Contents:

Acronyms

The following list shows the acronyms used in this document.

A/D	Analog to Digital
CE	Conformité Européenne
EMC	Electromagnetic Compatibility
GPIO	General Purpose Input Output
I2C	Inter Integrated Circuit
IC	Integrated Circuit
IDE	Integrated Development Environment
JTAG	Joint Test Action Group
LNA	Low Noise Amplifier
MAC	Medium Access Control
MCU	Micro Controller Unit
PA	Power Amplifier
PCB	Printed Circuit Board
PHY	Physical Layer
SBW	Spy-Bi-Wire
SCI	Serial Communication Interface
SMD	Surface Mount Device
SPI	Serial Port Interface
SW	Software
UART	Universal Asynchronous Receive Transmit
USB	Universal Serial Bus

References

For more detailed information, please consult the following documents:

Texas Instruments, Inc.
"MSP430 Hardware Tools, Users Guide SLAU208E, Rev. April 2010"
"MSP430F543xA, Datasheet SLAS612A, Rev. March 2010"
"CC2529, Datasheet SWRS068, Rev. December 2007"
"CC2590, Datasheet SWRS080, Rev. September 2008"

1 Overview

The DevCom 06 ZigBee Module offers a fast-track approach to development of IEEE 802.15.4 and ZigBee applications. The module comes with a 24-pole connector with access to different I/Os.

The module has an internal antenna. The DevCom 06 ZigBee Module is available as a module with standard software, but the module is also available with customized software developed by Develco A/S in close co-operation with the customer.

The module is based on TI's 16-bit MSP430 series and the 2.4 GHz ZigBee compliant radio, CC2520.

The DevCom 06 ZigBee Module includes the RF front end module, CC2590/CC2591 for extended range performance.

The board is supplied with software based on Texas Instruments Z-Stack, ZigBee-2007 Release.

1.1 Specifications

- Dimensions: 24 x 25mm
- Storage temperature: -30 to +105°C
- Operating temperature: -10 to +70°C
- Transmitter output power (maximum): 14 dBm[1]
- Receiver sensitivity: -101 dBm @ 1% PER
- Supply voltage range: 2.4 to 3.6V @ 25MHz system frequency
- Bit rate: 250 kbps
- Data rate: 200 kbps
- Frequency band: 2400 to 2483.5 MHz
- Number of channels: 16
- Current consumption, Rx: 32.1 mA
- Current consumption, Tx: 54.3 mA @ 12 dBm
- Flash memory: 256 kB
- RAM: 16 kB

1.2 General Features

- 2.4 GHz IEEE 802.15.4
- Low power consumption (down to 1.5 µA in standby mode. For cable replacement application down to 100 µA)
- VCC I/O level
- Up to 18 GPIOs (UART, Keyboard inputs, A/D, PWM, Comparator, I^{2}C and SPI)
- On-board antenna and prepared for external antenna
- CE compliant[2]
- RoHS compliant according to the EU Directive 2002/95/EC
- Software development board available

1.3 Interfaces

- 24 pin DIL connector (2mm spacing)
  - Up to 18 GPIOs
    - Up to 4 UARTs
    - Up to 7 Interrupt inputs
    - Up to 6 A/D inputs
    - Up to 6 Timer / Compare outputs

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[1] Output power shall be limited to comply with European regulations
[2] Pending

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- - Up to 2 I^{2}Cs
    - Up to 3 SPI
  - V_{CC}
  - GND

1.4 Software Configurations

Modules are preloaded with MAC based cable replacement software.

1.5 ZigBee Technology

The IEEE 802.15.4 specification is a cost-effective, low data rate (<250 kbps), 2.4 GHz and 868/915 MHz wireless technology designed for personal-area peer-to-peer and star networks. The IEEE 802.15.4 standard is the basis of an application and network layer protocol called ZigBee.

A number of companies, including Develco A/S, have formed a consortium known as the ZigBee Alliance. The purpose of this consortium is to create a specification for mesh networking and application profiles. The companies also perform interoperability and certification testing.

For additional information about the ZigBee Alliance, please visit the following website
http://www.ZigBee.org

2 Electrical Specifications

This section details the operating conditions, DC characteristics and AC characteristics of the DevCom 06 ZigBee Module.

2.1 Operating Conditions

Table 2.1 Operating Conditions

Parameter	Min	Typ	Max	Unit	Conditions
Supply Voltage (V_{CC})	2.4	3.0	3.6	V	
Frequency Range	2.405		2.480	GHz	16 available channels in the 2.4 GHz ISM band
Storage Temperature Range	-30		+105	°C	0% to 90% relative humidity (non-condensation)
Operating Temperature Range	-10		+70	°C	0% to 90% relative humidity (non-condensation)

2.2 DC Electrical Characteristics

Table 2.2 DC Electrical Characteristics[3]

