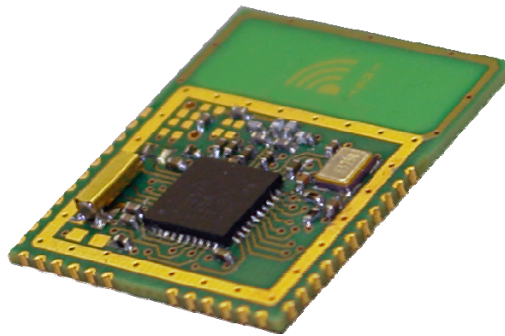


# WiMOD - iM222A

Application Note AN006 / Version 1.2

Software development for iM222A



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## Document Information

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## Revision History

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1.0	Released version.
1.1	Revised all chapter
1.2	Modifications to document format and layout. Added chapter 4 and 5.

## Aim of this Document

Aim of this document is to give a short description for software development for/with the iM222A.

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# 1 Overview

A Pre-qualified RF module like the iM222A offers the opportunity to fully concentrate on software development tasks without taking care of the time consuming and expensive RF circuit development.

This application note describes the necessary aspects to develop your own firmware for the radio module iM222A from IMST GmbH. The iM222A is designed for ZigBee and IEEE 802.15.4 applications, this application note explicitly points out the possibilities when using existing, free of charge TI stack firmware for these standard protocols. Figure 1-1 shows the available and later described software packages for the iM222A.

Please refer to the IMST GmbH customer service (see chapter 6.2) if you have any questions or requests regarding our WiMOD products.

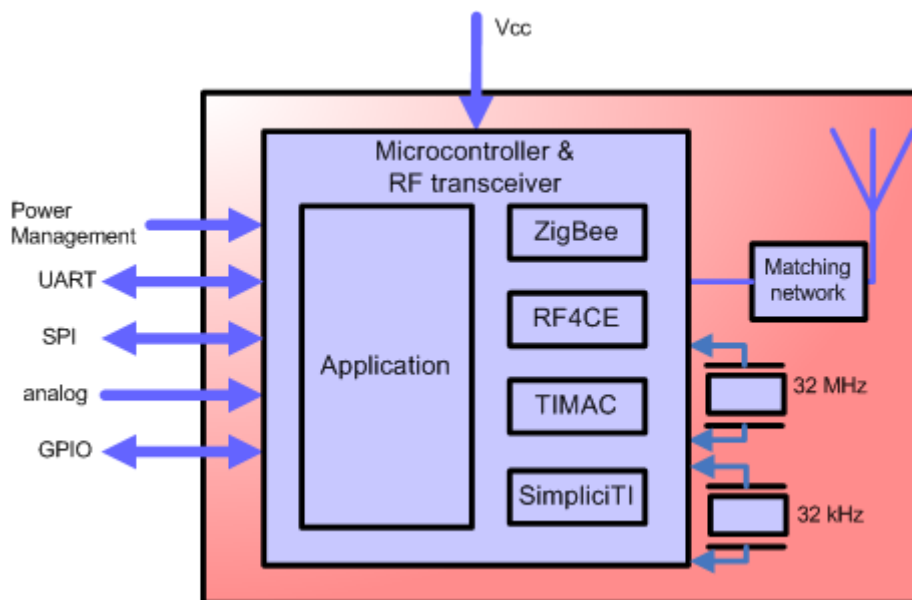


Figure 1-1: Module Overview – iM222A

## 2 Hardware Information

### 2.1 Schematic of the iM222A

The following figure shows the schematic overview of the iM222A. It shows the pinout and all necessary information regarding software development.

