# Datasheet

## ZDB5202 Z-Wave Development Board

| | |
|---|---|
| **Document No.:** | DSH12436 |
| **Version:** | 5 |
| **Description:** | This datasheet is for the ZM5202 Z-Wave module based ZDB5202 Z-Wave development board. |
| **Written By:** | MVITHANAGE;MVO;MHANSEN;BBR |
| **Date:** | 2018-03-06 |
| **Reviewed By:** | OPP;CRASMUSSEN |
| **Restrictions:** | None |

**Approved by:**

| Date | CET | Initials | Name | Justification |
|---|---|---|---|---|
| 2018-03-06 | 09:26:06 | NTJ | Niels Thybo Johansen | |

## REVISION RECORD

| Doc. Rev | Date | By | Pages affected | Brief description of changes |
|---|---|---|---|---|
| 4 | 20160716 | MHansen | Section3.2<br>Appendix A | Updated External NVM to M25PE20<br>Updated Schematic with correct symbol for ZM5202 and M25PE20 |
| 3A | 20131122 | MVithanage | §3.14,<br>Figure 4.1 | Removed blueprint section<br>Removed caption |
| 2C | 20130912 | MVithanage | §4 | Removed reference to schematic |
| 1B | 20130603 | MVO | §All | Fixed header and footer |
| 1A | 20130530 | MVithanage | §All | Initial draft |
| 2 | 20180306 | BBR | All | Added Silicon Labs template |

# Table of Contents



# Table of Figures



# Table of Tables

# 1 ABBREVIATIONS

| Abbreviation | Explanation |
|---|---|
| NVM | Non-Volatile Memory |
| SMA | Sub-Miniature A |
| HW | Hardware |
| SW | Software |
| API | Application Programming Interface |
| ZDB | Z-Wave Development Board |
| PCB | Printed Circuit Board |

# 2 INTRODUCTION

## 2.1 Purpose

The purpose of this datasheet is to describe the ZDB5202 Z-Wave Development Board, which contains the ZM5202 Z-Wave Module, external NVM (Flash), a push-button, HW interface protection circuitry, antenna matching circuitry, PCB antenna and a SMA connector for whip antenna mounting. The ZDB5202 has the same physical form factor as the ZM3102 based ZM3120C Z Wave Module, and the ZM4102 based ZM4120C, which enables easy migration to the new 500 series platform.

## 2.2 Audience and prerequisites

OEM customers that are using any of the 20cm$^2$ form factor Z-Wave Modules from previous generations, and who want to migrate from their existing platform to the new 500 series platform.

# 3 ZDB5202 Z-WAVE DEVELOPMENT BOARD

The ZDB5202 Z-Wave Development Board (ZDB) contains a ZM5202 Z-Wave Module, external NVM (Flash), a push-button, HW Interface protection circuitry, ADC input selection circuitry, antenna matching circuitry, PCB antenna and a SMA connector for whip antenna mounting. OEM customers who are currently using the ZM1220, ZM2120C, ZM3120C, or ZM4120C Z-Wave Module, and want to migrate to the ZM5202 Z-Wave Module, can use the ZDB5202. The block diagram of the ZDB5202 is shown in Figure 3.1.

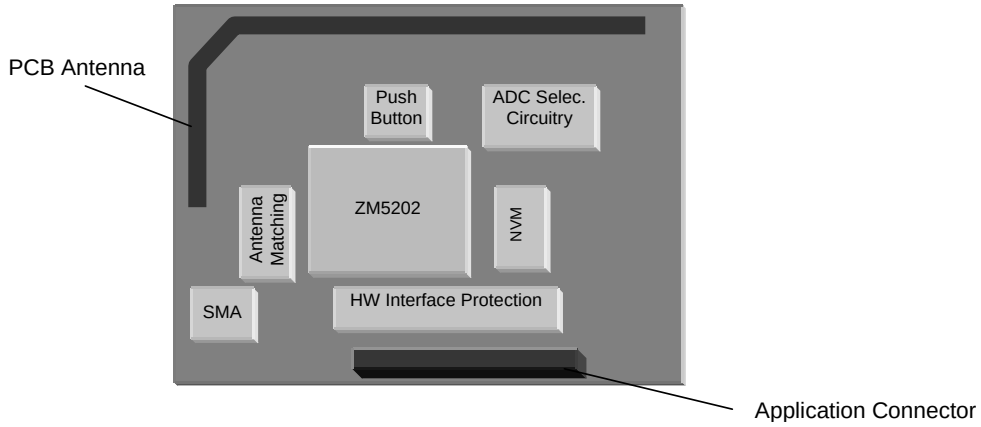



**Figure 3.1** ZDB5202 Z-Wave Development Board

## 3.1 HW Specifications

### 3.1.1 Application Connector Specification

The Application Connector (J1 in Appendix A) interfacing the ZDB5202 with the Application Module is a 2x10 2mm pitch pin row. The Application Connector signal names are shown in Table 3.1.