Parameter	Min	Typ	Max	Unit	Conditions
Current Consumption4, Standby		8		µA	VCC = 3.0V (Hibernate and Stop3 mode) Excluding on-board regulation
Current Consumption, Transmit Mode (Nominal)		65		mA	VCC = 3.0V (Transmit mode and Run mode) Output power limited for CE compliance
Current Consumption, Receive Mode		30		mA	VCC = 3.0V (Receive mode and Run Mode)
Input High Voltage (V_{ih})	0.70* V_{CC}			V	All digital inputs (-10°C to +70°C)
Input Low Voltage (V_{il})			0.25* V_{CC}	V	All digital inputs (-10°C to +70°C)
Output High Voltage (V_{oh})	V_{CC}- 0.6			V	All digital inputs (-10°C to +70°C) @ 6mA
Output Low Voltage (V_{ol})			0.6	V	All digital inputs (-10°C to +70°C) @ 6mA

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[3] V_{CC}=3.0V, Ta=+25°C, unless otherwise noted
[4] Current consumptions are for DevCom 06-x and include PHY and MAC only

DEVELCO

2.3 AC Electrical Characteristics

Table 2.3 AC Electrical Characteristics[5]

Parameter	Min	Typ	Max	Unit	Conditions
RF Data Rate		250		kbps	Over the air data rate
Receiver Sensitivity		TBD		dBm	≤1% Packet Error Rate, 20-byte payload
Saturation (Maximum Input Level)		TBD		dBm	
Frequency Error Tolerance			200	kHz	
Symbol Rate Error Tolerance			80	ppm	
Transmitter Output Power (Maximum)		TBD		dBm	Output power shall be limited to comply with European regulations
Transmitter Output Power (Nominal)		TBD		dBm	Output power limited for CE compliance[6]

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[5] V_{CC}=3.0V, Ta=+25°C, unless otherwise noted
[6] Excluding antenna gain

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3 Pin Assignments and Definitions

The interface of the DevCom 06 ZigBee Module consists of 24 connections. These connections are located in 2 rows of 12 pins each with a pitch of 2mm.

18 of these connections are available as digital General Purpose Input-Output connections for SW development purposes, which includes In-circuit debug and flash programming, UART, Keyboard inputs, A/D, Timer, Comparator, I^{2}C and SPI.

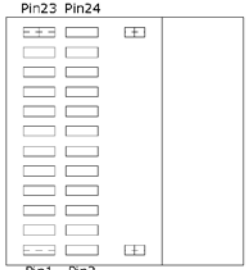Table 3.1 details the pin-out of the 24 interface connections of the DevCom 06 ZigBee Module .

For more detailed information about GPIO functionalities, please see the "MSP430F5438 Data Sheet" from Texas Instruments.

Table 3.1 Pin Definitions

Pin Number	Pin Name	MSP430 Connections and/or Description
1	V$_{CC}$ (Supply Voltage)	Internally connected to A$_{VCC}$, D$_{VCC1}$, D$_{VCC2}$, D$_{VCC3}$ and D$_{VCC4}$
2	Reset	Connected to /RST
3	BKGD	Connected to TEST/SBWTCK
4	GND	Internally connected to A$_{VSS}$, D$_{VSS1}$, D$_{VSS2}$, D$_{VSS3}$ and D$_{VSS4}$
5	UART0-RxD / IRQ2	P5.7/UCA1RXD/UCA1SOMI + P2.3/TA1.2
6	UART0-TxD / IRQ3	P5.6/UCA1TXD/UCA1SIMO + P2.5
7	UART1-RxD / SPI1(MISO)	P10.5/UCA3RXD/UCA3SOMI
8	UART1-TxD / SPI1(MOSI)	P10.4/UCA3TXD/UCA3SIMO
9	PWM4 / I2C1 (SDA)	P1.0/TA0CLK/ACLK + P2.4/RTCCLK + P10.1/UCB3SIMO/UCB3SDA
10	PWM1 / I2C1 (SCL)	P2.6/ACLK + P10.2/UCB3SOMI/UCB3SCL
11	SPI0 (SCLK) / UART4-RxD	P3.5/UCA0RXD/UCA0SOMI + P9.0/UCB2STE/UCA2CLK
12	SPI0 (MOSI) / UART2-TxD	P9.4/UCA2TXD/UCA2SIMO
13	SPI0 (MISO) / UART2-RxD	P9.5/UCA2RXD/UCA2SOMI
14	SPI0 (CS) / UART4-TxD	P3.4/UCA0TXD/UCA0SIMO + P9.3/UCB2CLK/UCA2STE
15	ADC5 / SPI1 (SCLK)	P6.5/A5 + P10.0/UCB3STE/UCA3CLK
16	IRQ4 / SPI1 (CS)	P2.2/TA1.1 + P10.3/UCB3CLK/UCA3STE
17	IRQ0 / PWM3	P2.7/ADC12CLK/DMAE0 + P4.0/TB0.0
18	IRQ1 / ADC4	P6.4/A4 + P2.1/TA1.0
19	PWM0 / ADC0	P6.0/A0 + P4.1/TB0.1
20	PWM2 / ADC1	P6.1/A1 + P4.2/TB0.2
21	I2C0 (SDA) / ADC2	P6.2/A2 + P9.1/UCB2SIMO/UCB2SDA
22	I2C0 (SCL) / ADC3	P6.3/A3 + P9.2/UCB2SOMI/UCB2SCL
23	GND	Internally connected to A$_{VSS}$, D$_{VSS1}$, D$_{VSS2}$, D$_{VSS3}$ and D$_{VSS4}$
24	GND	Internally connected to A$_{VSS}$, D$_{VSS1}$, D$_{VSS2}$, D$_{VSS3}$ and D$_{VSS4}$

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3.1 Assignments for Debug Interface

The DevCom 06 ZigBee Module has all connections necessary for easy programming and debugging of the module. The USB Flash Emulation Tool, MSP-FET430UIF from Texas Instruments can be used for these purposes. The following connection scheme shows the necessary interconnections, between the programmer and the DevCom06 module.

