Radio Z DataSheet

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L-ZM2102

Preliminary Datasheet

Datasheet

L-ZM2102 Z-Wave Module Datasheet

REVISION RECORD

Doc. Rev	Date	By	Pages affected	Brief description of changes
01.00	20050412	TJO	ALL	First release
01.01	20050718	TJO		Table 4: SAW filter insertion note inserted Table 5: Min temp extended from -15¡C to -30¡C Table 6: footnote 2 added Chapter 2.7 inserted: Reflow profile Table 7: module weight inserted Chapter 3.1: wording changed

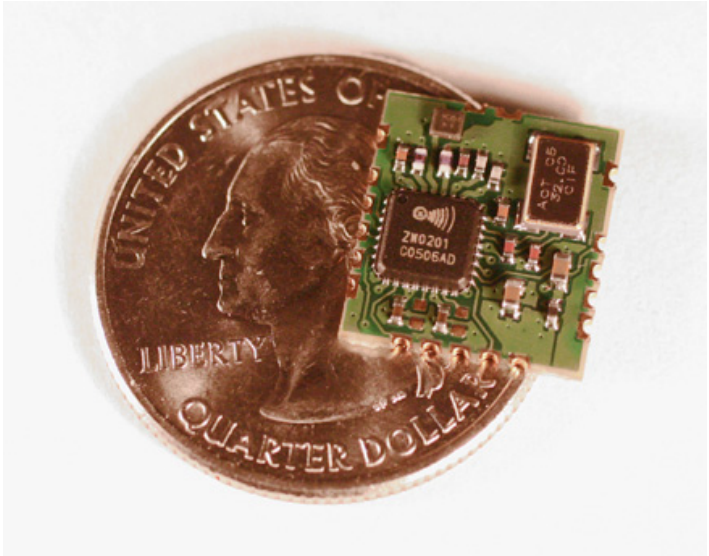
L-ZM2102

Preliminary Datasheet

Integrated Z-Wave RF Module

The L-ZM2102 Z-Wave Module is a fully integrated RF communication module that uses the unlicensed Short-Range-Device (SRD) frequency band of 868.42MHz in Europe and 908.42MHz in US. The L-ZM2102 is dedicated for wireless control and monitoring of residential products like lighting and appliance control, energy management, access control, security and building automation.

Together with the patented Z-Wave Protocol the L-ZM2102 Z-Wave Module delivers a complete highly reliable RF communication solution. The Z-Wave Protocol uses Frame Acknowledgement, Retransmission, Collision Avoidance, Frame Checksum Check and sophisticated Routing to assure reliable full home coverage.



The L-ZM2102 Z-Wave Module contains the integrated ZW0201 Z-Wave Single Chip, system crystal and RF front-end circuitry. The ZW0201 Single Chip is an integrated chip containing RF Transceiver, 8051 MCU core, SRAM, Flash Memory for Z-Wave Protocol and OEM Application software storage, Triac Controller and a wide range of HW interfaces.

This complete RF solution makes it very easy for OEM customers to RF enable their products without having to do the time consuming work of designing, verifying and optimizing the RF design and thereby enables faster time to marked.

Features

APPENDIX A.1 Interfaces

- 10 General Purpose I/O's
- Two Interrupt Inputs
- Serial UART
- SPI Interface
- Triac Control Interface
- PWM Output
- Four multiplexed 12/8 bit ADC inputs

APPENDIX A.2

APPENDIX A.3 ZW0201 Single Chip

- Optimized 8051 CPU Core
- 32kbyte Flash
- 2kbyte SRAM
- Power-On-Reset / Brown-Out Detection
- Supply Voltage: 2.1V-3.6V
- Power Consumption
    - o TX@-5dBm = 23mA
    - o TX@+3dBm = 39mA
    - o RX = 21mA
    - o Power down/sleep mode = 2.5µA

APPENDIX A.4 RF

- Freq: 908.42MHz (US) / 868.42MHz (EU)
- High Sensitivity (-101dBm)
- FSK Modulation
- 9.6kbit/s Data Rate
- -20dBm to +3dBm Output power (ZW0201)
- Complies with EN 300 220 and FCC CFR47 part 15

APPENDIX A.5 Applications

- Home Automation
    - o Lighting/Drape Control
    - o Automated Meter Reading
    - o Access Control
    - o HVAC
    - o Universal Remote Controls

Table of Contents

Compliance Statement

FCC Class B Part 15

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.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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.

