

WiMOD - iM222A

Datasheet Version 2.2



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Document Information

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Revision History

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| 1.0 | Released version. |
| 2.0 | Modifications to document format and layout. Added chapter 4.3, 8, and 9. |
| 2.1 | Updated Table 3-1 |
| 2.2 | FCC and IC statement added. |
| | |

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 iM222A.

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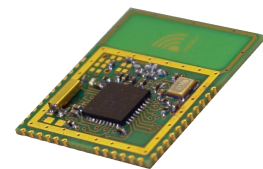
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1 Summary / Introduction

The iM222A is a compact, low power, bidirectional radio module for the 2.4 GHz frequency band. Using the iM222A in an application minimizes the need for an expensive and time-consuming RF development. Fast time to market is possible with this module.

The radio module has enough processing power to run an entire ZigBee application on top of the ZigBee Stack from Texas Instruments. IMST offers development support for any type of application on the basis of the iM222A, including different IEEE 802.15.4-based standards like 6LoWPAN, RF4CE and others.



This datasheet includes the hardware specifications and describes the hardware features of the iM222A. For additional information about programming and software development for the iM222A please read application note "iM222A_AN001_SW-Development".

1.1 Key Features

- Complete ZigBee Ready module
- Output power up to 4.5 dBm
- Excellent Link budget of 101dBm
- Integrated antenna or 50 Ohm pad
- UART, SPI and Debug interface
- 256 kB Flash memory, 8 kB RAM
- 12-Bit ADC
- 128-Bit AES encryption engine
- Bootloading support

1.2 Applications

- 2.4 GHz IEEE802.15.4 systems
- ZigBee PRO systems
- Low-Power wireless sensor networks
- RF remote control and RF4CE systems
- Smart Metering systems
- Home-, Building-, Industrial Automation
- Lighting systems
- Health Care
- Consumer Electronics
- ...

Please visit our web site www.wireless-solutions.de for more information.

2 Module Overview

The iM222A is a small radio module for the 2.4 GHz frequency band. It provides a complete RF/MCU design including a transceiver, a microcontroller with AES coprocessor, a PCB antenna, and all necessary passive components as depicted in Figure 2-1. It supports many different peripherals¹ like UART, SPI, 8-channel ADC and interrupt capable digital I/Os which can be configured by the user. Low power consumption is achieved with an integrated low frequency crystal unit that enables sleep mode support for ZigBee end devices.

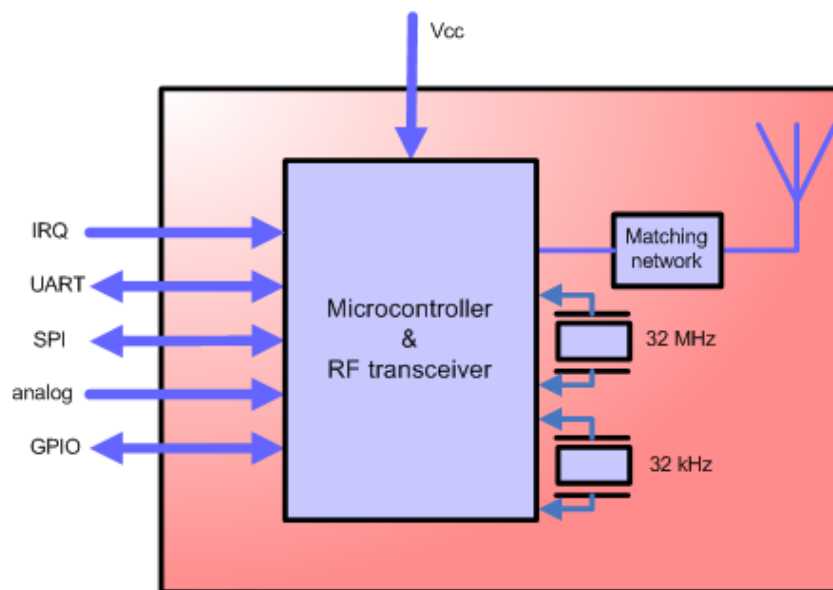


Figure 2-1: Block Diagram - iM222A

The used transceiver (CC2530) supports full IEEE 802.15.4 compatibility. With the integrated microcontroller, the ZigBee protocol stack (Z-stack) from Texas Instruments, and a ZigBee application it is possible to establish a ZigBee compliant network solution. When using the TI firmware additionally the complete TI development toolchain (Z-tool) can be used for testing and evaluating the iM222A. Furthermore the module can be used with proprietary application firmware and/or protocol stacks based on the IEEE 802.15.4 MAC layer.

