TECHNOLOGY SOLUTIONS UK LTD

LOCATING ASSETS WITH TSL'S TAG-FINDING MOBILE APPLICATIONS

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Design • Development • Manufacture

CONTENT

History

Version	Date	Modifications
1.0	13/01/2015	First Release

INTRODUCTION

Technology Solutions (UK) Ltd (TSL) provides a series of mobile applications to complement the TSL range of ASCII2-compatible, *Bluetooth*® UHF readers. This document provides details of how to rapidly locate hard to find tagged items using TSL's tag-finding Apps such as RFID Tag Finder (available for Android™ and Windows Phone) or the *Find-a-Tag* feature in RFID Explorer for iOS.

This document also describes setting up a tag finding App, provides some guidelines for the physical search operation and also describes the support provided for various UHF RFID tag encodings.

TSL's tag-finding Apps search for tags that have a particular pattern in the tag's Electronic Product Code (EPC) memory bank. The Apps can be used to search for tags that use custom encodings, such as a human-readable ASCII representation, and they also support searching for tags using standard encodings, such as SGTIN-96 (specified in the *GS1 EPC Tag Data Standards v1.9* and described in this document).

For additional information about the *GS1 EPC Tag Data Standards* refer to the EPC Global documents available for download from http://www.gs1.org/gsmp/kc/epcglobal

Please note that some of the features described below may not yet be available for all mobile platforms.

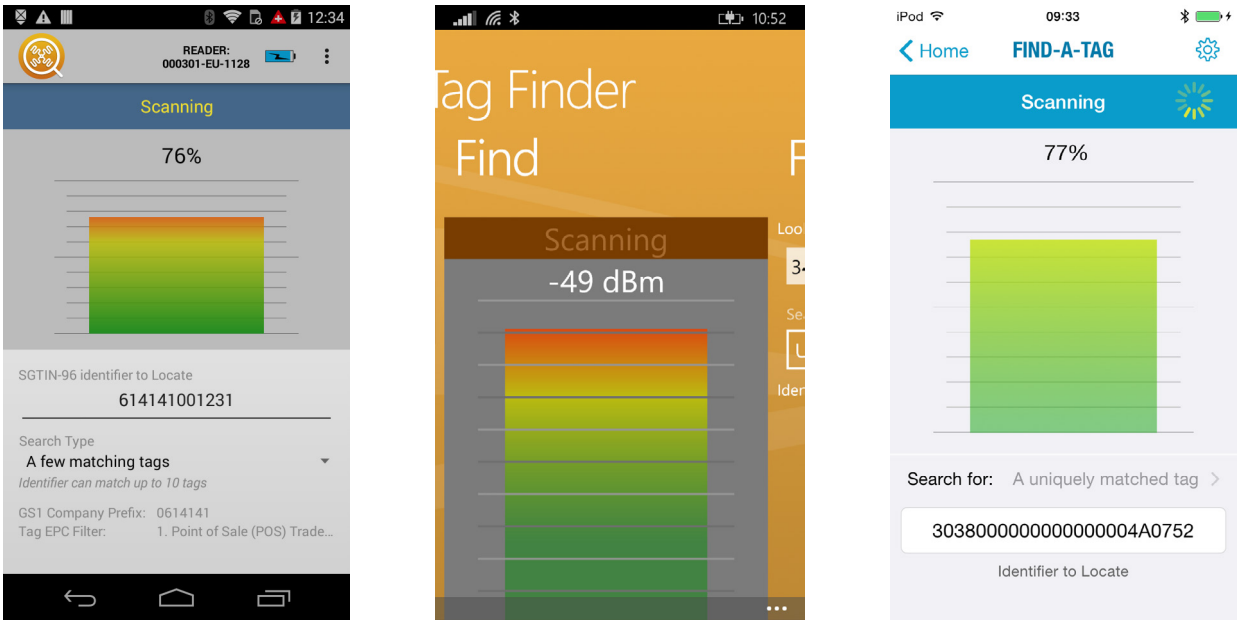

FIGURE 1: RFID Tag Finder for Android™ (left), Windows Phone (middle) and RFID Explorer Find-a-Tag for iOS (right)

