WiMOD iU880B

Datasheet

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Aim of this Document

The aim of this document is to give a detailed product description including interfaces, features and performance of the radio module iU880B.
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1. Introduction

The iU880B is a compact, low power, bidirectional USB adapter for the 868 MHz frequency band using Semtech’s LoRa™ modulation technology. The adapter provides ultra-long range spread spectrum communication and high interference immunity whilst minimising current consumption. Using the iU880B in an application minimizes the need for an expensive and time-consuming RF development. Fast time to market is possible with this qualified module.

The iU880B includes the radio module iM880B and the serial to USB converter chip FT232RQ from FTDI.

Comparing with the iU880A, the iU880B provides an optimized RF performance for the extreme temperature range. In addition, the iU880B is equipped with a STM32L151 of new "device generation A".

![iU880B](image_url)

*Figure 1-1: Picture of iU880B*

1.1 Key Features
- Compact module 65 x 25 x 14 mm
- LoRa™ modulation technology
- USB interface
- Supply voltage range from 4.0 to 5.25 V
- Integrated antenna
- Integrated +20 dBm power amplifier
- STM32L151CxU6Axx, FTDI FT232R
- Certified according to R&TTE 1999/5/EC

1.2 Applications
- Automated Meter Reading
- Wireless Networks
- Home-, Building-, Industrial automation
- Remote Control
- Wireless Sensors
- Telemetry
- Wireless Alarm and Security Systems
- …

Please visit our web site [www.wireless-solutions.de](http://www.wireless-solutions.de) for more information.
2. Module Overview

The iU880B is an ultra-long range, high-performance, R&TTE certified USB adapter for wireless communication. It operates in the license free 868 MHz SRD frequency band and includes all necessary passive components for wireless communication.

The iU880B uses Semtech’s patented LoRa modulation technique which combines spread spectrum modulation and forward error correction techniques to increase the range and robustness of radio communication links compared with traditional FSK or OOK based modulation. Typically examples of iU880B receive performances\(^1\) are given in the following table.

<table>
<thead>
<tr>
<th>Signal Bandwidth/[kHz]</th>
<th>Spreading Factor</th>
<th>Sensitivity/[dBm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>7</td>
<td>-123</td>
</tr>
<tr>
<td>125</td>
<td>12</td>
<td>-138</td>
</tr>
<tr>
<td>250</td>
<td>7</td>
<td>-121</td>
</tr>
<tr>
<td>250</td>
<td>12</td>
<td>-135</td>
</tr>
<tr>
<td>500</td>
<td>7</td>
<td>-116</td>
</tr>
<tr>
<td>500</td>
<td>12</td>
<td>-130</td>
</tr>
</tbody>
</table>

Table 2-1: Typically Radio Performance of iU880B

This high sensitivity combined with the integrated \(+20\) dBm power amplifier yields industry leading link budget.

The wide range of capabilities provided by the iU880B can be tested by using the WiMOD tools like WiMOD_LR_Studio or WiMOD_LoRaWAN_EndNode_Studio. Please refer to [http://www.wireless-solutions.de/products/long-range-radio.html](http://www.wireless-solutions.de/products/long-range-radio.html).

\(^1\) Determined by conducted measurements.
3. LoRa Modulation Technique

In LoRa mode the iU880B offers three bandwidth options of 125 kHz, 250 kHz, and 500 kHz with spreading factors ranging from 7 to 12.
The spread spectrum LoRa modulation is performed by representing each bit of payload information by multiple chips of information. The rate at which the spread information is sent is referred to as the symbol rate (Rs), the ratio between the nominal symbol rate and chip rate is the spreading factor and represents the number of symbols sent per bit of information. The range of parameters which can be configured are given in the following tables.