When using the TI stack an integrated bootloading functionality enables the user to make a firmware update over the UART interface. To use the bootloader an upload tool which is part of the Z-Stack package from TI (SBDemo) has to be used.

The module is solderable like a SMD-component and can easily be mounted on a simple carrier board with a minimum of required external connections. It is RoHS compliant and pre-qualified in accordance to ETSI EN 300 440-2 V1.4.1.

¹ Not all can be used at the same time

3 Specification

In the following different electrical characteristics of the iM222A are listed. Furthermore details and other parameter ranges are available on request.

3.1 Absolute Maximum Ratings

| Parameter | Range | Unit | Condition |
|-----------------------|------------------|------|-------------------------------------|
| Supply voltage | -0.3 to 3.9 | V | |
| Input voltage | -0.3 to VCC +0.3 | V | Any Digital pin |
| DC current | 4 | mA | Per digital pin |
| | 20 | mA | Only radio module pin 14 and pin 15 |
| Operating temperature | -20 to +70 | °C | |
| Storage temperature | -40 to +85 | °C | |

Table 3-1: Absolute Maximum Ratings

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

3.2 General Characteristics

T = 25°C, VDD = 3V (typ.) if nothing else stated

| Parameter | Range | Unit | Condition |
|--------------------------------|---------------|------|---|
| Operating supply voltage VCC | 2.0 to 3.6 | V | Typ. 3.0 V |
| Current consumption | typ. 24.3 | mA | Receive mode |
| | typ. 28.5 | mA | Transmit @ 0 dBm |
| | typ. 33.5 | mA | Transmit @ max. RF output power |
| | typ. 3.4 | mA | μC active, TRX off |
| | typ. 1 | μA | Power mode 2, 32.768kHz crystal |
| | typ. 0.4 | μA | Power mode 3 |
| Dimension (L x W x H) | 20 x 25 x 2.7 | mm | ±0.2mm |
| MCU operation frequency | 32 | MHz | |
| Real time oscillator frequency | 32.768 | kHz | |
| Memory (Flash) | 256 | KB | Minimum endurance: 1000 write/erase cycles. |
| Memory (RAM) | 8 | KB | |

Table 3-2: General Characteristics

3.3 Module Interface Characteristics

T = 25°C, VDD = 3V (typ.) if nothing else stated

| Parameter | Range | Unit | Condition |
|---|------------|------|--|
| Digital output voltage | 2.4 to VCC | V | High level |
| | GND to 0.5 | V | Low level |
| Digital input voltage | 2.5 to VCC | V | High level |
| | GND to 0.5 | V | Low level |
| I/O pin pull-up/pull-down resistor | 20 | kΩ | |
| Pulse width on /RESET pin | min. 2.5 | μs | Low active pin. See Note 1. |
| UART baud rate | typ. 115.2 | kbps | |
| SPI baud rate | max. 4000 | kbps | |
| ADC resolution | 7 to 14 | Bit | |
| ADC conversion time | 20 to 132 | μs | Depends on ADC resolution (68 μs @ 10 bit resolution) |
| ADC input resistance | 197 | kΩ | |
| Analog int. reference voltage | 1.15 | V | |
| Notes: | | | |
| 1) Shorter pulses may be recognized but will not lead to complete reset of all units within the module. | | | |

Table 3-3: Module Interface Characteristics

Note: Additional to the reset pin the module has a Power-On-Reset (POR) functionality which holds the module in reset state until supply voltage increase above the POR threshold (rising edge). It will not work unless VCC has been below POR threshold (falling edge). See chapter 3.5 for additional information to the POR feature.

All radio module IOs except DIO_7 and DIO_8 are configured as input with pull-up resistor when a reset condition becomes active.