USING A TSL TAG FINDING APP

TSL's Tag Finding Apps, when combined with a mobile UHF RFID reader such as the TSL 1128 or 1153, provide a powerful tool to rapidly locate tagged items.
After initial configuration, the general approach when using a Tag Finding App is as follows

1. Enter or scan the *target identifier* - this tells the App what to search for
2. While holding the reader trigger systematically scan the search area
3. Use the audible/visual, signal-strength feedback to help guide you to the required item

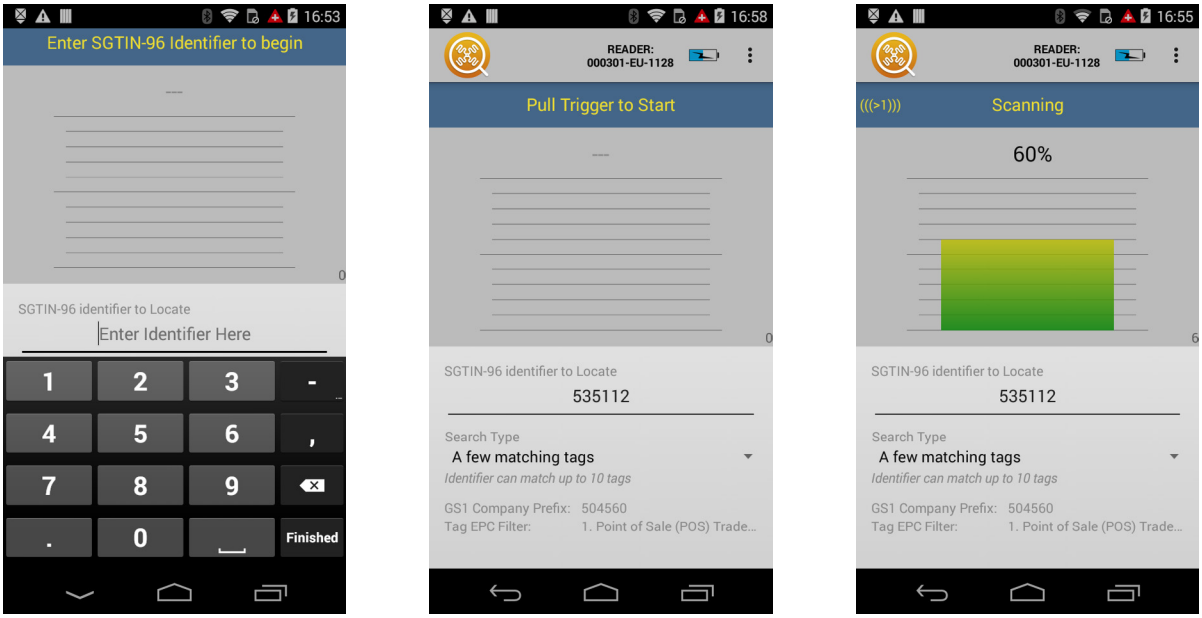

FIGURE 2: Entering an Identifier (Left), Ready to start (Middle), Scanning with tag in range (Right),

HOW TO SPECIFY THE ITEM TO SEARCH FOR (TARGET IDENTIFIERS)

The *target identifier* is the value that represents the item to be located. The valid values for the *target identifier* will depend on the chosen tag encoding (in the settings - see "Configuring TSL Tag Finding Apps"). The valid values are described for each encoding below.

HEX ENCODING

The *target identifier* is the tag EPC entered as hex digits - this allows any tag to be targeted by either a partial or the full EPC. Hex mode always matches from the start of the EPC so if fewer hex digits are entered than are in the full EPC then all tags that have these same starting values will be recognised.

ASCII ENCODING

The *target identifier* is the tag EPC entered as ASCII characters. ASCII mode always matches from the start of the EPC so if fewer characters are entered than are in the full EPC then all tags that have these same starting characters will be recognised.

SGTIN-96

With this encoding the *target identifier* is used, with values specified in the App settings, to construct the corresponding tag EPC.

The *SGTIN-96* EPC Global standard is used to identify trade items and uses the *Global Trade Item Number (GTIN)* and an additional serial number to allow individual items to be tracked.

