RE40 DKRE
Development Kit Radio Engine

User Guide
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Introduction

This guide provides information about using the Zebra RE40 Development Kit Radio Engine (DKRE) for development and testing.

IMPORTANT: If you have a problem with your equipment, contact Zebra Global Customer Support for your region. Contact information is available at: www.zebra.com/support.

Configurations

This guide covers the following configuration:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DKRE-4000-00WW</td>
<td>RE40 Standard Development Kit</td>
</tr>
</tbody>
</table>

Chapter Descriptions

Topics covered in this guide are as follows:

- **Getting Started** provides an overview of the development kit including the kit contents and block diagram.
- **DKRE Setup** provides information on installing and configuring the development kit hardware.
- **Software Overview** provides an overview of software applications, software installation and usage, APIs, and interface information.
- **Appendix A: Regulatory for Third Party Integration** provides regulatory and compliance information for third party integration.
- **Appendix B: Troubleshooting** provides troubleshooting solutions for potential problems.
- **Appendix C: Environmental Considerations** provides information and recommendations on environmental concerns that can potentially affect performance.

Notational Conventions

The following conventions are used in this document:

- “DKRE” refers to the Zebra Development Kit Radio Engine; “Device” or “RFID Module” refers to the RE40 RFID Module.
About This Document

- **Bold** text is used to highlight the following:
  - Dialog box, window and screen names
  - Drop-down list and list box names
  - Check box and radio button names
  - Icons on a screen
  - Key names on a keypad
  - Button names on a screen.

- Bullets (*) indicate:
  - Action items
  - Lists of alternatives
  - Lists of required steps that are not necessarily sequential.

- Sequential lists (e.g., those that describe step-by-step procedures) appear as numbered lists.

**Icon Conventions**

The documentation set is designed to give the reader more visual clues. The following graphic icons are used throughout the documentation set. These icons and their associated meanings are described below.

- **NOTE:** The text here indicates information that is supplemental for the user to know and that is not required to complete a task.

- **IMPORTANT:** The text here indicates information that is important for the user to know.

- **CAUTION:** If the precaution is not heeded, the user could receive minor or moderate injury.

- **CAUTION—ESD:** Observe proper electrostatic safety precautions.

- **CAUTION—ELECTRIC SHOCK:** Disconnect the printer power before performing certain procedures to avoid the risk of electric shock.

- **WARNING:** If danger is not avoided, the user CAN be seriously injured or killed.

- **DANGER!** If danger is not avoided, the user WILL be seriously injured or killed.

- **NOTE:** This is an icon for wired networking notes.

- **NOTE:** This is an icon for wireless networking notes.
Related Documents and Software

The following documents provide more information about the RE40 RFID Module:

- RE40 Integration Guide
- Carrier Board Integration Guide
- DKRE Quick Start Guide
- RFID Demo Application User Guide
- API Programmer’s Guide.

For the latest version of this guide and all guides, go to www.zebra.com/support.

Service Information

If you have a problem with your equipment, contact Zebra Global Customer Support for your region. Contact information is available at www.zebra.com/support.

When contacting support, please have the following information available:

- Serial number of the unit
- Model number or product name
- Software/firmware type or version number

Zebra responds to calls by email, telephone or fax within the time limits set forth in support agreements.

If your problem cannot be solved by Zebra Customer Support, you may need to return your equipment for servicing and will be given specific directions. Zebra is not responsible for any damages incurred during shipment if the approved shipping container is not used. Shipping the units improperly can possibly void the warranty.

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Feedback

If you have comments, questions, or suggestions about this guide, send an email to EVM-techdocs@zebra.com.
Getting Started

Introduction

The Development Kit Radio Engine (DKRE) is a composite test system comprising of a development board, two RE40 RFID modules, and accessories which provide the tools needed to design and test an embedded RE40 RFID module before integration into a host device.

Unpacking

Remove the material from its packing and inspect for damage. If the material was damaged in transit, contact Zebra Support. See Service Information on page 8 for information. KEEP THE PACKING. It is the approved shipping container; use this to return the equipment for servicing.

DKRE Contents

This DKRE contents consists the following:

Table 1 DKRE Contents

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE40 Development Board</td>
<td>DKRE-4000-00WW</td>
<td>1</td>
</tr>
<tr>
<td>5V Power Supply</td>
<td>PWR-WUA5V12W0WW</td>
<td>1</td>
</tr>
<tr>
<td>Development Kit Quick Start Guide</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>USB Drive with Software Tools and Documentation</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>Antennas:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US antenna, 3.5 dBiL (902-928MHz)</td>
<td>S9025PR</td>
<td>1</td>
</tr>
<tr>
<td>EU antenna, 3.0 dBiL (865-870MHz)</td>
<td>S8655PL</td>
<td>1</td>
</tr>
<tr>
<td>Universal Dipole antenna, (860-960MHz)</td>
<td>9000984-XLPDNB</td>
<td>1</td>
</tr>
<tr>
<td>RF Cable: SMA to SMA</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>RE40 Modules</td>
<td>RE4000-MR01000-WW</td>
<td>2</td>
</tr>
<tr>
<td>Micro USB Cables: USB Power 6 ft, USB Data 4.5 ft</td>
<td>N/A</td>
<td>2</td>
</tr>
<tr>
<td>RFID Tag Sample Kit</td>
<td>N/A</td>
<td>1</td>
</tr>
</tbody>
</table>
DKRE Board Overview

The DKRE is designed to allow for easy development of RE40 applications using a Windows PC or other hosts capable of utilizing UART. Components and connections on the PCB are displayed in Figure 1.

Figure 1  RE40 DKRE Block Diagram

Figure 2  DKRE Interface Connections

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro USB</td>
<td>Data, UART0 and UART1 through FTDI</td>
</tr>
<tr>
<td>Micro USB Client</td>
<td>Data, USB</td>
</tr>
<tr>
<td>GPIO Header</td>
<td>USER GPIO connection</td>
</tr>
<tr>
<td>Micro USB</td>
<td>Power, 5V/1.5A USB charger</td>
</tr>
<tr>
<td>DC Jack</td>
<td>Power 5V regulated power supply</td>
</tr>
<tr>
<td>JTAG Connector</td>
<td>For Debug</td>
</tr>
<tr>
<td>Data UART Header</td>
<td>UART 0</td>
</tr>
<tr>
<td>Debug UART Header</td>
<td>UART 1</td>
</tr>
<tr>
<td>Aux Header</td>
<td>Miscellaneous debug connections</td>
</tr>
<tr>
<td>ZIF Connector</td>
<td>Connects to carrier board to bring out debug pins to DKRE</td>
</tr>
<tr>
<td>SMA Connector</td>
<td>Two SMA when carrier board is present</td>
</tr>
<tr>
<td>Board to Wire Connector</td>
<td>Connects to carrier board</td>
</tr>
</tbody>
</table>
DKRE Setup

Introduction

This chapter provides instructions for installing and configuring the DKRE hardware.
DKRE Hardware

The Development Kit Radio Engine hosts the carrier board with 2 RF ports (SMA) and support for UART and USB. The DKRE is intended for development and testing purposes only.

The Development Board components and connections are shown in Figure 2. The DKRE main connections are power, RF, and UART communication. The power for the RE40 RFID Module default configuration comes from the micro USB for power or 5V DC power adaptor. The RF signal is connected to the antenna using the SMA connectors. The RE40 communication with UART is connected with the micro USB.