If the FCC ID for the module is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following:

Contains FCC ID: TOB-LZM2102

1 PRODUCT DESCRIPTION

1.1 Overview

The L-ZM2102 Z-Wave Module is a fully integrated module containing all the HW and SW required to Z-Wave enable OEM products. The L-ZM2102 Z-Wave Module contains the Z-Wave ZW0201 Single Chip, System Crystal, RF Front-end and RF Supply Voltage Filtering. Only the antenna needs to be implemented by the developer designing the Z-Wave enabled product.

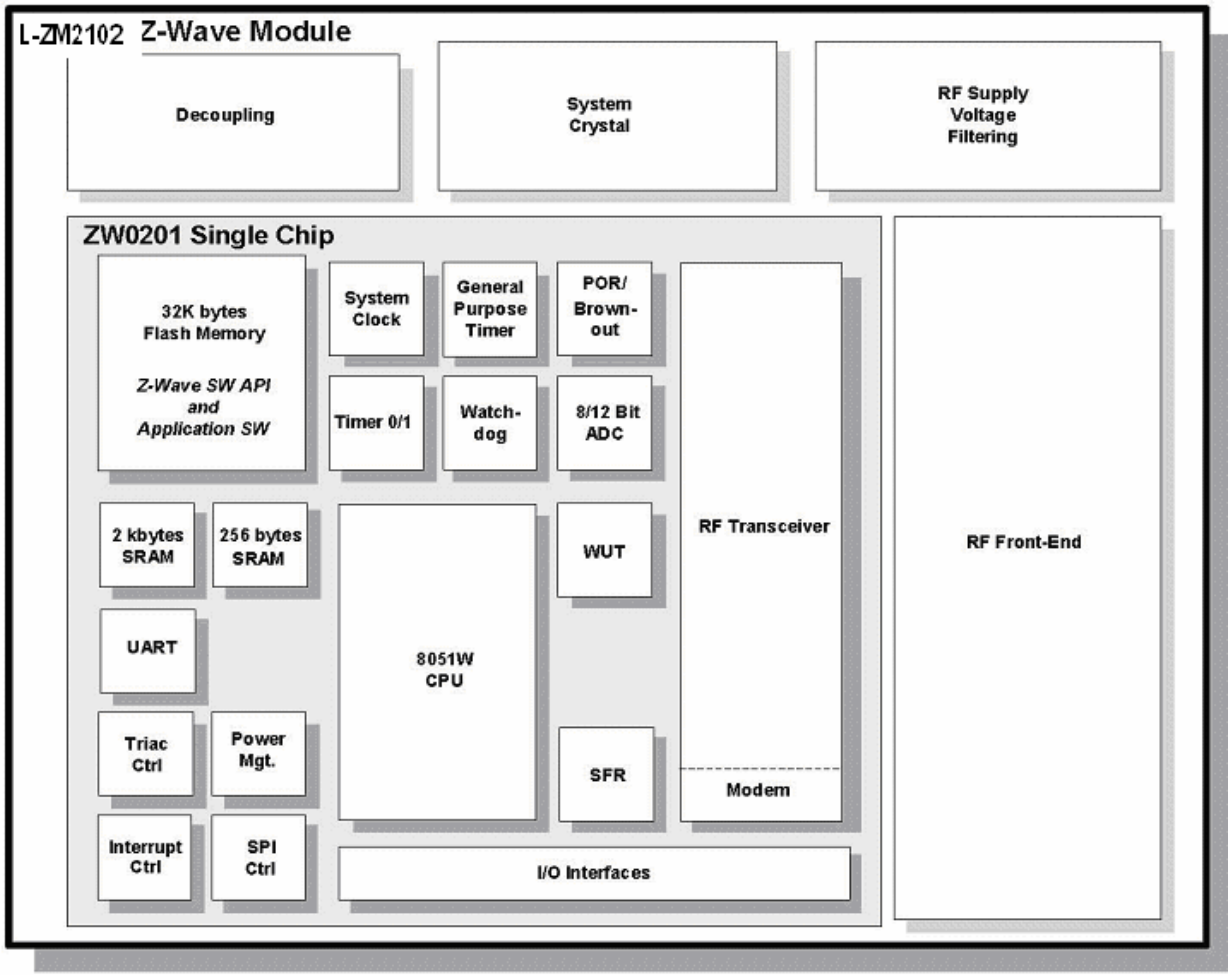


Figure 1 **ZM2102 Z-Wave Module Block Diagram**

The L-ZM2102 Z-Wave Module contains a system crystal, why no external crystal is needed. In order to get a high reliable and high performance RF communication, the RF Front-end has an optimized and throughout tested matching circuitry, a narrow band SAW filter dedicated for Z-Wave communication and there are filtering of the RF circuitry supply voltage. The L-ZM2102 Z-Wave Module is connector-

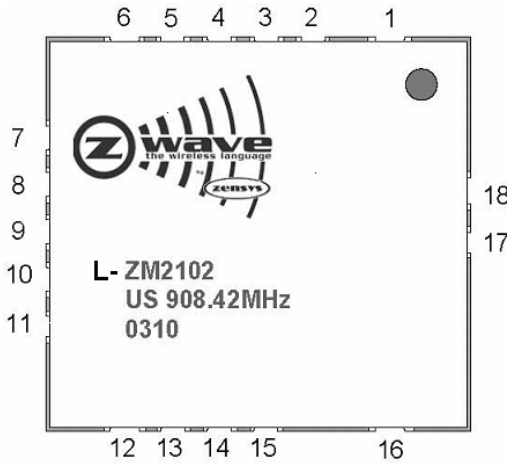
less using Castellation Notches for easy mounting of the module to an OEM Application PCB.

The L-ZM2102 Z-Wave Module has a top shield that improves noise immunity of the module and enables the module to be mounted by a standard pick-and-place machine on the production line.

The Z-Wave Protocol is designed to enable automatic network address assignment at installation, and simple inclusion/exclusion of nodes. These protocol-handling techniques ensure easy installation, expansion, and management of the Z-Wave control network. Furthermore each Z-Wave network has its own unique Network Identifier preventing control problems or interference from neighboring networks.

The Z-Wave Protocol has a well-defined Application-Programming-Interface (API) enabling easy and fast Application SW development.

1.2 Signal Description



Notch #	Signal Name
1	GND
2	RESET_N
3	P1.7 / INT1
4	P1.6 / PWM / INT0
5	P1.5
6	GND
7	P1.2 / MISO[1]
8	P1.4 / SCK[1]
9	P1.3 / MOSI[1]
10	P1.1 / ADC3 / RXD
11	VCC
12	GND
13	P0.1 /

