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Overview

This manual covers the Printronix T800, T4000 and T6000e Multi-protocol RFID printers running Class 1 Gen 2, EPCGlobal RFID tags, and labels. For the latest version of this reference manual, visit the Services & Support page at www.PrintronixAutoID.com.

What to Expect when Running an RFID Application

Factors Affecting Smart Label Performance

Smart labels are based on an EEPROM technology that requires time to be programmed. Every effort has been made to minimize the time to program labels, but you may notice this minor pause between labels. This time is necessary to better ensure consistent quality and improved reliability.

When dealing with smart labels, it is possible that an occasional RFID tag may need to be written and verified more than once (retry) before being considered acceptable. In this event each retry time will be added to the inter-label pause.

Static electricity can damage the smart labels. Open the media cover of the printer and touch an unpainted metal part of the printer before you handle smart labels. This will discharge any static electricity that may have built up on your hands.

Overstruck Smart Labels

If an RFID tag within a smart label is deemed unacceptable after execution of the defined number of retries, what occurs next depends upon the RFID > Control > Error Handling setting.

Smart Label Characteristics

IMPORTANT: Purchase additional smart labels directly from Printronix Auto ID to assure the highest level of performance and reliability. See the section “Printronix Customer Support Center”.

Currently supported smart labels have the following characteristics:

General Tag Type
• UHF 869/915 MHz radio frequency

Technology Tag Class
EPCGlobal Class 1 Gen 2 tags – 96 to 480 data bits EPC Read/Write, 512 bits User Memory.
**LabelSize**

Printronix Auto ID RFID printers are compatible with the latest chips (IC’s) and inlays from the major suppliers in the RFID industry. The printers are equipped with an *Auto-Calibration* feature for easy setup eliminating the need to specify exact inlay placement or RFID power settings. The calibration routine has been tested with most major inlays embedded in typical label sizes and will work with many other inlays as well. Here are a few things to consider for optimum performance.

**Referring to the diagram at right:**

Inlays should be centered horizontally across the media (dimension "C"). Consistent, tag-to-tag placement of the inlays is more important than how close to center the inlays are actually placed.

The pitch (overall distance from inlay to inlay) is shown as dimension "P".

The inlay should be set back from the lead edge of the media (dimension "L") a constant distance tag to tag.

Always test RFID media on your printer before purchasing large quantities of media.

**Website Support**

Printronix RFID printers support a number of RFID protocols and coupler configurations.

For a complete list of Certified RFID Smart Labels available from Printronix, go to [www.PrintronixAutoID.com](http://www.PrintronixAutoID.com) media and supplies.


**Disclaimer:**

The guidelines and suggestions for developing converted RFID labels, are provided by Printronix Auto ID on an "as is" basis and without warranty, expressed or implied. Printronix Auto ID disclaims any implied warranty of merchantability or fitness for a particular purpose. Printronix Auto ID will not be liable under any circumstances for any damages or losses related in any way to use of these guidelines, specifications or other information, including damages which may be incurred as a result of labels not working properly in a specific application. All specifications are subject to change without notice. Testing of the converted labels in the printer is strongly recommended prior to production quantities.


2 Setting up the RFID Printer

Media > Media Handling

- **Continuous.** Only forward media motion occurs. When the print job ends the trailing edge of the last label printed remains at the TOF position under the printhead (not aligned at the Tear Bar). If the RFID menu has Control > Tag Position set at a negative value, (ex., -0.2 inches), the printer will move in reverse for a 0.2 inch distance as each tag is encoded. The last label printed will still remain at the TOF position under the printhead (not aligned at the Tear Bar).

- **Tear-Off Strip.** When a print job is sent, the leading edge of the first label will be pulled back to the TOF position under the printhead. If the RFID menu has Tag Position set at a negative value, (ex., -0.2 inches), the printer will move in reverse for a 0.2 inch distance as each tag is encoded. When the print job is complete the printer will place the trailing edge of the last printed label at the tear bar for easy removal.

- **Cut.** When the optional media cutter is installed, the printer automatically cuts media after each label is printed or can cut the media after a specified number of labels have been printed using the Active IGP Emulation cut command.

Sensors > Control

- **Gap.** Select Gap sensing when a liner gap exists between die cut RFID labels.

- **Mark.** Select Mark sensing when a black mark exists on the underside of the RFID label liner. Mark is the preferred format for inter-label sensing, as the inlay/antenna within the label can sometimes be falsely sensed. The menu defaults to Mark when RFID is enabled.

**IMPORTANT:** When the correct sensing is done, perform an Auto-Calibrate.

RFID > Control

Software can automatically detect an installed RFID encoder when the printer is powered up. The state of the RFID feature can be observed from the ONLINE screen as shown in the Figure 2 below:

- The ONLINE screen will show the “enabled” RFID symbol under the model number when the RFID encoder is installed AND enabled via the menu RFID > Control > RFID Active.

- The ONLINE screen will show the “disabled” RFID symbol under the model number when the RFID encoder is installed and disabled via the menu RFID > Control > RFID Active.

- If the RFID encoder is not installed, then no RFID symbol will be present on the ONLINE screen and the RFID icon shown in the Settings section in Figure 2 is gray in color and cannot be selected.
Once the RFID is installed, the RFID section under Settings can be selected and the RFID configured. However, it may not be enabled by default:

- If the printer is powered up with the menu *Configs > Control > Power-Up Config* set to Factory, the *RFID > Control > RFID Active* will be set to “Enable” automatically.
- If the printer is powered up with *Configs > Control > Power-Up Config* to something other than Factory, the *RFID > Control > RFID Active* could be set to “Disable”.

To enable the RFID feature, change the menu *RFID > Control > RFID Active* to “Enable” and save the configuration as described in the *Administrator’s Manual*.

- **On printers with an internal antenna, open the print head to reveal RFID antenna.** Position RFID antenna to line up with the RFID chip on the tag. Close the print head and clear printer fault.
- **RFID Calibration.** Run RFID calibration to get the RFID chip type, program position, read/write power, and memory bank sizes. The RFID Calibration is found under *RFID > Tag Calibration*. 
RFID Calibration

Antenna System

The T800, T4000, and T6000e printers have RFID antenna coupler designs that support a wide variety of tag types. The T800 has an internal antenna coupler affixed to the media guard that can be adjusted horizontally into seven different detent positions. The T4000 and T6000e (4" and 6" printers) have a fixed position antenna coupler mounted at the exit of the printer (as part of the tear or cutter options) that requires no adjustment. The T6000e 4" printer has both internal and external RFID antenna couplers.

T800 - Selecting the Internal Antenna Coupler Position

1) Visually inspect the label to determine the best position for the antenna, locating the antenna loop within the tag. In most cases, the antenna loop will be directly above or below the chip.

The loop may be off to one side of the chip in some tags:

2) Rotate the deck lock lever fully clockwise to open the pivoting deck to access the antenna slide. Move the slide so that the position indicator aligns with the loop in the tag.
T6000e 4” - Selecting the Internal Antenna Coupler Position

1) Rotate the deck lock lever fully clockwise to open the pivoting deck to access the antenna slide. Move the slide so that the position indicator aligns with the loop in the tag.
**RFID Calibration Procedure**

There are a few steps to do the RFID calibration:

1) The first step is to perform Media Calibration. It is necessary to have label length set properly; or the results of the RFID calibration will not be optimal. Refer to Label Calibration in the printer’s *Administrator's Manual*.

2) For printers with the internal, adjustable RFID antenna, verify the antenna is set at the position of the center of the RFID chip or antenna loop on the tag.

3) Select RFID menu > Tag Calibration > RFID Calibrate and press the Enter key to execute the calibration.

4) Depending on the tag type and tag length, the calibration can take several minutes. At the end of calibration either a Green or Red window pops up. A green window signifies successful calibration.

5) If calibration fails, you will see a red screen. Press the Pause or Enter key to clear the failure notice. In most cases when this error occurs, it is necessary to re-position the antenna slide. In some cases it may be due to an incompatibility between the tag and the reader.

6) After calibration is complete, press the Enter key to continue.

7) When going next online, choose the option to save your settings into your configuration so that the RFID calibration values will be preserved.
4 \textbf{Smart Label Operation}

\section*{Overview}

This chapter describes how to use the RFID encoder. The RFID encoder is designed to be transparent to the printer operation. It provides the capability of programming smart labels (with embedded RFID tags) while printing the label format. The smart labels are provided with the printer or purchased separately from Printronix Auto ID.

There are several ways to program RFID tags in smart labels:

- Incorporate RFID commands into new or existing Printronix PGL® programs.
- Incorporate RFID commands into new or existing ZPL™ programs. By selecting the Printronix ZGL emulation you can seamlessly upgrade from Zebra™ printers.
- Incorporate RFID commands into new or existing SATO® printer language programs. By selecting the Printronix STGL emulation you can seamlessly upgrade from SATO printers.

\section*{Supported UHF Class 1 Gen2 Tag Types}

For tag type specifications, go to \url{www.PrintronixAutoID.com/rfid-inlay-placement/}. Select the desired Printronix specification for more information.

\subsection*{Alien Higgs 3 EPC/USR Lengths and PC Values}

Higgs 3 tags differ from other RFID tags in that its memory bank size is not fixed. To accommodate EPC lengths longer than 96 bits, Higgs 3 borrows memory from the USR bank. The default is 96 bits. If EPC values longer than 96 bits are to be written by the application, the menu item \textit{RFID > RFID Chip Params > Higgs 3 EPC Len} should be changed to accommodate the data.

When the EPC length is selected, the USR length sets automatically (see Table 1). Since the PC value indicates the length of the EPC in the Higgs 3, the PC value must be programmed when programming the EPC (if the EPC value has changed from its factory state).

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
EPC Length & USR Length & PC Value \\
\hline
96 & 512 & 0x3000 \\
112 & 448 & 0x3800 \\
128 & 448 & 0x4000 \\
144 & 448 & 0x4800 \\
160 & 448 & 0x5000 \\
\hline
\end{tabular}
\caption{EPC/USR Lengths and PC Values}
\end{table}
Overstrike Error Messages

When an error occurs with the RFID functions within a job, the user can choose different styles of Overstrike Style, including having the error printed on the label per Table 2. The x in the error messages represents a number code that identifies the area in the printer software or RFID encoder where the failure occurred.