Figure 2  DKRE Board Components and Connections

| 1 | SMA Connectors |
| 2 | MMCX Cable |
| 3 | RFID Enable Switch |
| 4 | Reset Button |
| 5 | GPIO Switch |
| 6 | Micro USB - UART Communication |
| 7 | UART, ADC, JTAG_EN Header |
| 8 | Micro USB - Power-in |
| 9 | GPIO Header |
| 10 | Power Selector |
| 11 | USB Channel Select Switch |
| 12 | Micro USB - USB Communication |
| 13 | Board-to-Wire Connector |
DKRE Accessories

Figure 3  DKRE Accessories

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SMA Connectors</td>
</tr>
<tr>
<td>2</td>
<td>MMCX Cable</td>
</tr>
<tr>
<td>3</td>
<td>Carrier Board PCB</td>
</tr>
<tr>
<td>4</td>
<td>Board to Wire Connector</td>
</tr>
<tr>
<td>5</td>
<td>Micro USB - UART Communication</td>
</tr>
<tr>
<td>6</td>
<td>Micro USB - Power-in</td>
</tr>
<tr>
<td>7</td>
<td>DC Input Jack</td>
</tr>
<tr>
<td>8</td>
<td>RF SMA Antenna Cable</td>
</tr>
<tr>
<td>9</td>
<td>USB Type A to Micro USB Cable</td>
</tr>
<tr>
<td>10</td>
<td>USB Wall Power Adaptor</td>
</tr>
<tr>
<td>11</td>
<td>RFID Tags</td>
</tr>
<tr>
<td>12</td>
<td>RFID Antenna with SMA Connector</td>
</tr>
</tbody>
</table>
Installing DKRE Hardware

Install the RE40 DKRE as follows:

1. Restore the default configuration if the connectors have been reconfigured since opening the kit (see DKRE Default Configuration on page 15).

2. Connect the development board to your Windows PC using the Micro USB - USB Communication or Micro USB - UART Communication.

3. Connect the 5V power supply to an AC outlet and use the Power USB cable to connect power to the development board at the Micro USB - Power in Port.

4. Observe the green Power LED on the DKRE to indicate that the module is powered on.
Table 3  Power and Status LED Definitions

<table>
<thead>
<tr>
<th>DKRE Power LED Green</th>
<th>Status LED Red</th>
<th>Status LED Yellow</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Power is off; RFID module is in sleep mode.</td>
</tr>
<tr>
<td>On</td>
<td>Off</td>
<td>On</td>
<td>Normal operation.</td>
</tr>
<tr>
<td>On</td>
<td>On</td>
<td>On</td>
<td>Error condition exists (check error log); RFID module may or may not be fully operational.</td>
</tr>
<tr>
<td>On</td>
<td>Flashing</td>
<td>Off</td>
<td>Firmware download is in progress.</td>
</tr>
<tr>
<td>On</td>
<td>On</td>
<td>Off</td>
<td>RFID module is in boot mode (may be on briefly after power up or reset).</td>
</tr>
</tbody>
</table>

5. Based on the country of operation, select the appropriate antenna provided in the DKRE kit (US antenna p/n: S9025PR; EU antenna p/n: S8655PL; Universal antenna p/n: 9000984-XLPDNB).

6. Connect the antenna to one of the J201 or J204 SMA antenna connectors (see Figure 14 on page 22) using the SMA RF Cable.

For instructions on software installation, connecting readers, and reading RFID tags, see Software Overview on page 27.

Carrier Board PCB

The Carrier Board PCB has a mounted module, two RF ports (MMCX), and other communication connectors. The Carrier Board is FCC Class B certified and regulatory approved.

For detailed information, refer to the Carrier Board Integration Guide, located at: www.zebra.com/support.

Figure 6  Carrier Board PCB

DKRE Default Configuration

The default configuration of the DKRE development board allows communication with the RE40 over the USB-UART interface with a host PC, and power 5V regulated power supply. To restore the default configuration, perform the following steps:

1. Set the switches on the DKRE to the default settings as shown in Figure 7.
2. Discover the COM port for the DKRE board in Windows 10.

3. Click **Windows > Device Manager**.

4. Select **Ports**.
5. The DKRE UART ports are enumerated as USB Serial Ports. Use the lowest port number for communication. For example, select COM6 in Figure 8.

6. Run the RE40Config tool from the command line (example: RE40Config.exe COM6 921600) to set the factory defaults as follows:
   a. Set the Protocol to Binary Interface.
   b. Set the Num of Antennas to 3 (for DKRE board).
   c. Erase the Region Configuration.
   d. Set Baud Rate.

   For additional information on options, see RE40Config on page 50.

Integration with Raspberry Pi

Raspberry Pi 4B Setup and Raspbian OS Installation

To setup the 4B board and install the operating system, go to:


RE40 DKRE Setup with Raspberry Pi Board

To setup the RE40 DKRE with the Raspberry Pi Board:

1. Connect the Micro USB Communication Cable from the Raspberry Pi board to the DKRE Debug USB port.
2. Connect to the Raspberry Pi module using the SSH login.

3. Execute the following command to list RE40 RFID module as two UART ports: 
   
   ```bash
   /dev/ttyUSB0
   and
   /dev/ttyUSB1
   ```

   (as shown in Figure 10).

   **NOTE:** The port device /dev/ttyUSB0 is used for RFID operations such as Tag Inventory, Tag Access, etc.

**RE40 DKRE GPIO Connections**

There are a total of 10 pins available in GPIO header on the RE40 DKRE board.

- Pins 1-2: Input DC Voltage Jumper
- Pins 3-4: Ground
- Pin 5: GPIO 0 (General Purpose Input Output)
- Pin 6: GPIO 1 (General Purpose Input Output)
- Pin 7: GPIO 2 (General Purpose Input Output)
- Pin 8: GPIO 3 (General Purpose Input Output)
• Pin 9: GPIO 4 (General Purpose Output Only)
• Pin 10: GPIO 5 (General Purpose Output Only)

**Figure 11** DKRE GPIO Connections

---

**Antennas**

The RE40 RFID module supports one monostatic bidirectional RF antenna port through castellated pad, which may be connected to a 50 ohm controlled impedance connector for the antenna. The module also provides two control lines for the external RF switch.

**NOTE:** The RE40 RFID module does not support bistatic operation.

**Using a Multi-port RF Switch**

The module supports using an RF switch, allowing up to four total logical antenna ports. RF switching is controlled using one or two of the GPIO lines. The number of antenna ports must be programmed into the module to allow for RF switching.

**Antenna Requirements**

Antennas that provide a suitable 50 ohm match at the operating frequency band produce best results. The level of performance specified is achieved with antennas providing an 18 dB return loss (VSWR of 1.3) or better across the operating band.
While a short period of exposure to 5dB or less is not expected to significantly harm the module, the module should never transmit in an open port. Damage may occur if an antenna is disconnected during operation or if the module observes a short circuit at the antenna port.

**NOTE:** The RE40 RFID module does not support automatic antenna detection.

**Authorized Antennas**

The RE40 RFID module supports the use of any 50 ohm commercial antenna with a maximum gain of 6 dBiL that meets VSWR 1.8:1 and meets all applicable regulatory requirements (gain, beam width, return loss, etc). Antennas that have a gain greater than 6 dBiL may not be used in some regions without additional regulatory approval.