	ADC1 / TRIAC
14	P0.0 / ADC0 / ZEROX
15	P1.0 / ADC2 / TXD
16	GND
17	GND
18	RF in/out

Figure 2 L-ZM2102 Outline and Signals

Name	Notch #	I/O	Description
ADC[3:0]	10, 13, 14, 15	I	Analog-to-Digital Converter input. The ADC is 12/8 bit and can use either VCC or an internal/external voltage as reference. ADC3: input ADC2: input ADC1: input / lower reference ADC0: input / higher reference
GND	1, 6, 12, 16, 17	Power	Ground signal
INT[1:0]	3, 4	I/O	Interrupt: The signal can be either level or edge trigged. When in power down mode, the L-ZM2102 Z-Wave Module's MCU can be woken up by asserting the interrupt signal.
P[0.1-0.0], P[1.7-1.0]	3, 4, 5, 7, 8, 9, 10, 13, 14, 15	I/O	In/Out: General purpose I/O signal.
MISO[1]	7	I/O	Master-In-Slave-Out SPI interface: output in slave mode operation and input in master mode operation.
MOSI[1]	9	I/O	Master Out Slave In SPI interface: input in slave mode operation and output in master mode operation.
PWM	4	I/O	Pulse Width Modulator Output: Used for frequency variation applications.
RESET_N	2	I	Reset: Active low reset. The ZW0201 Single Chip has an integrated Power-On-Reset and Brown-out detection circuitry.
RF	18	I/O	RF Input/Output
RXD	10	I/O	UART Receive Data: Supports 9.6kbaud, 38.4kbaud, 115.2kbaud.
SCK[1]	8	I/O	SPI Clock: Can be used as either master SPI clock output or slave SPI clock input.
TRIAC	13	I/O	TRIAC Control: A triac controller is implemented in the ZW0201 Single Chip that can controls a triac on the Application Module like light dimmer modules etc.

TXD	15	I/O	UART Transmit Data: Supports 9.6kbaud, 38.4kbaud, 115.2kbaud.
VCC	11	Power	L-ZM2102 supply voltage.
ZEROX	14	I/O	Zero Cross Detection: Zero cross detection signal used on dimmer modules 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 [3].

Table 1 **L-ZM2102 Signal Description**

All signals in Table 1 except RF, VCC and GND are connected directly to the corresponding signals on the ZW0201 Z-Wave Single Chip on the L-ZM2102 Z-Wave Module. A detailed description of these signals is given in the ZW0201 Z-Wave Single Chip datasheet [1].

1.3 RF Front-End

1.3.1 RF input/output

The L-ZM2102 Z-Wave Module is equipped with a SAW filter that rejects the unwanted frequencies both in receive and transmit operations.

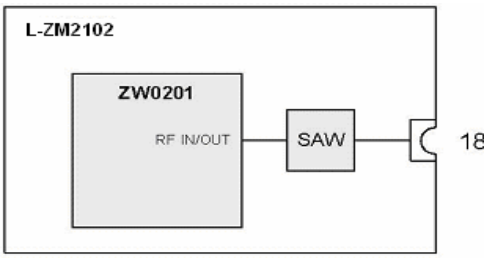


Figure 3 L-ZM2102 RF Front-end Circuitry

The RF input/output on the ZW0201 is a single ended input/output that is internally matched to 50 ohm.

1.3.2 Antenna Matching

The L-ZM2102 Z-Wave Module is using an antenna placed on the Application Module, the matching of the external antenna to 50 ohm (SAW filter impedance) must be made on the Application Module.

As the L-ZM2102 Z-Wave Module is integrated into various products, different types of antennas can be implemented to get the best RF performance, i.e. range and reliability. In [4], a good overview of the different antennas is given as well as their pro's and con's. In the case the antenna is not 50ohm a matching network must be implemented between the L-ZM2102 Z-Wave Module and the antenna. The matching network can for example be a "pi" or a "T" structure as shown in Figure 4.