### Table 2 Printed Overstrike Error Messages

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag R/W Err x</td>
<td>The printer software attempted to write to or read from the RFID tag, but the RFID encoder indicated that the tag could not be written to or read from.</td>
</tr>
<tr>
<td>Check media</td>
<td></td>
</tr>
</tbody>
</table>

When an error occurs with the RFID functions within a job, the user can choose different styles of Overstrike Style, including having the error printed on the label per Table 2. The x in the error messages represents a number code that identifies the area in the printer software or RFID encoder where the failure occurred.
<table>
<thead>
<tr>
<th>Tag Comm Err x Check cable</th>
<th>The printer software temporarily lost communication with the RFID encoder, or communication between the printer software and the RFID encoder was not synchronized and had to be forced.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precheck Fail x Check media</td>
<td>This failure occurs only when the <em>Precheck Tags</em> is enabled. It indicates that the RFID tag was automatically failed since it did not contain the correct pre-programmed quality code.</td>
</tr>
</tbody>
</table>
RFID Menu Overview

The RFID section is found by selecting the RFID icon from the second page of the Settings menu as shown in Figure 3.

**Figure 2 RFID Icon Location**

From there, the RFID section is structured into six submenus as shown in Figure 4 and Figure 5:

**Figure 3 RFID Control, Tag Calibration, Calibration Params Submenus**

Continued

1. Inches or Millimeters, depending on SYSTEM > Control > Media Units.
2. Value depends on the tag being installed.
• The **Control** submenu is used to configure how the RFID system will operate with respect to the encoder writing, reading, and verifying. Those menus are described below.

• The **Tag Calibration** submenu is used to perform the RFID Auto-Calibration.

• The **Calibration Params** submenu will contain the settings used for optimal tag encoding. These parameters can be obtained automatically through RFID Calibration.

  **Figure 4 RFID Chip Params, Diagnostics, Statistics Submenus**

  ![RFID Chip Params Diagram]

  - The **RFID Chip Params** submenu is used to configure the system when support of custom RFID tags is required. Those menus are described below.
  - The **Diagnostics** submenu is used to run test procedures to help determine the accuracy and troubleshoot the RFID system. Those menus are described starting on page 28.
  - The **Statistics** submenu is general read-only and used to gather and report statistics on how the RFID system is reporting on print jobs sent to the printer. Those items are described starting on page 32.

**Configuring the RFID**

Configuring the RFID is done by selecting the RFID icon within the Settings section. The RFID comes equipped with a default setting for each configuration option, and it works without having to change any of these options. However, in some cases it is necessary to adjust these options, which are described below.
If you are unable to select the RFID icon or the icon is grey, then the RFID is not properly installed. Refer to Section “Printronix Customer Support Center” for help on how to solve this problem.

If you make any changes to the default configuration menu items, you will be prompted to save the configuration. Use the UP and DOWN Arrow Keys to unlock the control panel. See “Auto Save Configuration” in the Administrator’s Manual.

Enabling and Disabling
Software can automatically detect an installed RFID when the printer is powered up. If the printer is powered up with Configs > Control > Power-Up Config set to “Factory”, the RFID icon can be selected and RFID > Control > RFID Active is set to “Enable”.

If Power-Up Config is not set to Factory, the RFID icon can be selected, but RFID > Control > RFID Active could be set to “Disable”. Set this menu to “Enable” and save the configuration as described in the Administrator’s Manual. In the same manner, the RFID can be disabled.

Control Submenu
A number of RFID options which define specific parameters for certain print jobs can be set from the RFID > Control submenu.

**RFID Active**

<table>
<thead>
<tr>
<th>RFID &gt; Control &gt; RFID Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software can automatically detect an installed RFID reader when the printer is powered up. If the printer is powered up with Configs &gt; Control &gt; Power-Up Config set to “Factory”, the RFID icon can be selected and this option is set to “Enable”. If Power-Up Config is not set to Factory, the RFID icon can be selected, but this option could be set to “Disable”.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disable</th>
<th>The RFID function is disabled and not active.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>The RFID function is enabled and active.</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Depends on Configs &gt; Control &gt; Power-Up Config setting. See above.</td>
</tr>
</tbody>
</table>
**Error Handling**

<table>
<thead>
<tr>
<th>RFID &gt; Control &gt; Error Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item selects the error handling mode for RFID failures.</td>
</tr>
<tr>
<td><strong>Overstrike</strong></td>
</tr>
<tr>
<td><strong>None</strong></td>
</tr>
<tr>
<td><strong>Stop</strong></td>
</tr>
<tr>
<td><strong>Factory Default</strong></td>
</tr>
</tbody>
</table>

**Label Retry**

<table>
<thead>
<tr>
<th>RFID &gt; Control &gt; Label Retry</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item selects the number of label retries that the RFID encoder will attempt before declaring a fault. This may indicate a problem with the RFID encoder, the coupler assembly, the printer setup, or the label stock.</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>Factory Default</strong></td>
</tr>
</tbody>
</table>

**IMPORTANT** Label Retry only applies when the Error Handling mode is set to Overstrike.
Max Retry Error

**RFID > Control > Max Retry Error**

This menu item determines if errors are declared when the Label Retry count is exceeded.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disable</td>
<td>Errors are not declared and the print content for the current label is discarded.</td>
</tr>
<tr>
<td>Enable</td>
<td>Errors are declared when the tag cannot be programmed within the Label Retry count.</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Enable</td>
</tr>
</tbody>
</table>

Auto Retry

**RFID > Control > Auto Retry**

This menu item selects the number of automatic (internal) retries that the printer will attempt on the same tag before taking action per the menu Error Handling. T800 menu only.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>1</td>
</tr>
<tr>
<td>Maximum</td>
<td>9</td>
</tr>
<tr>
<td>Factory Default</td>
<td>2</td>
</tr>
</tbody>
</table>

Overstrike Style

**RFID > Control > Overstrike Style**

This menu item selects the style of the overstrike pattern.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid</td>
<td>A grid pattern prints when it overstrikes. On the T6000, this will be a partial grid pattern.</td>
</tr>
<tr>
<td>Error Type Msg</td>
<td>An error message prints that indicates which error occurred per Table 2.</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Grid</td>
</tr>
</tbody>
</table>

**IMPORTANT**

If you are using a validator, set the RFID Overstrike Style different than VALIDATOR > Control > Overstrike Style. This will help you differentiate errors.

EPC Write Ctrl

**RFID > Control > EPC Write Ctrl**

This option controls how the printer encodes the RFID tag EPC field.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Length</td>
<td>Only the amount of data provided in the application is encoded.</td>
</tr>
<tr>
<td>Full EPC Length</td>
<td>The maximum EPC length for the particular tag type in use is written to the tag (padded with zeroes if necessary).</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Data Length</td>
</tr>
</tbody>
</table>
AutoID Mgr Rpt

<table>
<thead>
<tr>
<th>RFID &gt; Control &gt; AutoID Mgr Rpt</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item enables AutoID and label information to be sent out the network port. This information can be used by an RFID tag data and labels manager program.</td>
</tr>
<tr>
<td>Disable</td>
</tr>
<tr>
<td>Enable</td>
</tr>
<tr>
<td>Factory Default</td>
</tr>
</tbody>
</table>

Non-RFID Warning

<table>
<thead>
<tr>
<th>RFID &gt; Control &gt; Non-RFID Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item enables a warning to appear if the printer receives a print job that does not contain any RFID commands when RFID media is installed in the printer.</td>
</tr>
<tr>
<td>Disable</td>
</tr>
<tr>
<td>Enable</td>
</tr>
<tr>
<td>Factory Default</td>
</tr>
</tbody>
</table>

Tag Calibration Submenu

This submenu is used to do RFID calibration. The user must do the tag calibration when installing a new tag in the printer. RFID calibration operation determines the RFID chip type, the write/read power, program position, length of the EPC/User field.

RFID Calibration

<table>
<thead>
<tr>
<th>RFID &gt; Tag Calibration &gt; RFID Calibrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>The executable item performs RFID calibration.</td>
</tr>
</tbody>
</table>

**IMPORTANT**

This item should be executed when changing the RFID tag type.

The calibration process will set a number of RFID menus in the printer configuration, and after RFID calibration is complete, the configuration should be stored to preserve the results of the calibration in that configuration.
## Antenna Setting

### RFID > Tag Calibration > Antenna Setting

This menu determines which antenna to use for RFID encoding during the RFID calibration. After RFID calibration, an update will be applied to > RFID Calibration Params > Antenna Active. T6000e 4” menu only.

<table>
<thead>
<tr>
<th></th>
<th>RFID jobs and diagnostics will use the slit-antenna located at the exit of the printer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>RFID jobs and diagnostics will use the adjustable, sliding antenna located behind the print head.</td>
</tr>
<tr>
<td>Internal</td>
<td>The internal RFID antenna should be manually adjusted every time new RFID labels are used in the printer. Slide the antenna so the chip within the label is aligned with the center if the antenna. The external antenna cannot be adjusted.</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Internal</td>
</tr>
</tbody>
</table>

### IMPORTANT

The internal RFID antenna should be manually adjusted every time new RFID labels are used in the printer. Slide the antenna so the chip within the label is aligned with the center if the antenna. The external antenna cannot be adjusted.

## Num Label for Calibration

### RFID > Tag Calibration > Num Label for Calibration

The menu item determines how many tags to use for calibration. However, this value does not include tags moved when seeking gaps during the calibration process. Depending on the difficulty in calibrating the installed tags, the number of labels used could be more or less, but generally, the larger number chosen in this menu, the more tags that will be averaged together to determine the calibration result. Usually, this value should be left at the default value.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>3</td>
</tr>
<tr>
<td>Maximum</td>
<td>7</td>
</tr>
<tr>
<td>Factory Default</td>
<td>3</td>
</tr>
</tbody>
</table>

## Cal Mode

### RFID > Tag Calibration > Cal Mode

The menu item can be changed to Full mode for calibrating difficult tags. Most tags will calibrate correctly using the faster Quick mode, but certain tags that require a large amount of power or that are difficult to encode might require the Full setting.

If calibration fails with the Quick setting, try running a Full calibration instead. Also, if too many tags fail to encode during print jobs after a Quick calibration, try recalibrating the RFID tags in Full mode to see if the issue is resolved. T800 menu only.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick</td>
<td>This mode indicates a normal RFID calibration.</td>
</tr>
<tr>
<td>Full</td>
<td>This mode indicates a fuller RFID calibration that makes fewer adaptive assumptions during the calibration process. It is usually slower to execute than Quick</td>
</tr>
</tbody>
</table>
mode, but it will provide more accurate results with difficult RFID tags.