MSP-FET430UIF Connector	2 wire JTAG interconnection (SpyByWire) Vcc supplied from Target: ← Vcc			Devcom06 Connector
	MSP-FET430UIF Description	Pin	Pin	Devcom06 Description	
	TDO/TDI	1	2	RESET	
	Vcc Target	4	1	Vcc	
	TCK	7	3	BKGD/Test	
	Gnd	9	4	Gnd	
	Vcc supplied from Programmer: Vcc →				
	TDO/TDI	1	2	RESET	
	Vcc Tool	2	1	Vcc	
	TCK	7	3	BKGD/Test	
	Gnd	9	4	Gnd	

For proper utilization and detailed information of the USB Flash Emulation Tool, please look into the "MSP430 Hardware Tools – User's Guide" from Texas Instruments. The User's guide can be downloaded from http://www.ti.com

Figure 3.1 - MSP430-FT430UIF

4 Mechanical Specifications

This chapter details the mechanical specifications for the DevCom 06 ZigBee Module. Parameters described in detail are mechanical dimensions and mechanical implementation.

4.1 Mechanical Dimensions

The DevCom 06 ZigBee Module is available for SMD assembling only. The mechanical dimensions is shown in Figure 4.2. Maximum height including PCB is 2.9mm.
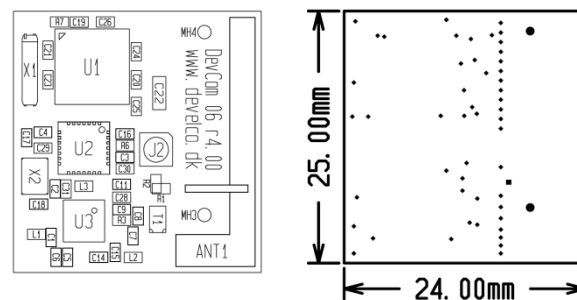

Figure 4.2 Mechanical dimensions

4.2 Mechanical Implementation

To achieve the specified performance and comply with regulatory approvals, the DevCom 06 ZigBee Module must meet the following requirements when implemented to an interface platform.

There must not be any ground plane or power plane above or below the antenna part of the module. FR-4 material under the antenna is, however, acceptable. The minimum distance from the DevCom 06 ZigBee Module to one of the mentioned planes must be at least 15mm to each side. See Figure 4.3 for implementation guidelines. All dimensions are designated in millimetres.

It is recommended that the ground plane of the interface platform is a as large as possible; the minimum ground plane acceptable must cover the DevCom 06 ZigBee Module , except for the antenna area as mentioned above.

It is important that the two pads for ground connections to the external interface board are fixed properly, to provide optimal ground connection and mechanical stability.

The drawing below is seen from top side (component side) and shows the soldering connections for the module.

It is required that the test points on the solder side of the DevCom 06 ZigBee Module are isolated from the ground plane. Se chapter 7 for coordinates.
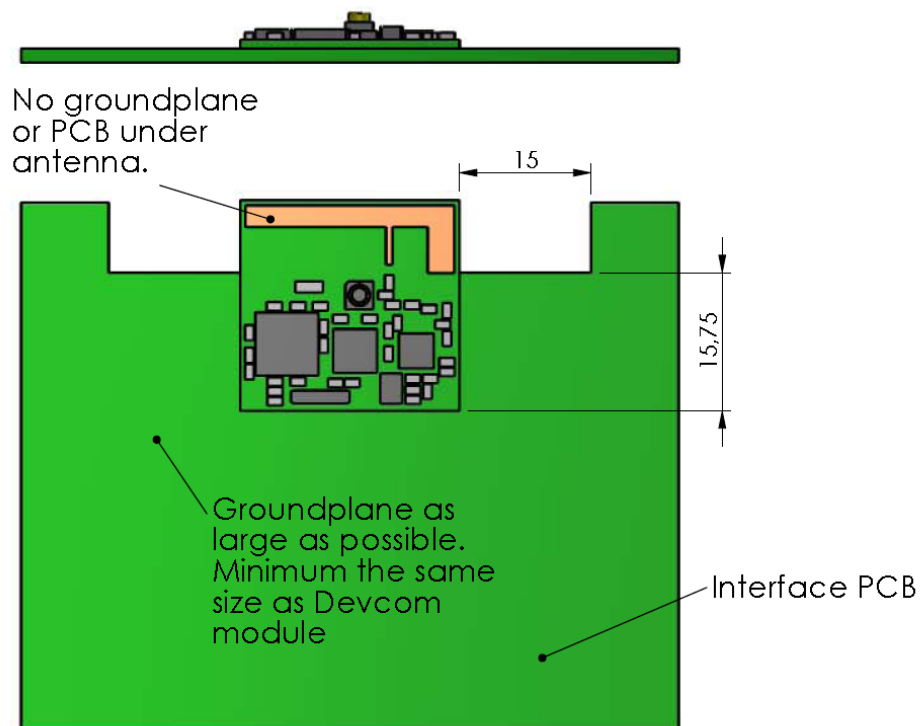
No groundplane
or PCB under
antenna.