<table>
<thead>
<tr>
<th>Spreading Factor</th>
<th>Chips/Symbol</th>
<th>SNR/[dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>128</td>
<td>-7.5</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>-10</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>-12.5</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>-15</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>-17.5</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>-20</td>
</tr>
</tbody>
</table>

*Table 3-1: Spreading Factors of Sx1272*

Note that the spreading factor must be known in advance on both transmit and receive sides of the radio link as different spreading factors are orthogonal to each other. Note also the resulting signal to noise ratio (SNR) required at the receiver input. It is the capability to receive signals with negative SNR that increases the sensitivity, so link budget and range, of the LoRa receiver.

To further improve the robustness of the radio link iU880B provides cyclic error coding with different coding rates. With using this coding scheme forward error detection and correction can be applied.

<table>
<thead>
<tr>
<th>Coding Rate</th>
<th>Cyclic Coding Rate</th>
<th>Overhead Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4/5</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>4/6</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>4/7</td>
<td>1.75</td>
</tr>
<tr>
<td>4</td>
<td>4/8</td>
<td>2</td>
</tr>
</tbody>
</table>

*Table 3-2: Coding Rate of iU880B*
4. Electrical Characteristics

In the following different electrical characteristics of the iU880B are listed. Furthermore details and other parameter ranges are available on request.

**Note:** Stress exceeding of one or more of the limiting values listed under “Absolute Maximum Ratings” may cause permanent damage to the radio module.

### 4.1 Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (VDD)</td>
<td></td>
<td>4.0</td>
<td>-</td>
<td>5.25</td>
<td>V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td></td>
<td>-40</td>
<td>-</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td></td>
<td>-40</td>
<td>-</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>RF Input Power</td>
<td></td>
<td></td>
<td></td>
<td>+10</td>
<td>dBm</td>
</tr>
</tbody>
</table>

Notes:

1) Unless otherwise noted, all voltages are with respect to GND

**Note:** With RF output power level above +16 dBm a minimum distance between two devices should be 1 m for avoiding too large input level.
## 4.2 Global Electrical Characteristics of iM880B

*T = 25°C, VDD = 3.0 V (typ.) if nothing else stated*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (VDD)</td>
<td></td>
<td>2.4</td>
<td>3.0</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>Current Consumption Low Power Mode</td>
<td>RTC off</td>
<td>680</td>
<td></td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td>RTC on</td>
<td>1.8</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Current Consumption System IDLE</td>
<td>TRX idle mode, µC idle mode</td>
<td>5</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Current Consumption RECEIVE LoRa</td>
<td>TRX receive mode, µC sleep mode</td>
<td>11.2</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Current Consumption TRANSMIT</td>
<td>µC sleep mode, all µC units off, max. RF power level</td>
<td>117</td>
<td>122</td>
<td>126</td>
<td>mA</td>
</tr>
<tr>
<td>MCU operation frequency</td>
<td></td>
<td>32</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32.768</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td>Memory (Flash)</td>
<td></td>
<td>128</td>
<td></td>
<td></td>
<td>kByte</td>
</tr>
<tr>
<td>Flash Memory Endurance</td>
<td>Program memory</td>
<td>10k</td>
<td></td>
<td></td>
<td>Erase/Write Cycles</td>
</tr>
<tr>
<td></td>
<td>Data memory</td>
<td>300k</td>
<td></td>
<td></td>
<td>Cycles</td>
</tr>
<tr>
<td>Memory (RAM)</td>
<td></td>
<td>32</td>
<td></td>
<td></td>
<td>kByte</td>
</tr>
</tbody>
</table>

Table 4-2: General Characteristics of iM880B
4.3 Programming Interface

The firmware of iU880B can be updated with the integrated bootloader of iU880B.

Firmware update functionality is included within the tools LR Studio and LoRaWAN_EndNode_Studio. Please refer to [http://www.wireless-solutions.de/products/long-range-radio.html](http://www.wireless-solutions.de/products/long-range-radio.html)
4.4 RF Characteristics

4.4.1 Applicable Frequency Bands and Sub-Bands

Following table depicts the applicable frequency bands within the 868 MHz band for “Non-Specific Short Range Devices” specified in the ERC Recommendation 70-03, [2].