**Table 3.1: ZDB5202 Application Connector Layout**

| Pin No. | Pin Name | Pin Name | Pin No. |
|---|---|---|---|
| 1 | NC | NC | 2 |
| 3 | P3.7 / ADC3 / ZEROX | P1.0 / INT0 / PWM | 4 |
| 5 | P3.6 / ADC2 / TRIAC | GPIO 1.1 / INT1 | 6 |
| 7 | AD1_C[2] (ADC1 or ADC3) | P0.4 | 8 |
| 9 | NC | P2.3 / SPI1 MISO / SPI ISP | 10 |
| 11 | VCC | P2.4 / SPI1 SCK / SPI ISP | 12 |
| 13 | GND | P2.2 / SPI1 MOSI / SPI ISP | 14 |
| 15 | RESET_N | P3.5 / ADC1 / UART0 TX | 16 |
| 17 | +3.3V | P3.4 / ADC0 / UART0 RX | 18 |
| 19 | NC | AD2_C[3] (ADC0) | 20 |

1. Resistors R8, R11, and R14 can select ADC1 or ADC3. By default, none of them are mounted.
2. Pin 20 is per default not connected to the RXD/ADC0 signal.

**Table 3.2: Application Connector Signal Descriptions**

| Name | Pin# | I/O | Description |
|---|---|---|---|
| +3.3V | 17 | Power | Module 3.3V supply input voltage. |
| VCC | 11 | Power | Supply input voltage to the Low-Drop Out (LDO) regulator. |
| ADC[3:0] | 18, 20,<br>7, 16,<br>5,<br>3, 7, | I | Analog-to-Digital Converter input. The ADC is 12/8 bit and can use +3.3V, an internal or an external voltage as reference.<br>ADC0: input<br>ADC1: input<br>ADC2: input or lower reference voltage<br>ADC3: input or higher reference voltage<br>See section 3.3 for further description. |
| GND | 13 | Power | Ground signal |
| INT[1:0] | 6, 4 | I | Interrupt: The signals can be either level or edge trigged. When in power down mode, the ZDB5202's MCU can be woken up by asserting INT1 (level trigged only). |
| P0.4,<br>P[1.0-1.1],<br>P[2.2-2.4],<br>P[3.4-3.7] | 8,<br>4, 6,<br>14, 10, 12,<br>18, 16, 5, 3 | I/O | In/Out: General purpose I/O signal. |
| MISO[1] | 10 | I/O | Master-In-Slave-Out SPI interface: output in slave mode operation and input in master mode operation. |
| MOSI[1] | 14 | I/O | Master Out Slave In SPI interface: input in slave mode operation and output in master mode operation. |
| PWM | 4 | O | Pulse Width Modulator Output: Used for frequency variation applications. |
| RESET_N | 15 | I | Reset: Active low reset with integrated Power-On-Reset and Brown-out detection circuitry. |
| RXD | 18 | I | UART Receive Data: Supports up to 230.4kbps. |
| SCK[1] | 12 | I/O | SPI Clock: Can be used as either master SPI clock output or slave SPI clock input. |
| TRIAC | 5 | O | TRIAC Control: A Dimmer implemented on the ZM5202 Z-Wave Module can control a TRIAC on the Application Module like light dimmer modules etc. |
| TXD | 16 | O | UART Transmit Data: Supports up to 230.4kbps. |
| ZEROX | 3 | I | Zero Cross Detection: Used on Dimmer modules for detecting 120/240V zero crossing. |

1. Please note that the SPI interface (MISO, MOSI and SCK) is not available for the Application SW in some Z-Wave protocol API's, see [2].

All signals in Table 3.2 except VCC, +3.3V, and GND are connected through a 1kohm resistor to the corresponding signals on the ZM5202 Z-Wave Module (U1 in Appendix A). A detailed description of these signals is given in the ZM5202 Z-Wave Module datasheet [1].

### 3.2 SPI Interface

The SPI interface is in some SW API's used by the protocol to store routing tables etc in an external NVM (Flash). When these SW API's are used, the Application SW must *not* use the SPI interface. Table 3.3 lists the available SW API's and shows in which the SPI can be used by the Application SW.