<table>
<thead>
<tr>
<th>Start Power</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RFID &gt; Tag Calibration &gt; Start Power</strong></td>
<td></td>
</tr>
<tr>
<td>This menu item determines the lowest power that the RFID calibration will Attempt. During the RFID Calibration, the process will test all power levels between and including the Start Power and End Power. T800 menu only.</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>3</td>
</tr>
<tr>
<td>Maximum</td>
<td>7</td>
</tr>
<tr>
<td>Factory Default</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>End Power</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RFID &gt; Tag Calibration &gt; End Power</strong></td>
<td></td>
</tr>
<tr>
<td>This menu item determines the highest power that the RFID calibration will Attempt. During the RFID Calibration, the process will test all power levels between and including the Start Power and End Power. T800 menu only.</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>3</td>
</tr>
<tr>
<td>Maximum</td>
<td>7</td>
</tr>
<tr>
<td>Factory Default</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test EPC Length</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RFID &gt; Tag Calibration &gt; Test EPC Length</strong></td>
<td></td>
</tr>
<tr>
<td>The menu item determines the size of the EPC data that will be used to perform the RFID Calibration. This menu can be increased to improve the accuracy of the RFID Calibration, but it should not be increased to a value greater than the maximum EPC length that the current Tag Type can support.</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>16</td>
</tr>
<tr>
<td>Maximum</td>
<td>256</td>
</tr>
<tr>
<td>Factory Default</td>
<td>96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Operation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RFID &gt; Tag Calibration &gt; Test Operation</strong></td>
<td></td>
</tr>
<tr>
<td>The menu item determines the actual RFID operations that will be performed during the RFID Calibration. The calibration will test multiple areas of the current RFID label with write commands and (if selected) read commands. T800 menu only.</td>
<td></td>
</tr>
<tr>
<td>Write</td>
<td>The RFID Calibration will perform RFID Write commands</td>
</tr>
<tr>
<td>Write and Read</td>
<td>The RFID Calibration will perform RFID Write commands and RFID Read commands</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Write</td>
</tr>
</tbody>
</table>
Calibration Params
Settings saved on the printer to optimize RFID encoding.

Antenna Active

<table>
<thead>
<tr>
<th>RFID &gt; Calibration Params &gt; Antenna Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu determines which Antenna will be used to encode RFID tags during host jobs. This menu can only be read, and is updated after every RFID Calibration. T6000e 4&quot; menu only.</td>
</tr>
<tr>
<td>External</td>
</tr>
<tr>
<td>Internal</td>
</tr>
<tr>
<td>Factory Default</td>
</tr>
<tr>
<td><strong>IMPORTANT</strong></td>
</tr>
</tbody>
</table>

Operation Order

<table>
<thead>
<tr>
<th>RFID &gt; Calibration Params &gt; Operation Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu determines when the RFID encoding operations will be performed, relative to any printing operations, on RFID tags during host jobs. This menu will be updated automatically after every RFID Calibration.</td>
</tr>
<tr>
<td>Encode Before Print</td>
</tr>
<tr>
<td>Encode After Print</td>
</tr>
<tr>
<td>Encode During Print</td>
</tr>
<tr>
<td>Factory Default</td>
</tr>
<tr>
<td><strong>IMPORTANT</strong></td>
</tr>
</tbody>
</table>
Tag Position

**RFID > Calibration Params > Tag Position**

This menu determines how far the RFID tag encoding position of the currently installed tag should be offset from Top of Form.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>-1.0 inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>12.0 inches</td>
</tr>
<tr>
<td>Factory Default</td>
<td>0.0 inches (Top of Form)</td>
</tr>
</tbody>
</table>

**IMPORTANT**
The units display in inches or millimeters, depending on SYSTEM > Control > Media Units.

This value will be set when RFID calibration is executed. Normally, this value should be left at the value chosen by RFID calibration because this was determined to be the optimal programming position.

Write Power

**RFID > Calibration Params > Write Power**

This menu item selects the write power level to be used in the RFID encoder. 1 is the lowest power level setting on all models, while the highest is 7 for T800, 30 for the T4000 and T6000e. Normally, this value is set automatically by the RFID calibration process and should not be changed.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>25 (T6000) / 7 (T800) / 30 (T4000 and T6000e)</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Depends on the type of RFID encoder installed.</td>
</tr>
</tbody>
</table>

Read Power

**RFID > Calibration Params > Read Power**

This menu item selects the read power level to be used in the RFID encoder. 1 is the lowest power level setting on all models, while the highest is 7 for T800, 30 for the T4000 and T6000e. Normally, this value is set automatically by the RFID calibration process and should not be changed.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>25 (T6000) / 7 (T800) / 30 (T4000 and T6000e)</td>
</tr>
<tr>
<td>Factory Default</td>
<td>Depends on the type of RFID encoder installed.</td>
</tr>
</tbody>
</table>

Read Tries

**RFID > Calibration Params > Read Tries**

This menu item selects how many times the RFID encoder will try each read command. T800 menu only.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>10 or Infinite</td>
</tr>
</tbody>
</table>
Write Tries

<table>
<thead>
<tr>
<th>RFID &gt; Calibration Params &gt; Write Tries</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item selects how many times the RFID encoder will try each write command. T800 menu only.</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>Factory Default</strong></td>
</tr>
</tbody>
</table>

Sensitivity

<table>
<thead>
<tr>
<th>RFID &gt; Calibration Params &gt; Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item defines the sensitivity of RFID signals. When set to 0 means low sensitivity. RFID tags that are marginal in signal will have higher chance to fail if not programmed at the perfect location. It is recommended not to change this value. T800 menu only.</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>Factory Default</strong></td>
</tr>
</tbody>
</table>

**IMPORTANT** This option affects RFID read and write operation. Only change it when you absolutely know it’s needed.

RFID Chip Params

A number of RFID options which define specific parameters for custom RFID tags can be set from the RFID > RFID Chip Params submenu.

USR Size

<table>
<thead>
<tr>
<th>RFID &gt; RFID Chip Params &gt; USR Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item selects the size in bytes of the USR block within the RFID tag memory. Normally, this value is set automatically by the RFID calibration process and should not be changed.</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
</tr>
<tr>
<td><strong>Factory Default</strong></td>
</tr>
</tbody>
</table>

**IMPORTANT** This value will be hidden if Higgs3 tags are detected, and the Higgs 3 USR Len menu will be un-hidden instead.

Higgs 3 USR Len

<table>
<thead>
<tr>
<th>RFID &gt; RFID Chip Params &gt; Higgs 3 USR Len</th>
</tr>
</thead>
</table>
Higgs 3 tags differ from other RFID tags in that its memory bank size is not fixed. To accommodate EPC lengths longer than 96 bits, Higgs 3 borrows memory from the USR bank. This display only menu indicates the size in bits of the USR block within the RFID tag memory.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>128</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>512</td>
</tr>
<tr>
<td>Factory Default</td>
<td>512</td>
</tr>
</tbody>
</table>

**IMPORTANT**

This menu will only be shown if a Higgs 3 tag is detected. Otherwise, it will be hidden.

When an EPC length is selected by the user in this menu, the value in this USR length menu will change automatically per Table 1. The USR length in this menu must be set to a value that is equal to or longer than all USR value lengths to be written by the application. If the value displayed in this menu is too short in length, the Higgs 3 EPC Len menu must be reduced so that this menu value will increase.

**USR Address**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>32</td>
</tr>
<tr>
<td>Factory Default</td>
<td>0</td>
</tr>
</tbody>
</table>

**TID Size**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>12</td>
</tr>
<tr>
<td>Factory Default</td>
<td>8</td>
</tr>
</tbody>
</table>

**Tag Length**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>64</td>
</tr>
</tbody>
</table>
Higgs 3 EPC Len

<table>
<thead>
<tr>
<th><strong>IMPORTANT</strong></th>
<th>This value will be hidden if Higgs3 tags are detected, and the Higgs 3 EPC Len menu will be hidden instead.</th>
</tr>
</thead>
</table>

**RFID > RFID Chip Params > Higgs 3 EPC Len**

Higgs 3 tags differ from other RFID tags in that its memory bank size is not fixed. To accommodate EPC lengths longer than 96 bits, Higgs 3 borrows memory from the USR bank. This menu item selects the number of bits dedicated to the EPC block within the RFID tag memory.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>480</td>
</tr>
<tr>
<td>Factory Default</td>
<td>96</td>
</tr>
</tbody>
</table>

**IMPORTANT**

This menu will only be shown if a Higgs 3 tag is detected. Otherwise, it will be hidden.

When an EPC length is selected by the user in this menu, the USR length will change automatically per Table 1. The EPC length in this menu must be set to a value that is equal to or longer than all EPC value lengths to be written by the application.

Since the PC value indicates the length of the EPC in the Higgs 3, the PC value must be programmed when programming the EPC (if the EPC value has changed from its factory state). The PC value to be programmed for each of the supported EPC lengths is shown in Table 1.

EPC Address

**RFID > RFID Chip Params > EPC Address**

This menu item selects the starting location of the EPC block within the RFID tag memory. Normally, this value is set automatically by the RFID calibration process and should not be changed.

<table>
<thead>
<tr>
<th>Minimum</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>32</td>
</tr>
<tr>
<td>Factory Default</td>
<td>0</td>
</tr>
</tbody>
</table>

Block Size

**RFID > RFID Chip Params > Block Size**

This menu item selects the maximum number of bytes written to the USR block within the RFID tag memory at one time. Normally, this value is set automatically by the RFID calibration process and should not be changed.

| Minimum | 0 |
Diagnostics Submenu

The following items are in the RFID > Diagnostics section and used to check correct behavior with the RFID system or the tags being used. The printer does not move the tag to proper position before performing read/write. To perform diagnostics with RFID tag, you need to manually position the tag at the reader’s antenna. This is a quick way to find out the tag type or data in the RFID memory bank.