3.4 RF Characteristics

T = 25°C, VDD = 3V (typ.) if nothing else stated

| Parameter | Range | Unit | Condition |
|--|--------------|------|---|
| Frequency range | 2405 to 2480 | MHz | 16 IEEE 802.15.4 channels |
| Channel spacing | 5 | MHz | |
| RF data rate | 250 | kbps | |
| RF output power | max. +4.5 | dBm | |
| RF output power range | 32.5 | dB | |
| RF sensitivity | typ. -97 | dBm | 1 % PER (Note 1) |
| Modulation techniques | O-QPSK | | |
| Range | up to 500 | m | Outdoor (line of sight) with external antenna (0 dBi) on pin ANT. |
| Notes: | | | |
| 1) PER = Packet Error Rate ; 20 bytes packet length. | | | |

Table 3-4: RF Characteristics

3.5 Pinout Description

Figure 3-1 depicts the pinout of the iM222A.

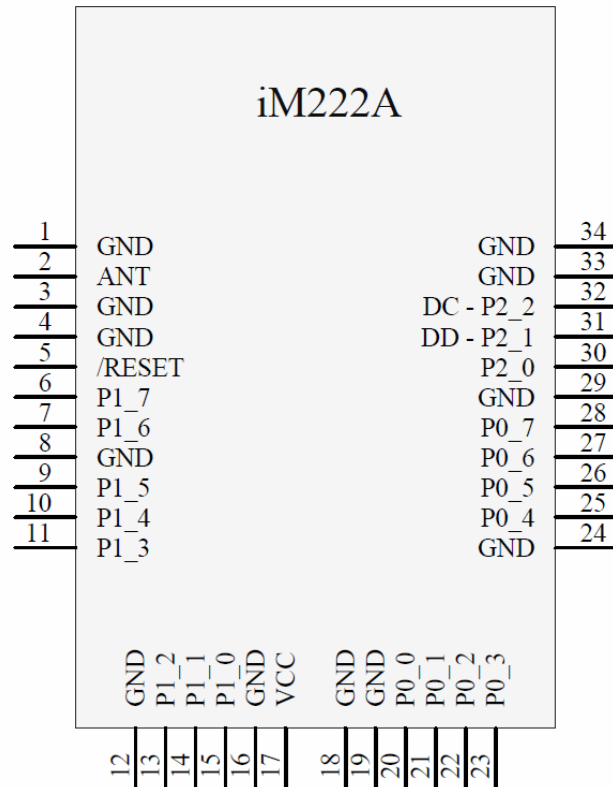


Figure 3-1: Pinout

Table 3-5 shows the pinout and short description of the iM222A. The pin naming relates to the pin description of the CC2530 datasheet (SWRS081B) from Texas Instruments. The pin functionality as well as their usage is described in the aforementioned document in detail. For a customized application with the iM222A all peripheral features of the CC2530 can be used (see CC2530 datasheet).

Note: The POR functionality does not work correctly if the I/O-pins are connected to a second power supply while the radio module is powered up.

For example, if connecting the radio module to a host controller (e.g. RXD and TXD to another microcontroller) with separate power supply, it is strictly recommended to set all I/O-pins of this controller to high impedance or to GND potential when the radio module is powered down. If do not so, it is possible that the radio module is powered by the host controller over its I/O-pins with the result that the POR feature does not work correctly and the module status is undefined.