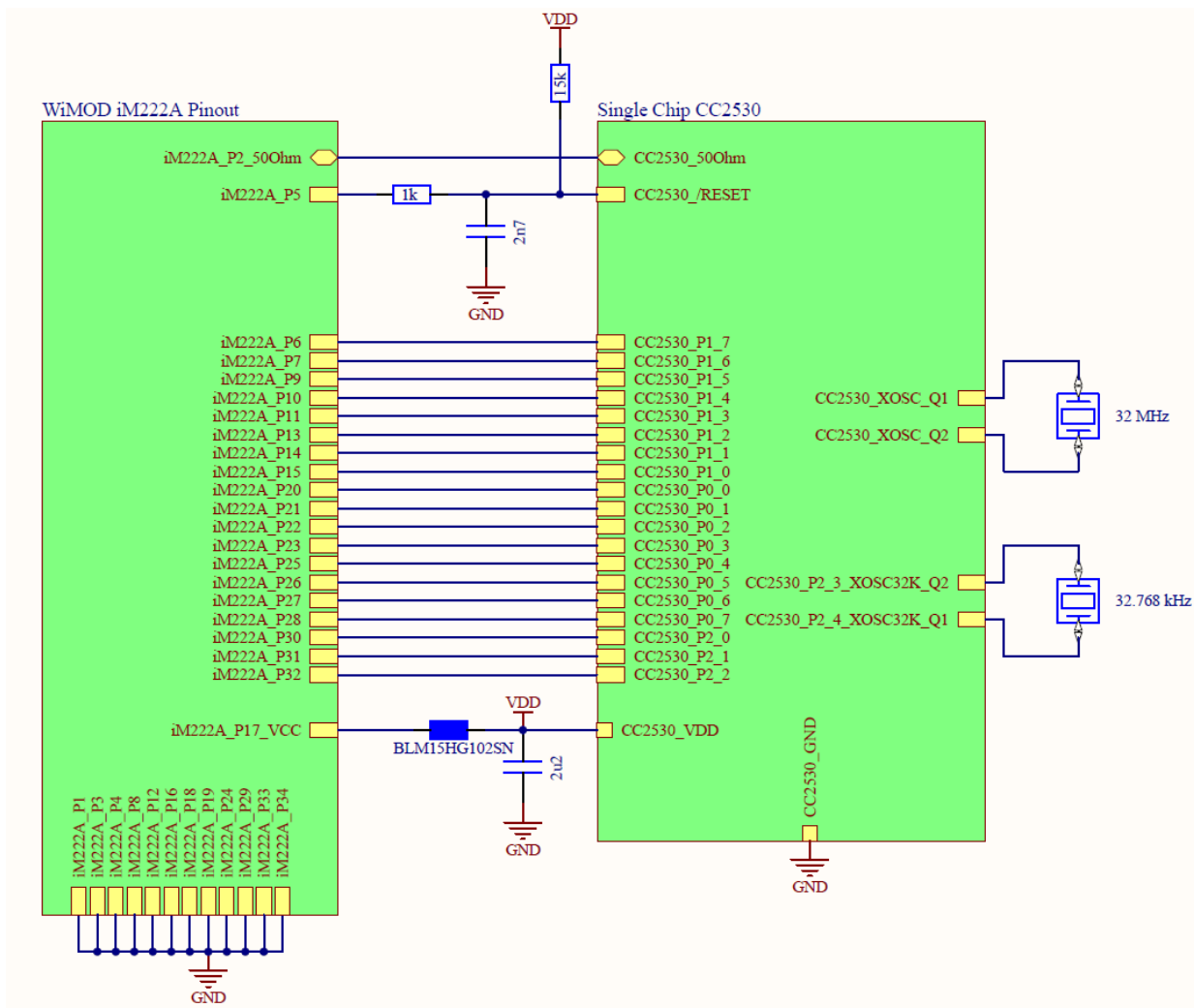


Figure 2-1: Schematic Overview of the iM222A

Main component of the iM222A is the single chip CC2530 from Texas Instruments. This chip can be reprogrammed by using the integrated programming and debug interface described in chapter 2.3. All necessary information about the 8051 core, the peripherals and the integrated radio can be found in the CC2530 datasheet [2], available at TI's website [3].

On the iM222A-ext the RF path is switched to the 50  $\Omega$  pad and an external antenna is necessary. On the iM222A-int the integrated PCB antenna is used.

## 2.2 WiMOD Demo Board

The WiMOD Demo Board offers several often used peripherals like buttons, LEDs, a potentiometer, a buzzer and a temperature sensor. The module can easily be accessed via the on board UART to USB converter. To develop software for the iM222A it is necessary to use the CC Debugger or a comparable tool from Texas Instruments, the connection is described in chapter 2.3 and the Demo Board User Guide [4]. Figure 2-2 gives an overview of the WiMOD Demo Board and its peripherals.