Read Tag

<table>
<thead>
<tr>
<th>RFID &gt; Diagnostics &gt; Read Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>This executable menu reads the tag in range of the internal RFID coupler and reports the tag data to the debug port and momentarily displays it on the control panel’s LCD. It is primarily intended for development verification by checking that the system is working.</td>
</tr>
</tbody>
</table>

**IMPORTANT**
This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate reading.

Read Tag & Eject

<table>
<thead>
<tr>
<th>RFID &gt; Diagnostics &gt; Read Tag &amp; Eject</th>
</tr>
</thead>
<tbody>
<tr>
<td>This executable menu works exactly the same as Read Tag executable, except that after the printer reads the tag, it feeds the label to the next top-of-form.</td>
</tr>
</tbody>
</table>

**IMPORTANT**
This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate reading.

Read USR

<table>
<thead>
<tr>
<th>RFID &gt; Diagnostics &gt; Read Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>This executable menu reads the User Memory bank of the tag in range of the internal RFID coupler and reports the data to the debug port and momentarily displays it on the control panel’s LCD. It is primarily intended for development verification by checking that the system is working.</td>
</tr>
</tbody>
</table>

**IMPORTANT**
This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate reading.

Read TID

<table>
<thead>
<tr>
<th>RFID &gt; Diagnostics &gt; Read TID</th>
</tr>
</thead>
<tbody>
<tr>
<td>This executable menu reads the TID (Tag ID) from the tag in range of the internal RFID coupler and displays the value read in the Tag ID menu.</td>
</tr>
</tbody>
</table>

**IMPORTANT**
This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate reading.
Tag ID

**RFID > Diagnostics > Tag ID**

This menu item displays the first TID (Tag ID) read since power-up, or if using the Read TID menu, the most recently read TID. If no tag is in range of the internal RFID coupler, “Unknown” displays.

Read PC

**RFID > Diagnostics > Read PC**

This executable menu reads the PC (Protocol Control) field from an RFID tag in range of the internal RFID coupler and displays the value read in the Tag PC menu.

**IMPORTANT**

This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate reading.

Tag PC

**RFID > Diagnostics > Tag PC**

This menu item displays the last PC (Protocol Control) field read from an RFID tag. If no tag is in range of the internal RFID coupler, “Unknown” displays.

Write EPC with 1s

**RFID > Diagnostics > Write EPC with 1s**

This executable menu writes all ones to the tag in range of the internal RFID coupler. It is primarily intended for development verification by checking that the system is working.

**IMPORTANT**

This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate writing.

Write EPC with 2s

**RFID > Diagnostics > Write EPC with 2s**

This executable menu writes all twos to the tag in range of the internal RFID coupler. It is primarily intended for development verification by checking that the system is working.

**IMPORTANT**

This menu item does not position the RFID tag over the coupler. Make sure to position the tag over the coupler to receive an accurate writing.

Statistics Submenu

The following items are in the **RFID > Statistics** section and used to store statistics about the RFID system activities. The statistics can be reset by executing the menu **Clear Tag Stats** operation within this section.
Reporting Statistics

After any completed print job, you can request a report from the printer which describes the RFID statistics since the printer was turned on, or since the last time the RFID > Statistics > Clear Tag Stats was executed.

Requesting an RFID/ODV Report

This procedure prints a summarized RFID report. (This report also includes Validator data if the printer has a Validator installed.)

1. Press the PAUSE key to take the printer OFFLINE.
2. If necessary, press the UP+DOWN ARROW keys at the same time to unlock the front panel.
3. Edit the menu Tools > Print Tests > Run Tests.
4. Find the printer test named “Valid. Report” and press the ENTER key.
5. Lock the panel again using the UP+DOWN ARROW keys.
6. Press PAUSE again to put the printer ONLINE.

Tag Write Count

<table>
<thead>
<tr>
<th>RFID &gt; Statistics &gt; Tag Write Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item displays on the LCD the number of tags attempted to be written since the last Clear Tag Stat operation has been initiated.</td>
</tr>
</tbody>
</table>

Tag Failed Count

<table>
<thead>
<tr>
<th>RFID &gt; Statistics &gt; Tag Failed Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item displays on the LCD the number of failed RFID tags since the last Clear Tag Stat operation has been initiated.</td>
</tr>
</tbody>
</table>

Tag Read Count

<table>
<thead>
<tr>
<th>RFID &gt; Statistics &gt; Tag Read Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>This menu item displays the number of tags read since the last Clear Tag Stat operation.</td>
</tr>
</tbody>
</table>

Clear Tag Stat

<table>
<thead>
<tr>
<th>RFID &gt; Statistics &gt; Clear Tag Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>This executable menu item clears the Count menu items in this submenu.</td>
</tr>
</tbody>
</table>

Resetting RFID Data

The RFID statistics are kept since the last time the RFID > Statistics > Clear Tag Stats was executed. For example, you print a large batch of labels reading and writing RFID tags and then print an RFID/ODV report. Then you print/encode another batch of labels and print another report. The report will contain information on both batch jobs. However, if you reset the RFID data between batch jobs, the second report will only contain information on the second batch job.

To reset RFID Data, execute the menu RFID > Statistics > Clear Tag Stats.

RFID Reader F/W

<table>
<thead>
<tr>
<th>RFID &gt; Statistics &gt; RFID Reader F/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shows the RFID firmware version installed in the encoder.</td>
</tr>
</tbody>
</table>
RFID Reader Hd/W

<table>
<thead>
<tr>
<th>RFID &gt; Statistics &gt; RFID Reader Hd/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shows the RFID Hardware version installed in the encoder. Not available on T800.</td>
</tr>
</tbody>
</table>

Checking Firmware Revision

For troubleshooting purposes, you may need to reference the RFID firmware revision number. This can be found in two different places within the Settings section:

- RFID > Statistics > RFID Reader F/W.
- TOOLS > About > RFID Reader F/W.
5 RFID Commands

This section will cover different emulations that support RFID within the Printronix RFID thermal products:

- Incorporate RFID commands into new or existing Printronix PGL® programs.
- Incorporate RFID commands into new or existing ZPL™ programs. By selecting the Printronix ZGL emulation you can seamlessly upgrade from Zebra™ printers.
- Incorporate RFID commands into new or existing SATO® printer language programs. By selecting the Printronix STGL emulation you can seamlessly upgrade from SATO printers. PGL RFID Commands.

IMPORTANT With all examples make sure MEDIA > Image > Label Length matches the physical length of the installed media.

RFWTAG

Purpose The RFWTAG command is used to program an RFID tag (embedded in a smart label) using structured data format. The data structure of an RFID tag can consist of one or more bit fields. Each bit field specifies its own field length, the data format, the field type plus additional options if the type is incremental, and finally the field value.

NOTE: The RFWTAG command is supported only on Thermal printers.

Mode CREATE

Format RFWTAG[;LOCKn[;format]];size[;mem bank]
(Bit Field)+
STOP
RFWTAG Specifies the RFWTAG command, enter RFWTAG;
LOCKn[;format] or PERMALOCKn[;format]
Optional parameter to lock the data block to prevent it from being overwritten. By default, the data are not locked initially. n is the passcode. The acceptable values for n are 1 to FFFFFFFF in hex, a 4 bytes data. When the LOCKn option is used to lock any memory bank, which at the same time is programmed with the write data, the same passcode will be written on ACS memory bank. The ACS memory bank will also be locked if ACS is not locked at the time of the operation. If ACS is already locked at the time of the operation, the passcode needs to match the current content of ACS so that the memory bank lock takes effect. The passcode (n) can also be in dynamic format. For dynamic format, enter LOCK<DFn>, where DFn is the dynamic field defined in EXECUTE mode. Both LOCK and PERMALOCK share the same syntax. For differences in functionality, see Note 12 on page 38.

format An optional parameter to specify the format for the passcode data. Enter
B for binary, D for decimal, and H for hexadecimal. The default is decimal if format is not specified.

**size**  
A decimal number specifying the overall bit length of the memory bank.

**mem bank**  
Specifies which tag logical memory area that this command will be applied. If omitted, it defaults to the EPC memory area. Other areas include Identification, User Data, Access area and Kill area. Enter one of the following values:

- **‘EPC’** – EPC 12 bytes data area (default)
- **‘TID’** – Tag identification 8 bytes area (currently not applicable for RFWTAG)
- **‘USR’** – User 32 bytes area
- **‘ACS’** – 4 bytes access code area
- **‘KIL’** – 4 bytes kill code area
- **‘PC’** – 2 bytes PC code area (Gen 2 tags only)

**NOTE:** New tags, such as RSI IN47 Crkscr, support 240 bits of EPC memory and 512 bits of USR memory.

**Bit Field**  
A line description of a bit field and must have one of the following syntax formats:

1. For non-incremental data (both static and dynamic)  
   \[\text{length;}[\text{DF}n;]\text{format;}(\text{D})\text{datafield}(\text{D})\]
2. For incremental fixed data  
   \[\text{length;}\text{format;STEP[}\text{idir}\text{step;[RPT}n;]\text{[RST}n;]\text{(D)}\text{startdata}(\text{D})\]
3. For dynamic incremental data  
   \[\text{length;}\text{IDF}n;\text{format;}\]

**length**  
A decimal number specifying the bit length of a field within a tag. The maximum length for each DFn field of NON-HEX format is 64 bits. For hexadecimal format, the bit length can be up to the maximum bit length specified for the corresponding memory bank.

**DFn**  
Optional parameter to indicate this field has dynamic data. Replace \(n\) with a number ranging from 1 to 512 to identify the field number of this particular field. If this option is used, datafield is ignored, and dynamic data must be entered via the DF command in the EXECUTE mode.

**IDFn**  
Enter IDF to indicate this field is a bit field with dynamical assignment of increment (or decrement) data. The step and startdata parameters will be supplied by the IDF command in the EXECUTE mode. Replace \(n\) with a number ranging from 1 to 512 to identify the field number of this bit field. Dynamically enter the step and startdata parameters using the IDF command in the EXECUTE mode.

**NOTE:**

1. The same field number cannot be used in both DFn and IDFn.  
2. If a field is defined as IDFn, it must be referenced as IDFn later for consistency. The same applies for DFn.
3. If <IDFn> syntax is used for merging data into AFn or BFn, neither DFn, AFn, or BFn will be incremented. The increment only takes place in the ~DFn command where the STEP is specified.
**format**  
A letter specifying the format of the data field.  
B – binary, D – decimal, H – hexadecimal

**(D)**  
Delimiter designating the start and end of static data for this bit field.  
Replace (D) with any printable character, except the SFCC and the slash character (/).

**datafield**  
The static data of this static field. It is a mandatory parameter of bit field with static data.

**I**  
Identifies this field is an incremental bit field.

**STEP**  
Specifies that the incremental data field will use the step method.  
Enter **STEP**; The STEP option replaces the STEPMASK option that is used in Alpha and Barcode.