The *GTIN* consists of four components:

- *Indicator Digit* - defines the packaging type or identifies a variable measure item
- *GS1 Company Prefix* – the globally unique company number allocated by the GS1 organisation
- *Item Reference* – the reference number allocated by the company to specify the type of trade item e.g. Red T-Shirt, Size L
- *Check Digit* – the calculated number used to verify the other components

Note:

- The check digit is not used in the tag *SGTIN-96* encoding)
- When using *SGTIN-96* there is an additional *filter value* that is encoded in the tag (which readers can use to improve performance). This value is specified in the settings.

When using *SGTIN-96* encoding, valid *target identifiers* are either full *GTIN* values or simply the *Item Reference* number (the *GS1 Company Prefix* is specified in the App's settings).

The *target identifier* is used to match against the *GTIN* information in *SGTIN-96* encoded tag EPCs ignoring the serial number. This allows searches to locate any item from the specified category rather than searching for a specific, unique item.

Target identifiers are entered as one of the following:

- *GTIN-12, GTIN-13* or *GTIN-14* - identifiers can be manually entered or scanned from barcodes. Only identifiers that contain the *GS1 Company Prefix* specified in the Settings will be considered valid.
- *GTIN-8* - This encoding uses a fixed length *GS1 Company Prefix* that does not need to match the *GS1 Company Prefix* set in the App. All valid *GTIN-8* values can be used as a *target identifier*.
- *RCN-8* - Any 8-digit code that has a valid *GS1* check-digit and starts with either 0 or 2 will be considered a *Restricted Circulation Number (RCN)*. The App will accept *GTIN Item References* stored in *RCN-8* codes by ignoring both the first and last digits. The *GS1 Company Prefix* is used to determine the maximum number of digits that the *Item Reference* can have. Leading zeroes will be ignored as needed to make the *Item Reference* the correct length. If the RCN value has too many non-zero, leading digits then it is considered invalid.
- Short codes - The *Item Reference* can be entered directly as the *target identifier*. Any sequence of digits that is short enough to fit the *Item Reference* (padded with zeroes as necessary) will be considered valid.

GRAI-96

This encoding uses the *target identifier*, with values specified in the App settings, to construct the corresponding tag EPC.

The *GRAI-96* EPC Global standard is used to identify returnable assets and uses the *Global Returnable Asset Identifier (GRAI)* and an additional serial number to allow individual items to be tracked.

The *GRAI* consists of the following components:

- *Application Identifier* – '8003' indicates that this is a GRAI
- *Leading zero* – padding
- *GS1 Company Prefix* – the globally unique company number allocated by the GS1 organisation
- *Asset Type* – the reference number allocated by the company to specify the type of returnable asset e.g. Tray, Pallet, etc…
- *Check Digit* – the calculated number used to verify the other components
- *Serial Number* - optional number to identify individual returnable assets

Note:

- The application identifier and the check digit are not used in the tag *GRAI-96* encoding
- When using *GRAI-96* there is an additional *filter value* that is encoded in the tag (which readers can use to improve performance). This value is specified in the settings.

Valid *target identifiers* are used to match against the *GRAI* portion of *GRAI-96* encoded tag EPCs i.e. the serial number is ignored. This allows searches to locate any assets of a particular type rather than searching for a specific, serialised asset.

Target identifiers are entered as one of the following:

- *GRAI* - Any value with 18 or more digits, which begins with the *GRAI* identifier 8003, has a valid check digit at position 18 and contains the correct *GS1 Company Prefix* will be considered valid.
- *RCN-8* - Any 8-digit code that has a valid *GS1* check-digit and starts with either 0 or 2 will be considered a restricted circulation number. This App will accept values stored in RCN-8 codes as *GRAI Asset Types* by ignoring both the first and last digits. The *GS1 Company Prefix* is used to determine the maximum number of digits that the *Asset Type* can have. Leading zeroes will be ignored as needed to make the *Asset Type* the correct length. If the value has too many non-zero, leading digits then it is considered invalid.
- Short codes - The *Asset Type* can be entered directly as the identifier. Any sequence of digits that is short enough to fit the *Asset Type* (padded with zeroes as necessary) will be considered valid. The length is calculated using the *GS1 Company Prefix* specified in the App settings.

