SM125-M2 Datasheet

Release 1.1.0

SonMicro Elektronik

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CONTENTS

CHAPTER

ONE

INTRODUCTION

SM125-M2 is a second-generation 125KHz RFID Reader module that is successor of the first generation SM125-M1 module. It supports same SM125-M1 functionality, communication interface and command set. SM125-M2 is pin-to-pin compatible with the SM125-M1 module. However, both SM125-M1 and SM125-M2 is offered only for the existing designs. For new designs please check SM1250-B-MINI (MINI20 package) and SM1251-SMD (SMD20 package) 125 kHz RFID modules.

Note: To check your existing design compatibility (migration from SM125-M1 to SM125-M2) please read the comparision section below.

Attention: SM125-M2 is offered only for existing designs previosly using the SM125-M1 module. SM125-M1 and SM125-M2 is not available for new designs.

SonMicro has standardized modules with MINI20 and SMD20 package types. These new packages comes with great advantages such as to be pin-to-pin compatible with cross-field modules (e.g. Mifare® Modules) All new base boards and evaluation kits are designed based on these new package type modules. Thus, for example a base reader board can be used both for 125 kHz RFID and Mifare® modules by only changing the antenna.

For new designs please check SM1250B-MINI or SM1251-SMD module.

Please notice that SM125-M1 and SM125-M2 are not obsolete, existing customers can continue to buy. However, it is encouraged to use new package type modules

SM125-M2 is a 28 pin DIP type, second generation 125 kHz RFID Reader module integrated with a ARM® Cortex®-M0 microcontroller, analog front-end and all neccessary passive components except for only coil antenna.

SM125-M2 internal design is same with the SM1250B-MINI and SM1251-SMD second generation modules. It is provided for one-to-one SM125-M1 replacement.

SM125-M2 can be controlled over UART-RS232 /I2C or can read proper tag automatically without requiring any external controller.

Module performs all the required analog and digital signal processes and make the tag data ready to be sent over UART/ I2C/ Wiegand and can output signal to trigger Buzzer/LED/Relay circuit.

It is integrated with a bootloader and can be upgraded over UART-RS232.

1.1 SM125-M1 and SM125-M2 COMPARISON

SM125-M2 and SM125-M1 internal designs are different but SM125-M2 is designed to replace SM125-M1 design providing same functionality with improvements.

1.1.1 Important Differences

Attention:

- SM125-M1 Resets with Active High pulse signal, SM125-M2 resets with **Active Low pulse signal.**
- Sleep operation is removed.
- Eventough I2C protocol is same; improperly written I2C Master controllers previosly designed with tricks may need to check the new design and review the I2C master code.

1.1.2 Improvements

SM125-M2 is designed with ARM® Cortex®-M0 microcontroller which is better than the previous 8-bit microcontroller in many aspects. This design change provides the following benefits:

SM125-M2 (Second Generation)	SM125-M1 (First Generation)
Supply Voltage	**Supply Voltage**
VDD can be anywhere between 3.3V & 5V. (3.3V may yield better read range)	SM125-M1 requires firmware change for 3.3V or 5V operation seperately. It cannot work under 4.85V for 5V operation.
Bootloader	**Bootloader**
Integrated with a better bootloader. • Boot program is write protected so that it cannot destroy itself • On-board function LED (FLED) indicates that the module is in boot mode	SM125-M1 bootloader may not recover itself from a false Program Counter Jump which may happen from external enviromental effects. Thus it has the possibility to overwrite and corrupt the boot program found in the flash
Read Performance	**Read Performance**
• Designed with better analog front end. Yields better read range at 3.3V • SM125-M2 have optional external crystal osc support for temperature stability	
Function LED (FLED)	**Function LED (FLED)**
Comes with on-board LED for assistance purpose	

Note:

- SM125-M2 new generation module gives best read range when the RADF is 94/95 when used with the SonMicro 125KHz antennas (860uH)
- SM125-M2 new generation modules simplifes the calibration process and does not use A1,A2,A3,G1,G2 settings for the calibration. It only requires RADF to be changed with SET_RADF(0x5F) command.

CHAPTER

TWO

FEATURES

- Ready-to-use System-on-Module for 125KHz proximity RFID applications. Requires only coil antenna and power supply to function.
- Integrated with analog-front-end, Arm Cortex microcontroller with property firmware flashed.
- Automatically demodulates and decodes RF signal and make the actual card data ready.
- Compatible pinout and package with SM125-M1 module. (Reset logic is inverted)
- Wide supply voltage range, works between 3.3V and 5V without any firmware change.
- Firmware upgrade-able for custom specific applications
- Supports Atmel/Temic T55xx transponders with Manchester RF/32 and RF/64 modulations and EM4100/02.(Unique)
- UART Interface up to 115200bps - I2C Interface up to 400KHz.
- Supports Wiegand interface
- Comes with General Purpose Inputs and Outputs
- Wide range of supported mother boards available supporting RS232, RS485 and USB.