15

15,75

Groundplane as
large as possible.
Minimum the same
size as Devcom
module

Interface PCB

Figure 4.3 Requirements for mechanical implementation of DevCom 06 ZigBee Module

The ground plane on the interface board can be on both sides or on one side only.

5 Certifications

The DevCom 06 ZigBee Module is fully CE certified[7] and compliant to the following standards:

- EN 300 328 V1.7.1 (2006-05) EMC for Radio spectrum Matters (ERM); Data transmission equipment for operating in the 2.4GHz ISM band and using wide band modulation techniques.
- EN 301 489-1 V1.6.1 (2005-09) EMC for Radio spectrum Matters (ERM); Common technical requirements.
- EN 301 489-17 V1.2.1 (2002-08) EMC for Radio spectrum Matters (ERM); Specific conditions for 2.4GHz wideband transmission systems.
- EN 60950 (2000-June) Safety of information technology equipment
- EN 50371 (2002) Basic restrictions related to human exposure

Part 15 - Class B digital device or peripheral §15.105(b)
"This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: —Reorient or relocate the receiving antenna. —Increase the separation between the equipment and receiver. —Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. —Consult the dealer or an experienced radio/TV technician for help."

This device complies part 15 of FCC rules and RSS-210 of IC rules. Operation is subjected 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. The term "IC" before the equipment certification number only signifies that the Industry Canada technical specifications were met.
Changes or modification not expressly approved by the partly responsible for compliance could void the user's authority to operate the equipment.

Ce dispositif est conforme à la norme partie 15 de FCC et CNR-210 d'Industrie Canada. Le terme «IC» devant le numéro de certification de l'équipement signifie uniquement que les spécifications techniques d'Industrie Canada ont été respectées.
Les changements ou modifications non expressément approuvés par la partie responsable de conformité pourrait annuler l'autorité de l'utilisateur à utiliser l'équipement"

FCC ID: 2AC5K289023121
IC: 12307A-289023121
M/N::"DevCom 06 ZigBee Module

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[7] Pending

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6 Antenna Characteristics

This section details the antenna part of the DevCom 06 ZigBee Module. The module has an internal antenna implemented.

NOTE:
If any other antenna than the default F-antenna is used, the DevCom 06 ZigBee Module is no longer certain to comply with the already approved certifications. To ensure full compliance, approval is therefore necessary.

6.1 Internal F-antenna

The antenna implemented on the DevCom 06 ZigBee Module is an in-PCB F-antenna. The F-antenna has good efficiency and an almost omni-directional radiation pattern.

Figure 6.1 and Figure 6.2 show the DevCom 06 ZigBee Module horizontal and vertical radiation patterns. The red colour represents the vertical polarization and the blue colour the horizontal polarization. Both radiations are measured in dBi.
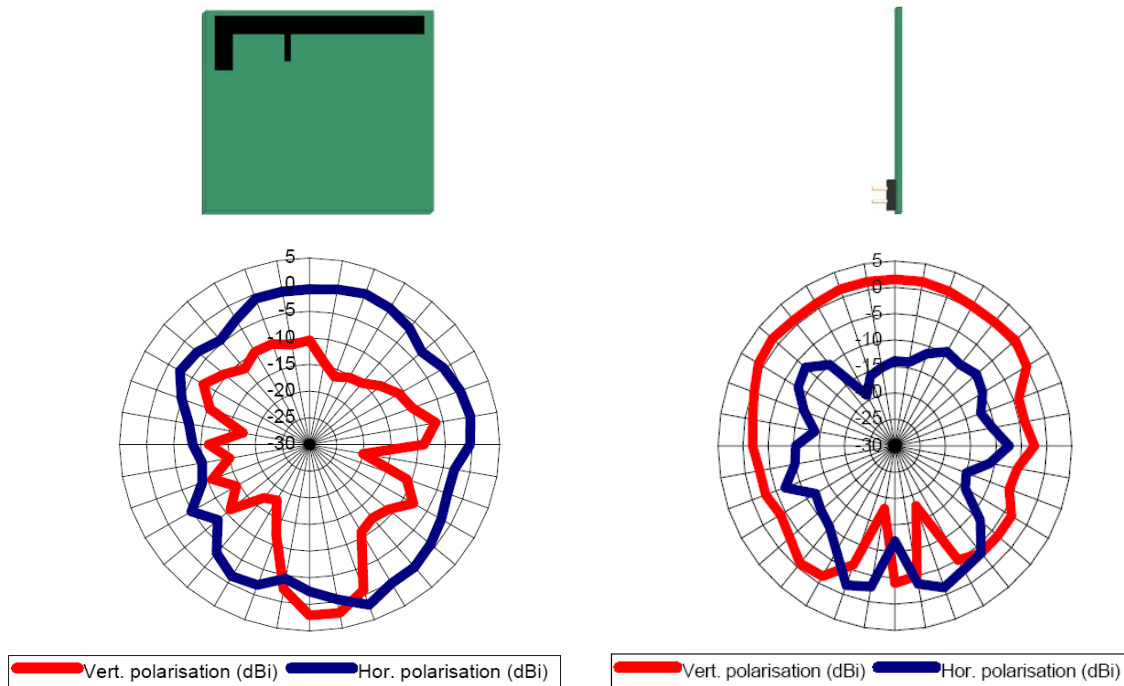
Figure 6.1 Horizontal radiation pattern   Figure 6.2 Vertical radiation pattern