**Table 3.3** SW API / SPI availability

| SW API | External NVM used by Protocol API |
|---|---|
| Slave | No |
| Routing Slave | No |
| Enhanced Slave | Yes |
| Controller | Yes |
| Static Controller | Yes |
| Installer | Yes |
| Bridge | Yes |

The SPI interface is used to access the external NVM and the P0.4 signal (J1 pin 8) is used by the Z-Wave Protocol as external NVM Chip Select. If the external NVM is used by the protocol the signal P0.4 may not be used by the application SW and may not be connected to other circuitry through J1 pin 8 on the Application Module. To assure proper control of the external NVM chip select signal during reset and power-up, a pull up resistor on the P0.4 is implemented as shown in Figure 3.2.

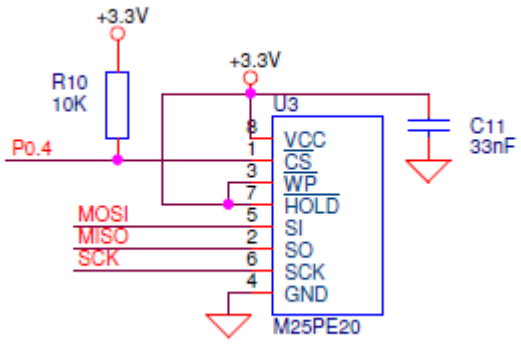



**Figure 3.2** External NVM mounted on ZDB5202

Only a part of the external NVM is used for protocol data storage. The Application SW can use the remaining memory area using an API call (see [2]). The external NVM memory area requirements of the different protocol API's are described in [2].

### 3.3 ADC

The two ADC pins 'AD1_C' and AD2_C' on the Application connector (J1) can be used to access all four ADC inputs on the ZDB5202. Different resistor mounting configurations can be used as described in Table 3.4.

**Table 3.4 ADC input selection**

| Application Connector Signal | Reference Designator | ADC input |
|---|---|---|
| AD1_C | Mount R8 and R11 | ADC1 |
| | Mount R8 and R14 | ADC3 |
| AD2_C | Unmount R6 and mount R19 | ADC0 |
| ZEROX | Mount L4 and R1 | ADC3 |
| TRIAC | Mount L5 and R2 | ADC2 |

### 3.4 Power

The ZDB5202 has a mounting option for a Low-Drop-Out (LDO) voltage regulator, which can be mounted when having supply voltages greater than 3.3V on the Application Module.

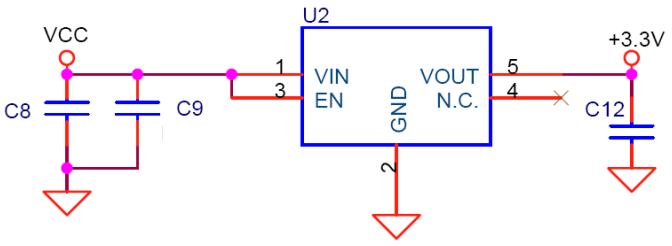



**Figure 3.3** LDO DC/DC Converter Schematic

**Table 3.5** LDO DC/DC Converter Components

| Reference Designator | Description | Vendor / Vendor P/N |
|---|---|---|
| U2 | Vreg, 3.3V, LDO 200mV, 150mA, SO23-5 | Analogic Tech: AAT3221IGV-3.3-T1 |
| C8 | Cap. Cer., 20%, 0603, 4.7uF, Y5V/Z5U, 10V | Any according to spec |
| C12 | Cap. Cer., 20%, 0402, 33nF, X7R, 50V | Any according to spec |
| C9 | Cap. Cer., 20%, 0402, 33nF, X7R, 50V | Any according to spec |
| L1* | Induct., Ferrite Bead, 0805, 330R@100MHz | Murata: BLM21AG331SN1D |

* Ferrite bead connects the pin 11 (VCC) on the Application Connector to the Voltage Regulator

The voltage regulator specified in the table above have a drop out of 200mV meaning that the voltage supplied by the Application Module must be greater than +3.5V. The supply voltage from the Application Module must then be supplied to the ZDB5202 via Application connector pin 11 (VCC) and the passive components listed in Table 3.5 must be mounted (see Figure 3.3).

When implementing the ZDB5202 together with noisy power electronics such as light dimmer products, motor control products etc. it is recommended to use the LDO regulator as it is a cheap way to attenuate

noise from the Application Module power supply. The Analogic Tech voltage regulator listed in the table above has a typical Power Supply Rejection Ratio of 50dB at 100Hz. Other footprint compatible voltage regulators can also be used.

