WiMOD iU880B

Datasheet

Document ID: 4100/40140/0111

IMST GmbH
Carl-Friedrich-Gauß-Str. 2-4
47475 KAMP-LINTFORT
GERMANY

Document Information

File name	iU880B_Datasheet.docx
Created	2016-01-26
Total pages	19

Revision History

Version	Note
1.0	Created

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.

Table of Contents

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".

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 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.

Signal Bandwidth/[kHz]	Spreading Factor	Sensitivity/[dBm]
125	7	-123
125	12	-138
250	7	-121
250	12	-135
500	7	-116
500	12	-130

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.

[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.

Spreading Factor	Chips/Symbol	SNR/[dB]
7	128	-7.5
8	256	-10
9	512	-12.5
10	1024	-15
11	2048	-17.5
12	4096	-20

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.

Coding Rate	Cyclic Coding Rate	Overhead Ratio
1	4/5	1.25
2	4/6	1.5
3	4/7	1.75
4	4/8	2

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

Parameter	Condition	Min	Typ.	Max	Unit
Supply Voltage (VDD)		4.0	-	5.25	V
Storage Temperature		-40	-	+85	°C
Operating Temperature		-40	-	+85	°C
RF Input Power				+10	dBm
Notes: 1) Unless otherwise noted, all voltages are with respect to GND					

Table 4-1: Absolute Maximum Ratings

> **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

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

Table 4-2: General Characteristics of iM880B

4.3 Programming Interface

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

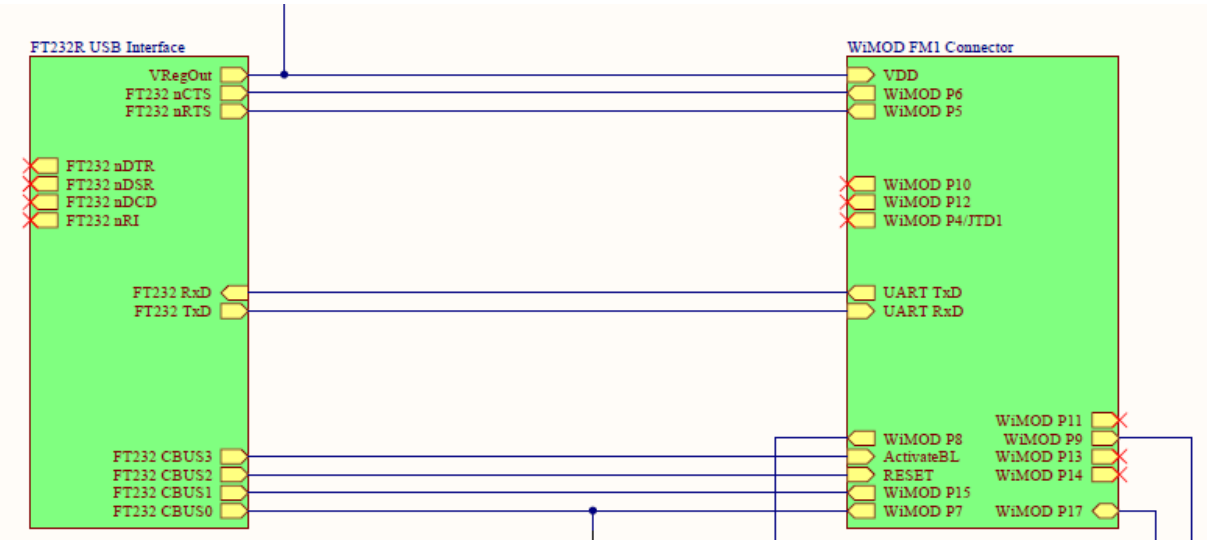


Figure 4-1: Connection between FTDI and iM880B.

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

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].