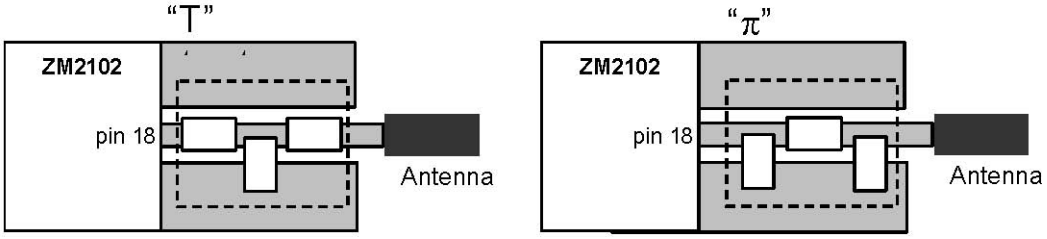


Figure 4 **"π" ant "T" structure for the antenna-matching network**

1.4 Z-Wave Module Programming

The L-ZM2102 Z-Wave Module is programmed using the SPI interface and the RESET_N signal. For detailed programming instructions see [2] and recommended programming tool(s) see [3].

2 SPECIFICATIONS

2.1 ZW0201 Specification

MCU	**Description**
MCU Type	Optimized 8-bit 8051 MCU core.
MCU speed	16 MHz (integrated clock divider, external crystal frequency is 32MHz)
Flash	32kbyte. Programmed through the SPI interface.
SRAM	2kbyte
SRAM (CPU)	256byte
MCU Peripherals	12/8-bit ADC, UART, SPI, 2x16 bit timers one with PWM mode, Watch Dog Timer, Wake Up Timer, Power-on Reset/Brown-Out Detector.
Interrupt sources	Internal and external.

Table 2 **MCU Specifications**

2.2 ZW0201 Single Chip Peripherals

Peripherals	**Description**
Crystals	System Clock: 32MHz, ±10ppm@25¡C, ±14ppm@-15¡C to +85¡C, 3ppm aging per 5 years. Alternative: 32MHz, ±8ppm@25¡C, ±8ppm@-15¡C to +85¡C, 3ppm aging per year.
Optional Peripherals	EEPROM

Table 3 **External Peripherals**

2.3 RF Specification

RF	Description
RF Data rate	9.6 kbps
RF frequency (center frequency)	US: 908.42 MHz EU: 868.42 MHz
Modulation	Frequency Shift Keying (FSK)
Frequency deviation	Center frequency ± 25kHz
Signal coding	Manchester Encoded
RF filter	SAW Filter US: Center frequency = 908MHz, BW = 20MHz EU: Center frequency = 868MHz, BW = 20MHz
Typical RF receiver sensitivity	-101dBm (including SAW filter)
ZW0201 RF Output Power (RF transceiver output)	-20dBm to +3dBm Typical Saw filter insertion loss: 2.2dB
RF Input/Output Impedance	50ohm @ respective EU/US frequencies
Range (typical)	Indoor >30 meters line of sight, in unobstructed environment. Outdoor > 60 meters line of sight
RF regulatory	US: FCC Part 15 EU: R&TTE Directive 1999/5/EC, EN 300 220-3/2000

Table 4 **RF Specifications**

2.4 Electrical Specification

The “Absolute Maximum Ratings” specifies the conditions in which the L-ZM2102 Z-Wave Module is guaranteed not to be damaged but correct operations are not guaranteed. Exceeding the “Absolute Maximum Ratings” may destroy the L-ZM2102 Z-Wave Module. See “DC Characteristics” for guaranteed operation limits.

2.4.1 Absolute Maximum Ratings

Electrical	Value
Operating Temperature	-30¡C to +85¡C
Storage Temperature	-40¡C to +85¡C
Voltage on input pins	-0.3V to VCC+0.3V (5V max)
Minimum Operating Voltage (VCC)	-0.3V
Maximum Operating Voltage (VCC)	5V

Table 5 **Absolute Maximum Ratings**

2.4.2 DC Characteristics

The following DC characteristics are preliminary for the L-ZM2102 Z-Wave Module.