The module has been certified to operate with the antennas listed in Figure 4.

**NOTE:** The performance of the RE40 RFID module is dependent upon the detailed specifications of the third-party antenna being used.

**Table 4  Approved Antennas**

<table>
<thead>
<tr>
<th>Model</th>
<th>Polarization</th>
<th>Frequency Range</th>
<th>Maximum Linear Gain</th>
<th>VSWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN440</td>
<td>1 x Left-hand Circular</td>
<td>EU: 865-868 MHz</td>
<td>US/Canada: 6.0 dBiL</td>
<td>1.22:1</td>
</tr>
<tr>
<td></td>
<td>1 x Right-hand Circular</td>
<td>US: 902-928 MHz*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AN480</td>
<td>Left-hand Circular or</td>
<td>EU: 865-868 MHz</td>
<td>6.0 dBiL</td>
<td>1.3:1</td>
</tr>
<tr>
<td></td>
<td>Right-hand Circular</td>
<td>US: 902-928 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AN610</td>
<td>Left-hand Circular</td>
<td>EU: 865-868 MHz</td>
<td>5.0 dBiC</td>
<td>1.4:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US: 902-928 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AN620</td>
<td>Left-hand Circular</td>
<td>EU: 865-868 MHz</td>
<td>7.0 dBiC</td>
<td>1.4:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US: 902-928 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AN710</td>
<td>Left-hand Circular</td>
<td>EU: 865-868 MHz</td>
<td>3.0 dBiC</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US: 902-928 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AN720</td>
<td>Left-hand Circular</td>
<td>EU: 865-868 MHz</td>
<td>US/Canada: 3.0 dBiL</td>
<td>1.5:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US: 902-928 MHz</td>
<td>EU: 3.5 dBiL</td>
<td></td>
</tr>
<tr>
<td>AN510</td>
<td>Right-hand Circular</td>
<td>EU: 865-868 MHz</td>
<td>8.5 dBiC</td>
<td>1.3:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US: 902-928 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laird</td>
<td>S9025PL</td>
<td>US: 902-928 MHz</td>
<td>5.5 dBiC</td>
<td>1.5:1</td>
</tr>
<tr>
<td></td>
<td>S9025PR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laird</td>
<td>S8655PL</td>
<td>EU: 865-870 MHz</td>
<td>5.0 dBiC</td>
<td>1.5:1</td>
</tr>
<tr>
<td></td>
<td>S8655PR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Values optimized for US.

**Third Party Antenna Support**

The RE40 may be used with third party antennas provided they meet VSWR 1.8:1 and meet all applicable regulatory requirements (see Antenna Requirements on page 55).

**NOTE:** Depending on the detailed specifications of the third party antenna (for example: gain, efficiency, beam width, return loss, axial ratio), the performance of the module may vary.
Connecting the Mini RFID Panel Antennas

To connect the Mini RFID Panel antennas:

1. Connect the one end of the RF cable to the antenna.
2. Connect the other end of the RF cable to the RF SMA Connector port (see Figure 2) on the development board.

![Figure 12](Mini RFID Panel Antennas)

Connecting the SMA-Male Rubber Duck Antenna

To connect the SMA-Male Rubber Duck antenna, connect the cable directly into the RF SMA Connector port (see Figure 2) on the development board.

![Figure 13](SMA-Male Rubber Duck Antenna)
DKRE Connectors and Switches

Figure 14  DKRE Connector and Switch Diagram
### Table 5 DKRE Connector and Switch Descriptions

<table>
<thead>
<tr>
<th>DKRE Board Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J205</td>
<td>DC jack which connects to 5V/2A external power adapter. <strong>Caution</strong>: Do not use at the same time as the J202 USB Wall adapter.</td>
</tr>
<tr>
<td>J202</td>
<td>Micro USB connector for connection to USB 5V wall adapter. <strong>Caution</strong>: Do not use at the same time as the J205 USB Wall adapter.</td>
</tr>
<tr>
<td>J216</td>
<td>Dual row pin header (Berg stick) 10 pins 0.1 inch for AUX UART, ADC and JTAG DBGPWR_EN.</td>
</tr>
<tr>
<td>S203</td>
<td>Module enable switch used to activate the RFID Module or Carrier Board.</td>
</tr>
</tbody>
</table>
Table 5  DKRE Connector and Switch Descriptions (Continued)

<table>
<thead>
<tr>
<th>DKRE Board Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S204 - S209</td>
<td>GPIO switch used to pull-high or pull-low.</td>
</tr>
<tr>
<td>S210</td>
<td>Reset switch connected to TEST_RESET.</td>
</tr>
<tr>
<td>S214, S215</td>
<td>USB channel switch used to select Module Socket or Carrier Board.</td>
</tr>
<tr>
<td>J208</td>
<td>Board to Wire Connector on the Carrier Board.</td>
</tr>
</tbody>
</table>
### Table 5  DKRE Connector and Switch Descriptions (Continued)

<table>
<thead>
<tr>
<th>DKRE Board Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J218, J219</td>
<td>MMCX connector on the Carrier Board.</td>
</tr>
</tbody>
</table>

![Diagram of J218, J219]  

| J201, J204           | SMA connector used for the external antenna. |

![Diagram of J201, J204]
## DKRE Connector and Switch Descriptions (Continued)

<table>
<thead>
<tr>
<th>DKRE Board Reference</th>
<th>Description</th>
</tr>
</thead>
</table>
| J301                 | Micro USB connector used for FTDI chip (USB to UART).  
                         • CH1 – UART0 of TIRCON (Debug UART)  
                         • CH2 - UART1 of TRICON |
| S301 - S306          | Switch of FTDI UART signals to RFID Module UART0/UART1 or OPEN. |
| TOOL201 - TOOL204    | GND PCB Turret terminal. |
Software Overview

Introduction

This chapter provides an overview of software applications, software installation and usage, APIs, and interface information.

API

Where API utilization is not feasible or convenient, the RE40 can also be configured in RCI mode to enable the use of RAIN RCI-based applications.

**NOTE:** The RFID SDK for C is supported in any host that supports POSIX threads.

Table 6 Available SDKs

<table>
<thead>
<tr>
<th>SDK</th>
<th>Programming Languages</th>
<th>Sample App</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID SDK for Windows (Windows 10 64-bit)</td>
<td>C</td>
<td>RFIDHostSample1 (GUI)</td>
</tr>
<tr>
<td></td>
<td>C# .NET Framework 4.5.2</td>
<td>CS_RFID_Host_Sample2 (GUI)</td>
</tr>
<tr>
<td></td>
<td>C# .NET Core 3.0</td>
<td>CS_RFIDSample4</td>
</tr>
<tr>
<td></td>
<td>Java (JDK 1.8)</td>
<td>J_RFIDHostSample1 (GUI)</td>
</tr>
<tr>
<td>RFID SDK for Linux (Ubuntu 18.04 64-bit / Raspberry Pi 32-bit)</td>
<td>C</td>
<td>RFIDSample4</td>
</tr>
<tr>
<td></td>
<td>C# .NET Core 3.0</td>
<td>CS_RFIDSample4</td>
</tr>
<tr>
<td></td>
<td>Java (JDK 1.8)</td>
<td>J_RFIDSample4</td>
</tr>
<tr>
<td>RFID SDK for Android (Android 10)</td>
<td>Android Java</td>
<td>Hello RFID Application (GUI)</td>
</tr>
<tr>
<td>RFID RCI (Any OS which supports UART/USB CDC)</td>
<td>Python 3.0</td>
<td>rcisample.py</td>
</tr>
</tbody>
</table>

Interfaces

Serial UART driver support at the host with a baud rate of 921600 is required.
Demo Application Overview

Zebra offers demo applications for both Windows and non-Window based hosts as outlined in Table 7.