Band	Edge Frequencies		Field Power	Spectrum Access	Band Width
g (Note1,2)	863 MHz	870 MHz	+14 dBm	0.1% or LBT+AFA	7 MHz
(Note2)	863 MHz	870 MHz	-4.5 dBm / 100 kHz	0.1% or LBT+AFA	7 MHz
(Note2)	865 MHz	870 MHz	-0.8 dBm / 100 kHz	0.1% or LBT+AFA	5 MHz
	865 MHz	868 MHz	+6.2 dBm / 100 kHz	1% or LBT+AFA	3 MHz
g1	868.0 MHz	868.6 MHz	+14 dBm	1% or LBT+AFA	600 kHz
g2	868.7 MHz	869.2 MHz	+14 dBm	0.1% or LBT+AFA	500 kHz
g3	869.4 MHz	869.65 MHz	+27 dBm	10% or LBT+AFA	250 kHz
g4	869.7 MHz	870 MHz	+14 dBm	1% or LBT+AFA	300 kHz
g4	869.7 MHz	870 MHz	+7 dBm	No requirement	300 kHz
Note1: Modulation bandwidth ≤ 300 kHz is allowed. Preferred channel spacing is ≤ 100 kHz. Note2: Sub-bands for alarms are excluded (see ERC/REC 70-03 Annex 7).					

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°C, VDD = 3 V (typ.), 866.5 MHz if nothing else stated

Parameter	Condition	Min	Typ.	Max	Unit
Frequency Range		863	-	870	MHz
RF Output Power (EIRP)	868 MHz Band		19.0		dBm
Modulation Techniques	LoRa™, FSK				
TX Frequency Variation vs. Temperature	-40 to +85°C	-	±10	-	kHz
TX Power Variation vs. Temperature		-	±0.5	-	dB

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°C

Parameter	Min	Typ.	Max	Unit
Frequency Range	863	-	870	MHz
Antenna Gain	-0.7	-0.2	+0.1	dBi
Antenna Efficiency	-3.7	-3.3	-3.0	dB