7 Assembly Guidelines

This chapter details the assembly guidelines for the DevCom 06 ZigBee Module, including guidelines for PCB layout and soldering.

7.1 PCB Layout Guidelines

This section describes the guidelines for recommended footprint for the interface PCB for SMD assembling of the DevCom 06 ZigBee Module. The guidelines include recommendations on copper layer, solder mask and solder paste.

These recommendations are guidelines only and may need to be adjusted, depending on other components on the interface PCB and the assembly facility in general.

The data for copper layout, solder mask and solder paste for the DevCom 06 ZigBee Module are illustrated in Figure 7.4, Figure 7.5 and Figure 7.6. A similar footprint is recommended for the interface PCB as well and illustrated in Figure 7.1, Figure 7.2 and Figure 7.3. It is recommended to adjust the stencil opening and thickness in correlation with the interface PCB.

Test points are illustrated in Figure 7.7. Sufficient clearances for the test points are highly recommended to implement in the ground layer on the interface PCB.

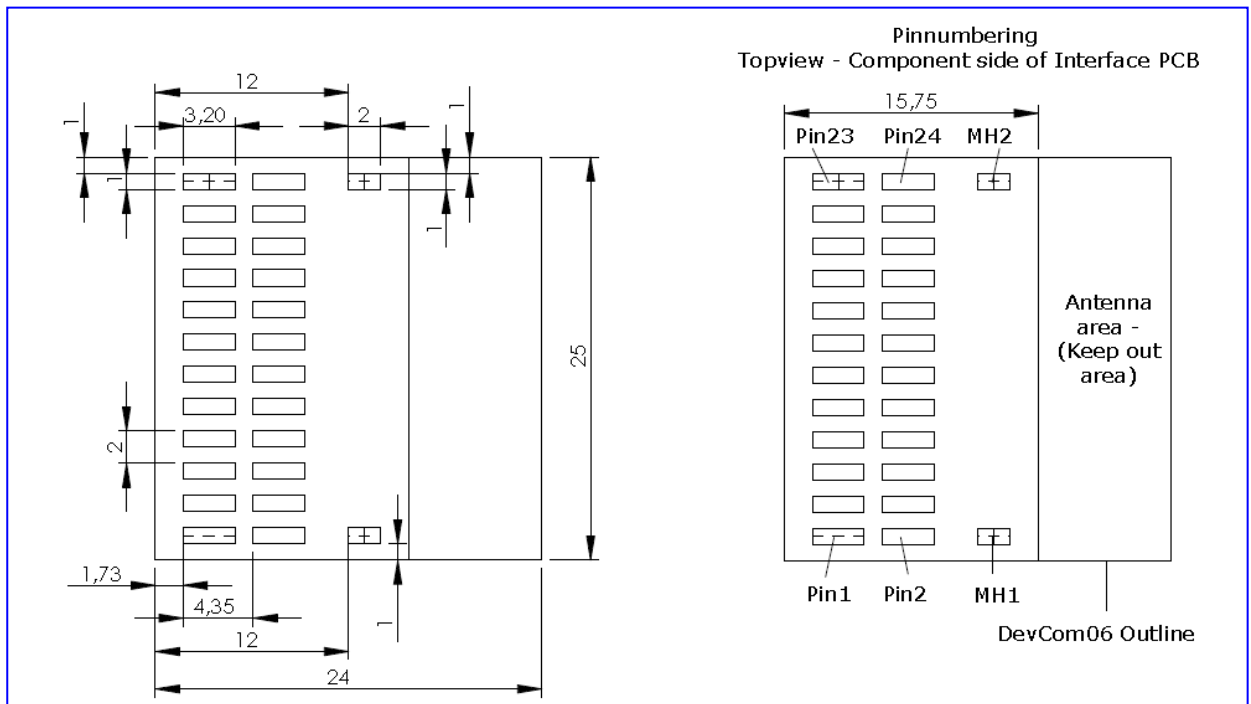All dimensions are in millimetres with a tolerance of approximately ±0.05mm.