Table 7 Demo Application Tools

<table>
<thead>
<tr>
<th>Tools</th>
<th>Operating System</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>123RFID Desktop</td>
<td>Windows 10 64 bit</td>
<td>A GUI-based Windows application used to configure and update module firmware. See 123RFID Desktop on page 29 for detailed instructions.</td>
</tr>
<tr>
<td>RFID Demo Application for .NET Core 3.0</td>
<td>Operating System Supporting .NET Core 3.0</td>
<td>A console-based application used to demonstrate reader configuration and file-based firmware updates. Intended for non-Windows based hosts that are unable to use 123RFID Desktop. See RFID Demo Application for Linux/Raspbian on page 42 detailed instructions.</td>
</tr>
</tbody>
</table>

123RFID Desktop Application

123RFID Desktop is a software tool that simplifies reader setup and is intuitive enough for first time users. It finds and connects to a reader with three simple clicks.

123RFID Desktop features include:

• Find, connect reader, and start reading tags with three simple mouse clicks.

• Update firmware.

• Streamline the optimization process using the intuitive configuration wizard.
  • Save optimized settings to a file for later use.
  • Load an already saved configuration file to the connected reader.
  • Print a report of optimized settings.

• Analyze tag data using filtering tools.
  • Use the Asset Tag List file to filter by known tags.
  • Filter by EPC or RSSI values.

• Check reader performance using charts.
  • Charts that represent tag read counts by antennas.
  • Check RSSI signal on individual tags during an inventory.
  • Program the GPIO accessory (for example: have a photo-eye sensor activate an inventory session).
  • Built-in screen-by-screen help and How-To-Videos link to guide users through the tool.

For more information go to www.zebra.com/123rfid.
RFID Demo Application

RFID demo application is provided in all supported SDKs. The RFID demo applications come with development project and source code. They showcase RFID module configuration and various RFID operations.

A console-based demo tool is also provided. The console-based demo tool for .NET core 3.0 demonstrates a reader configuration and a firmware update for non-Windows based hosts.

For detailed information, refer to the RFID Demo Application User Guide located at: www.zebra.com/support.

123RFID Desktop

Installing 123RFID Desktop

To install and open 123RFID Desktop:

1. Install the 123RFID Desktop software on your PC. Choose one of the following options.
   - Copy the 123RFID Desktop file from the USB drive if provided.

2. Open the 123RFID Desktop software by double-clicking on the 123RFID Desktop icon on your desktop. The 123RFID loading window displays.

3. Read the 123RFID Desktop Overview screen that appears on startup to familiarize yourself with the application features.
Connecting Reader with 123RFID Desktop

The DKRE can be connected with 123RFID Desktop in one of the following ways:

- Locate the DKRE on the local subnet or USB port using Reader Discovery.
- Enter the COM port.

Once connected, you can begin reading RFID tags and performing inventory.

Connecting via Reader Discovery

To connect to the RE40 RFID module using the Reader Discovery feature:

1. Open the 123RFID Desktop software by double-clicking on the 123RFID Desktop icon on your desktop. The Welcome Screen displays.
2. Click **Find Readers** to initiate Reader Discovery.

3. For initial use only, you must configure the region of operation.
   a. After selecting **Find Readers** and **Connect** (next to the desired reader to connect to) for the first time, the Region Configuration Prompt window displays.

4. **Built-in Help**
   - Click ![Help icon](image) to get high-level screen-by-screen explanation of capabilities.
   - Click ![Video icon](image) for step-by-step instructions on tool capabilities.

5. **Helpful Hints**
   - **How to find hostname of reader:** Refer to the label on the reader.
   - **How to find IP address of a reader:** Type in the hostname in your browser to visit the reader's console web page. After logging in, the home page will display the reader's network IP address.

6. **Program GPIO accessory**
   - In five minutes, setup a proof of concept demonstrating solutions using GPIO accessories.
d. Click Login.

**Figure 20** 123RFID Region Configuration Window

- e. Click on the **Region of Operation** drop-down menu and select your region of operation.

**IMPORTANT:** Selecting a Region different from the country of use is illegal.

- f. Click on the **Communication Standard** drop-down menu and select the standard for your region if applicable.

- g. Click on the **I understand implications of setting an illegal region** check box.

- h. Click SET.

**Figure 21** Region Configuration Successful Window

4. A successful update message window displays. Click OK.

5. Once Reader Discovery is complete, the readers display in the **Available Readers** section of the screen. Click **Connect** next to the desired reader to connect to.
6. Once connected, the reader displays in the **Connected Readers** section of the screen as shown in Figure 27.

**Connecting via COM Port**

To connect to the RE40 RFID module by entering the COM port:

1. Open the 123RFID Desktop software by double-clicking on the **123RFID Desktop** icon on your desktop.
2. Enter the reader COM port in the field provided (see Figure 17). Once connected, the reader displays in the **Available Readers** section of the screen.
3. Click **Connect**. For initial use only, you must configure the region of operation as follows:
   a. After selecting **Connect** for the first time, the Region Configuration Prompt window displays.

**Figure 23  Region Configuration Prompt Window**

b. Click **Continue**. The **RE Module Admin Login** window displays.
c. Enter a **Username** and **Password** of your choosing.

**Figure 24** RE Module Admin Login

![RE Module Admin Login]

- d. Click **Login**.
- e. Click on the **Region of Operation** drop-down menu and select your region of operation.

**WARNING:** Selecting a Region different from the country of use is illegal.

- f. Click on the **Communication Standard** drop-down menu and select the standard for your region if applicable.
- g. Click on the I **understand implications of setting an illegal region** check box.

**Figure 25** 123RFID Region Configuration Window

![123RFID Region Configuration Window]

- h. Click **SET**.

**Figure 26** Region Configuration Successful Window

![Region Configuration Successful Window]

4. A successful update message window displays. Click **OK**.

5. Once connected, the reader displays in the **Connected Readers** section of the screen.
Reading RFID Tags

Once the device is connected, begin reading RFID tags as follows:

1. Select the **Read** tab to display the **Data View** screen.
2. Place the tags within a few inches of the antenna field of view.
3. Click **Start** to begin reading tags.
4. Monitor the **Data View** screen.

**NOTE:** Depending on the detailed specifications of the third party antenna (for example: gain, efficiency, beam width, return loss, axial ratio), the performance of the module may vary.
Software Overview

Figure 29  123RFID Desktop Data View Screen Populated

Figure 30  123RFID Data View Options
### Changing Region Configuration

**IMPORTANT:** Selecting a Region different from the country of use is illegal.

To change the region configuration:

1. Under **Available Readers**, click **Connect** next to the desired RE40 module. The module displays under **Connected Readers**.