Table 4-5: Antenna Parameters

4.5 Antenna Characteristic

4.5.1 863.1 MHz

863.1 MHz

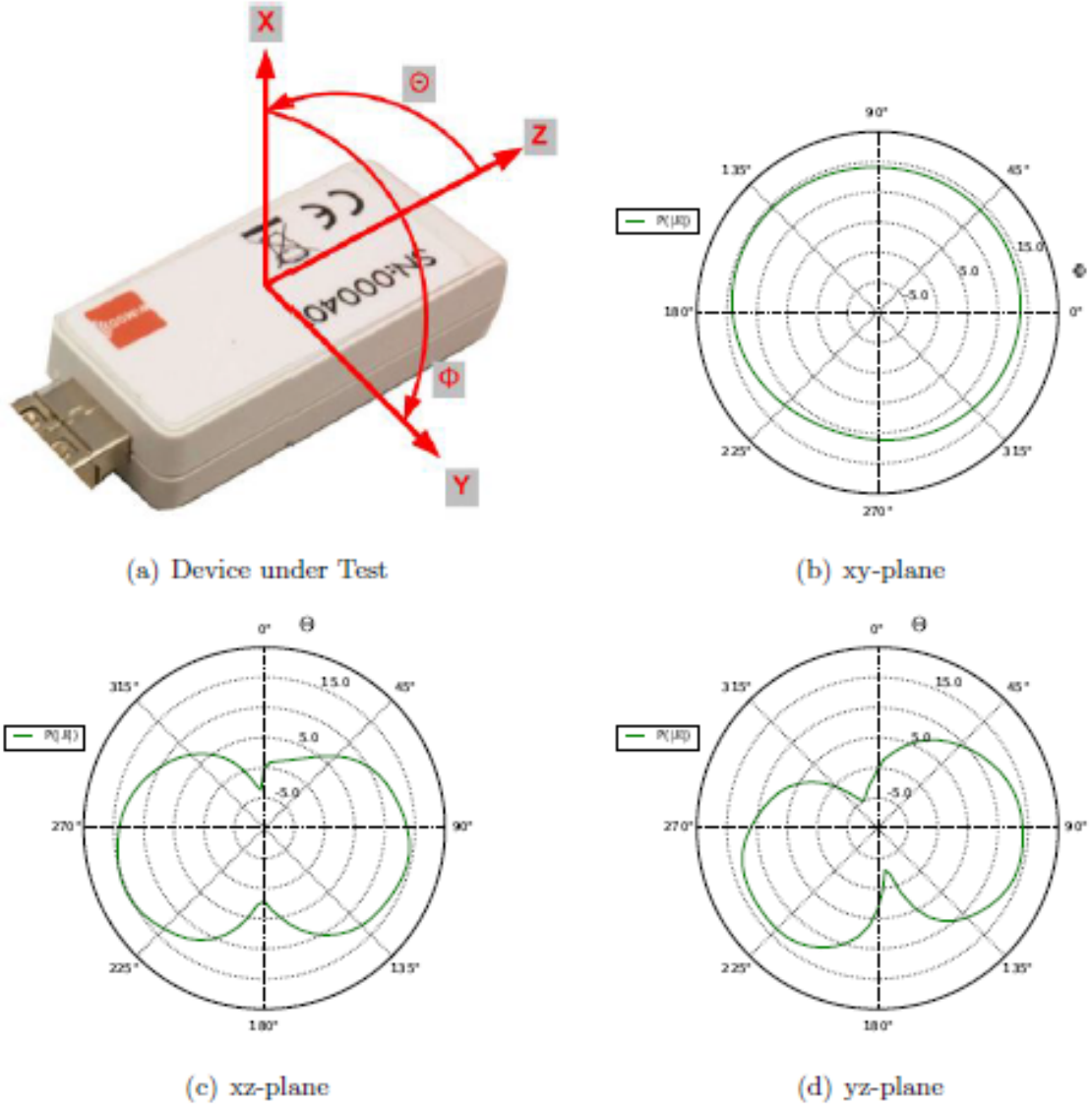
Frequency: 863062500 Hz

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°)