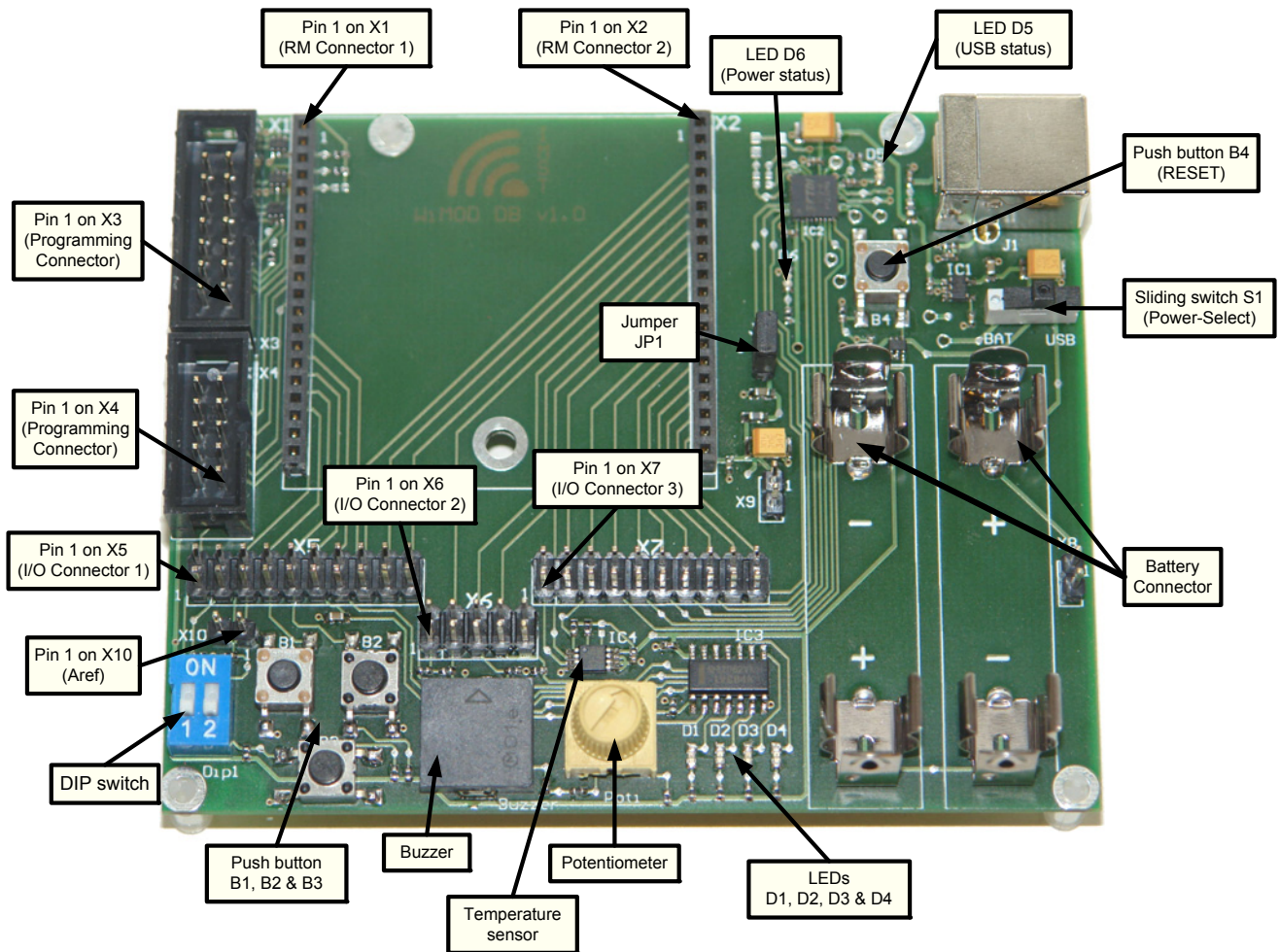


Figure 2-2: WiMOD Demo Board

When using the Demo Board with the iM222A, the module has to be soldered on its specific adapter board AB\_02 and plugged into X1 and X2. Now all necessary module pins are available on X4 (programming interface), X5, X6, and X7 of the Demo Board.

**Note:** The pin assignment of X4 differs to the standard programming connector from Texas Instruments.

Table 2-1 shows the most important peripherals and its mapping to the radio module iM222A when setting the corresponding jumper on X5, X6 and X7.