AUDIBLE FEEDBACK

The Tag-finding apps use audible feedback to indicate when the reader has detected one or more tags matching the *target identifier*. Two types of audible feedback are provided:

- A series of rapid, fixed pitch beeps that indicate that one or more matching tags have been detected
- A continuous tone that varies in pitch to indicate that a matching tag is in range and how strong the response from the tag is – higher pitches represent stronger signals

VISUAL FEEDBACK

The strength of responding tags is also displayed in visual form. In addition to a percentage-based strength value there is a choice of two graphical representations available (see Figure 3)

- *Bar Graph* – a column is drawn where the height represents the strength of the signal.
- *Block display* – a simple, large block is displayed to indicate that a matching tag has been detected. The block size does not depend on the signal strength.

In both display modes the column or block is also coloured so that weaker signals show as green and stronger signals are orange or red.

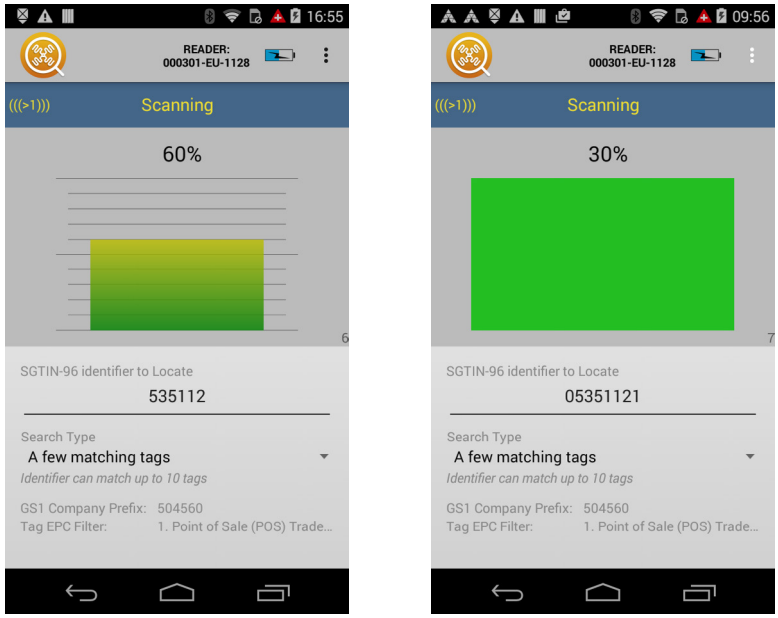

FIGURE 3: Bar Graph display mode (left) and Block display mode (right)

It is possible that the *target identifier* can match more than one item - particularly when using category based encodings *(SGTIN-96, GRAI-96)*. When this occurs the App will target the strongest signal and indicate that more than one matching item response has been detected by displaying this icon: **(((>1)))** (see Figure 3). The *Search Type* setting can be used to improve performance when multiple matching responses are expected.

DEFAULT CONFIGURATIONS

The Apps are highly configurable to support operation in many environments but, for convenience, can be set to default configurations that are optimised for:

- *Near Range Detection* - only detect when the asset is very nearby - rapidly and efficiently search rooms full of cages, boxes and racks
- *Long Range Seeking* - rapidly sweep large areas and hone in on just the asset you are looking for

These configurations provide good performance in a variety of environments and use appropriate audible/visual feedback settings but all settings can be adjusted to create a custom solution for your tag environment if necessary. These default configurations can be set in the App's settings and are described further below. All the settings that control how the App operates are described in detail in "Configuring TSL Tag Finding Apps".

NEAR RANGE DETECTION

This configuration provides a very straightforward search procedure - by passing the reader close to all potential item locations you will receive a clear, audible tone and visual confirmation only when the target asset is very close to the reader. This will locate the target to a few possible items such as a small section of racked garments or to a particular box which contains the target asset. This much smaller group of items can then be checked individually with the reader to locate the specific target item.