**idir**  
Enter a plus sign (+) or leave the field blank to increment (default). Enter a minus sign (–) to decrement.

**step**  
A decimal number specifies the amount to increment/decrement each time the form is executed. The increment is at bit level and will automatically wrap based on the field size.

**RPTn**  
The optional incremental repeat count parameters to specify the number of times a particular field value is repeated before it is incremented. The default repeat count parameter \( n \) is 1, which will increment the field value each time it prints. The repeat count can range from 1 to 65535.

**RSTn**  
The optional incremental reset count parameter to specify the number of times an incremented field is printed before it is reset to the starting value. By default, there is no reset count. The reset count parameter \( n \) can range from 1 to 65535.

**startdata**  
Defines the value of the field or the starting value of the incremented field. If the field is dynamic, the value will be specified later in the EXECUTE mode. The data must be specified within a pair of delimiters (D). The delimiter (D) cannot be a “/” or SFCC character since the “/” will comment out the rest of the line and SFCC is reserved for PGL commands. If “R” or “S” is used as delimiters, the data pattern must not comprise of the keywords in the incrementing options. Since the delimiters could be different from one value to another, proper care must be taken to avoid one of the letters mentioned above.
NOTE: 1. The RFWTAG command cannot be mixed with RFWRITE in the same form.

2. Each field structure must be specified in a single line and in the order it appears in the RFID tag from MSB bits to LSB bits (left to right). The sum of all the field lengths must match the size of the tag.

3. The host data are read in as ASCII characters. They would be converted to binary representation for the base field on the field format. Therefore, if the converted value is larger than the maximum value that a field can hold, an error will be reported. If the data value is smaller than the specified field length, on the other hand, the field will be padded to the left with zero bits.

4. Unlike the Alpha and Barcode command which use STEPMASK for incremental data, RFWTAG uses the STEP which will increment or decrement at bit level.

5. 432 IGP dots in the ~CREATE line specifies a 6 inch label. 6 inches = 432 (IGP dots)/72 (dpi) Use 144 for 2 inch labels and 288 for 4 inch labels.

6. ACS and KIL are similar to other memory banks. ACS contains the passcode which is used for LOCK and UNLOCK operations. KIL contains the killcode which is used to kill a tag. The user can write to or read from KIL memory bank, but the functionality of killing a tag is not currently applicable. Also, once ACS and KIL are locked, both cannot be written to or read from. For other memory banks, EPC, USR, and TID, once locked, they can be read from but not written to.

7. There are two ways to program the ACS memory area. One is to write to the ACS memory area directly with RFWTAG. The other is to use the LOCK option while writing to other memory banks. If ACS is not previously locked, then LOCK option will lock the memory bank and also write the passcode to ACS and lock ACS. When write to ACS with RFWTAG, ACS is not automatically locked. To lock ACS, use LOCKn with RFWTAG, where the passcode (n) should be the same as the write data to ASC.

8. There is only one passcode, the content of ACS memory bank, for each tag. The same passcode is used to lock or unlock any memory bank in that tag.

9. For LOCKn and UNLOCKn, the passcode (n) (which includes the dynamic format <DFn>) does not accept incremental data. This also applies to the ACS and KIL memory banks. The write data to the ACS and KIL memory banks do not accept incremental data because the ACS memory bank contains passcodes for LOCK and UNLOCK operations, and the KIL memory bank contains a killcode to kill a tag. Incremental data do not apply to passcodes or killcodes.

10. When LOCK<DFn> and UNLOCK<DFn> are used in the same form with the same dynamic data (the passcode), the dynamic format <DFn> needs to be a different dynamic number for LOCK and UNLOCK since it is designed with a unique dynamic number that can be linked to only one object type. In this case, LOCK is linked to RFWTAG object and UNLOCK is linked to RFRTAG object. Although both options use the same passcode, the dynamic format needs to be in a different dynamic number in the same form.

11. Because PC field is related to EPC field, when PC RFWTAG is used in the form, it must be followed immediately by EPC RFWTAG, or else an error will be reported. Also, by specification, the first 5 bits of PC data need to comply with the length of EPC data, or else an error will be reported. For example, for 96 bits EPC, the 5 bits of PC data is 00110. For 64 bits EPC, the first 5 bits of PC data is 00100. Also, LOCK option is not and will not be supported for PC field, since PC field works with EPC field (which already supports LOCK option).

12. Both LOCK and PERMALOCK requires the user to enter the password. Once the tag is permanently locked with the PERMALOCK command, it cannot be unlocked again; the tag can only be read from and never be written to once it is permanently locked. On the other hand, after the tag is locked with the LOCK command, it can be unlocked again with the same password.
For PERMALOCK (ex, EPC), the password must match the current content of ACS bank for PERMALOCK to work. If the current content of ACS bank is null (0x0) which could be the case for the brand new tag, the password for PERMALOCK EPC will be 0x0. If you use a different password for PERMALOCK, you need to write (RFWTAG) the new content (password) to ACS first, and then use this new password to PERMALOCK EPC.

For LOCK (ex, EPC), the password may be different from the current content of ACS. When a new password is used to lock EPC where ACS is not locked, this new password is written to ACS and locks ACS at the same time while locking EPC. For new tags where ACS is not locked and has all null data, you can lock EPC with a new password directly without writing to ACS first.

Example 1
The following example programs an SGTIN–64 value into the RFID tag that is embedded in a 4x6 smart label. Assume that the SGTIN–64 value is provided as a single number.

```
~CREATE;SGTIN–64;432
RFWTAG;64
64;H;*87D0034567ABCDEF* /EPC number
STOP
END
~EXECUTE;SGTIN–64;1
~NORMAL
```

Example 2
Same as Example 1, except the EPC number is broken into its component parts. Assume that the SGTIN–64 value has the Header = 2d, Filter Value = 5d, EPC Manager Index = 15383d, Object Class = 703710d or 0xABCD, and the Serial Number = 0123456d.

```
~CREATE;SGTIN–64;432
RFWTAG;64
2;B;*10* /Header
3;D;*5* /Filter Value
14;D;*15383* /EPC Manager Index
20;H;*ABCDE* /Object Class
25;D;*000123456* /Serial Number
STOP
END
~EXECUTE;SGTIN–64;1
~NORMAL
```

Example 3
Same as Example 2, except it uses a dynamic method. This example also shows how to program another RFID tag without redefining the data structure of the SGTIN–64.

```
~CREATE;SGTIN–64;432
RFWTAG;64
2;DF1;B /Header
3;DF2;D /Filter Value
14;DF3;D /EPC Manager Index
20;DF4;H /Object Class
25;DF5;D /Serial Number
STOP
ALPHA
```
Example 4
This example shows how to program a roll of 1500 smart labels with SGTIN–64 values, where the Header = 2d, Filter Value = 5d, EPC Manager Index = 15383d, Object Class = 703710d or 0xABCDE, and the Serial Number starting from 0000000 to 0001499d.

~CREATE;SGTIN–64;432
RFWTAG;64
2:B;**10* /Header
3:D;*5* /Filter Value
14:D;*15383* /EPC Manager Index
20:H;*ABCDE* /Object Class
25:I;D;STEP1;*0* /Serial Number
STOP
END
~EXECUTE;SGTIN–64;ICNT1500
~NORMAL

Example 5
This example shows how to program a 96 bit RFID tag. A SGTIN–96 format is used and the EPC number is broken into its component parts. Assume that the SGTIN–96 value has the Header = 48, Filter Value = 5d, EPC Manager Index = 123456d, Object Class = 777777d or 0xBDE31, and the Serial Number = 123456d.

NOTE: 96 bit tags must be broken up as in Examples 2, 3, and 4, and no field can be more than 64 bits in length if the format is binary or decimal. There is no restriction on the bit length if the format is hexadecimal.

~CREATE;SGTIN–96;432
RFWTAG;96
8:B;*00110000* /Header
3:D;*5* /Filter Value
3:D;*6* /Partition
20:D;*123456* /EPC Manager Index
Example 6

This example shows memory bank usage, where multiple RFWTAG and RFRTAG can be used.

~CREATE;SGTIN;216
SCALE;DOT;203;203
RFWTAG;96;EPC
96;IDF1;H
STOP
RFRTAG;96;EPC
96;DF3;H
STOP
RFWTAG;256;USR
256;IDF2;H
STOP
RFRTAG;256;USR
256;DF4;H
STOP

ALPHA
IAF1;24;POINT;90;60;16;6
IAF2;64;POINT;130;60;16;4
STOP

BARCODE
C3/9;X1;IBF1;64;170;60
PDF
STOP

VERIFY;DF1;H;*EPC W= *;*
VERIFY;DF3;H;*EPC R= *;*
VERIFY;DF2;H;*USR W= *;*
VERIFY;DF4;H;*USR R= *;*

END
~EXECUTE;SGTIN;ICNT4
~IDF1;STEP+1;313233343536373839414243
~IDF2;STEP+1;3132333435363738394142434445464748494A
4B4C4D4E4F
~IAF1;<DF3>
~IAF2;<DF4>
~IBF1;<DF3>
~NORMAL

Example 7

This example shows memory bank usage with LOCK and UNLOCK option, where multiple RFWTAG and RFRTAG can be used, and the passcode for lock and unlock can be in dynamic format.
Example 8
This example shows the usage of RFWTAG with PC field which needs to be followed immediately by RFWTAG with EPC field. There is not restriction for RFRTAG with PC filed.
Example 9
This example shows the usage of PERMALOCK.

~NORMAL
~CREATE;RFID;432
ALPHA
IAF1;24;POINT;4;5;10;10
STOP
RFWTAG;32;ACS
32;H;*ABC*
STOP
RFWTAG;PERMALOCKABC;H;96;EPC
96;DF1;H
STOP
RFRTAG;96;EPC
96;DF2;H
STOP
VERIFY;DF1;H;*DF1 = *;*
VERIFY;DF2;H;*DF2 = *;*
END
~EXECUTE;RFID;ICNT5
IDF1;STEP+1;*222222222222222222220011*
IAF1;<DF2>
~NORMAL

Example 10
This example shows the access of 240 bits EPC and 512 bits USR.