| PIN # | Name | Description | PIN Type |
|-------|--------|--|----------|
| 1 | GND | Ground connection | Supply |
| 2 | ANT | Ext. antenna connection. Use only after consultation. | |
| 3 | GND | Ground connection | Supply |
| 4 | GND | Ground connection | Supply |
| 5 | /RESET | RESET input pin ³ | |
| 6 | P1_7 | Digital IO / SPI1_MISO ² / UART1_RX ² | I/O |
| 7 | P1_6 | Digital IO / SPI1_MOSI ² / UART1_TX ² | I/O |
| 8 | GND | Ground connection | Supply |
| 9 | P1_5 | Digital IO / SPI0_MOSI ² / UART0_TX ² / SPI1_C ² / UART1_RT ² | I/O |
| 10 | P1_4 | Digital IO / SPI0_MISO ² / UART0_RX ² / SPI1_SS ^{2,3} / UART1_CT ² | I/O |
| 11 | P1_3 | Digital IO / SPI0_C ² / UART0_RT ² | I/O |
| 12 | GND | Ground connection | Supply |
| 13 | P1_2 | Digital IO / SPI0_SS ^{2,3} / UART0_CT ² | I/O |
| 14 | P1_1 | Digital IO | I/O |
| 15 | P1_0 | Digital IO | I/O |
| 16 | GND | Ground connection | Supply |
| 17 | VCC | Supply voltage (typ. 3V) | Supply |
| 18 | GND | Ground connection | Supply |
| 19 | GND | Ground connection | Supply |
| 20 | P0_0 | Digital IO / Analog input A0 | I/O |
| 21 | P0_1 | Digital IO / Analog input A1 | I/O |
| 22 | P0_2 | Digital IO / SPI0_MISO ¹ / UART0_RX ¹ / SPI1_SS ^{1,3} / UART1_CT ¹ , Analog input A2 | I/O |
| 23 | P0_3 | Digital IO / SPI0_MOSI ¹ / UART0_TX ¹ / SPI1_C ¹ / UART1_RT ¹ , Analog input A3 | I/O |
| 24 | GND | Ground connection | Supply |
| 25 | P0_4 | Digital IO / SPI0_SS ^{1,3} / UART0_CT ¹ / SPI1_MOSI ¹ / UART1_TX ¹ , Analog input A4 | I/O |
| 26 | P0_5 | Digital IO / SPI0_C ¹ / UART0_RT ¹ / SPI1_MISO ¹ / UART1_RX ¹ , Analog input A5 | I/O |
| 27 | P0_6 | Digital IO / Analog input A6 | I/O |
| 28 | P0_7 | Digital IO / Analog input A7 | I/O |
| 29 | GND | Ground connection | Supply |
| 30 | P2_0 | Digital IO | I/O |
| 31 | P2_1 | Digital IO / Debug Data (data line for programming and debugging) | I/O |
| 32 | P2_2 | Digital IO / Debug Clock (clock line for programming and debugging) | I/O |
| 33 | GND | Ground connection | Supply |
| 34 | GND | Ground connection | Supply |

Notes:

- 1) Alternative location one of the peripheral unit.
- 2) Alternative location two of the peripheral unit.
- 3) Low active pin.

Table 3-5: Pinout iM222A

Note that the peripheral units (UART, SPI, Timer) have two alternate locations for their I/O pins. Please read the CC2530 datasheet (SWRS081B) or the CC2530 user's guide (SWRU191B) from Texas Instruments for detailed information.

3.6 Module Dimension

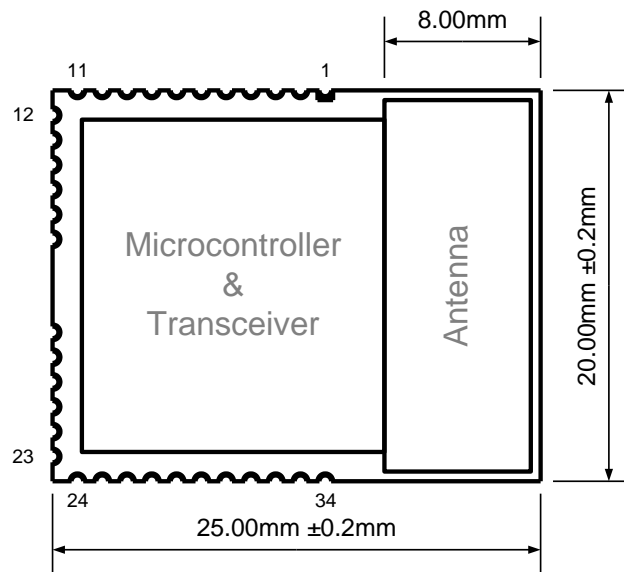


Figure 3-2: Module Dimension

3.7 Recommended Footprint

The pad pitch is 1.27mm.