   ![123RFID Desktop Connected Readers](image)

   **Figure 31** 123RFID Desktop Connected Readers

2. Under **Connected Readers**, select the RE40 module check box under the **Read** column.

3. Click on the **Configure** tab.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Read</strong></td>
<td>Select the <strong>Read</strong> tab to access the Data View screen.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Filters</strong></td>
<td>Select <strong>Filters</strong> to apply an asset tag list and select reader(s) to display.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Tag Alert</strong></td>
<td>Select the <strong>Tag Alert</strong> icon to highlight a row if an RFID tag has not been seen in a specified amount of seconds.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Charts</strong></td>
<td>Select <strong>Charts</strong> to see tag reads and RSSI signal per tag across antennas.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Tag Focus</strong></td>
<td>Select <strong>Tag Focus</strong> to minimize redundant reads of strong tags to allow the reader to focus on tags that are typically the last to be read.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Clear</strong></td>
<td>Select <strong>Clear</strong> to clear all of the RFID tags currently displayed in Data View.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Tag Fields</strong></td>
<td>Select the <strong>Tag Fields</strong> icon to select the desired columns to display.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Export</strong></td>
<td>Select <strong>Export</strong> to export summary or history data to Excel (.csv file format).</td>
</tr>
<tr>
<td>9</td>
<td><strong>Start</strong></td>
<td>Select <strong>Start</strong> to begin reading RFID tags.</td>
</tr>
</tbody>
</table>
Figure 32  Selecting Reader to Configure Screen

a. Click on the RE40 module.

Figure 33  Edit Reader Configuration Button

b. Click on Edit Configuration on Reader.

Figure 34  Region Config Screen

c. Click on Region Config from the Configure menu. The current configured region displays.

d. Enter the required region configuration parameters: Region of Operation, Communication Standard, Frequency Hopping, Selected Channels.

e. Select the region compliance check box I understand implications of setting an illegal region.

f. Click SET.
Figure 35  Region Configuration Update Confirmation Window

When the region configuration is complete, the RE40 disconnects and a successful update message window displays. Click OK.

Figure 36  Connect Tab Screen

h. The Connect screen displays.

Updating Firmware with 123RFID

To update the reader firmware with 123RFID:

1. Select the Firmware tab.
2. Select the check box next to the desired reader.
3. Click **Update Firmware**. A Reader Firmware Update window displays.

4. Click **Browse** and navigate to the firmware version you want to install on the selected device.

5. Click **Continue**.

6. The Update Status column provides a progress status bar indicating the percentage complete. Once the firmware update is complete, a successful update window displays.
7. Click OK.

**RFID Demo Application for Linux/Raspbian**

**Install SDK**

To install SDK .net Core 3.0:

1. Download .net core RunTime (3.0).
   - For Raspberry Pi, go to:  
     https://dotnet.microsoft.com/download/dotnet-core/thank-you/sdk-3.0.100-linux-arm32-binaries
   - For Linux X64, go to:  
     https://dotnet.microsoft.com/download/dotnet-core/thank-you/sdk-3.0.100-linux-x64-binaries

2. When the download completes, open a terminal and go to the path where you downloaded the .net core SDK.

3. Run the following commands to extract the SDK and make the commands available at the terminal:

   ```
   mkdir -p $HOME/dotnet && tar zxf dotnet-sdk-3.0.100-linux-arm.tar.gz -C $HOME/dotnet
   export DOTNET_ROOT=$HOME/dotnet
   export PATH=$PATH:$HOME/dotnet
   ```

4. Run the `dotnet --info` command in your terminal to verify that .NET is correctly installed and ready to use.
5. The DKRE board can be connected to Raspberry Pi/Linux System with USB UART and USB CDC port.
   
   - For USB UART
     
     - Run `ls/dev/ttyUSB*`
     - For data communication, use the port `/dev/ttyUSB0`

5. The DKRE board can be connected to Raspberry Pi/Linux System with USB UART and USB CDC port.
   
   - For USB UART
     
     - Run `ls/dev/ttyUSB*`
     - For data communication, use the port `/dev/ttyUSB0`

   - For USB CDC
     
     - Run `ls/dev/ttyACM*`
     - For data communication, use the port `/dev/ttyACM0`

6. To run the sample application:

   a. Go to the path `CS_RFIDSample4.dll` where the sample application is present.

   b. Run the following command from the terminal using the USB port where the DKRE board is connected: `dotnet CS_RFIDSample4.dll /dev/ttyUSB0 921600`
7. The DKRE is connected and the following **Command Menu** displays.

```
---Command Menu---
1. Capability
2. Configuration
3. Inventory
4. Access
5. Region Configuration
6. Firmware Update
7. Exit
```

---

`Figure 43  Run Sample Application Screen`

---

Run Sample Application Screen

```
pi@raspberrypi:~/Pramod $ dotnet CS_RFID4Sample4Core.dll /dev/ttyUSB0 921600
Welcome to RFID API .NET Standard Sample Application

---Command Menu---
1. Capability
2. Configuration
3. Inventory
4. Access
5. Region Configuration
6. Firmware Update
7. Exit
```

Reader Capabilities

- FirmwareVersion=3.0.6.0
- ModelName=RF40
- NumAntennaSupported=1
- NumGPIPorts=2
- NumGPIOPorts=4
- IsUTClikeSupported=True
- IsBlockEraseSupported=True
- IsBlockWriteSupported=True
- IsRegInventoryStateAwareSupported=True
- MaxNumOperationsInAccessSequence=8
- MaxNumPrefilters=32
- CommunicationStandard=US_FCC_PART_15
- CountryCode=40
- IsHoppingEnabled=True
Configuring the Region

For initial use, you must configure the region as follows:

1. From the Command Menu, enter 5 for Region Configuration.

   --Command Menu----
   1. Capability
   2. Configuration
   3. Inventory
   4. Access
   5. Region Configuration
   6. Firmware Update
   7. Exit
   5

2. From the Region Configuration Sub Menu, enter 1 for Get Supported Regions.

   ----Region Configuration Sub Menu----
   1. Get Supported Regions
   2. Get Region Standards
   3. Get Active Region
   4. Get Active Region Standard
   5. Activate Region
   6. Set Region Frequency
   7. Back to Main Menu
   1

3. The regions display.

   Successfully logged into /dev/ttyUSB0

   Total number of Regions 43
   Region 1 UAE
   Region 2 Albania
   Region 3 Argentina
   Region 4 Australia
   Region 5 Bangladesh
   Region 6 Bolivia
   Region 7 Bosnia
   Region 8 Brazil
   Region 9 Canada
   Region 10 Chile
   Region 11 China
   Region 12 Colombia
   Region 13 Costa Rica
   Region 14 Dominican republic
   Region 15 Ecuador
   Region 16 El salvador
   Region 17 European Union
   Region 18 Georgia
   Region 19 Guatemala
   Region 20 Hongkong
   Region 21 Honduras
Region 22 India
Region 23 Indonesia
Region 24 Japan
Region 25 Korea
Region 26 Mexico
Region 27 Malaysia
Region 28 Nicaragua
Region 29 New Zealand
Region 30 Peru
Region 31 Philippines
Region 32 Puerto Rico
Region 33 Russia
Region 34 Saudi Arabia
Region 35 Singapore
Region 36 Thailand
Region 37 Turkey
Region 38 Taiwan
Region 39 United States
Region 40 Uruguay
Region 41 Venezuela
Region 42 Vietnam
Region 43 South Africa

----Region Configuration Sub Menu----
1. Get Supported Regions
2. Get Region Standards
3. Get Active Region
4. Get Active Region Standard
5. Activate Region
6. Set Region Frequency
7. Back to Main Menu