Peripheral on the Demo Board	Jumper setting on the Demo Board	iM222A pin	CC2530 pin
Button 1	X5.7 to X5.8	9	P1.5
Button 2	X5.9 to X5.10	7	P1.6
Button 3	X5.1 to X5.2	11	P1.3
LED 1	X5.17 to X5.18	6	P1.7
LED 2	X6.3 to X6.4	30	P2.0
LED 3	X6.5 to X6.6	27	P0.6
LED 4	X6.7 to X6.8	21	P0.1
Potentiometer	X5.11 to X5.12	20	P0.0 (AIN0)
UART RxD	X7.13 to X7.14	23	P0.3
UART TxD	X7.19 to X7.20	22	P0.2

Table 2-1: Pin mapping to important peripherals of the WiMOD Demo Board

## 2.3 Programming Interface

The CC2530 has got a two-wire serial interface (Debug-Clock and Debug-Data) that is used for programming the on-chip-flash and for in-circuit debugging. Table 2-2 lists the necessary pads of the iM222A which have to be connected to the programming device. For detailed information about the debug/programming interface please see the flash controller section of the CC253x User's Guide [5] and the website from Texas Instruments [3].

iM222A Pin #	Demo Board Pin row X4	Description
-	X4.1	
-	X4.2	GND
-	X4.3	
-	X4.4	VCC - Reference voltage for the programming device; must not be used to supply the demo board and the radio module
Pad 31	X4.5	DD – data line for the Debug Interface
Pad 5	X4.6	/RESET
-	X4.7	Not connected
Pad 32	X4.8	DC – clock line for the Debug Interface
-	X4.9	
-	X4.10	GND

Table 2-2: Pinout of X4 ( Debug Interface) on the WiMOD Demo Board

With the WiMOD Starter Kit, the programming interface is reachable on pin row X4 (see Figure 2-3) of the WiMOD Demo Board.

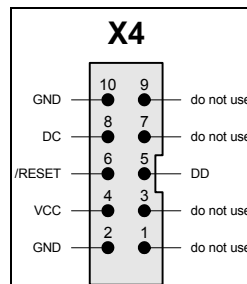


Figure 2-3: Pinout of X4 on the Demo Board



## 3 Developing Software for the iM222A

### 3.1 Useful Tools

#### 3.1.1 CC Debugger

The CC Debugger is a small programmer and debugger for the TI Low Power RF System-on-Chips. It can be used together with “IAR Embedded Workbench for 8051” (version 7.51A or later) for debugging and “SmartRF Flash Programmer” for flash programming. The CC Debugger can also be used for controlling selected devices from SmartRF Studio.

Link: <http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html>, Texas Instruments

#### 3.1.2 SmartRF Studio

SmartRF™ Studio is a Windows application that can be used to evaluate and configure the CC2530 from Texas Instruments. It is especially useful for generation of configuration register values. SmartRF Studio can be used with the CC Debugger tool connected as described in chapter 2.3.

Link: <http://focus.ti.com/docs/toolsw/folders/print/smartrfstudio.html>, Texas Instruments

#### 3.1.3 SmartRF Flash Programmer

The SmartRF Flash Programmer can be used to program the flash memory of the iM222A with the CC Debugger tool.

Link: <http://focus.ti.com/docs/toolsw/folders/print/flash-programmer.html>, Texas Instruments

## 3.2 ZigBee PRO

The Z-Stack package is available free-of-charge and can be downloaded from TI's website [3]. It is compliant to ZigBee 2007 (ZigBee and ZigBee PRO) and offers several sample applications that can be used as a starting point when beginning with the development of an own ZigBee application. To evaluate the Z-Stack at least a 30 days trial version of IAR embedded workbench EW8051 7.60 is needed. The trial version must be requested from IAR directly. After installation of the Z-Stack package, the documentation can be found in the documents folder. The documents "Z-Stack API", "Z-Stack Sample Applications" and "Z-Stack Developer's Guide" help to start with TI's Z-Stack. Mapping of the CC2530 pins to the iM222A pins is described in chapter 2.1.

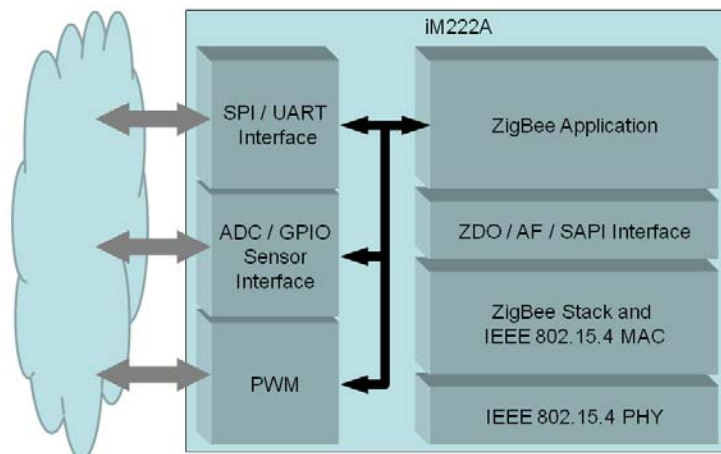


Figure 3-1: ZigBee Application for the iM222A

The Z-Stack sample applications from Texas Instruments can directly be ported to the WiMOD Demo Board by replacing and adding the following five files within the Z-Stack folder with WiMOD Demo Board specific files available from IMST GmbH.

```
OnBoard.c  
hal_key.c  
hal_key.h  
hal_board_cfg.h  
iM222_HALkey.c
```