<table>
<thead>
<tr>
<th>Band</th>
<th>Edge Frequencies</th>
<th>Field Power</th>
<th>Spectrum Access</th>
<th>Band Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>g (Note1,2) (Note2)</td>
<td>863 MHz 870 MHz</td>
<td>+14 dBm</td>
<td>0.1% or LBT+AFA</td>
<td>7 MHz</td>
</tr>
<tr>
<td>g (Note2) (Note2)</td>
<td>863 MHz 870 MHz</td>
<td>-4.5 dBm / 100 kHz</td>
<td>0.1% or LBT+AFA</td>
<td>7 MHz</td>
</tr>
<tr>
<td>g365 MHz 868 MHz</td>
<td>865 MHz 868 MHz</td>
<td>+6.2 dBm / 100 kHz</td>
<td>1% or LBT+AFA</td>
<td>3 MHz</td>
</tr>
<tr>
<td>g1</td>
<td>868.0 MHz 868.6 MHz</td>
<td>+14 dBm</td>
<td>1% or LBT+AFA</td>
<td>600 kHz</td>
</tr>
<tr>
<td>g2</td>
<td>868.7 MHz 869.2 MHz</td>
<td>+14 dBm</td>
<td>0.1% or LBT+AFA</td>
<td>500 kHz</td>
</tr>
<tr>
<td>g3</td>
<td>869.4 MHz 869.65 MHz</td>
<td>+27 dBm</td>
<td>10% or LBT+AFA</td>
<td>250 kHz</td>
</tr>
<tr>
<td>g4</td>
<td>869.7 MHz 870 MHz</td>
<td>+14 dBm</td>
<td>1% or LBT+AFA</td>
<td>300 kHz</td>
</tr>
<tr>
<td>g4</td>
<td>869.7 MHz 870 MHz</td>
<td>+7 dBm</td>
<td>No requirement</td>
<td>300 kHz</td>
</tr>
</tbody>
</table>

Table 4-3: Applicable Frequency Bands for Non-Specific Short Range Devices

Note: National laws and regulations, as well as their interpretation can vary with the country. In case of uncertainty, it is recommended to contact either IMST’s accredited Test Center or to consult the local authorities of the relevant countries.
4.4.2 Transmitter RF Characteristics

The iU880B has an excellent transmitter performance as given by Table 4-4.

\( T = 25^\circ C, \) VDD = 3 V (typ.), 866.5 MHz if nothing else stated

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td></td>
<td>863</td>
<td>-</td>
<td>870</td>
<td>MHz</td>
</tr>
<tr>
<td>RF Output Power (EIRP)</td>
<td>868 MHz Band</td>
<td></td>
<td>19.0</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Modulation Techniques</td>
<td>LoRa\textsuperscript{TM}, FSK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TX Frequency Variation vs. Temp.</td>
<td>-40 to +85°C</td>
<td>-</td>
<td>±10</td>
<td>-</td>
<td>kHz</td>
</tr>
<tr>
<td>TX Power Variation vs. Temp.</td>
<td>-</td>
<td>-</td>
<td>±0.5</td>
<td>-</td>
<td>dB</td>
</tr>
</tbody>
</table>

Table 4-4: Transmitter RF Characteristics

**Note:** The duty cycle of transmission at maximum output power is limited to 1%. The antenna has to be matched with a maximum VSWR of 3:1.

4.4.3 Antenna parameters

The parameters for the iU880B integrated ceramic antenna are given in Table 4-5.