2
Successfully logged into /dev/ttyUSB0
Enter Region Name
India
-----------------------------------------------

Standard name INDIA
Is Hopping Configurable True
Number of channels 3
Channel index 1 value 865700
Channel index 2 value 866300
Channel index 3 value 866900

5. From the Region Configuration Sub Menu, enter 3 for Get Active Region.

----Region Configuration Sub Menu----
1. Get Supported Regions
2. Get Region Standards
3. Get Active Region
4. Get Active Region Standard
5. Activate Region
6. Set Region Frequency
7. Back to Main Menu

Successfully logged into /dev/ttyUSB0
Region Name: United States
Region Standard Name: United States
Active Channel index(s):

6. From the Region Configuration Sub Menu, enter 5 for **Activate Region**.

   ----Region Configuration Sub Menu----
   1. Get Supported Regions
   2. Get Region Standards
   3. Get Active Region
   4. Get Active Region Standard
   5. Activate Region
   6. Set Region Frequency
   7. Back to Main Menu
   5
   Successfully logged into /dev/ttyUSB0
   Enter Region Name
   India
   Enter Communication Standard Name
   INDIA
   Region activated successful. Setting Channel(s).

7. From the Region Configuration Sub Menu, enter 6 for **Set Region Frequency**.

   ----Region Configuration Sub Menu----
   1. Get Supported Regions
   2. Get Region Standards
   3. Get Active Region
   4. Get Active Region Standard
   5. Activate Region
   6. Set Region Frequency
   7. Back to Main Menu
   6
   Successfully logged into /dev/ttyUSB0
   Enter Region Name
   India

Standard name INDIA
Is Hopping Configurable True
Number of channels 3
Channel index 1 value 865700
Channel index 2 value 866300
Channel index 3 value 866900
Enter Communication Standard Name
INDIA

<table>
<thead>
<tr>
<th>Index</th>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>865700</td>
</tr>
<tr>
<td>2</td>
<td>866300</td>
</tr>
<tr>
<td>3</td>
<td>866900</td>
</tr>
</tbody>
</table>

Please select Channel index(s) to set (use , to input more than one index)
For example: 1,2,3
1,3
Selected Channel index(s)
1,3
Do you want to set selected Channel(s)? (y/n)
y
Region activated successful. Setting Channel(s).
Region Channel(s) Setting successful.

8. A success log in message displays.

----Region Configuration Sub Menu----
1. Get Supported Regions
2. Get Region Standards
3. Get Active Region
4. Get Active Region Standard
5. Activate Region
6. Set Region Frequency
7. Back to Main Menu
3
Successfully logged into /dev/ttyUSB0
Region Name: India
Region Standard Name: INDIA
Active Channel index(s):
1
3

9. To return to the Main Menu, enter 7.

**Reading Tags**

To begin reading tags to perform inventory:

1. From the Command Menu, enter 3 for Inventory.

--Command Menu----
1. Capability
2. Configuration
3. Inventory
4. Access
5. Region Configuration
6. Firmware Update
7. Exit
3

2. From the Inventory Sub Menu, enter 1 for Simple inventory.

--Inventory Sub Menu----
1. Simple
2. Periodic Inventory
3. Pre-filter
4. Back to Main Menu
1

The inventory displays.

Firmware Update

To update the reader firmware with 123RFID:

1. From the Command Menu, enter 6 for Firmware update.

----Command Menu----
1. Capability
2. Configuration
3. Inventory
4. Access
5. Region Configuration
6. Firmware Update
7. Exit
6

2. At the Enter firmware file: prompt, enter the path to the firmware file in the remote machine.
Enter firmware file:
d:\3.0.6\3.0.6
Successfully logged into COM7
Update:  : 0
Stopping packet formater thread
Update:  : 0
Update:  : 0
Update:  : 0
Update:  : 0
Sending FLASH PROGRAM
Update:  : 0
RE40Config

The RE40Config tool may be used to change the initial RE40 RFID Module default settings such as the protocol, baud rate, number of antenna ports, and erase the region configuration.

The default configuration of RE40 RFID is shown in Table 8.

Table 8  RE40 RFID Default Settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>Binary</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>921600</td>
</tr>
<tr>
<td>Number of Antenna Ports</td>
<td>3 (DKRE with 1 and 4 Antenna Ports)</td>
</tr>
</tbody>
</table>

The RE40Config tool runs on the Windows 10 operating system. To download the tool, go to: www.zebra.com/support.

Running RE40Config

To run the RE40Config, go to the Windows menu and execute the following command at the prompt:

RE40Config <com port> <baud rate>

(For example, RE40Config COM6 921600)
When connected, enter one of the following operations at a time:

1: Set Mode
2: Set No of Antennas
3: Erase Region Config
4: Set Baud Rate

Press Enter after each input to complete the operation.

**Configuring Protocol Mode**

To change the protocol to interface with RE40 RFID Module, first enter 1 to select Set Mode and then enter 1 for Binary mode or 2 for RCI mode. See example as follows:

Choose operation 1: Set Mode, 2: Set No of Antennas, 3: Erase Region Config, 4: Set Baud Rate
1
Choose Mode 1: Binary, 2: RCI
1

**Configuring Number for Antennas**

To change the maximum number of antenna ports supported by the RE40 RFID Module, first enter 2 to select Set No of Antennas and then enter the option number that corresponds to the desired antenna ports (as shown in Table 9).

The following table lists the antenna options as they relate to the antenna(s) ports enabled.

**Table 9**  Antenna Port Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Antenna Port Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1 and 2</td>
</tr>
<tr>
<td>3</td>
<td>1 and 4 (DKRE Board)</td>
</tr>
<tr>
<td>4</td>
<td>1, 2, 3, 4</td>
</tr>
</tbody>
</table>

In following example, by entering the number 2 under Choose Number of Antennas 1 - 4, antenna ports 1 and 2 are enabled (as shown in Table 9.)

Choose operation 1: Set Mode, 2: Set No of Antennas, 3: Erase Region Config, 4: Set Baud Rate
2
Choose Number of Antennas 1 - 4
2

**Erasing Region Config**

The 123RFID Desktop tool or RFID API can be used to configure the region depending on the country that it is deployed. There is also an option to remove the region configuration setting. To erase Region Config permanently, enter 3 to select Erase Region Config and then enter y to confirm your selection as follows:
Choose operation 1: Set Mode, 2: Set No of Antennas, 3: Erase Region Config, 4: Set Baud Rate

3
Permanently Erase Region Config
Confirm y/n: y

**Setting Baud Rate**

Depending on the baud rate of the host supported, you may change the baud rate by entering 4 for Set Baud Rate and then the option number that corresponds to the desired Baud Rate (as shown in Table 10).

The RE40 supports the baud rates in Table 10 to be configured.

**Table 10** Baud Rate Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Baud Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115200</td>
</tr>
<tr>
<td>2</td>
<td>230400</td>
</tr>
<tr>
<td>3</td>
<td>460800</td>
</tr>
<tr>
<td>4</td>
<td>921600</td>
</tr>
</tbody>
</table>

In following example, by entering the number 3 under Choose Baud Rate, the Baud Rate default is changed to 460800 (as shown in Table 10).

