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1. General Information Multiple-Protocol RFID/NFC Reader/Writer

1.1. Scope

This document describes the basic functionalities and the electrical specifications of Univelop Tech. LLC’s Multiple-Protocol RFID/NFC Reader/Writer, which is fully compatible with TI (Texas Instruments), a programming and debugging development tool designed to work with TI MSP430 microcontrollers.

1.2. General Description

The TRF796x is an integrated analog front end & data framing system for a 13.56 MHz RFID/NFC reader system. Built-in programming options make it suitable for a wide range of applications both in proximity and vicinity RFID/NFC systems. The reader is configured by selecting the desired protocol in the control registers. Direct access to all control registers allows fine tuning of various reader parameters as needed.

The TRF796x can be interfaced to a microcontroller such as the MSP430 through a parallel 10-pin interface or a 4-wire SPI (serial) interface. The MCU is the master device and initiates all communication with the reader. The anti-collision procedures (as described in the ISO standards 14443A/B, 15693 and Tag-it™) are implemented in the MCU firmware to help the reader detect and communicate with one PICC/VICC among several PICCs/VICCs. The MCU is also used for communication (through a UART) to a higher level host station which is normally a personal computer. The user can send the desired commands to the MCU through the GUI. The MCU interprets the data received and sends appropriate commands to the TRF796x.

1.3. Features

- Supports Multiple Protocols ISO-15693,
- Supports Multiple Protocols ISO-14443A, ISO-14443B (Philips MiFare RFID) tags,
- Support for the Texas Instruments Tag-it™ standard
- Operation frequency : 13.56Mhz
- Built-in transceiver antenna;
- Maximum effective distance up to 10 cm;
- Less than 100ms decoding time;
- TTL interface (USB/RS232 Interface optional)
- Two firmware inside (one standard-alone, another client/host program)
- Built-in 5 LEDs to indicate which type of protocol card you are using
- Size: 58 mm X 56mm (embedded Antenna)
- USB interface to Host computer (in some model it is optional)
2. Descriptions of MSP430 USB Debugger

2.1. Photo of RFID/NFC Reader/Writer

2.1.1 USB Multiple-protocol RFID/NFC Reader/Writer

Fig. 1 USB Multiple-protocol RFID/NFC Reader/Writer
Dimension: 66mm X 56mm.

2.1.2 UART Multiple-protocol RFID/NFC Reader/Writer

Fig. 2 UART Multiple-protocol RFID/NFC Reader/Writer*
Dimension: 58mm X 56mm.

2.1.3 TINY Multiple-protocol RFID/NFC Reader/Writer
Fig. 3 TINY Multiple-protocol RFID/NFC Reader/Writer*
Dimension: 36mm X 56mm (2/3 Name card)
* these models need optional USB interface board(2.1.4) to be used with USB.

2.1.4 USB/ RS232 Interface Board for 13.56Mhz RFID/NFC Reader/Writer

Fig. 4 USB/ RS232 Interface Board for 13.56Mhz RFID/NFC Reader/Writer

2.2. Key Features
- excellent EMC with multiple-layer PCB and SMT tech.
- All IC chips in the module are brand names’ chips from TI.
- USB interface
- USB powered needn’t external power for RFID/NFC reader
- Combine most of current used RFID/NFC Standards.

2.3. Electrical Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;STR&lt;/sub&gt;</td>
<td>Storage Temperature</td>
<td>-40</td>
<td></td>
<td>+150</td>
<td>°C</td>
</tr>
<tr>
<td>T&lt;sub&gt;OP&lt;/sub&gt;</td>
<td>Working Temperature</td>
<td>-15</td>
<td>+25</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>V&lt;sub&gt;CC&lt;/sub&gt;</td>
<td>Working Voltage</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>V</td>
</tr>
</tbody>
</table>

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3. **Hardware Connection**

3.1. **Connection for USB Multiple-protocol RFID/NFC Reader/Writer**

![USB Connection Diagram](image1)

Fig.5. Use USB cable to connect the USB RFID/NFC reader/writer with a Personal Computer (PC).

3.2. **Connection for UART Multiple-protocol RFID/NFC Reader/Writer**

![UART Connection Diagram](image2)

Fig.6. Use USB cable to connect the USB interface board and a Personal Computer (PC), and use a 6 pin to connect USB interface board with the RFID/NFC reader/writer.

3.3. **Connection for TINY Multiple-protocol RFID/NFC Reader/Writer**

![Tiny Connection Diagram](image3)

Fig.7 Use USB cable to connect the USB interface board and a Personal Computer (PC), and use a 6 pin to connect USB interface board with the RFID/NFC reader/writer.

3.4. **Connection between Interface board and RFID/NFC Reader/Writer**
RFID/NFCGeek Multiple-Protocol RFID/NFC Reader/Writer V1.0 Users Manual

Fig. 8 Port (P6) for RFID/NFC Reader/Writer

Fig. 9 Port (P6) USB/RS232 Interface board

Connection between USB/RS232 Interface board and RFID/NFC Reader/Writer: (You can use the 6-pin cable we provided with RFID/NFC Reader/Writer to connect the interface board and the RFID/NFC reader).

Fig. 10 connection between USB/RS232 Interface board and RFID/NFC Reader/Writer
### 4. Software and PC Configuration

#### 4.1. Two models of Multiple-protocol RFID/NFC reader/writer

The Multiple-protocol RFID/NFC reader/writer has two models:

1. **Standard-alone**
   
   When a Multiple-protocol RFID/NFC reader/writer first starts up, the firmware inside it runs under standard-alone model. In this case, the Multiple-protocol RFID/NFC reader/writer works like a RFID/NFC tag detector, it uses LEDs to indicate which types of RFID/NFC tags close to the reader. Total 4 types of RFID/NFC can be detected at this model.
   