The minimum supply voltage for the ZDB5202 depends on whether the external NVM is mounted and what type of external NVM is mounted, as listed in Table 3.6. The ZDB5202 has been mounted with a Micron 2Mbit SPI based external Flash, although an Atmel 128kbit SPI based external EEPROM can also be used.

**Table 3.6** Minimum Supply Voltage

| External NVM | Minimum Supply Voltage |
|---|---|
| Not Mounted | 2.3V |
| M25PE10-VMN6P | 2.7V |
| AT25xxxxN-10Sx-2.7 | 2.7V |
| AT25xxxxN-10Sx-1-8 | 2.3V |

### 3.5 EMC

As default, a 1000R@100MHz Ferrite Bead is mounted between the Application Connector +3.3V and module +3.3V (L2 in Appendix A) to reduce noise from the Application Circuitry.

As default 1000R@100MHz Ferrite Beads are mounted in series with the TRIAC signal and the ZEROX signal (L4 and L5) to reduce the noise from noisy TRIAC circuitry. Two zero ohm resistors can be mounted instead in applications where TRIAC and ZEROX is not used for power electronic control.

### 3.6 Antenna

In order to implement the ZDB5202 in various products, different types of antennas can be implemented to get the best RF performance, i.e. range and reliability. The ZDB5202 is equipped with a PCB antenna and a SMA connector for Whip antenna mounting.

**Table 3.7** PCB/Whip Antenna component mount

| Antenna | E | U | H |
|---|---|---|---|
| PCB | R4: NM<br>R12: 5.6pF<br>C4: 0ohm<br>C6: 3.6nH<br>C7: NM | R4: NM<br>R12: 3.3pF<br>C4: 0ohm<br>C6: 3.9nH<br>C7: NM | R4: NM<br>R12: 3.3pF<br>C4: 0ohm<br>C6: 3.9nH<br>C7: NM |
| Whip (SMA) | R4: 10nH<br>R12: NM<br>C4: 0ohm<br>C6: 3.3pF<br>C7: NM | R4: 10nH<br>R12: NM<br>C4: 0ohm<br>C6: 3.3pF<br>C7: NM | R4: 10nH<br>R12: NM<br>C4: 0ohm<br>C6: 3.3pF<br>C7: NM |

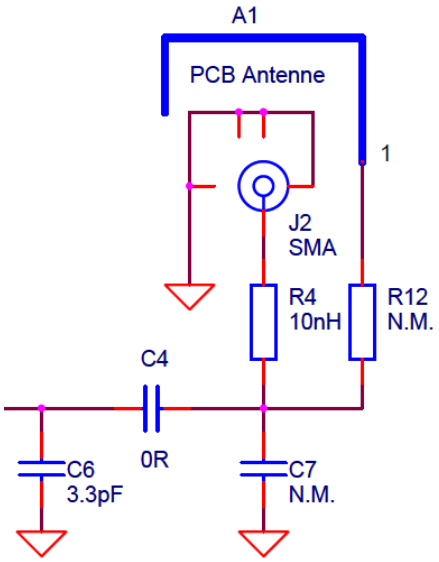



**Figure 3.4:** ZDB5202 PCB Antenna and SMA Connector

Please note that the antenna matching components listed in Table 3.7 are found and verified when the ZBD5202 is mounted on the ZDP03A Z-Wave Development Platform. If the ZDB5202 is used in another application it may be necessary to design a new matching circuit for best RF performance.

Three versions of the ZDB5202 are currently available: E/U/H with Whip antenna. Please refer to [4], [5], and [6].

A description of relevant antenna types for short range devices are given in [3].

### 3.7 Z-Wave Module Programming

The ZDB5202 is programmed using the SPI interface and the RESET_N signal. For programming instruction and recommended programming tool(s) see [1] and [2].

### 3.8 ZM5202 Z-Wave Module Specification

**Table 3.8** ZM5202 Z-Wave Module Specification

| Item | Description |
|---|---|
| MCU Type | Optimized 8-bit 8051 MCU core. |
| MCU speed | 32 MHz (integrated clock divider, 32MHz external crystal) |
| Flash | 128kByte Programmed through the SPI interface. |
| SRAM | 16kByte |
| SRAM (CPU) | 256Byte |
| MCU Peripherals | 12/8-bit ADC, UART, SPI, 3x16 bit timers one with PWM mode, Watch Dog Timer, Wake Up Timer, Power-on Reset/Brown-Out Detector. |
| Interrupt sources | Internal and external. |
| Crystal | System Clock: 32 MHz, ±10ppm@25°C, ±10ppm@-15°C to +85°C, 3ppm aging per 5 years.<br>Alternative: 32 MHz, ±8ppm@25°C, ±8ppm@-15°C to +85°C, 3ppm aging per year. |

