcode label.

4. Reader Diagnostics

5. **Boot Logs (if using a networked reader):** Follow the process for collecting boot logs described in the hardware user guide, reboot the reader and save the full output from the console.

6. **Physical Configuration:** any details available about the number and types of antennas connected, cables used, power supply, etc. and tags being used.

7. **Environment**: any details about the physical environment the M6 and Astra-EX is being used/tested in. Temperature, humidity, vehicle mounted, office, etc.