~CREATE;TEST;X;NOMOTION
RFWTAG;LOCK0C0D0E0F;H:240;EPC
240;i;H;STEP+1;"0102030405060708091011121314
15161718192021222324252627282930*
STOP
RFWTAG;LOCK0C0D0E0F;H:512;USR
512;i;H;STEP+1;"0102030405060708091011121314
151617181920212223242526272829303132333435
363738394041424344454647484950515253545556
5758596061626364*
STOP
RFWTAG;LOCK0C0D0E0F;H:32;KIL
32;H;"08090A0B"
STOP
RFRTAG;UNLOCK0C0D0E0F;H:32;ACS
32;DF31;H
STOP
VERIFY;DF31;H;"#ACS=";"\r\n"
RFRTAG;UNLOCK0C0D0E0F;H:32;KIL
32;DF22;H
STOP
VERIFY;DF22;H;"KIL=";"\r\n"
RFRTAG;UNLOCK0C0D0E0F;H:240;EPC
240;DF1;H
STOP
VERIFY;DF1;H;"EPC=";"\r\n"
RFRTAG;UNLOCK0C0D0E0F;H:512;USR
512;DF7;H
STOP
VERIFY;DF7;H;"USR=";"\r\n"
END
~EXECUTE;TEST;10
~NORMAL

RFRTAG

Purpose  To read the content of an RFID tag (embedded in a smart label) into a dynamic field. This command cannot be mixed with the RFREAD command.

NOTE: The RFRTAG command is supported only on Thermal printers.

Mode CREATE

Format RFRTAG[:UNLOCKn[:format][:size][:mem bank]]
(Bit Field)+
STOP
RFRTAG       Specifies the RFRTAG command, enter RFRTAG;
size         A decimal number specifying the overall bit length of the RFID tag memory bank.

UNLOCKn[:format]
Optional parameter to unlock the data block so it can be overwritten later. n is the passcode. The acceptable values for n are 1 to FFFFFFFF in hex, a 4 bytes data. The value of n should be the same
passcode used for the LOCK option to unlock the protected data block. When the UNLOCKn option is used to unlock any memory bank, which at the same is programmed to read the tag, the operation UNLOCKn will not unlock ACS memory area. The passcode (n) can also be in dynamic format. For dynamic format, enter LOCK<DFn>, where DFn is the dynamic field defined in EXECUTE mode.

*format* is the optional parameter to specify the format for the passcode data. Enter B for binary, D for decimal, and H for hexadecimal. The default is decimal if *format* is not specified.

### mem bank

Specifies which tag logical memory area that this command will be applied. If omitted, it defaults to the EPC memory area. Other areas include Identification, User Data, Access area, and Kill area. Enter one of the following values:

- **‘EPC’** – EPC 12 bytes data area (default)
- **‘TID’** – Tag identification 8 bytes area
- **‘USR’** – User 32 bytes area
- **‘ACS’** – 4 bytes access code area
- **‘KIL’** – 4 bytes kill code area
- **‘PC’** – 2 bytes PC code area (Gen 2 tags only)

### Bit Field

A line description of a bit field; must have one of the following syntax formats:

```
length;DFn;format
```

- **length**
  
  A decimal number specifying the bit length of a field within a tag. The maximum length is 64 bits for binary or decimal format. For hexadecimal format, the bit length can be up to the maximum bit length specified for the corresponding memory bank.

- **DFn**
  
  Indicate dynamic data field to store the read result. Replace *n* with a number ranging from 1 to 512 to identify the field number of this particular field.

- **format**
  
  A letter specifying the representation format of the field data.
  
  - B – binary, D – decimal, H – hexadecimal

### NOTE:

1. Multiple RFRTAG commands are allowed in the same form but the same DFn field cannot be defined multiple times.

2. The DF field length is restricted to 64 bits for binary or decimal format and must be a multiple of 8 bits. The sum of all field lengths must be equal to the tag size.

3. The first field always start at the MSB bit. The bit length of a field dictates the start bit of the next field, etc. As a result, DF fields will not overlap each other.

4. RFRTAG does not allow incremental fields (with the “I” prefix).

5. 432 IGP dots in the ~CREATE line specifies a 6 inch label. 6 inches = 432 (IGP dots)/72 (dpi)
Use 144 for 2 inch labels and 288 for 4 inch labels.

Example
Same as Example 4 on page 40, except the increment is dynamic and the result is merged into Alpha to print on the smart label.

~CREATE;SGTIN–64;432
RFWTAG;64
2;B;*10*/Header
3;D;*5*/Filter Value
14;D;*15383*/EPC Manager Index
20;D;*123456*/Object Class
25;IDF1;H/Serial Number STOP
RFRTAG;64
64;DF2;H;
STOP
ALPHA
IAF1;16;3;12;0;0
STOP
END
~EXECUTE;SGTIN–64;ICNT1500
~IDF1;STEP+1;*0*
~IAF1;<DF2>
~NORMAL

NOTE: 1. The <IDF1> usage does not increment the DF1 field. It merges the DF1 content into the AF1 field, keeping the same representation previously defined for IDF1.

2. The use of IAF1 is to print alpha on every label. If AF1 is used instead, only the first label is printed. The AF1 field is not incremented either since it is using the result from the DF1 merge.

VERIFY
Purpose Request the printer to send to the host the ASCII representation of a dynamic field. The dynamic field could be one of AFn, BFn, or DFn, but cannot be RFn.

NOTE: The Verify command is supported only on Thermal printers.

Mode CREATE

Format VERIFY;field;format;(D)ASCIIheader(D);(D)ASCIITrailer(D)

VERIFY The command to verify data of a dynamic field, enter VERIFY;
field The dynamic field AFn, BFn, or DFn that contains the data to be sent to the host.

format A letter specifying the format of the outgoing data to be sent to the host.

B – binary, D – decimal, H – hexadecimal, S – string

Based on the incoming format of the data field, a format conversion may be performed if the outgoing format is not the same. The AFn and BFn format is always S type. The DFn format could be either B, D, or H. Due to the possible conversion the outgoing data stream could be longer than the incoming one. The maximum length for the outgoing
data is 512 bytes. If the format request will result in a data stream exceeding the maximum length, an error would be reported.

**ASCIIheader**
A mandatory parameter to specify an ASCII string of characters, which is followed by the RFID data, to be sent by the printer to the host.

**ASCIItrailer**
An optional parameter to specify an ASCII string of characters, which will follow the RFID data, to be sent by the printer to the host.

(D)
Delimiter designating the start and end of a character string. Replace (D) with any printable character, except the SFCC and the slash character (/). The string could be empty, i.e. there are not headers preceding the field data.

**NOTE:**
1. The DFn field must be defined previously in the CREATE mode before it can be specified in the VERIFY command otherwise it will be considered as a syntax error and the VERIFY command will abort.
2. All RFID Read/Write commands are executed first in the order they appear in CREATE mode, followed by Alpha and Barcode commands, and finally VERIFY commands. The VERIFY commands are always executed last although they may appear before other commands in the CREATE mode. The reason for this is to make sure the data are sent back to the host only if other commands are completed and the form is not aborted.
3. If the data comes from a DFn field, the DFn format is the original format before any conversion. If the VERIFY command specifies a different format, the data would then be converted to the new format. If the data comes from an AFn or BFn, the original format is S format.
4. Below is the possible syntax for header and trailer string,
   1. VERIFY;DF2;H;*Head = *   //Header only
   2. VERIFY;DF2;H;*Head = *; *Tail* //Header & trailer
   3. VERIFY;DF2;H;**;*Tail* //Trailer only
   4. VERIFY;DF2;H;*Head = *;** //Header only

To insert the CR/LF character, add “\r” and “\n” as CR/LF characters, such as

VERIFY;DF2;H;*Header\r\n* //this will display “Header\r\n” on the screen, where double back slash “\" (0x5C 0x5C) will be replaced with one back slash ‘\’ (0x5C).

The characters \r and \n can be inserted anywhere in the header string and trailer string.

To summarize,

\r -> 0x0D //CR
\n -> 0x0A //LF
\ \ -> \ //one back slash

**Example 1**
This example requests the printer to send to the host the content of the RFID tag, in hexadecimal format, both before and after the RFWTAG command writes data to the tag. Also, the label is not moved.

~CREATE;VERIFY;432;NOMOTION
RFRTAG;64
64;DF1;H
STOP
VERIFY;DF1;H;*TagBefore=*  
RFWTAG; 64
2;B;*01*
6;D;*29*
24;H;*466958*
17;H;*ABC*
15;D;*1234*
STOP
RFRTAG;64
64;DF2;H
STOP
VERIFY;DF2;H;*TagAfter=* 
END
~EXECUTE;VERIFY;1
~NORMAL
TagBefore=A5A500005D055E04  
TagAfter=5D466958055E04D2  
Example 2  
This example reads a roll of 1500 pre-programmed smart labels.

~CREATE;READONLY;432
RFRTAG;64
64;DF1;H
STOP
VERIFY;DF1;H;**
END
~EXECUTE;READONLY;1500
~NORMAL
A5A500005D055E04  
another 1498 lines of RFID data................
A5A50000000550D4  
Example 3
This example requests the printer to program a roll of 2000 smart labels using the RFWTAG command with incremental field. Then, it sends the actual data from each of the 2000 tags to the host.

~CREATE;SIMPLE;432;NOMOTION
RFWTAG;64
2;B;*01*
6;D;*29*
24;H;*466958*
17;H;*ABC*
15;I;D;STEP+1;*0000*
STOP
RFRTAG; 64
64;DF1;H
STOP
ZGL RFID Commands

Read Tag ^RT

Purpose This command allows data from the RFID tag (embedded in the smart label) to merge into any previously defined dynamic data field. It is equivalent to the Field Number command (^FN) except that the data come from the RFID tag.

Format ^RT x, start, length, hex, retries, motion, reserved

^RT Read Tag command.

x Specified Field Number (value assigned to the field). The default is 0. The acceptable value range is 0 to 9999.

start Location where data will be read from the RFID tag. The ZGL only supports Alien Technology Class 1a tags, which have only one 8-byte or 12-byte block. Therefore, start will be set to 0, regardless of the specified value.

length The number of blocks to be read from the RFID tag. The ZGL only supports Alien Technology Class 1a tags, which have only one 8-byte or 12-byte block. Therefore, length will be set to 1, regardless of the specified value.

hex This flag indicates whether the data, after being read from the RFID tag, should be translated into hexadecimal format. The default is 0, meaning the data will not be translated. The other acceptable value is 1, meaning the data will be translated into hexadecimal format.

retries The number of automatic attempts to read data from the tag if previous reads failed. The ZGL absorbs the number and uses the value on the control panel's LCD.

motion Set this flag to 1 to read data from the tag without moving the label. The printer may adjust the label position while it reads data from the tag, but this adjustment will reverse before any subsequent normal label movement. Even if this flag is set to 1, other commands (i.e., alpha or barcode) may move the label.

reserved This is a reserved flag. The ZGL absorbs this number.