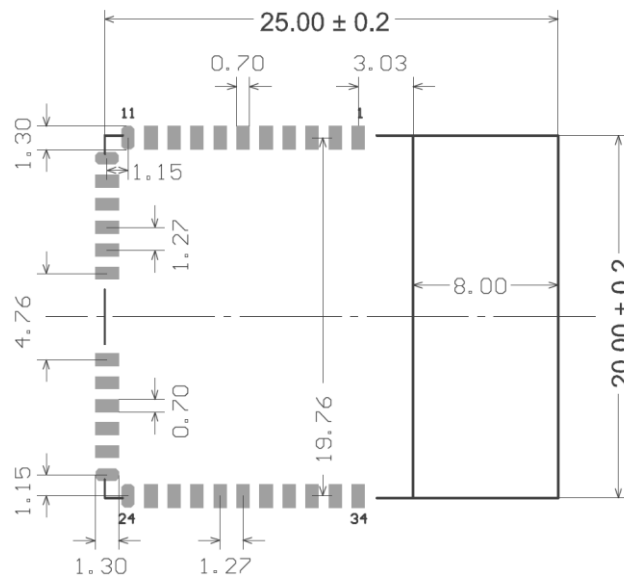


Figure 3-3: Footprint

All dimensions are in millimeters.

4 Integration Guide

4.1 Typical Application Schematic

Figure 4-1 shows a schematic of a typical application.

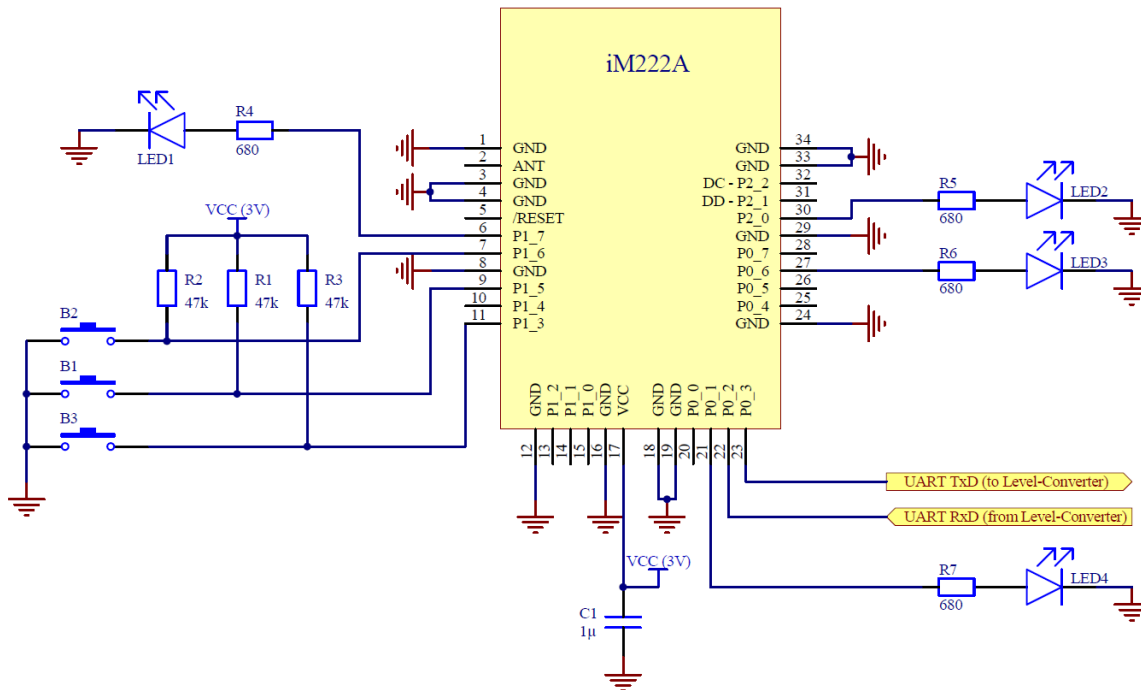


Figure 4-1: Sample application schematic using UART communication

In this sample application P0_2 and P0_3 are used as serial interface and should be connected to a host controller or to a host PC (via a level converter). P1_7, P0_1, P0_6, and P2_0 are used as outputs. It must be ensured that the maximum DC current per pin (see Table 3-1) is not exceeded. P1_3 to P1_5 are used as digital inputs. A blocking capacitor is recommended between VCC and GND.