\( T = 25^\circ C \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>863</td>
<td>-</td>
<td>870</td>
<td>MHz</td>
</tr>
<tr>
<td>Antenna Gain</td>
<td>-0.7</td>
<td>-0.2</td>
<td>+0.1</td>
<td>dBi</td>
</tr>
<tr>
<td>Antenna Efficiency</td>
<td>-3.7</td>
<td>-3.3</td>
<td>-3.0</td>
<td>dB</td>
</tr>
</tbody>
</table>

Table 4-5: Antenna Parameters
4.5 Antenna Characteristic

4.5.1 863.1 MHz

863.1 MHz
Frequency: 863062500 Hz  
TRP: 11.9 dBm  
max. EIRP (Θ): 15.1 dBm at (Θ=110.0°, Φ=−195.0°)  
max. EIRP (Φ): 3.1 dBm at (Θ=180.0°, Φ=−350.0°)  
max. EIRP (abs): 15.3 dBm at (Θ=110.0°, Φ=−190.0°)

Figure 4-2: 2-D Plots of iU880B at 863.1MHz and 15dBm Tx Power
4.5.2 866.5 MHz

866.5 MHz

Frequency: 866494010 Hz
TRP: 11.3 dBm

max. EIRP (Θ): 14.3 dBm at (Θ=110.0°, Φ=-200.0°)
max. EIRP (Φ): 3.2 dBm at (Θ=180.0°, Φ=-355.0°)
max. EIRP (abs): 14.5 dBm at (Θ=115.0°, Φ=-185.0°)

Figure 4-3: 2-D Plots of iU880B at 866.5 MHz and 15dBm Tx Power
### 4.5.3 869.9 MHz

**869.9 MHz**

**Frequency:** 869931610 Hz

**TRP:** 12.0 dBm

max. **EIRP** (Θ): 15.0 dBm at (Θ=110.0°, Φ=-200.0°)

max. **EIRP** (Φ): 4.4 dBm at (Θ=180.0°, Φ=-5.0°)

max. **EIRP** (abs): 15.3 dBm at (Θ=110.0°, Φ=-195.0°)

---

*Figure 4-4: 2-D Plots of iU880B at 869.9 MHz and 15 dBm Tx Power*
5. Ordering Information

<table>
<thead>
<tr>
<th>Ordering Part Number</th>
<th>Description</th>
<th>Distributor</th>
</tr>
</thead>
<tbody>
<tr>
<td>iU880B</td>
<td>LoRa USB Adapter</td>
<td><a href="mailto:sales@imst.de">sales@imst.de</a></td>
</tr>
<tr>
<td></td>
<td>128 KB Flash, 32 KB RAM, 16 MHz MCU crystal</td>
<td>webshop.imst.de</td>
</tr>
</tbody>
</table>

*Table 5-1: Ordering Information*
6. Appendix

6.1 List of Abbreviations

ADC  Analog-to-Digital Converter
BER  Bit Error Rate
BSC  Basic Spacing between Centers
CPWG Coplanar Waveguide
CW   Continuous Wave
GND  Ground
GPIO General Purpose Input/Output
I²C   Inter-Integrated Circuit
MCU  Microcontroller Unit
PCB  Printed Circuit Board
RAM  Random Access Memory
RF   Radio Frequency
SMBus System Management Bus
SMT  Surface Mounted Technology
SPI  Serial Peripheral Interface
TRX  Transceiver
USB  Universal Serial Bus
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6.4 References

[1] Semtech Sx1272 Data Sheet from www.semtech.com
[4] …
7. Regulatory Compliance Information

The use of radio frequencies is limited by national regulations. The radio module has been designed to comply with the European Union’s R&TTE (Radio & Telecommunications Terminal Equipment) directive 1999/5/EC and can be used free of charge within the European Union. Nevertheless, restrictions in terms of maximum allowed RF power or duty cycle may apply.

The radio module has been designed to be embedded into other products (referred as “final products”). According to the R&TTE directive, the declaration of compliance with essential requirements of the R&TTE directive is within the responsibility of the manufacturer of the final product. A declaration of conformity for the radio module is available from IMST GmbH on request.

The applicable regulation requirements are subject to change. IMST GmbH does not take any responsibility for the correctness and accuracy of the aforementioned information. National laws and regulations, as well as their interpretation can vary with the country. In case of uncertainty, it is recommended to contact either IMST’s accredited Test Center or to consult the local authorities of the relevant countries.
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