Figure 7.1 - Recommended copper layout for the Interface Module
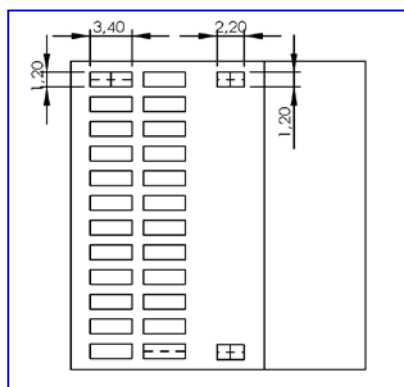
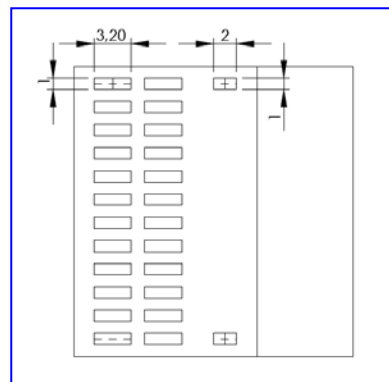**Figure 7.2 Recommended solder mask for the Interface Module**

Figure 7.3 Recommended solder paste for the Interface Module
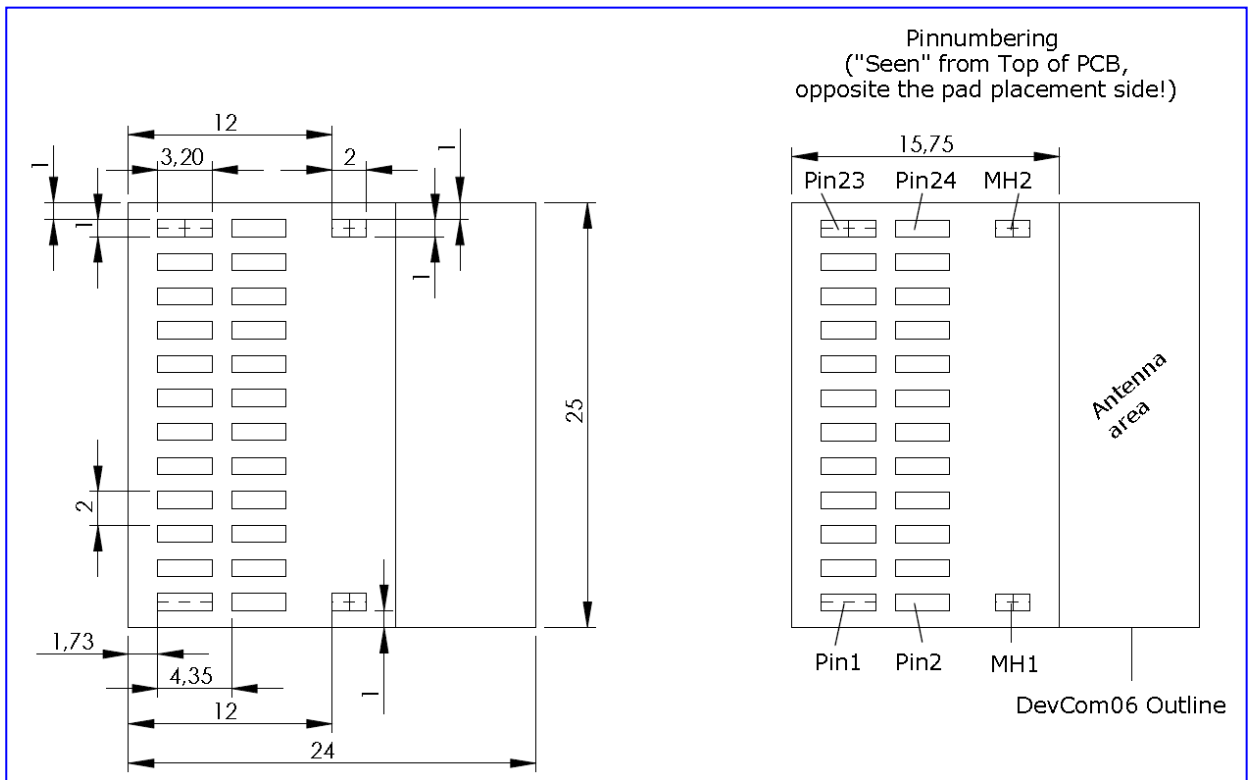
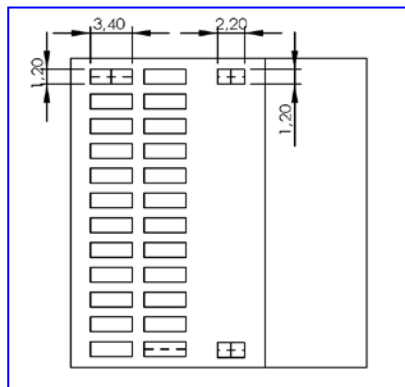**Figure 7.4 Copper layout for the DevCom 06 ZigBee Module**

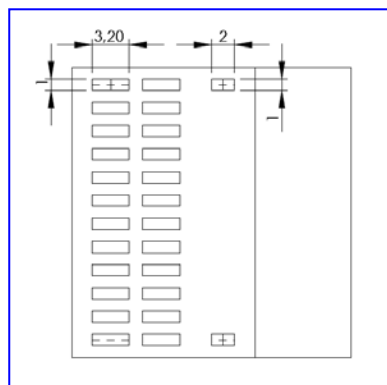**Figure 7.5 Solder mask for the DevCom 06 ZigBee Module**