T_A = 25¡C, VCC = 3.3V (unless otherwise noted)

Symbol	Parameter	Condition	Min	Typ	Max	Units
VCC	Digital Supply Voltage		2.1	3.3	3.6	V
RRST[2]	Reset Pull-up Resistor	Integrated in ZW0201	10			MΩ
I_C	Continuous Output Current	One GPIO	-20		20	mA
I_{CTOT}	Total continuous output source/sink current	All GPIO's	-100		100	mA
I_{CC}	Transmitting (16MHz system clock)	-5dBm (transceiver output) +3dBm (transceiver output)		23 39		mA
	Receiving (16MHz system clock)	VCC = 3.3V		21		mA
	Power Down	WUT active (POR enabled[1])		2.5		µA
		WUT disabled (POR enabled[1])		2.5		µA
T_{OP}	Operating Temperature		-15		85	¡C
H_{OP}	Operating Relative Humidity		8		80	%

1. The POR cannot be disabled
2. The integrated Reset pull up is not for external circuitry. An external pull up resistor should be implemented.

Table 6 **DC Characteristics**

2.5 Physical Specification

Physical Specification	Description
Size	12.5mm. x 13.6mm. x 2.4mm (0.492" x 0.535" x 0.094")
Weight	7g (with shield)

	5g (without shield)
Castellation Notches	18

Table 7 Physical Specifications

2.6 Process Specification

Specification	Description
MSL-3	Moisture Level Verification tested according to JEDEC J-STD-020C
RoHS	Designed in compliance with The Restriction of Hazardous Substances Directive (RoHS)