(a) Device under Test

(b) xy-plane

(c) xz-plane

(d) yz-plane

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

4.5.2 866.5 MHz

866.5 MHz

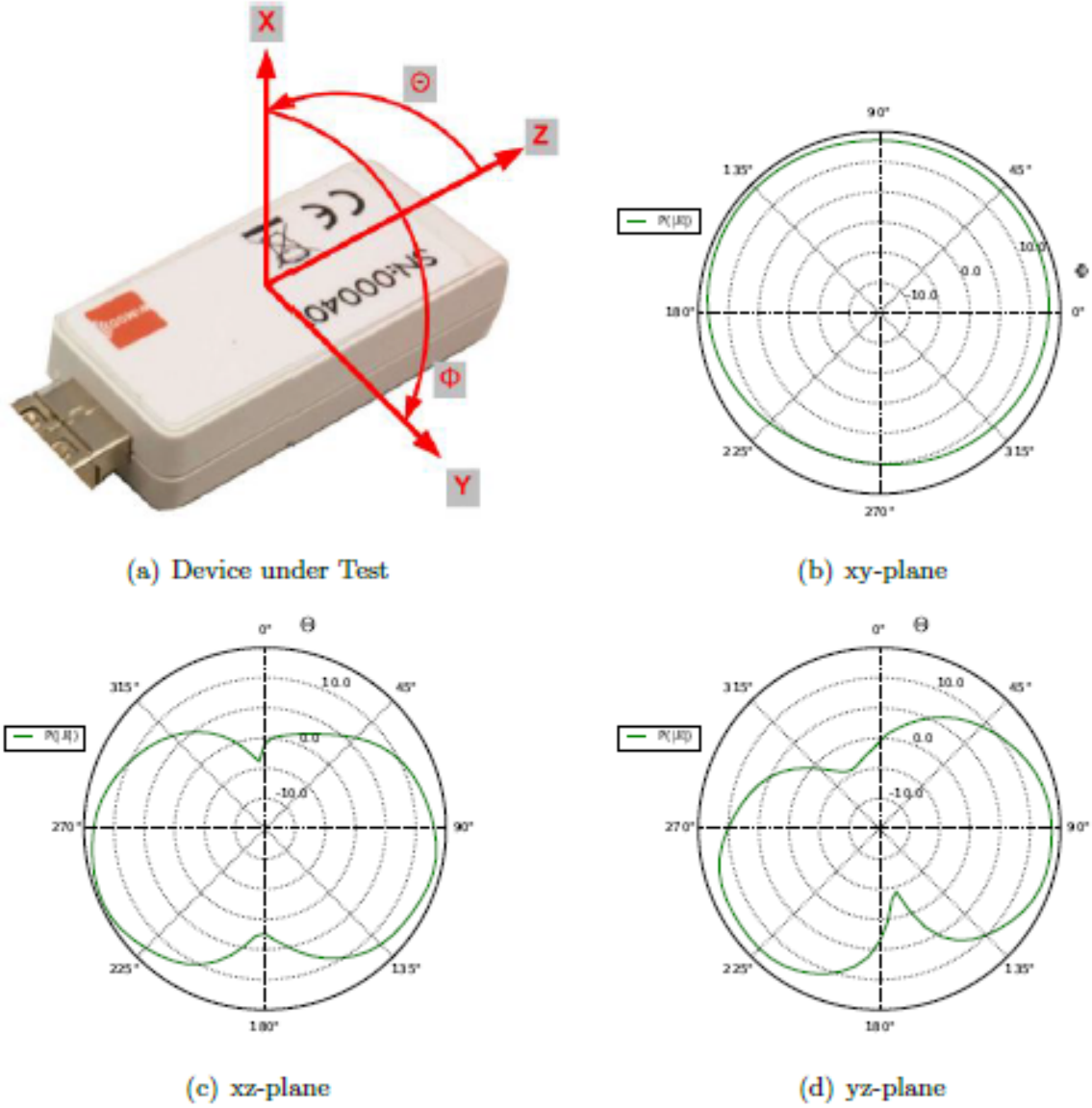
Frequency: 866494010 Hz

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°)