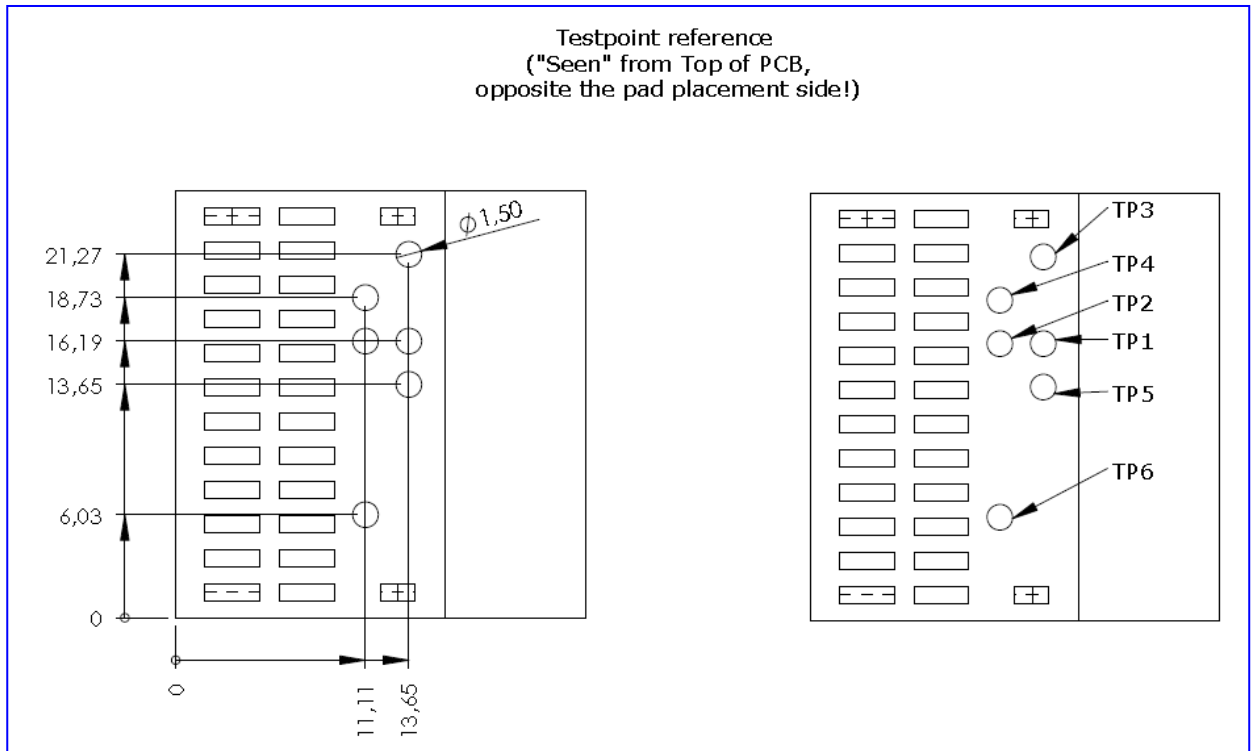**Figure 7.6 Solder paste for the DevCom 06 ZigBee Module**

Figure 7.7 Test points for the DevCom 06 ZigBee Module

7.2 Soldering Guidelines

This section describes soldering guidelines for the interface PCB for SMD assembling of the DevCom 06 ZigBee Module. The guidelines include recommendations on the soldering profile.

Concerning humidity and sensitivity, the DevCom 06 ZigBee Module must be handled in accordance with IPC/JEDEC J-STD-020C classification 3.

Figure 7.8 illustrates a recommended reflow soldering profile for the DevCom 06 ZigBee Module (Extracted from IPC/JEDEC J-STD-020C). These recommendations are guidelines only and may need to be adjusted, depending on other components on the interface PCB and the assembly facility in general.
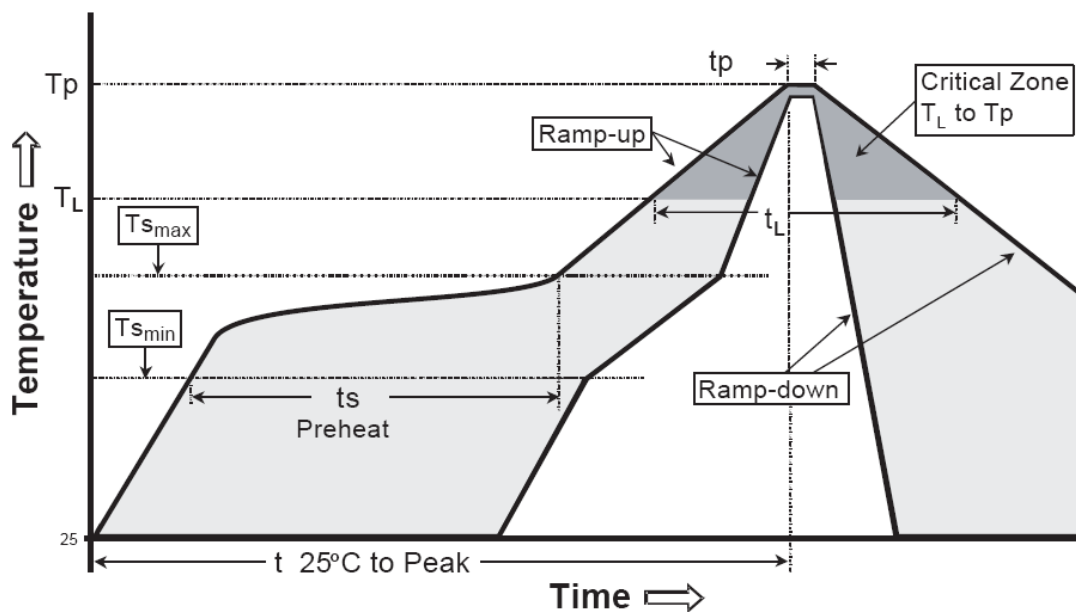