### 3.2.1 Additional ZigBee PRO Documents

1. ZCL API document (SWRA197), Texas Instruments
2. ZigBee wiki (<http://processors.wiki.ti.com/index.php/Zigbee>), Texas Instruments
3. Z-Stack package (<http://focus.ti.com/docs/toolsw/folders/print/z-stack.html>), Texas Instruments
4. IAR website download page (<http://www.iar.com/website1/1.0.1.0/675/1/>), IAR systems
5. TI low power RF developer's network ([http://e2e.ti.com/support/low\\_power\\_rf/default.aspx](http://e2e.ti.com/support/low_power_rf/default.aspx)), Texas Instruments

## 3.3 TIMAC

The TIMAC package defines an IEEE 802.15.4 Medium Access Control Software Stack. To evaluate the TIMAC software at least a 30 days trial version of IAR embedded workbench EW8051 7.60 is needed. The trial version can be requested from IAR directly.

You can use TIMAC when you:

1. Need a wireless point-to-point or point-to-multipoint solution. E.g. multiple sensors reporting directly to a master.
2. Need a standardized wireless protocol.
3. Have battery powered and/or mains powered nodes.
4. Need support for acknowledgement and retransmission.
5. Have low data rate requirements. (Around 100 kbps effective data rate.)

The TIMAC software package can be downloaded from the corresponding website and may be used free of charge on the iM222A.

### 3.3.1 Additional TIMAC Documents

1. TIMAC website (<http://focus.ti.com/docs/toolsw/folders/print/timac.html>), Texas Instruments
2. TI low power RF developer's network ([http://e2e.ti.com/support/low\\_power\\_rf/default.aspx](http://e2e.ti.com/support/low_power_rf/default.aspx)), Texas Instruments

## 3.4 SimpliCI

SimpliCI is a simple low-power RF network protocol aimed at small RF networks. Such networks typically contain battery operated devices which require long battery life, low data rate and low duty cycle and have a limited number of nodes talking directly to each other or through an access point or range extenders. Access point and range extenders are not required but provide extra functionality such as store and forward messages. With SimpliCI the MCU resource requirements are minimal which results in the low system cost.

SimpliCI was designed for easy implementation and deployment out-of-the-box on several TI RF platforms such as the CC2530.

### 3.4.1 Additional SimpliCI Documents

1. SimpliCI website (<http://focus.ti.com/docs/toolsw/folders/print/simpliCI.html>), Texas Instruments
2. TI low power RF developer's network ([http://e2e.ti.com/support/low\\_power\\_rf/default.aspx](http://e2e.ti.com/support/low_power_rf/default.aspx)), Texas Instruments

## 3.5 RF4CE

The RF4CE software package from Texas Instruments is internally called "RemoTI". It is build on the TIMAC medium access layer and offers a simple, intuitive software framework needed to build an RF4CE compliant product. The sample code can be downloaded directly from Texas Instruments.

### 3.5.1 Additional RF4CE Documents

1. RemoTI website (<http://focus.ti.com/docs/toolsw/folders/print/remoti.html>), Texas Instruments
2. RemoTI Basic Remote Developer's Guide ([swru224a.pdf](#)), Texas Instruments
3. RemoTI Network Processor Developer's Guide ([swru223a.pdf](#)), Texas Instruments
4. RemoTI Host Processor Sample Application and Porting Guide ([swra259.pdf](#)), Texas Instruments
5. TI low power RF developer's network ([http://e2e.ti.com/support/low\\_power\\_rf/default.aspx](http://e2e.ti.com/support/low_power_rf/default.aspx)), Texas Instruments

## 4 Appendix

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### 4.4 References

- [1] <http://www.wireless-solutions.de>, IMST GmbH
- [2] CC2530 datasheet (swrs081b.pdf), Texas Instruments
- [3] [CC2530 website](#), Texas Instruments
- [4] DemoBoard\_UserGuid, IMST GmbH  
(<http://www.wireless-solutions.de/wireless-solutions/de/produkte/demo-board>)
- [5] CC2530 User's Guide (swru191b), Texas Instruments

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## 5 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.

## 6 Important Notice

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