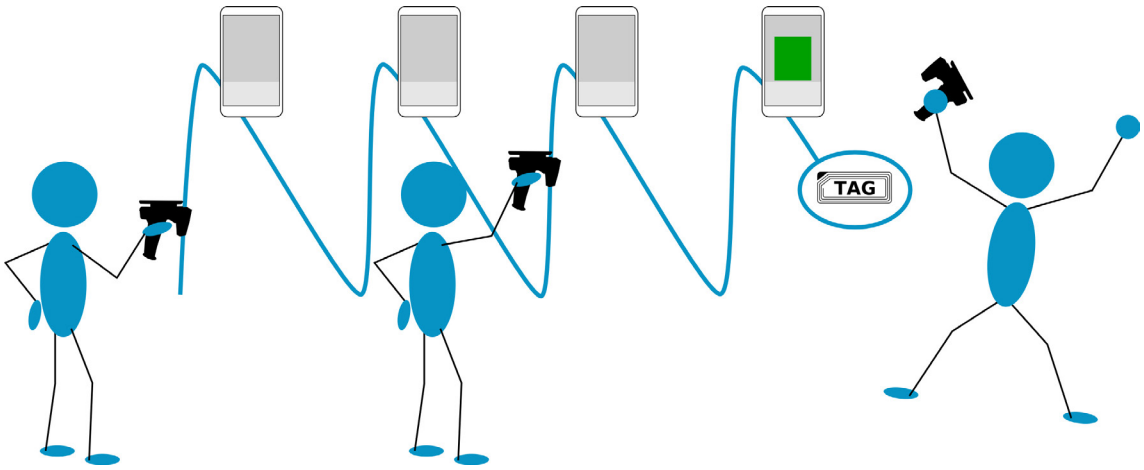

FIGURE 4: Near range detection path - passing the reader close to all potential item locations

This configuration minimises one of the problems when searching for UHF RFID tags - that of reflected signals which can sometimes be misleading. Since the reader is set to only detect strong signals the reflected, usually weaker, signals are ignored. However, take care to move the reader close to all potential locations otherwise the target item may be missed.

LONG RANGE SEEKING

This configuration provides an alternative search approach where the reader attempts to detect the item from the furthest possible distance. This is particularly useful when large areas need to be covered. The audible and visual feedback provides a continuous responsive indication of the signal strength. By moving the reader slowly in an arc motion the direction of the strongest signal can be determined. By moving in this direction and repeating the procedure the target item can be discovered.