(a) Device under Test

(b) xy-plane

(c) xz-plane

(d) yz-plane

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

4.5.3 869.9 MHz

869.9 MHz

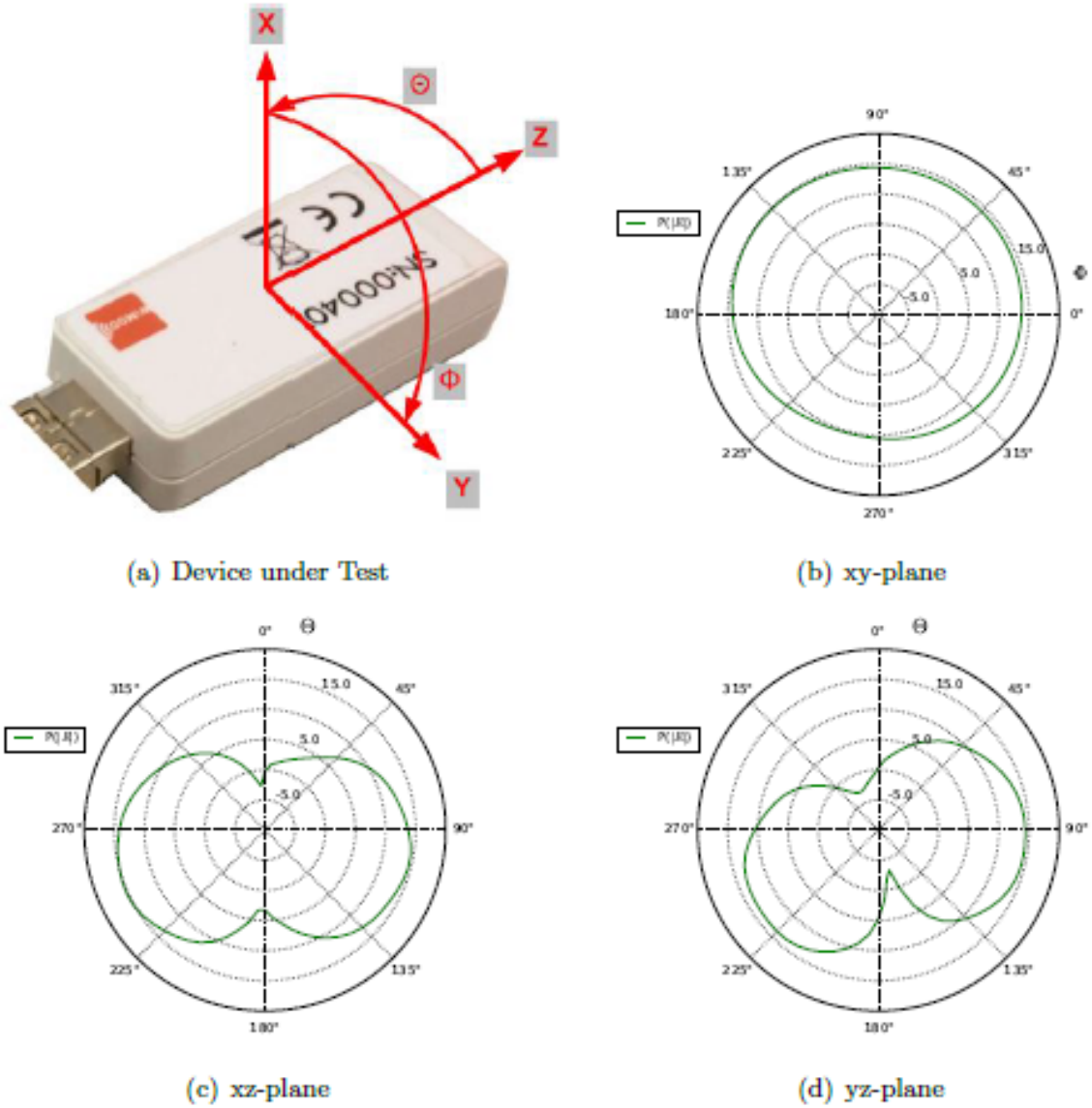
Frequency: 869931610 Hz

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°)



(a) Device under Test

(b) xy-plane

(c) xz-plane

(d) yz-plane

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

5. Ordering Information

Ordering Part Number	Description	Distributor
iU880B	LoRa USB Adapter 128 KB Flash, 32 KB RAM, 16 MHz MCU crystal	sales@imst.de webshop.imst.de

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
I^2C	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

6.2 List of Figures

6.3 List of Tables

6.4 References

[1] Semtech Sx1272 Data Sheet from www.semtech.com

[2] REC Recommendation 70-03 “Relating to the use of Short Range Devices (SRD)”, Tromsø 1997, CEPT ECC subsequent amendments 9 th October 2012

[3] iM880B_Datasheet from www.wirelss-solutions.de

[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.

8. Important Notice

8.1 Disclaimer

IMST GmbH points out that all information in this document is given on an "as is" basis. No guarantee, neither explicit nor implicit is given for the correctness at the time of publication. IMST GmbH reserves all rights to make corrections, modifications, enhancements, and other changes to its products and services at any time and to discontinue any product or service without prior notice. It is recommended for customers to refer to the latest relevant information before placing orders and to verify that such information is current and complete. All products are sold and delivered subject to "General Terms and Conditions" of IMST GmbH, supplied at the time of order acknowledgment.

IMST GmbH assumes no liability for the use of its products and does not grant any licenses for its patent rights or for any other of its intellectual property rights or third-party rights. It is the customer's duty to bear responsibility for compliance of systems or units in which products from IMST GmbH are integrated with applicable legal regulations. Customers should provide adequate design and operating safeguards to minimize the risks associated with customer products and applications. The products are not approved for use in life supporting systems or other systems whose malfunction could result in personal injury to the user. Customers using the products within such applications do so at their own risk.

Any reproduction of information in datasheets of IMST GmbH is permissible only if reproduction is without alteration and is accompanied by all given associated warranties, conditions, limitations, and notices. Any resale of IMST GmbH products or services with statements different from or beyond the parameters stated by IMST GmbH for that product/solution or service is not allowed and voids all express and any implied warranties. The limitations on liability in favor of IMST GmbH shall also affect its employees, executive personnel and bodies in the same way. IMST GmbH is not responsible or liable for any such wrong statements.

8.2 Contact Information

IMST GmbH

Carl-Friedrich-Gauss-Str. 2-4
47475 Kamp-Lintfort
Germany

T +49 2842 981 0
F +49 2842 981 299
E sales@imst.de
I www.wireless-solutions.de