Comments This command is only executed by the demand for data from any dynamic field. The ZGL absorbs this command if there are no demands for the data.
Write Tag ^WT

Purpose  This command programs data into an RFID tag (embedded in the smart label).

Format  ^WT start, retries, motion, protect, data format, reserved

^WT  Write Tag command.

start  Starting block location where data will be programmed into the RFID tag. The ZGL only supports Alien Technology Class 1a tags, which have only one 8-byte or 12-byte block. Therefore, start will be set to 0, regardless of the specified value.

retries  The number of automatic attempts to write data into the tag if previous writes failed. The ZGL absorbs the number and uses the value on the control panel’s LCD.

motion  Set this flag to 1 to program data into the tag without moving the label. The printer may adjust the label position while it writes data into the tag, but this adjustment will reverse before any subsequent normal label movement. Even if this flag is set to 1, other commands (i.e., alpha or barcode) may move the label.

protect  This flag indicates whether the data should be protected from being overwritten later. The default is 0, meaning the data are not protected. Other acceptable values are 1 to 255, meaning the data are protected using this number as the LOCK password.

Data format  0 (ASCII) or 1 (hex). The default is 0.

reserved  This is a reserved flag. The ZGL absorbs this number.

Write or Read Format ^RF

Purpose  This command allows you to write or read to an RFID tag.

Format  ^RFa,b,c,d,e

^RF  Write or Read RFID command.

a  Specifies the read or write option. The default is W.
W = write to the tag
L = write with LOCK
R = read the tag
P = read password (Gen 2 tags only; used when c is set to K or A).

b  Specifies the data format. The default is H.
A = ASCII
H = Hex
E = EPC format.

c  Specifies the starting block number. The default is 0. Since there are currently only 8-byte or 12-byte blocks, the starting block number can only be 0. Or,
specifies which password to read (Gen 2 tags only; used when a is set to P):
K = kill password
A = access password
d Specifies the number of blocks to read. This option is valid only for the read operation. Since there are currently only 8–byte or 12–byte blocks, the number of blocks to be read can only be 1.
e Specifies the memory bank to write to or read from. The default is E.
E = EPC
0 = Reserved
1 = EPC
2 = TID (only for read)
3 = USER

Calibrate Transponder ^HR

Purpose This command initiates an RFID transponder calibration for a specific RFID label and returns the results to the host computer.

Format ^HRa,b

^HR Calibrate RFID command.
a The start string to appear before the returned result. The default is “start”. The acceptable value is any string less than 65 characters.
b The end string to appear after the returned result. The default is “end”. The acceptable value is any string less than 65 characters.

Define EPC Data Structure ^RB

Purpose This command defines the structure of EPC data, which can be read from or written to an RFID transponder.

Format ^RBp0,p1,p2...,p15

^RB EPC Data command.
n Total bit size of the field. The default is 96. The acceptable value range is 1 to n, where n is the total bit size of the tag.
p1..p15 Specifies each partition size. These must add up to the total bit size. The default is 1. The acceptable value range is 1 to 64 bits for each partition.

Enable RFID Motion ^RM

Purpose This command enables or disables RFID paper motion. By default, labels automatically print at the end of the format. This command allows you to inhibit the label from moving.

Format ^RMa

^RM Enable RFID Motion command.
a The default is Y. The acceptable values are Y (Yes, move the label) or N (No, do not move the label).

Specify RFID Retries for a Block ^RR

Purpose This command specifies the number of times that the printer attempts to read from or write to a particular block of a single RFID tag. The number will reflect in the RFID > Control > Auto Retry menu.

Format ^RR

Specify RFID Retries command.
a The default is 2. The acceptable value range is 1 to 9.

RFID Setup ^RS

Purpose This command sets up parameters including tag type, read/write position of the transponder, and error handling.

Format ^RS

Selects the tag type. The acceptable values range is 0 to 5. (This option is currently not supported.).
b Sets the read/write position of the transponder in the vertical (Y axis) in dot rows from the top of the label. Set to 0 if the transponder is already in the effective area without moving the media. The default value is label length minus 1 mm. The acceptable value range is 0 to label length.
c Sets the length of the void printout in dot rows. The acceptable value range is 0 to label length. (This option is currently not supported.)
d Sets the number of retries that will be attempted in case of read/write failure. The number will reflect in the Label Retry menu.
e Error handling. Enter N for no action. Enter P to place the printer in Pause mode. Enter E to place the printer in Error mode. (This option is currently not supported.)
f Signals on applicator. Enter S to single signal. Enter D for double signal. (This option is currently not supported.)
g Certify tag with a pre-read. (This option is currently not supported.)
h Sets the print speed at which “VOID” will be printed across the label. (This option is currently not supported.)

Tag Password ^RZ

Purpose This command defines the password for the tag during writing.

WARNING: With Gen 2 tags you can lock a tag’s memory bank with an access password, or define a kill password that can permanently disable a tag
Set RFID Tag Password command.

\[ ^{\text{RZ}}a,b,c \]

\[ ^{\text{RZ}} \]
Sets a password. Gen 2 tags use a 32-bit password and they specify the memory bank and lock style. Other tags use 8 bits and they ignore the memory bank and lock style. To read the password, see section "Write or Read Format ^RF" on page 50. The default is 00. The acceptable value range is 00 to FF (hexadecimal).

\[ a \]
Specifies the memory bank (Gen 2 tags only). There is no default value.

- \( K \) = kill password
- \( A \) = access password
- \( E \) = EPC
- \( T \) = tag identifier (TID)
- \( U \) = user

\[ b \]
Specifies the lock style (Gen 2 tags only). There is no default value.

- \( U \) or \( O \) = unlocked
- \( L \) = locked
- \( P \) = permalocked
- \( W \) = write value (used only when \( b \) is set to \( K \))

**IMPORTANT** Tags that have been permalocked cannot be unlocked or rewritten.

**Example**

\[ ^{\text{XA}} \]
\[ ^{\text{RZA1B2C3D4,K,W}} \]
//Write "A1B2C3D4" to the kill memory bank to set the kill password.
\[ ^{\text{RZ1234ABCD,K,L}} \]
//Use the access password "1234ABCD" to lock (make unreadable) the kill memory bank
\[ ^{\text{XZ}} \]
\[ ^{\text{XA}} \]
\[ ^{\text{RZ1234ABCD,A,U}} \]
//Unlock the access memory bank.
\[ ^{\text{RZ1234ABCD,K,U}} \]
//Unlock the kill memory bank.
\[ ^{\text{FO50,550^A0N,50^FN1^FS}} \]
\[ ^{\text{FN1^RFP,H,K^FS}} \]
//Read from the kill memory bank.
\[ ^{\text{FO50,650^A0N,50^FN2^FS}} \]
\[ ^{\text{FN2^RFP,H,A^FS}} \]
//Read from the access memory bank.
\[ ^{\text{HV1,16,KIL=^FS}} \]
\[ ^{\text{HV2,16,ACS=^FS}} \]
\[ ^{\text{XZ}} \]

**Host Verification ^HV**

**IMPORTANT** This command requires setting up the SYSTEM > Printer Mgmt > Ret. Status Port menu up correctly. See the Administrator’s Manual for more details.
Purpose
This command sends back the data in a ^FN (Field Number) field to the host.

Format
^HVx.y,<ASCII>

^HV Host Verification command.
x Specified Field Number. The default is 0. The acceptable value range is 0 to 9999.
y Number of characters to be returned. The default is 64. The acceptable value range is 0 to 256).
<ASCII> Header (in uppercase ASCII characters). The default is None. The acceptable value range is 0 to 256 characters.

Example

^XA
^WT0^FDHELLO^FS
^RT3,0,1^FS
^FO100,100^A0N,60^FN3^FS
^HV3,16,TAGNO = ^FS
^XZ

Response from Printer
TAGNO = 48454C4C4F544147

EPC Programming Examples

IMPORTANT With all examples make sure MEDIA > Image > Label Length matches the physical length of the installed media.

Example 1
This programming example programs data into an RFID tag and prints that data onto a smart label.

^XA
//Begin ZPL form.
^WT0^FDHELLO^FS
^RT1,0,1^FS
^FO100,100^A0N,60^FN1^FS
//Print data in element 1.
^XZ
//End and print label.

Example 2
Same as Example 1, except an alternative ZGL syntax that does not require underscores between the hex characters is used

^XA
//Begin ZPL form.
^WT0,1FDN^FD87D0034567ABCDEF^FS
//Write Tag with data = "87D0034567ABCDEF" hex format.
^RT1,0,1^FS
//Read Tag into data element 1, 8-byte (16 characters) long (hex format).
^FO100,100^A0N,60^FN1^FS
//Print data in element 1.
^XZ
//End and print label.
//Read Tag into data element 1, 8-byte (16 characters) long (hex format).
^FO100,100^A0N,60^FN1^FS
   //Print data in element 1.
^XZ
   //End and print label.

Example 3
This example uses the ^RF command to write and read the tag.

^XA
   //Begin ZPL form.
^RFW,H,0^FD31323334^FS
   //Write tag data 31323334 in hex.
^FO100,100^A0N,60,60^FN1^FS
   //Print tag data in FN1.
^FN1^RFR,H,0^FS
   //Read tag data and store into FN1.
^XZ
   //End and print label.

Example 4
This example uses the ^RF command to write and read the tag with EPC format.

^XA
^RMY
^RB64,16,16,16,16
^RZ01^RR3^RFW,E^FD12594,13108,13622,14136^FS
^FO50,150^A0N,50^FN0^FS
^FN0^RR4^RFR,E^FS
^XZ

Example 5
On a Gen 2 tag, this example:

- Writes EPC data “112233445566778899001122” to the tag in hexadecimal format
- Locks the tag’s EPC data with the password “1234ABCD”
- Renders the tag’s access password unreadable

^XA
^RFW,H^FD112233445566778899001122^FS
^RZ1234ABCD,E,L^FS
^RZ1234ABCD,A,L^FS
^XZ

This example:

- Unlocks EPC data “112233445566778899001122” using the password “1234ABCD”
- Writes EPC data “newdata” to the tag in ASCII format
- Locks the tag’s new EPC data

Since the access password and its lock state are not changed, the access password remains unreadable
Example 6
This example shows the access of 240 bits EPC and 512 bits USR.

STGL RFID Commands

RFID Write

Purpose This command specifies data to be written into RFID tags.