Table 8 Process Specifications

2.7 Recommended PCB Footprint Outline

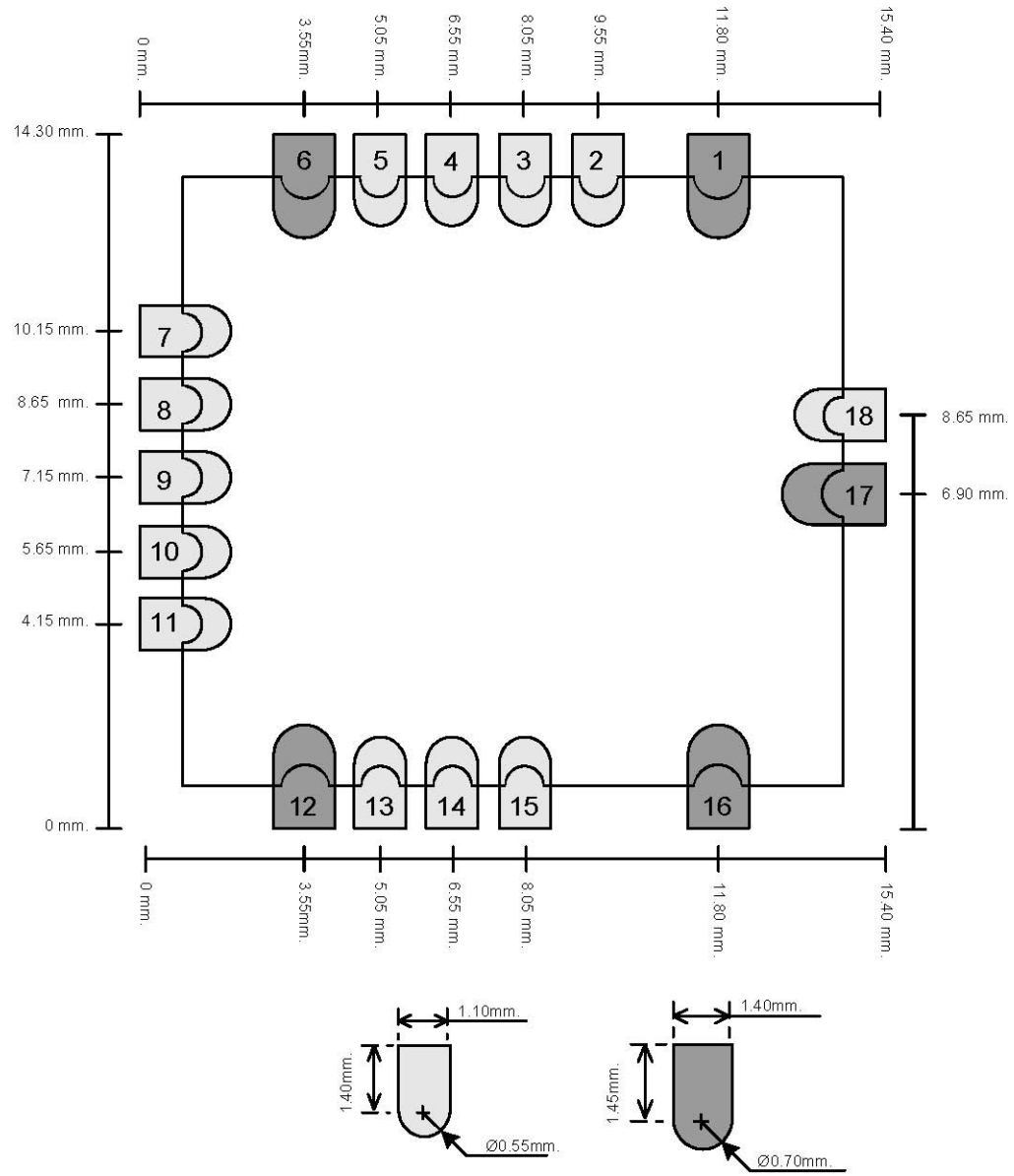


Figure 5 **Recommend L-ZM2102 PCB footprint Outline**

2.8 Recommended Reflow Profile

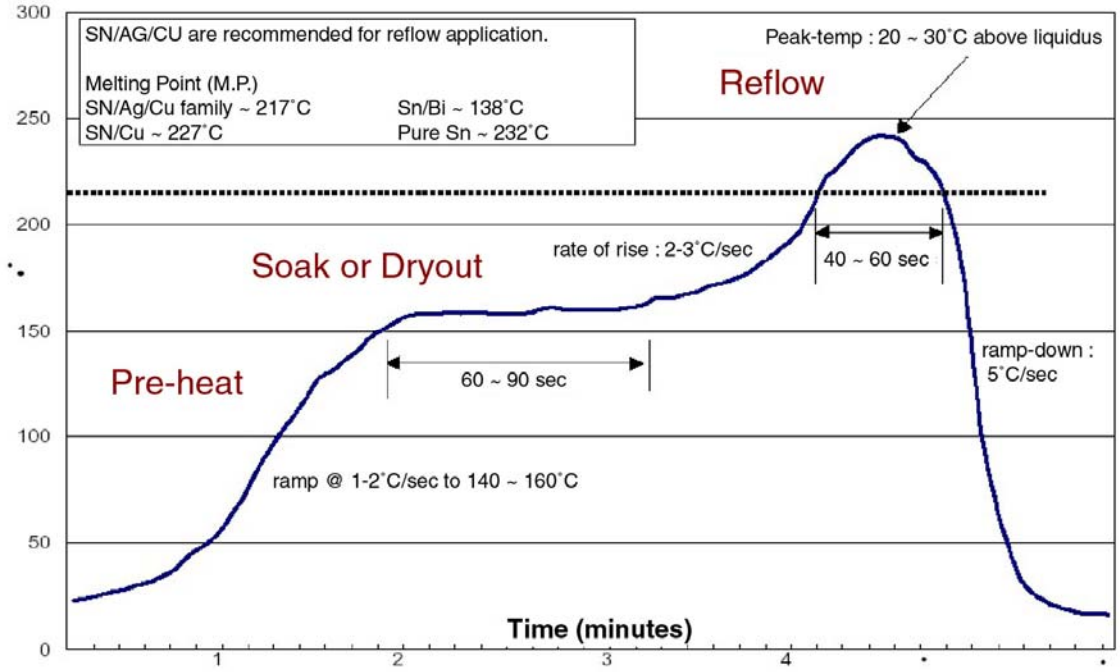


Figure 6 Recommended Reflow Temperature Profile

2.9 Application PCB Layout Recommendation

2.9.1 Supply Voltage

As the L-ZM2102 Z-Wave Module contains a RF transceiver good supply voltage decoupling is important. Two decoupling capacitors should be placed at the VCC pin (EP11) a 4.7uF and a 100nF capacitor is recommended. The two capacitors should be placed as close EP11 as possible and the capacitor should be placed between the L-ZM2102 Z-Wave Module and the via that goes to the power plane as shown in Figure 7.