Choose operation 1: Set Mode, 2: Set No of Antennas, 3: Erase Region Config, 4: Set Baud Rate
4
RE40 supports the following baud rates to be configured
Choose Baud rate 1: 115200  2: 230400  3: 460800  4: 921600
3
Success
Appendix A: Regulatory for Third Party Integration

Third Party Integration Overview

The RE40 is pending approval for modular certification by FCC and Industry Canada under the following ID numbers:

- FCC ID - UZ7RE40
- IC ID - 109AN-RE40

Modular approval allows installation in different end-use products by an OEM with limited or no additional testing or equipment authorization for the transmitter function provided by the RE40:

- No additional transmitter compliance testing is required if the module is operated with an approved antenna.
- No additional transmitter compliance testing is required if the module is operated with the same general type of antenna listed as approved in the RE40 documentation.
- Acceptable antennas must be of equal or less far field gain than the antenna previously authorized under the same FCC ID and must have similar in band and out of band characteristics.

The end-product must comply with all applicable FCC equipment authorizations, regulations, requirements and equipment functions not associated with the RE40.

- Compliance must be demonstrated to regulations for other transmitter components within the host product, to requirements for unintentional radiators (Part 15B), and to additional authorization requirements for the non-transmitter functions.

The OEM applying the RE40 is required to include all FCC and/or IC statements and warnings detailed in the following sections to the end-product labeling and in the finished product manual.

Product Labeling

A statement must be included on the exterior of the final OEM product which communicates that the device identified by the FCC and Industry Canada ID numbers are contained within the product. Include the statements:

- Contains FCC ID: UZ7RE40
- Contains IC: 109AN-RE40

Additionally, the OEM must include the following statements on the exterior of the finished product:

- This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including any interference that may cause undesired operation.
User Manuals

Any user documentation that accompanies the end-product must include the following information in a location that is easily read:

- To comply with EU RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20 cm is maintained between the reader (antenna) and user’s/nearby people’s body at all times and must not be co-located or operating in conjunction with another antenna or transmitter.

- To comply with FCC/ISED’s RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 25 cm is maintained between the reader (antenna) and user’s/nearby people’s body at all times and must not be co-located or operating in conjunction with another antenna or transmitter.

US Requirements

The finished product manual must contain the following statement:

- WARNING: The Federal Communications Commission warns that changes or modifications of the radio module within this device not expressly approved by Zebra Technologies, Inc. could void the user's authority to operate the equipment.

In the case where an OEM seeks class B (residential) limits for the host product, the finished product manual must contain the following statement:

- Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
  - Reorient or relocate the receiving antenna.
  - Increase the separation between the equipment and receiver.
  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
  - Consult the dealer or an experienced radio/TV technician for help.

In the case where an OEM seeks the lesser category of a Class A digital device for their finished product, the following statement must be included in the manual of the finished product:

- Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his expense.

Canadian Requirements

The OEM must include the following regulatory statements in both the English and the French product manual and/or on the finished product:
Appendix A: Regulatory for Third Party Integration

- This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s). Operation is subject to the following two conditions:
  (1) This device may not cause interference.
  (2) This device must accept any interference, including interference that may cause undesired operation of the device.

- Cet appareil contient des émetteurs / récepteurs exemptés de licence qui sont conformes aux RSS exempts de licence d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes:
  (1) Cet appareil ne doit pas provoquer d'interférences.
  (2) Cet appareil doit accepter toute interférence, y compris les interférences pouvant entraîner un fonctionnement indésirable de l'appareil.

Antenna Requirements

Although the RE40 is compatible with many different antennas, the device’s modular certification with the FCC and IC was tested with Zebra tested antennas enlisted for RE40. As a result, the following instructions allow end users to certify with the FCC and IC using their own antenna.

- To operate the RE40 under the FCC ID or IC, the following guidelines must be followed:
  - The OEM may operate:
    - With the following antenna or antennas of the same type (patch) with maximum gain (6 dBi) according to Zebra UHF RFID Antenna spec, examples:
      AN510, AN610, AN620, AN720, AN440, AN480, AN710
    - Laird Technologies Model S9025PL, S9025PR, S8655PL, S8655PR.
  - RF I/O interface to the antenna connector on the PCB shall be accomplished via a microstrip or stripline transmission line with characteristic impedance of 50 ohms +/- 10%. A custom coaxial pigtail may also be utilized to connect to the antenna in lieu of a connector.
  - The FCC and IC modular certification testing was performed using Zebra's RE40 Carrier Board PCB, detailed documentation of which can be downloaded from the Zebra support site at www.zebra.com/support.
  - The connector on the OEM's PCB which interfaces to the antenna must be of a unique type to disable connection to a non-permissible antenna in compliance with FCC section 15.203. The following connectors are allowed:
    - Right angle Reverse-Polarity SMA (RP-SMA) Jack: Amphenol p/n 132136RP or equivalent
    - Ultra-Miniature Coaxial Connector (UMCC) Jack: Molex p/n 0734120110 or equivalent
    - Custom 50 Ohm coaxial pigtail from PCB to antenna
  - The OEM must professionally install the RE40 into its final environment to ensure that the conditions are met.

Statement of Compliance

Zebra Technologies, Inc. hereby declares that this radio equipment is in compliance with Directives, 2014/53/EU and 2011/65/EU.

The full text of the EU Declaration of Conformity is available at the following Internet address: www.zebra.com/doc.
OEM/Host Manufacturer Responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the RED before it can be placed on the EU market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the RED. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment.

In all cases assessment of the final product must be met against the Essential requirements of the RE Directive Articles 3.1(a) and (b), safety and EMC respectively, as well as any relevant Article 3.3 requirements.

1. The patch antenna (gain: 6 dBi) AN480 was verified in the conformity testing, and for compliance; the antenna shall not be modified.

2. A separate approval is required for all other operating configurations, including different antenna configurations (antenna gain increase or different antenna type).

3. If any other simultaneous transmission radio is installed in the host platform together with this module, or above restrictions cannot be kept, a separate RF exposure assessment and CE equipment certification is required.
## Troubleshooting