### 3.9 RF Specification

**Table 3.9:** RF Specifications

| RF Parameter[1] | Description |
|---|---|
| RF Data Rate | 9.6 kbps<br>40 kbps<br>100 kbps |
| Typical RF receiver sensitivity | -103.0dBm @ 9.6 kbps<br>-99.0dBm @ 40 kbps<br>-91.8dBm @ 100 kbps |
| Typical RF Output Power | -26.3dBm to +2.0dBm |
| Typical Range | Indoor > 40 meters line of sight, in unobstructed environment<br>Outdoor > 100 meters line of sight |
| RF Input/Output Impedance | 50ohm @ respective E/U/H frequencies |
| RF regulatory | ACMA Compliance<br>CE Compliance<br>FCC Compliance<br>IC Compliance<br>MIC Compliance |

1. Test Conditions: ZDB5202 with quarter wavelength monopole whip antenna mounted on ZDP03A Z-Wave Development Platform.

### 3.10 Electrical Specification

The “Absolute Maximum Ratings” specifies the conditions in which the ZDB5202 is guaranteed not to be damaged, but correct operations are not guaranteed. Exceeding the “Absolute Maximum Ratings” may destroy the ZDB5202. See “DC Characteristics” for guaranteed operation limits.

### 3.10.1 Absolute Maximum Ratings

**Table 3.10:** Absolute Maximum Ratings

| Electrical | Value |
|---|---|
| Operating Temperature | -10°C to +85°C |
| Main Supply Voltage | -0.3V to +3.6V |
| Minimum Voltage Applied On Any I/O | -0.3V |
| Maximum Voltage Applied On Any I/O | +3.6V |

### 3.10.2 DC Characteristics

The following DC characteristics are for the ZDB5202 at an Ambient Temperature = 25°C and Supply Voltage = 3.3V (unless otherwise noted).

**Table 3.11** DC Characteristics

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| +3.3V | Main Supply voltage (1) | | 2.3 | 3.3 | 3.6 | V |
| $R_{AC}$ | Application Connector Serial Resistor | All signals | 0.9 | 1.0 | 1.1 | KΩ |
| $I_C$ (2) | Continuous Output Current | One GPIO | -8.0 | | +8.0 | mA |
| $I_C$ (2) | Continuous Output Current | One GPIO *(P3.4 to P3.7)* | -16.0 | | +16.0 | mA |
| $I_{CTOT}$ (2) | Total continuous output source/sink current | All GPIO | -120.0 | | +120.0 | mA |
| $I_{CC}$ | Transmitting (3) | Pout = 0dBm (Setting: 32)<br>Pout = +2dBm (Setting: 63) | | 36.0<br>41.0 | | mA |
| | Receiving (4) | | | 32.0 | | mA |
| | Power Down (5) | | | 2.0 | | µA |
| $T_{OP}$ | Operating Temperature | | -10.0 | | +85.0 | °C |

(1) Minimum supply voltage depends on external NVM selection if mounted. See Table 3.6.
(2) If serial 1K ohm resistor is replaced with 0 ohm resistor.
(3) The transceiver is in transmit mode with the MCU running. The ADC is off. The crystal is 32MHz.
(4) The transceiver is in receive mode with the MCU running. The ADC is off. The crystal is 32MHz.
(5) The ADC, transceiver, MCU and flash are shut down. The chip can be woken by brownout, an external reset pulse, external interrupt (if enabled) or periodical wakeup by WUT (if enabled). POR cannot be disabled. External NVM standby current added to ZDB5202 power down current.

## 3.11 Physical Specification

**Table 3.12** Physical Specifications

| Physical | Description |
|---|---|
| Dimension (H x W x D) | 8 mm x 50 mm x 40 mm |