Figure 7.8 Soldering guidelines for the DevCom 06 ZigBee Module

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-Up Rate (Ts_{max} to Tp)	3 °C/second max.	3° C/second max.
Preheat – Temperature Min (Ts_{min}) – Temperature Max (Ts_{max}) – Time (ts_{min} to ts_{max})	100 °C 150 °C 60-120 seconds	150 °C 200 °C 60-180 seconds
Time maintained above: – Temperature (T_L) – Time (t_L)	183 °C 60-150 seconds	217 °C 60-150 seconds
Peak/Classification Temperature (Tp)	See Table 4.1	See Table 4.2
Time within 5 °C of actual Peak Temperature (tp)	10-30 seconds	20-40 seconds
Ramp-Down Rate	6 °C/second max.	6 °C/second max.
Time 25 °C to Peak Temperature	6 minutes max.	8 minutes max.

Note 1: All temperatures refer to topside of the package, measured on the package body surface.

Table 4-1   SnPb Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 ≥ 350
<2.5 mm	240 +0/-5 °C	225 +0/-5°C
≥ 2.5 mm	225 +0/-5°C	225 +0/-5°C

Table 4-2   Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 350 - 2000	Volume mm^3 >2000
<1.6 mm	260 +0 °C *	260 +0 °C *	260 +0 °C *
1.6 mm - 2.5 mm	260 +0 °C *	250 +0 °C *	245 +0 °C *
≥2.5 mm	250 +0 °C *	245 +0 °C *	245 +0 °C *

* Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0 °C. For example 260 °C+0°C) at the rated MSL level.

Note 1: The profiling tolerance is + 0 °C, -X °C (based on machine variation capability) whatever is required to control the profile process but at no time will it exceed - 5 °C. The producer assures process compatibility at the peak reflow profile temperatures defined in Table 4.2.

Note 2: Package volume excludes external terminals (balls, bumps, lands, leads) and/or nonintegral heat sinks.

Note 3: The maximum component temperature reached during reflow depends on package thickness and volume. The use of convection reflow processes reduces the thermal gradients between packages. However, thermal gradients due to differences in thermal mass of SMD packages may still exist.

Note 4: Components intended for use in a "lead-free" assembly process **shall** be evaluated using the "lead free" classification temperatures and profiles defined in Tables 4-1, 4.2 and 5-2 whether or not lead free.

8 Ordering Information

The DevCom 06 ZigBee Modules includes the following variants:

Product name	Order number	Develco item number
DevCom 06-SB ZigBee Module	DevCom06-SB	A0043Z0000

9　Contact Information

Technical support,
Sales & DevCom Registration :　　　　　Please contact Develco:

　　　　　　　　　　　　　　　　　　　　　Sales & Marketing
　　　　　　　　　　　　　　　　　　　　　Olof Palmes Allé 40
　　　　　　　　　　　　　　　　　　　　　8200 Aarhus N
　　　　　　　　　　　　　　　　　　　　　Denmark
　　　　　　　　　　　　　　　　　　　　　Tel. +45 87 400 300
　　　　　　　　　　　　　　　　　　　　　devcom@develco.com
　　　　　　　　　　　　　　　　　　　　　http://www.develco.com

10 About Develco A/S

Develco is an independent design house. It was founded in 1989, and most of our staff have an engineering background.

Develco's core competencies are in electronic engineering and embedded software. As we work in close partnerships in an extensive and highly competent network, we are able to handle very comprehensive projects. Our customers are primarily industrial operators who have their own product line. We provide complete solutions that turn our customers into leaders in their field.

Develco transfers knowledge across business lines. We work in several lines of business - Wireless, Automotive & Industrial. The synergy achieved by working with diverse companies in a broad spectrum of businesses benefits all of our customers.

Technological development is an area of high priority in Develco. We continuously strive to introduce new technologies and improve quality, doing our utmost to keep our customers on the leading edge.

Develco is a member of the ZigBee Alliance and is also a Freescale Alliance Partner. We have been developing ZigBee enabled products since January 2004, e.g. for home control, security and AMR systems, the first of which have already been brought into production.

Develco is ISO14001:2004 and ISO9001:2000 certified.