CHAPTER

THREE

CONNECTION PINOUT DIAGRAM

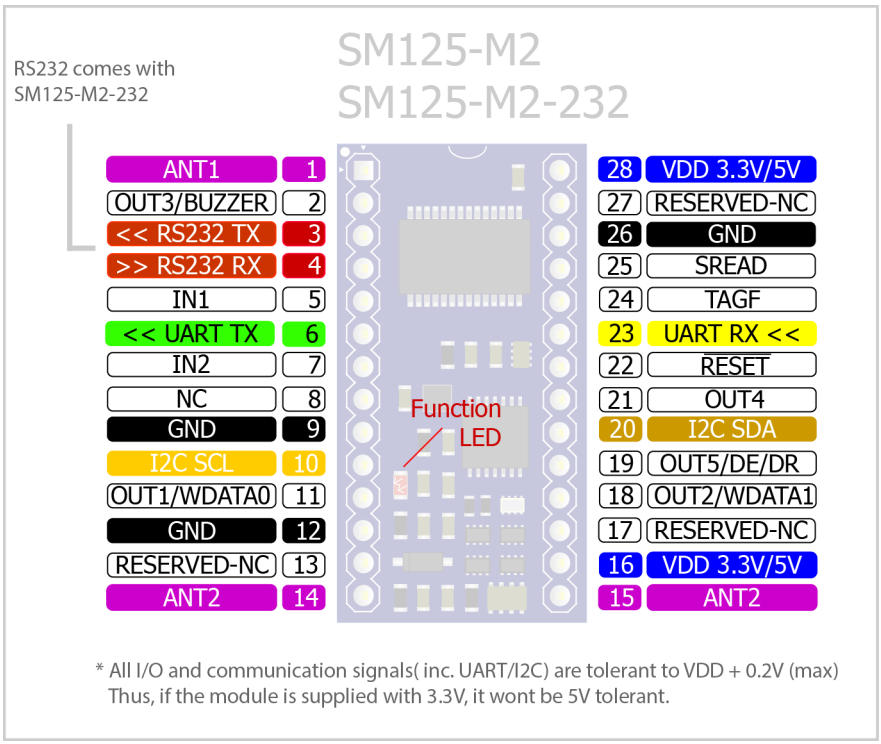

Figure 3 *SM125-M2 Pin Out*

3.1 PIN DESCRIPTIONS

Pin #	Name	Notes
1	ANT1	Antenna Pin 1. (Coil antenna value should be 860uH %2) The first end of the coil wire antenna should be connected to this pin. This pin drives the antenna with ~125 kHz square wave signal, %50 duty cycle. The other end of the antenna should be connected to ANT2 pin of the module.
2	OUT3/*Output0 (previosly named Output0)*	General Purpose Input Output. This pin matches with the Output0 of the previous generation module(SM125-M1 with B13 firmware) It can be controlled with the supported firmware command CMD_WRITE_OUPUT_PINS. If configured in settings, this pin will be logic high for a determined period automatically when a card is detected. This pin can be connected to a DC buzzer or Relay thru a transistor driver.
3	RS232 TX (+/-12V) *(found on SM125-M2-232 model)*	RS232 Transmit. +/- 12V. This signal exist only in SM125-M2-232 model. This pin is connected to the MAX232/ST232 driver IC at the bottom layer of the SM125-M2-232 PCB. This pin can be directly connected to an RS232 device such as PC serial port. User can connect this pin to RX pin of RS232 device. (For PC, pin2 of DB9 connector). **DO NOT CONNECT TTL/CMOS 0-5V signals to this pin;** otherwise the external microcontroller unit will get damaged! To connect TTL/CMOS level device, use the UART_TX pin of the module
4	RS232 RX (+/-12V) *(found on SM125-M2-232 model)*	RS232 Receive. +/- 12V. This signal exist only in SM125-M2-232 model. This pin is connected to the MAX232/ST232 driver IC at the bottom layer of the SM125-M2-232 PCB. This pin can be directly connected to an RS232 device such as PC serial port. User can connect this pin to TX pin of the RS232 device. (For PC, pin3 of DB9 connector). **DO NOT CONNECT TTL/CMOS 0-5V signals to this pin;** otherwise the external microcontroller unit will get damaged! To connect TTL/CMOS level device, use the UART_RX pin of the module
5	IN1	General Purpose Input Output. IRQ is not supported on state change in standard firmware versions. Input state can be read by relevant command.
6	UART TX	UART TX. UART Transmit pin of the module. It can be connected to UART RX (CMOS/TTL Receive) of the external controller, or RS232/RS485/FT232 interface chip relevant CMOS/TTL pin. **It is strongly recommended to have connection to UART pins to support onboard upgrading, and/or configure settings by USB-UART converter.**
7	IN2	General Purpose Input Output. IRQ is not supported on state change in standard firmware versions. Input state can be read by relevant command.
8	RESERVED NC *(previosly named Sleep)*	Reserved - No Connection. This pin is reserved for internal use only and must be left floating and must not be connected to any signal. **Sleep operation was supported on first generation module (SM125-M1 with B13 firmware) but is removed with the SM125-M2 second generation module**
9	GND	Ground. This pin is internally connected to the Pin#12 and Pin#26 of the module. Any of these pin should be connected to ground.
10	I2C CLK	I2C Clock. External 4.7K pull-up resistor is required. I2C must be enabled thru configuration.
11	OUT1/WDATA0	General Purpose Input Output. This pin can be used for Wiegand Data 0 output with supporting firmware. Standard firmware versions may not support wiegand output, please check for the availability.