4.2 PCB Design Recommendation

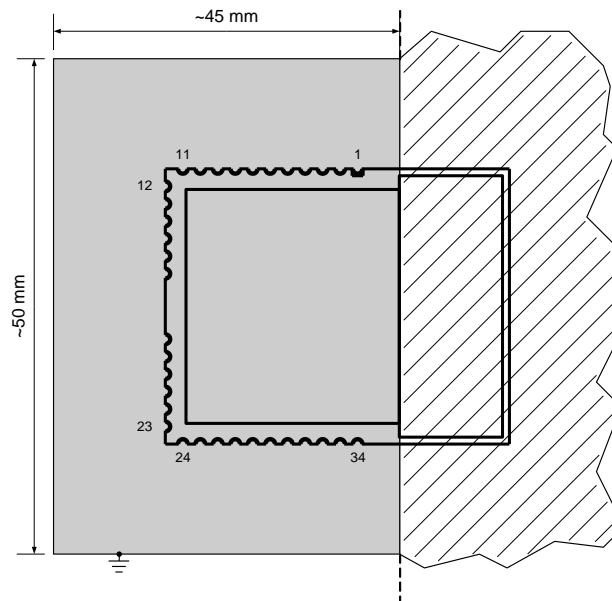


Figure 4-2: Recommended Environment

When designing a carrier board layout for the iM222A the following design considerations are recommended:

- The Top Layer of the carrier board should be kept free of tracks and vias under the iM222A because there are some testpads on the bottom side of the module which are not covered by solder resist.
- As shown in Figure 4-2, the solid grey area must be a ground-plane on the Bottom Layer (or Layer 2 in a multi-layer structure) of the carrier board. Antenna matching and all other measurements have been done with these dimensions.

Info: Other dimensions can affect the RF performance respective RF output power, sensitivity, and unwanted emissions. Maybe the matching network of the integrated PCB antenna must be renewed.

- All radio module ground pads must be directly connected to the ground-plane by vias next to each ground pad.
- The hatched area shown in Figure 4-2 has to be free of material (e.g. PCB, metal, housing). If possible, the distance from the antenna area to any material should be at least $\lambda/2$ ^{see 1}.

¹ At 2.4 GHz it is approximately 62.5 mm.

4.3 Recommended Soldering Conditions

An example of the temperature profile for the reflow soldering process of the iM222A is depicted in Figure 4-3 with the corresponding values as given by Table 4-1. The temperature values should not exceed the limits.