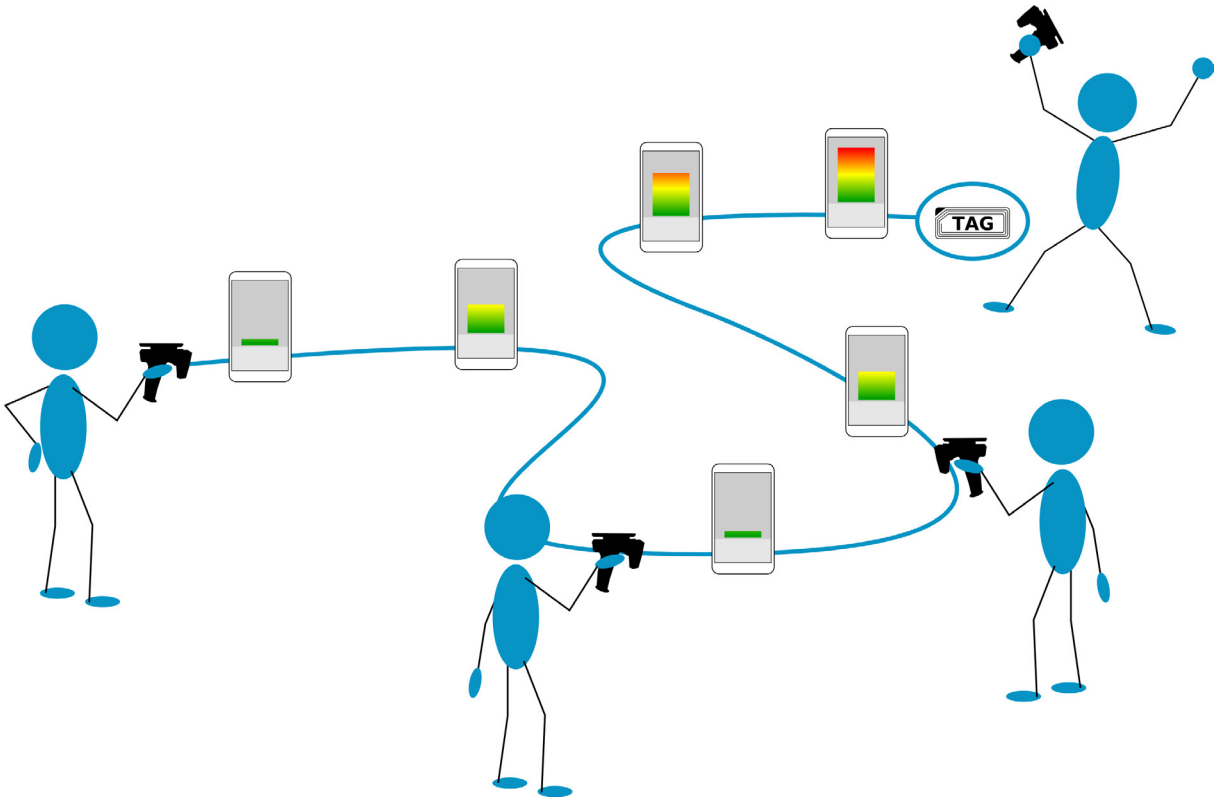

FIGURE 5: Long Range Seeking - path dictated by signal strength

This approach can be susceptible to reflected signals so may require testing several different directions before the strong, direct responses are discovered. This is very much dependent on the amount of RF reflective materials in the environment.

TIPS FOR BETTER SEARCHES

TSL Tag-Finding Apps can greatly reduce the time it takes to locate assets but here are a few general tips that should improve search performance:

- Avoid moving the reader too rapidly while searching – slower steady movements will provide better results
- TSL's readers will detect tags in a wide arc in front of the antenna – not a pencil thin beam. Take this into account when trying to hone-in on a target
- Closely packed assets, e.g. clothes hanging on a rail, can sometimes reduce the strength of signals from the tags so separate such items while searching where practical.

CONFIGURING TSL TAG FINDING APPS

The following sections describe the settings available and the necessary configuration required to prepare a TSL Tag Finding App for use. These controls are located in the App's *Settings* screen.

ENCODING SETUP

For a Tag-Finding App to efficiently search for a particular tag (or one from a category of tags) requires that it knows the encoding of the tag – that is, how to interpret the binary data stored in the EPC section of the EPC memory bank.
The following encodings are supported:

- Hex - represents the bytes of the tag EPC as Hexadecimal characters
- ASCII – interprets the bytes of the tag EPC as ASCII characters for a human readable representation
- SGTIN-96 – 96-bit EPC Global standard for trade items
- GRAI-96 – 96-bit EPC Global standard for returnable assets and allows searching for assets of a particular type

The *Encoding* section of the App *Settings* contains the *Target Identifier Encoding*, the *GS1 Company Prefix* and the *EPC Tag Filter* value.
The *GS1 Company Prefix* and the *EPC Tag Filter* are only used when an EPC Global tag encoding is chosen. The *GS1 Company Prefix* is a required value and a *target identifier* cannot be entered on the main screen when it is missing or invalid.

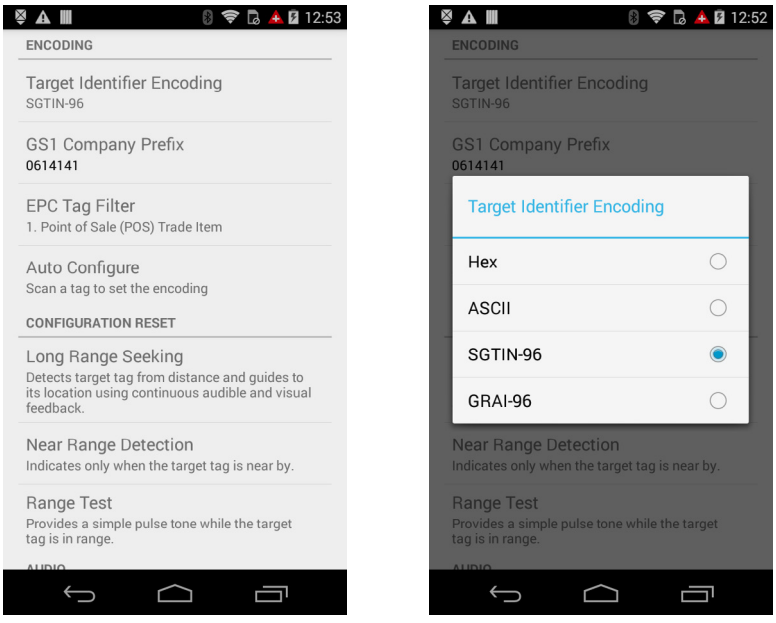

FIGURE 6: Encoding Settings (left) Choosing the Encoding (right)