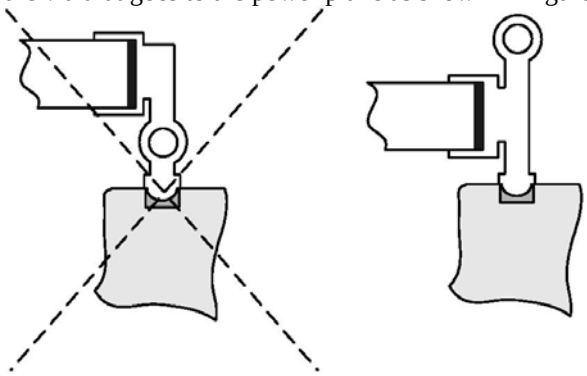


Figure 7 Placement of decoupling capacitor (power pin, EP11)

2.9.2 Ground Plane

In order to minimize any noise coupling from noisy signals (typically power products) it is recommended

to insert as much ground cobber below the L-ZM2102 Z-Wave Module as possible on the Application PCB.

2.9.3 Antenna Interconnection

As the RF signal (EP18) is 50ohm the trace from the EP18 to the matching circuitry (see 1.3.2) must be 50ohm. The Application PCB designer must therefore take the PCB layer structure and thickness into account when designing the 50ohm trace (either Microstrip or Stripline).

3 SOFTWARE

3.1 SPI Interface

The signals 'P1.2/MISO', 'P1.4/SCK' and 'P1.3/MOSI' signals are in some SW API's used by the protocol to store Routing Tables and HomeID in an external EEPROM. When these SW API's are used, the Application SW must ***not*** use these three signals. Table 9 shows the available SW API's and in which the SPI interface is used by the protocol.

SW API	**SPI interface used by Protocol**
Slave	No
Routing Slave	No
Enhanced Slave	Yes
Controller	Yes
Static Controller	Yes
Installer	Yes
Bridge	Yes

Table 9 **SW API / SPI availability**

3.2 EEPROM

Some SW API's require an external EEPROM to be implemented on the Application PCB for protocol information storage (like routing table, HomeID etc.). The SPI interface is used to access the EEPROM and the 'P1.5' signal (EP5) is used by the Z-Wave Protocol as EEPROM Chip Select. To assure proper control of the EEPROM chip select signal during reset and power-up a pull up resistor on the P1.5 should be implemented as shown in Figure 8.

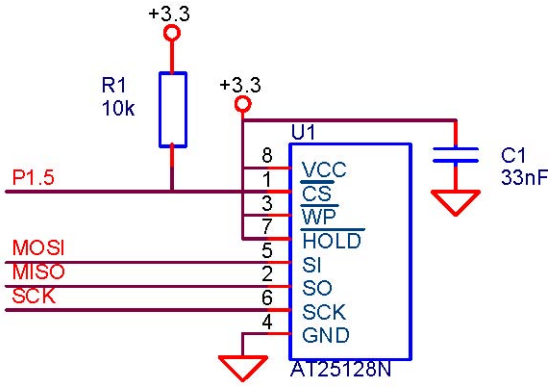


Figure 8 **External EEPROM**

Only a part of the EEPROM is used for protocol data storage, the Application SW can use the remaining memory area using an API call (see [3]). For the EEPROM memory area requirements of the protocol API please refer to the documentation for the Z-Wave Controller code selected (see [3]).