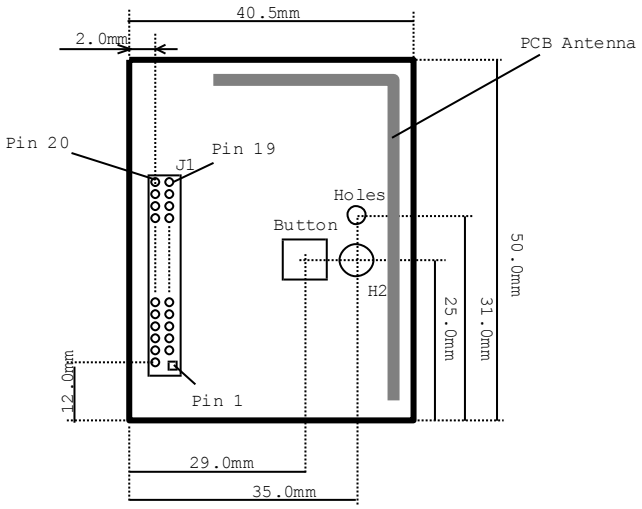



**Figure 3.5** ZDB5202 PCB outline

The Application Connector is a standard 2mm pitch 2x10 pin-row. The pin hole is a Ø0.9mm plated hole. When implementing the ZDB5202 in a product together with an Application Module any metallic objects must be minimum 10mm from the PCB antenna.

### 3.12 Z-Wave Module Component Placement

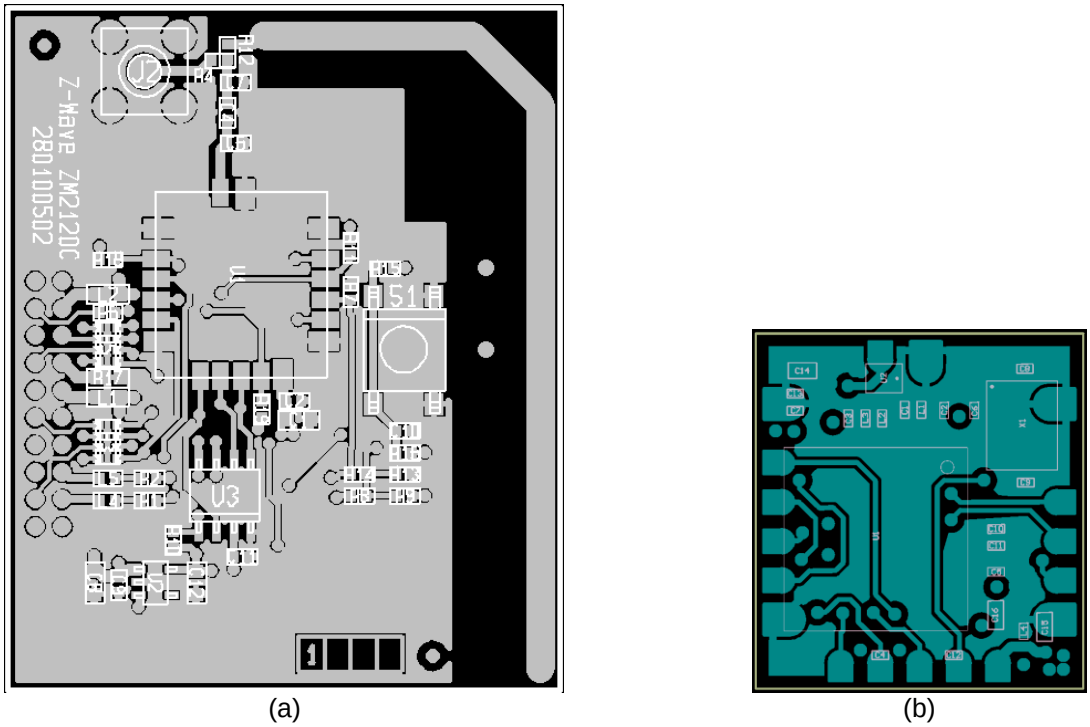



**Figure 3.6** (a): ZDB5202 Component Placement
(b) ZM5202 Z-Wave Module with Pads and Component Placement

The ZM5202 Z-Wave Module footprint on the ZDB5202 contains 19 pads including the discontinued high voltage pad used for programming. The ZM5202 Z-Wave Module is Flash based and hence do not require a high voltage during programming. It contains only 18 pads as shown in Figure 3.6b. The

ZM5202 Z-Wave Modules pads 16, 17, 18 will be connected to the pads 17, 18, 19 on the ZDB5202. The signals used for interconnection between ZDB5202 and ZM5202 Z-Wave Module are shown in the schematic in Appendix A.