The encoding can be set in two ways: manually or by using *auto-configuration*. When the auto-configuration option is chosen a tag containing the target encoding is presented to the reader and scanned. The App will then set all relevant Encoding parameters based on the information in the EPC of the scanned tag. Figure 5 shows the auto-configure operation in action.

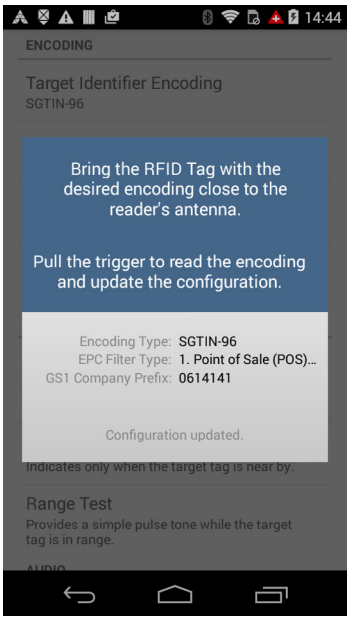

FIGURE 7: The Encoding Auto-Configure dialog

CONFIGURATION RESET

The Configuration Reset section provides a quick way to restore multiple settings to default values. The settings that are reset control how the App works and the type of audio/visual feedback that is presented but does not change the encoding settings and audio volume controls.

As described above in "Default Configurations", configurations are provided for operating in a *Long Range Seeking* mode or a *Near Range Detection* mode. Resetting to a default configuration will modify settings for *Audio, Display, Power Ramping* & *Detection Thresholds*. Because these options affect multiple values a confirmation dialog is presented before the changes are made.

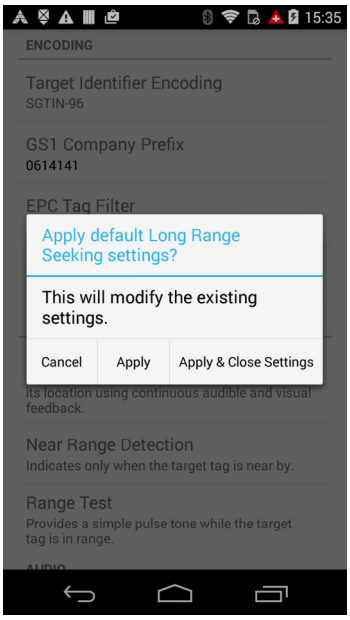

FIGURE 8: Resetting to the Long Range Seeking configuration

AUDIO & DISPLAY

The Audio and Display settings control how the target tag's response is presented.

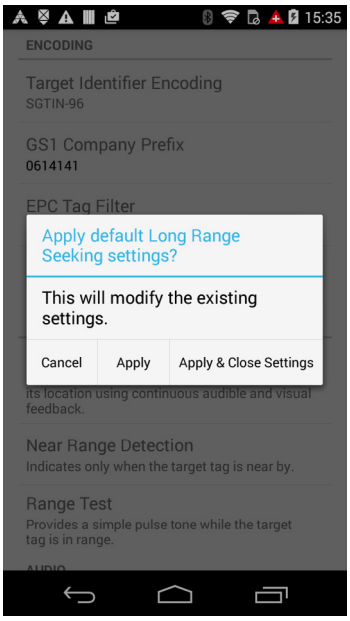

FIGURE 9: Audio and Display Settings

The *Tone Volume* control allows the level of the audible feedback to be adjusted relative to the overall volume of the device.

The *Use Sweeping Tone* setting switches between the continuous, variable pitch tone and the fixed pitch beeping described in "Audible Feedback".

The *Use Signal Strength Bargraph* setting, when checked, selects the bar graph display mode otherwise the Block display mode is used (see "Visual Feedback").