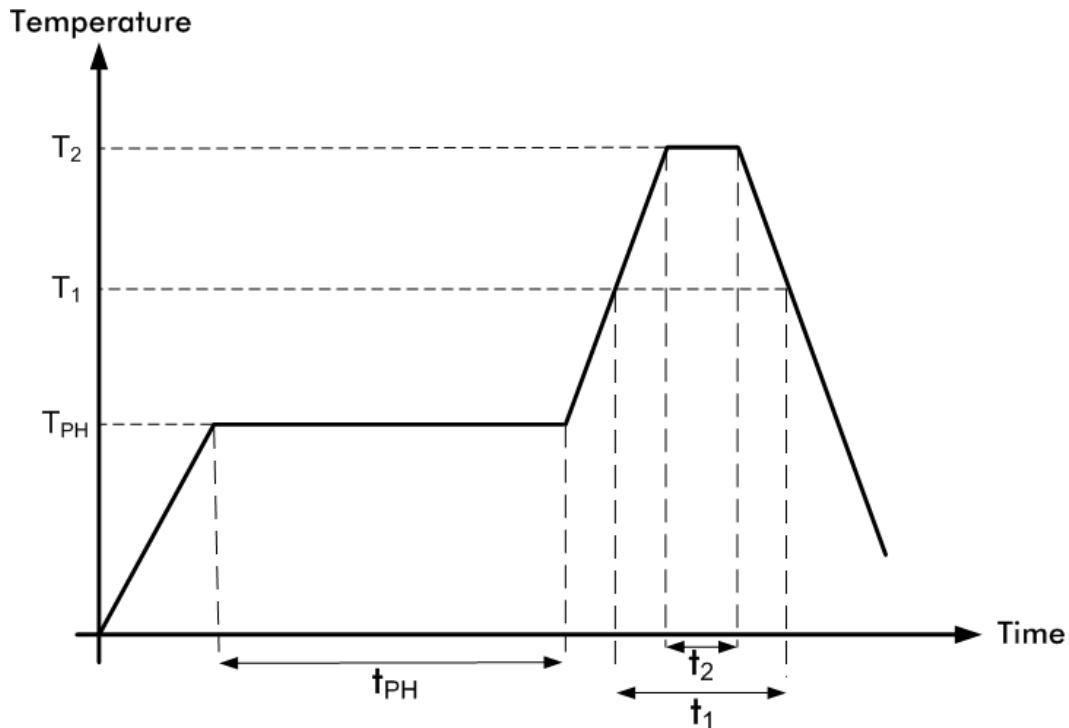


Figure 4-3: Recommended Solder Reflow Profile

| Phase | Pb-Free Conditions |
|--------------|--|
| Preheating | $t_{PH} = 120s$ $T_{PH} = 160\sim 180^{\circ}C$ |
| Primary heat | $t_1 = 60s$ $T_1 = 220^{\circ}C$ |
| Peak | $t_2 = 10s$ (max) $T_2 = 255^{\circ}C$ |

Table 4-1: Recommended Soldering Parameter for Temperature and Timing

Note: The quality of the soldering process depends on several parameters, e.g. soldering paste, carrier board design, fabrication equipment,...

5 Additional documentation

1. “iM222A_AN001_SW-Development”, IMST GmbH

This document gives an overview of the possible software options from Texas Instruments that can be used in conjunction with the iM222A and assists in finding the right documentation for a specific software solution. The pinout of the iM222A and the mapping to the CC2530 as well as the debugging interface and the WiMOD development board are described in detail within this document.

2. CC2530 datasheet ([swrs081b.pdf](#)), Texas Instruments

Datasheet of the CC2530, hardware information.

3. CC2530 User’s Guide ([swru191b.pdf](#)), Texas Instruments

This document describes the specific features, the peripherals and the register settings of the CC2530.

7 Ordering Information

| Ordering Part Number | Description | Distributor |
|----------------------|---------------------|--|
| iM222A | Radio module iM222A | wimod@imst.de |
| SK – iM222A | Coming soon | wimod@imst.de |
| AB – iM222A | Coming soon | wimod@imst.de |
| Notes: | | |

Table 7-1: Ordering Information

8 Appendix

8.1 List of Abbreviations

| | |
|----------|---|
| AB | = Adapter Board |
| ADC | = Analog-to-Digital Converter |
| AES | = Advanced Encryption Standard |
| DIO | = Digital Input/Output |
| E.I.R.P. | = Equivalent Isotropic Radiated Power |
| O-QPSK | = Offset Quadrature Phase Shift Keying |
| GPIO | = General Purpose Input/Output |
| MCU | = Microcontroller Unit |
| PCB | = Printed Circuit Board |
| PER | = Packet Error Rate |
| RAM | = Random Access Memory |
| RF | = Radio Frequency |
| RSSI | = Received Signal Strength Indication |
| SPI | = Serial Peripheral Interface |
| UART | = Universal Asynchronous Receiver/Transmitter |
| USB | = Universal Serial Bus |
| ZNP | = ZigBee Network Processor |
| API | = Application Programming Interface |
| ZNP | = ZigBee Network Processor |
| ZDO | = ZigBee Device Object |
| AF | = Application Framework |

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8.4 References

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9 Regulatory Compliance Information

R&TTE

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.

FCC

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 interference that may cause undesired operation. (FCC Part 15.19).

Warning: Changes or modifications made to this equipment not expressly approved by IMST GmbH may void the FCC authorization to operate this equipment. (FCC Part 15.21)

IC

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.(RSS-GEN)

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1)

l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement. (RSS-GEN).

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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