Format <ESC>RK 1,a,b,D16,c..c

^HV Host Verification command.

a RFID tag Error Ignore. 0 = Disable (default when value is omitted), 1 = Enabled, 2 to 9 = Auto retry on tag error.

IMPORTANT This “a” parameter is ignored for STGL. The error handling for all RFID commands on all supported emulations is set according to the menus on the front panel. Using the RFID menu, the user can set the error handling, number of retries, and tag type.

b Write Protector Designation. Valid range is 0 to 1. 0 = Fixed (default).

D Write Protector Designation. Valid range is 0 to 1. 0 = Fixed (default).
16 or 24 Specification of Writing Data Size. Valid data size is 16 or 24 characters.

c..c EPC data (fixed at 16 characters). Valid range is 0 to 9 or A to F only.

Example
<ESC>RK1,0,0,D16,ABCDEF1234567543

RFID Write(IP0), RFID Read(IP1)
Refer to your SATO programmer’s reference manual for a description of the RFID command syntax for IP0 and IP1.

PTX SETUP Commands
The PTX SETUP commands are a superset of commands which allow the printer to perform several tasks by parsing commands either stored in flash or sent to the printer by the host. Commands range from re-routing debug statements to downloading complete printer configurations. See the Administrator’s Manual for a full description of all the commands available. Those specific to RFID are shown in Table 3.

Concepts to Note

1. PTX_SETUP commands are not emulation specific. They work regardless of how Applications > Control > Active IGP Emul is setup.

2. The PTX_SETUP command set is case sensitive; all PTX_SETUP commands are in uppercase characters only.

3. The white space separating commands may be any number of spaces and tabs. This allows a PTX_SETUP file to be formatted for easier readability.

4. Any unknown command will terminate the PTX_SETUP processing. The offending command will be the first line of printed text.

Each emulation has modes in which the PTX_SETUP commands could get missed. It is highly recommended that all PTX_SETUP commands be placed between print jobs, rather than attempting to embed them within jobs.

PTX_SETUP commands have the following format:

(SFCC)PTX_SETUP
Command-Sub Command; Value
PTX_END

For example, if the SFCC assigned to PTX_SETUP is the default value of the exclamation mark (!, hex 21), and you want to change the EPC Length for a Higgs-3 RFID tag to 256, use the following command sequence:

!PTX_SETUP RFID;EPC_LENGTH;256 PTX_END
### Table 3: PTX-Setup Commands for RFID

<table>
<thead>
<tr>
<th>Command</th>
<th>Sub-Command</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID</td>
<td>OVERSTRIKE_REPORT</td>
<td>0</td>
<td>When set to 0 (OFF), an RFID overstrike occurs then it is not reported to the host.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>When set to 1 (ON), an RFID overstrike occurs then it is reported to the host.</td>
</tr>
<tr>
<td>STATISTICS_REPORT</td>
<td></td>
<td>0</td>
<td>When set to 0 (OFF), RFID statistics are not reported to the host.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>When set to 1 (ON) RFID overstrikes are reported to the host when an alert is processed.</td>
</tr>
<tr>
<td>STATISTICS_CLEAR</td>
<td></td>
<td>None</td>
<td>When this command is processed the RFID statistics are cleared.</td>
</tr>
<tr>
<td>EPC_LENGTH</td>
<td>EPC field length</td>
<td></td>
<td>Specifies the EPC length for RFID tag types that have a variable length EPC field (e.g. higgs-3). EPC field length can be one of (96, 112, 128, 144, 160, 176, 192, 208, 224, 240, 256). <strong>NOTE:</strong> When the EPC length is selected with the command, the USR field is automatically set to the corresponding size as defined by the EPC Global Class-1 Generation-2 UHF RFID Specification. When the EPC length is selected with the command, the PC field must be programmed with the correct value as defined by the EPC Global Class-1 Generation-2 UHF RFID Specification.</td>
</tr>
</tbody>
</table>
Pitch is defined as the distance from one point on an inlay to the same point on the next inlay. The reference point can be any point on the inlay: leading (or trailing) edge of the antenna (often described as the foil), leading (or trailing) edge of the antenna substrate, or the distance between ICs.

**On-Pitch RFID Labels**

Use the RFID Inlay Reference Figure 6 for a clearer understanding of the various points that can be used to determine pitch. The figure shows the minimum distance our printers can work with between inlays from 0.5 to 0.625”. The reason for this is to prevent the printer’s coupler from talking to two or more tags at once. Any closer together and the coupler in the printer would be broadcasting to the tag in back or in front at the same time.
## Errors and Troubleshooting

### Error Messages

The RFID encoder can detect a number of errors. When one of these errors occurs, the RFID encoder alerts the printer to perform the currently selected error action (see section Error! Reference source not found. on page Error! Bookmark not defined.) and display the appropriate error message on the control panel’s LCD (see Table 4).

<table>
<thead>
<tr>
<th>Displayed Message</th>
<th>Solution/Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID Comm Err Check Cable</td>
<td>RFID error: communication cannot be established between the printer and the RFID encoder.</td>
</tr>
<tr>
<td></td>
<td>1. Press <strong>PAUSE</strong> to clear the message.</td>
</tr>
<tr>
<td></td>
<td>2. Disable the <em>Control &gt; RFID Active</em> menu.</td>
</tr>
<tr>
<td>RFID FW ERR: Version Mismatch</td>
<td>The RFID encoder firmware version is not capable of operating with the printer software.</td>
</tr>
<tr>
<td></td>
<td>1. Press <strong>PAUSE</strong> to clear the message.</td>
</tr>
<tr>
<td></td>
<td>2. Download the program file to the printer again.</td>
</tr>
<tr>
<td>RFID LOCK CMD: Not supported!</td>
<td>A lock command was executed on a tag which does not support locking. Most Gen 2 tags support locking.</td>
</tr>
<tr>
<td></td>
<td>1. Press <strong>PAUSE</strong> to clear the message.</td>
</tr>
<tr>
<td></td>
<td>2. Remove the lock command from the application.</td>
</tr>
<tr>
<td>RFID MAX RETRY Check System</td>
<td>The menu <em>Control &gt; Error Handling</em> is set to <em>Overstrike</em>, and the Label Retry count has been exhausted.</td>
</tr>
<tr>
<td></td>
<td>1. Press <strong>PAUSE</strong> to clear the message.</td>
</tr>
<tr>
<td></td>
<td>2. See “Troubleshooting” on page 61.</td>
</tr>
<tr>
<td>Displayed Message</td>
<td>Solution/Explanation</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>RFID TAG ERR:</strong> Read-Only Tag</td>
<td>A write was attempted on a read-only tag.</td>
</tr>
</tbody>
</table>
|                                       | 1. Press PAUSE to clear the message.  
|                                       | 2. See “Troubleshooting” on page 61.                                                                                                                  |
| **ODV COMM ERR**                      | Communication error between printer and online data validator (ODV).                                                                                   |
|                                       | 2. If the problem persists, contact your authorized customer service representative.                                                                  |
| **RFID TAG FAILED**                   | The menu Control > Error Handling is set to Stop, and the RFID encoder could not read the RFID tag.                                                     |
| Check Media                           | 1. Press PAUSE to clear the message.  
|                                       | 2. See “Troubleshooting” on page 61.                                                                                                                  |
| **RFID UNLOCK CMD:** Not Supported!  | An unlock command was executed on a tag which does not support locking.                                                                               |
|                                       | 1. Press PAUSE to clear the message.  
|                                       | 2. Remove the unlock command from the application.                                                                                                    |
| **RFID ACS FIELD:** Not Supported!   | The ACS field was accessed on a tag which does not support the ACS field.                                                                          |
|                                       | 1. Press PAUSE to clear the message.  
|                                       | 2. Remove references to ACS field from the application.                                                                                             |
| **RFID KIL FIELD:** Not Supported!   | The KIL field was accessed on a tag which does not support the KIL field.                                                                           |
|                                       | 1. Press PAUSE to clear the message.  
|                                       | 2. Remove references to KIL field from the application.                                                                                              |
| **RFID PC FIELD:** Not Supported!    | The PC field was accessed on a tag which does not support the PC field.                                                                              |
|                                       | 1. Press PAUSE to clear the message.  
|                                       | 2. Remove references to PC field from the application.                                                                                               |

**Troubleshooting**

If you are having problems with the RFID system, consult Table 5 for a list of symptoms and possible solutions.

**Table 5 Troubleshooting the RFID System**
<table>
<thead>
<tr>
<th>Symptom</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No communication between the printer and the RFID encoder</td>
<td>1. Make sure the reader is enabled via Control &gt; RFID Active menu (page Error! Bookmark not defined.).&lt;br&gt;2. Use the Diagnostics &gt; Read Tag feature (page 31) to read and display the current RFID tag content.&lt;br&gt;3. If the problem persists, your RFID encoder may be disconnected or defective. Contact your authorized service representative.</td>
</tr>
<tr>
<td>Tag failed</td>
<td>1. The label could be misaligned. Perform the Sensors &gt; Control &gt; Auto Calibrate procedure to ensure the label is at top-of-form. For more information, refer to the Administrator’s Manual.&lt;br&gt;2. Make sure the media are smart labels with RFID tags located in the correct position.&lt;br&gt;3. The RFID tag could be defective. Try another tag.&lt;br&gt;4. Make sure the application does not send too few or too many digits to the RFID tag.</td>
</tr>
<tr>
<td>Inconsistent results</td>
<td>Make sure the media is loaded correctly. For more information, refer to the Administrator’s Manual.</td>
</tr>
<tr>
<td>The RFID encoder works, but it does not meet expectations</td>
<td>Make sure that both Control &gt; Error Handling and Control &gt; Label Retry are set to desired values.</td>
</tr>
<tr>
<td>The RFID icon is greyed out in the Settings section:</td>
<td>The printer did not detect the RFID encoder at power-up. Your RFID encoder may be disconnected or defective. Contact your authorized service representative.</td>
</tr>
</tbody>
</table>
Contact Information

Printronix Customer Support Center

**IMPORTANT** Please have the following information available prior to calling the Printronix Customer Support Center:

- Model number
- Serial number (located on the back of the printer)
- Installed options (i.e., interface and host type if applicable to the problem)
- Configuration printout: Refer to the *Administrator’s Manual.*
- Is the problem with a new install or an existing printer?
- Description of the problem (be specific)
- Good and bad pictures that clearly show the problem (faxing or emailing of these pictures may be required)

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