The following table provides potential problems that may arise and the solution for correcting the problem.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Tag Reads.</td>
<td>Antenna is not connected.</td>
<td>Connect the correct antenna specific to your region (see DKRE Contents on page 9 for antenna options). Region must be configured (For 123RFID, see Connecting via Reader Discovery on page 30, Connecting via COM Port on page 33; for RFID Demo Application, see Configuring the Region on page 45).</td>
</tr>
<tr>
<td></td>
<td>Antenna cable is not correct.</td>
<td>Connect the correct antenna specific to region (see DKRE Contents on page 9 and Antennas on page 19 for antenna information).</td>
</tr>
<tr>
<td></td>
<td>Antenna is not connected correctly to the development board.</td>
<td>Connect the antenna to the development board SMA port (see Installing DKRE Hardware on page 14).</td>
</tr>
<tr>
<td></td>
<td>Power is not connected properly.</td>
<td>Connect the power to the correct Micro USB port using the Micro USB - Power Cable (see Installing DKRE Hardware on page 14).</td>
</tr>
<tr>
<td></td>
<td>Tags are not close enough to the antenna.</td>
<td>Move the tags closer so that they are within a few inches of the antenna.</td>
</tr>
<tr>
<td></td>
<td>Antenna configuration is not set accurately.</td>
<td>Ensure transmit power is set.</td>
</tr>
<tr>
<td></td>
<td>Module temperature is above the operational threshold.</td>
<td>Improve air circulation; wait for the ambient temp to reduce; reduce the transmit power.</td>
</tr>
<tr>
<td>Issue</td>
<td>Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Module not connecting.</td>
<td>Region is not configured.</td>
<td>Configure the region using 123RFID Desktop Demo tool(^1) (see Connecting via Reader Discovery on page 30, Connecting via COM Port on page 33).</td>
</tr>
<tr>
<td></td>
<td>No COM ports enumerated in OS.</td>
<td>Ensure the proper driver is installed for UART/USB CDC(^1). For USB CDC protocol, the Zebra CDC driver is recommended. Go to: <a href="https://www.zebra.com/us/en/support-downloads/software/drivers/usb-cdc-driver.html">https://www.zebra.com/us/en/support-downloads/software/drivers/usb-cdc-driver.html</a>.</td>
</tr>
<tr>
<td></td>
<td>Invalid COM port used for connection.</td>
<td>Ensure that the right COM port is used(^1). For Windows, find the assigned COM ports for RE40 in the Device Manager under Ports. For Linux, use /dev/tty*.</td>
</tr>
<tr>
<td></td>
<td>Improper power supply.</td>
<td>Ensure that a Zebra provided power adapter is used(^1).</td>
</tr>
<tr>
<td></td>
<td>Module configured to RCI protocol.</td>
<td>Use the RE40Config tool to set back to the binary interface protocol(^1).</td>
</tr>
<tr>
<td>123RFID is not launching.</td>
<td>.NET framework version for 4.5.2 is not installed.</td>
<td>Install the .NET framework 4.5.2.</td>
</tr>
</tbody>
</table>

\(^1\)After implementing, power cycle the DKRE development board.
Appendix C: Environmental Considerations

Introduction

This chapter provides information and recommendations on environmental concerns that can potentially affect performance or damage equipment.

ESD Considerations

CAUTION—ESD: The RFID antenna port may be susceptible to damage from Electrostatic Discharge (ESD). Equipment failure can result if the antenna or communication ports are subjected to ESD. Standard ESD precautions should be taken during installation to avoid static discharge when handling or making connections to the RFID reader antenna or communication ports. Environmental analysis should also be performed to ensure static is not building up on and around the antennas, possibly causing discharges during operation.

ESD Damage

For DKRE installations that fail without a known cause, ESD (ElectroStatic Discharge) may potentially be the cause. Failures due to ESD commonly appear in the software interface as follows:

- RF operations such as reading or writing respond with errors which could be due to RF front end damage or deterioration due to ESD discharge.
- RF operations respond with No Antenna Connected or Detected although it is confirmed that a good antenna is installed.
- Invalid Command errors appears signaling that a command is not supported although the command previously worked properly. To prevent further damage, a command may become unsupported and return to the bootloader.

Identifying ESD Damage

Determining if ESD is the cause of a failure is challenging. Confirmation is only possible if failed components are isolated and examined under high power microscopy. Concluding that ESD is the cause of a failure is inferred if conditions that could produce ESD are present, anti-ESD precautions have not been taken, and other potential causes are eliminated.

Suggested methods for identifying ESD as the cause for an RFID reader damage are as follows:

- Return failed units for analysis.
- Measure ambient static levels with a static meter. High static levels that change are highly characteristic of discharges.
• Touch some things around the antenna and operating area to feel for static discharges.
• Use the mean operating time statistic before and after one or more of the changes listed below to determine if the change has resulted in an improvement. Be sure to restart your statistic after the change.

Installation Best Practices

To ensure an RFID reader is not unnecessarily exposed to ESD, apply the following guidelines to all installations including full power, partial power, with or without ESD:

• Ensure that RFID module, reader housing, and antenna ground connection are all grounded to a common low inductance ground.
• Verify R-TNC knurled threaded nuts are tight. Do not use a thread locking compound that would compromise the grounding connection of the thread to thread mate. If there is any indication that field vibration might cause the R-TNC to loosen, apply RTV or other adhesive externally.
• Use antenna cables with double shield outer conductors, or full metallic shield semi rigid cables. Zebra specified cables are double shielded and adequate for most applications. ESD discharge currents flowing on the outer surface of a single shield coaxial cable have coupled to the inside of coaxial cables, causing ESD failure.
• Minimize ground loops in coaxial cable runs to antennas. Tying both the RFID module and antenna to ground could lead to the possibility of ground currents flowing along antenna cables. The tendency of these currents to flow is related to the area of the conceptual surface marked out by the antenna cable and the nearest continuous ground surface. When this conceptual surface has minimal area, these ground loop currents are minimized. Routing antenna cables against grounded metallic chassis parts helps minimize ground loop currents.
• Keep the antenna radome in place to provide ESD protection for the antenna’s metallic parts and to protect the antenna from performance changes due to environmental accumulation.
• Record serial numbers, operating lifetimes, and numbers of units operating to determine the mean operating lifetime. This number indicates if you have a failure problem, and indicates if improvements or failures are confined to one instance or across your population.

Variables Affecting Performance

Environmental

The RFID reader performance may be affected by the following environmental conditions:

• Metal surfaces such as desks, filing cabinets, and bookshelves, may enhance or degrade reader performance.
• Mount antennas away from metal surfaces that may adversely affect the system performance.
• Devices that operate at 900 MHz, such as cordless phones and wireless LANs, can degrade reader performance. Conversely, the RFID reader may affect the performance of these 900 MHz devices.
• Turn off moving machinery when testing as it many interfere with reader performance.
• Fluorescent lighting fixtures are a source of strong electromagnetic interference. Replace or keep the RFID reader cables and antennas away from them.
• Coaxial cables leading from the reader to antennas may be a strong source of electromagnetic radiation. Lay the cables flat and do not coil them.
Tag Considerations

There are variables associated with tags that can affect reader performance to be aware of:

- Some materials, metal, and moisture, interfere with tag performance.
- Most tags have folded dipole antennas. They read well when facing the antenna and when their long edge is oriented toward the antenna. Tags read poorly when the short edge is oriented toward the antenna.
- There are many tag models available and each have its own performance characteristics.

Antenna Considerations

- Use a circularly polarized antenna. Linear antennas can only be used if the tag orientation to the antenna is consistent, or if not in the ideal orientation the antenna or tag can be rotated for best reading.
- To reduce or eliminate ESD issues, use an antenna with a design that naturally presents a short to DC.
- Use an antenna with a return loss of 10 dB or greater (1.92 VSWR) in the transmission band of the region the module is using.
- Use an outdoor-rated antenna if there is a chance that water or dust could get into the antenna and change its RF characteristics.
- Ensure that the antenna is mounted so that personnel do not stand in the radiation beam of the antenna unless they are more than 21 cm away from the face of the antenna (to adhere to FCC limits for long term exposure). If the application calls for personnel to work in the antenna beam and they will be less than 21 cm from the face of the antenna, power should be reduced, or a lower gain antenna must be used (21 cm assumes a 27 dBm power level into an 8.15 dBi antenna).

Multiple Readers

- The RFID reader adversely affects performance of 900 MHz devices. These devices also may degrade performance of the reader.
- Antennas on other readers operating in close proximity may interfere with one another, thus degrading performance of the readers.
- Interference from other antennas may be eliminated or reduced by using either one or both of the following strategies:
  - Affected antennas may be synchronized with a separate user application using a time-multiplexing strategy.
  - Antenna power can be reduced by reconfiguring the RF Transmit Power setting for the reader.