### 3.13 Module Naming

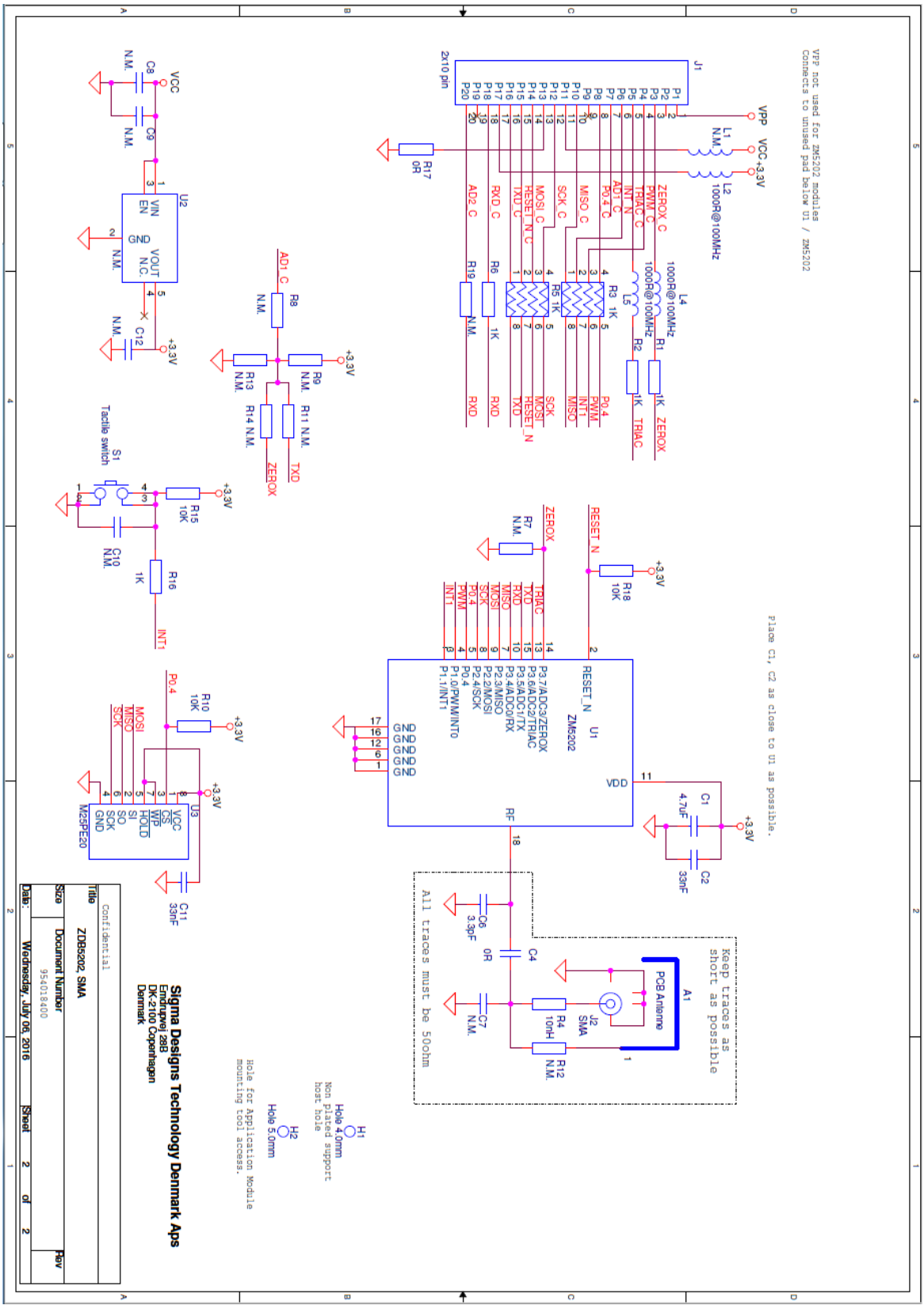
The following naming convention is used by Silicon Labs:

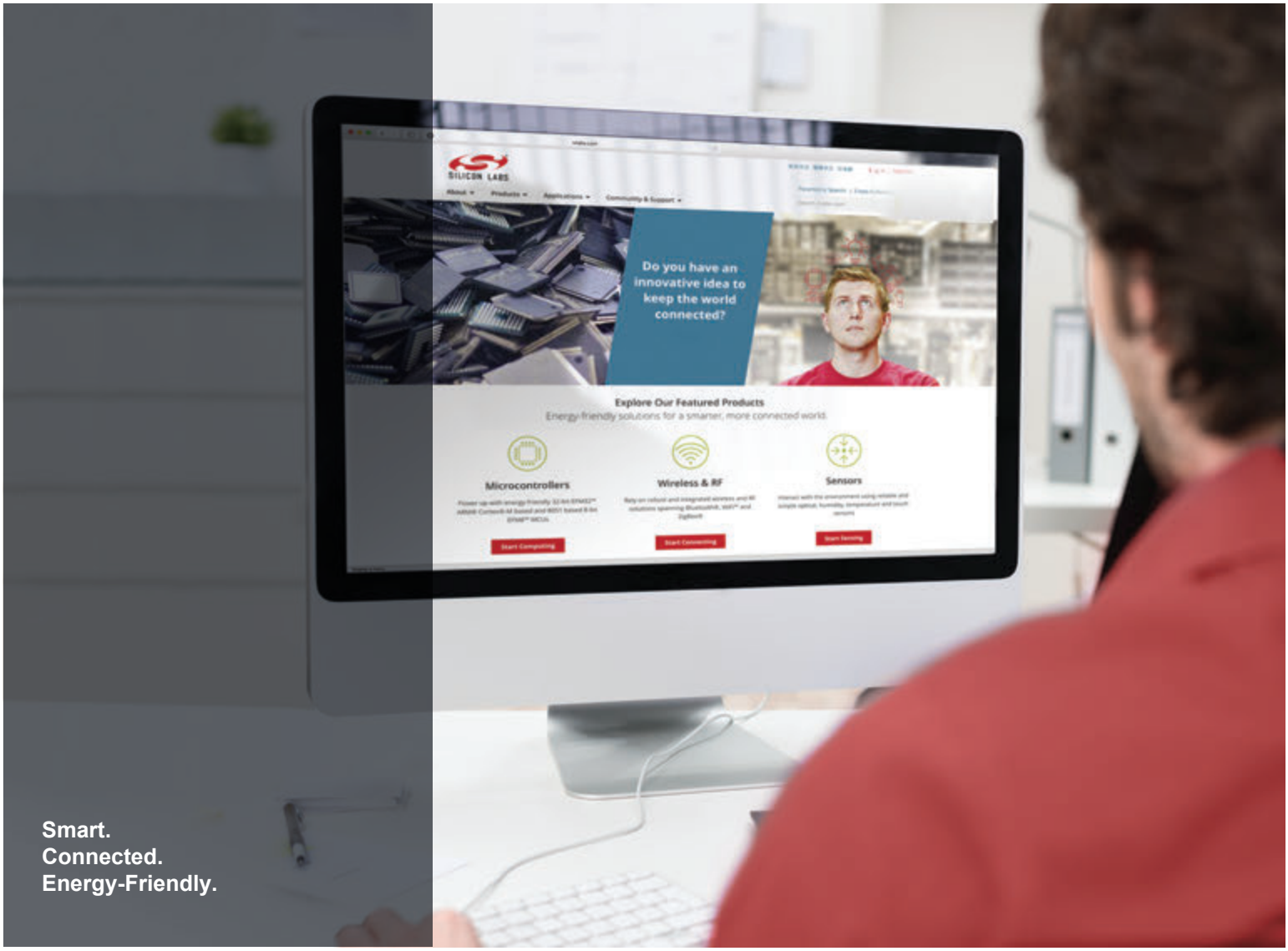
| Z-Wave Module | Z-Wave Development Board |
|---|---|
| ZMGVSS<br>ZM – Z-Wave Module<br>G – Z-Wave Generation<br>V – Module Variant<br>SS – Size in $cm^2$<br><br>e.g.: ZM5202 | ZDBGVSS<br>ZDB – Z-Wave Development Board<br>Mounted Module:<br>G – Z-Wave Generation<br>V – Module Variant<br>SS – Size in $cm^2$<br><br>e.g.: ZDB5202 |

# 4 REFERENCES

[1] Silicon Labs, DSH12435, Datasheet, ZM5202 Z-Wave Module
[2] Silicon Labs, INS11681, Instruction, 500 Series Z-Wave Chip Programming Mode
[3] Silicon Labs, APL10045, Application Note, Antennas for Short Range Devices
[4] Silicon Labs, BOM12396, Bill of Material, ZDB5202 EU, SMA, BOM-370101640
[5] Silicon Labs, BOM12474, Bill of Material, ZDB5202 US, SMA, BOM-370101890
[6] Silicon Labs, BOM12475, Bill of Material, ZDB5202 HK, SMA, BOM-370101900

# APPENDIX A SCHEMATIC






**Products**
*www.silabs.com/products*

**Quality**
*www.silabs.com/quality*

**Support and Community**
*community.silabs.com*



SILICON LABS®

**Silicon Laboratories Inc.**
**400 West Cesar Chavez**
**Austin, TX 78701**
**USA**

**http://www.silabs.com**

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Silicon Laboratories:

ACC-ZDB5202-H2 ACC-ZDB5202-U2 ACC-ZDB5202-E2