Always Show Signal Value is used to override the normal behaviour when using a detection threshold (see "Near Range Detection" and below). When a detection threshold is enabled the signal strength value will normally only be displayed when the signal strength exceeds that threshold. If the *Always Show Signal Value* setting is checked then the signal strength value will always be displayed.

DETECTION THRESHOLD

The *Detection Threshold* settings (see Figure 10) can be used to ignore weaker signal responses completely and to provide either a single or dual level threshold above which notifications occur.

When *Use Detection Threshold* is enabled all tag responses with signal strength below the *Detection Threshold* value are ignored except when the *Use Lower Threshold* setting is also enabled.

The *Use Lower Threshold* setting allows a second threshold level to be used that causes a simple tone to sound when the tag signal strength response is above the *Lower Threshold* level but below the *Detection Threshold* level. This is useful in environments where densely packed items often occur causing some tag responses to be significantly lower than others.

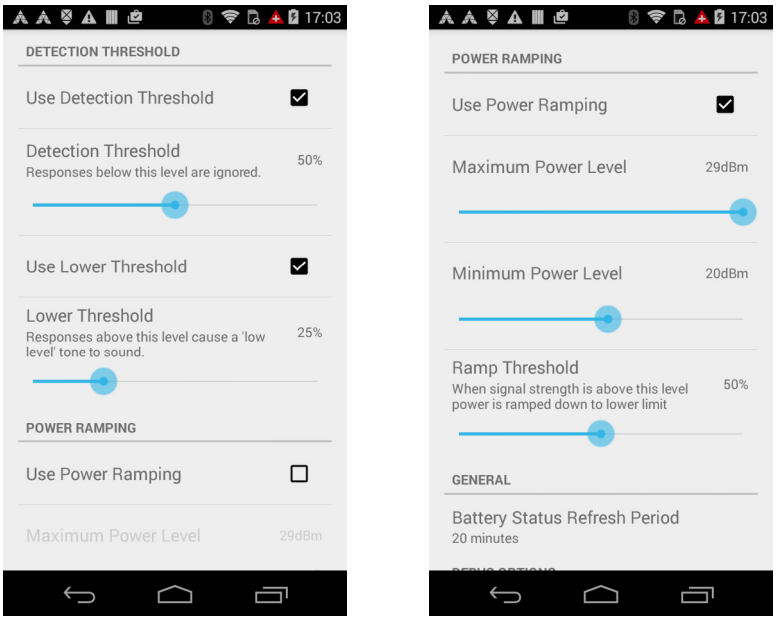

FIGURE 10: Settings for Detection Threshold (left) and Power Ramping (right)

POWER RAMPING

The *Power Ramping* settings (see Figure 10) allow the antenna power of the reader to be reduced while the target tag is in range and returning a sufficiently strong response. This can help isolate a matching tag when other matching tags are nearby. If the target tag moves out of range the power is steadily restored, to the maximum, enabling the tag to be detected again.

The *Use Power Ramping* control turns power ramping on or off. When power ramping is enabled and a matching tag signal strength response is above the *Ramp Threshold* the antenna power is reduced steadily until it reaches the *Minimum Power Level* value. When the matching tag signal strength response falls below the *Ramp Threshold* the antenna power is steadily returned to the *Maximum Power Level*.

ABOUT TSL

ABOUT

TSL designs and manufactures both standard and custom embedded, snap on and standalone peripherals for handheld computer terminals. Embedded technologies include:

- RFID - Low Frequency, High Frequency & UHF
- *Bluetooth*® wireless technology
- Contact Smartcard
- Fingerprint Biometrics
- 1D and 2D Barcode Scanning
- Magnetic Card Readers
- OCR-B and ePassport

Utilizing class leading Industrial design, TSL develops products from concept through to high volume manufacture for Blue Chip companies around the world. Using the above technologies TSL develops innovative products in a timely and cost effective manner for a broad range of handheld devices.

CONTACT

Address:	Technology Solutions (UK) Limited, Suite A, Loughborough Technology Centre, Epinal Way, Loughborough, Leicestershire, LE11 3GE. United Kingdom.
Telephone:	+44 1509 238248
Fax:	+44 1509 214144
Email:	enquiries@tsl.uk.com
Website:	www.tsl.uk.com

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