   This model will switch to the next model (communication model), when a multiple-protocol RFID/NFC reader/writer get an command from a PC.

2. **Communication model**
   
   In this model, a PC communicates with a multiple-protocol RFID/NFC reader/writer to read/writer all supported RFID/NFC tags.
   
   In order to create a connection between PC and a Multiple-protocol RFID/NFC reader/writer, the program in PC should setup the following configuration for serial port:
   
   1. Baudrate: 115200 bit/s
   2. Data bits: 8
   3. Parity: None
   4. Stop bits: 1

#### 4.2. Commands supported by Multiple-protocol RFID/NFC reader/writer

A **raw command format** (PC -> Reader)

<table>
<thead>
<tr>
<th>SOF (0x01)</th>
<th>Number of bytes</th>
<th>0x09</th>
<th>0x0304</th>
<th>Command + parameters</th>
<th>EOF (0x0000)</th>
</tr>
</thead>
</table>

The communication starts with SOF (0x01). The second byte defines the number of bytes in the frame including SOF. The third byte should be kept at 0x00, fourth byte at 0x03 and the fifth byte at 0x04. The sixth byte is the command code, which is followed by parameters or data. The communication ends with 2 bytes of 0x00.

**Command list:**

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameters</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>0xFF Initialize Reader</td>
<td>N/A</td>
<td>01 08 00 03 04 FF 00 00</td>
</tr>
<tr>
<td>0xFE Get Version</td>
<td>N/A</td>
<td>01 08 00 03 04 FF 00 00</td>
</tr>
<tr>
<td>0xF1 AM/PM input selection</td>
<td>0x00 – PM input, 0xFF – AM input</td>
<td>01 09 00 03 04 F1 00 00 00</td>
</tr>
<tr>
<td>0xF0 AGC selection</td>
<td>0x00 – AGC enable, 0xFF – AGC disable</td>
<td>01 09 00 03 04 F0 FF 00 00</td>
</tr>
<tr>
<td>0x03 TRF796x enable/disable</td>
<td>0x00 – Reader enable, 0xFF – Reader disable</td>
<td>01 09 00 03 04 03 FF 00 00</td>
</tr>
<tr>
<td>0x0F Direct mode</td>
<td>N/A</td>
<td>01 08 00 03 04 0F 00 00</td>
</tr>
<tr>
<td>0x10 Write single register</td>
<td>Address, data, address, data...</td>
<td>01 0A 00 03 04 10 15 67 00 00</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Command Code</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x11</td>
<td>Write continuous</td>
<td>01 0C 00 03 04 <strong>11 13 67 46</strong> A4 0000</td>
</tr>
<tr>
<td>0x12</td>
<td>Read single register</td>
<td>01 0B 00 03 04 <strong>12 01 0A 13</strong> 0000</td>
</tr>
<tr>
<td>0x13</td>
<td>Read continuous</td>
<td>01 0A 00 03 04 <strong>13 05 03</strong> 0000</td>
</tr>
<tr>
<td>0x15</td>
<td>Direct command</td>
<td>01 09 00 03 04 <strong>15 0F 0000</strong></td>
</tr>
<tr>
<td>0x16</td>
<td>Write raw</td>
<td>01 10 00 03 04 <strong>16 91 3D 00</strong> 40 AA BB CC DD 0000</td>
</tr>
<tr>
<td>0x18</td>
<td>Request command ISO 15693, Tag-it, 14443B Halt</td>
<td>01 0B 00 03 04 <strong>18 06 20 01</strong> 0000</td>
</tr>
<tr>
<td>0x14</td>
<td>Inventory ISO 15693</td>
<td>01 0B 00 03 04 <strong>14 06 01 00</strong> 0000</td>
</tr>
<tr>
<td>0x54</td>
<td>Begin round</td>
<td>01 09 00 03 04 <strong>54 03 0000</strong></td>
</tr>
<tr>
<td>0x55</td>
<td>Close slot sequence</td>
<td>01 08 00 03 04 <strong>55 0000</strong></td>
</tr>
<tr>
<td>0x34</td>
<td>SID poll</td>
<td>01 0B 00 03 04 <strong>34 00 50 00</strong> 0000</td>
</tr>
<tr>
<td>0xA0</td>
<td>REQA</td>
<td>01 08 00 03 04 <strong>A0 0000</strong></td>
</tr>
<tr>
<td>0xA2</td>
<td>Select</td>
<td>01 0D 00 03 04 <strong>A2 11 22</strong> 33 44 44 0000</td>
</tr>
</tbody>
</table>

1. InitCom  
*Command:* direct mode  
*Command description:* Switch Reader from Standalone model to Client/Host model  
*Command Type:* Com port operation  
(you can copy/paste from Datasheet)  
Format:  
**PC ->Reader:**  
01 08 00 03 04 **FF 00 00**  
**Reader ->PC:**  
0108000304FF0000  
TRF7960EVM*  

Note: 1. this command must be run before all other command runs.  
   2. *if it is other series model, then return other strings.  
   3. If in a pc, there are many com or some other exceptions, may receive “01N” string or “80T” string, just reset the reader or restart the computer.
4.3. Some example output for commands

1. 0xFF example:
   PC --> Reader: 0108000304FF0000
   PC<--Reader: 0108000304FF0000
   TRF7960 EVM

2. 0xFE example:
   PC --> Reader: 0108000304FE0000
   PC<--Reader: 0108000304FE0000
   Firmware Version 3.2.1.EXP