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12	GND	Ground. This pin is internally connected to the Pin#9 and Pin#26 of the module. Any of these pin should be connected to ground.
13	RESERVED NC	Reserved - No Connection. This pin is reserved for internal use only and must be left floating and must not be connected to any signal.
14	ANT2	Antenna Pin 2. (Coil antenna value must be 860uH %2) The second end of the coil wire antenna should be connected to this pin or Pin#15 of the module. Pin#15 and Pin#14 of the module are connected internally on the PCB. The other end of the antenna should be connected to ANT1 pin of the module.
15	ANT2	Antenna Pin 2. (Coil antenna value must be 860uH %2) The second end of the coil wire antenna should be connected to this pin or Pin#14 of the module. Pin#15 and Pin#14 of the module are connected internally on the PCB. The other end of the antenna should be connected to ANT1 pin of the module.
16	VDD	Input Supply voltage. This pin is connected to Pin#28 of the module internally. Any of these pin can be connected to 3.3V/5V. It can be anywhere between 3.3V and 5V. However for best read range performance, the 5V operation is recommended. **I/O and communication input tolerances are defined as max VDD + 0.2V. Thus if the module is supplied with 3.3V then the inputs shall not be tolerant to 5V and special care must be taken in this case when interfacing with a 5V system**
17	RESERVED NC	Reserved - No Connection. This pin is reserved for internal use only and must be left floating and must not be connected to any signal.
18	OUT2/WDATA1	General Purpose Input Output. This pin can be used for Wiegand Data 1 output with supporting firmware. Standard firmware versions may not support wiegand output, please check for the availability.
19	OUT5/DE/DR *(previosly named DREADY)*	General Purpose Input Output. For RS485 this pin controls DE (Data Enable) pin of the RS485 IC. It is High when transmitting data. For I2C, this pin is used (optional) to notify i2c master by asserting High that data is ready so that master can poll data.
20	I2C SDA	I2C Data. External 4.7K pull-up resistor is required. I2C must be enabled thru configuration.
21	OUT4 / *Output1 (previosly named Output1)*	General Purpose Input Output. This pin matches with the Output1 of the previous generation module(SM125-M1 with B13 firmware) It can be controlled with the supported firmware command CMD_WRITE_OUPUT_PINS.
22	RESET	Active Low Reset Pin. A logic low pulse will reset the module. It can be left floating, it has an internal pull-up resistor and capacitor to prevent parasitic resets or it can be connected to the external microcontroller output pin. **ATTENTION! Previous generation module(SM125-M1 with B13 firmware) had Active High Reset pin. The new generation module (SM125-M2) comes with Active Low Reset**

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23	UART RX	UART RX. UART Receive pin of the module. It is required to be connected to UART TX(CMOS/TTL Transmit) of the external controller, or RS232/RS485/FT232 interface chip relevant TTL/CMOS pin. **If you do not use this pin then connect a pull-up resistor to prevent it floating.** Otherwise it will process random noise data continuously.** **It is strongly recommended to have connection to UART pins and isolate UART RX pin of the module by jumpers (or 0R resistors) from your external MCU whereas possible to support onboard upgrading, and/or configure settings by USB-UART converter.**
24	TAGF	Tag Found. General Purpose Input Output. This pin will generate pulses continuously while a valid tag is in RF Field indicating that a tag is being found. It can be connected to a LED for visual effects.
25	SREAD	Status Read. General Purpose Input Output. This pin indicates with a logic high that 'Read is active' and module is searching for a tag. It can be connected to a LED for visual effects.
26	GND	Ground. This pin is internally connected to the Pin#9 and Pin#12 of the module. Any of these pin should be connected to ground.
27	RESERVED NC	Reserved - No Connection. This pin is reserved for internal use only and must be left floating and must not be connected to any signal.
28	VDD	Input Supply voltage. This pin is connected to Pin#28 of the module internally. Any of these pin can be connected to 3.3V/5V. It can be anywhere between 3.3V and 5V. However for best read range performance, the 5V operation is recommended. **I/O and communication input tolerances are defined as max VDD + 0.2V. Thus if the module is supplied with 3.3V then the inputs shall not be tolerant to 5V and special care must be taken in this case when interfacing with a 5V system**

Table 3.1 *SM125-M2 Pin Description Table for standard firmware version*

3.2 FLED (Function LED)

There is a red colored on-board LED on SM125-M2 module for assisting purpose. This LED is useful to understand the following states:

- When module first powers up, FLED blinks one time at startup indicating that the module is successfully running the firmware.
- When a command is received thru UART, FLED blinks for one time indicating that the command is received successfully.
- When a tag is read, FLED blinks for one time indicating that the card is read successfully.
- FLED blinks continuously indicating that it is in boot mode and ready for the upgrade operation.

CHAPTER

FOUR

DESIGN NOTES

4.1 ESD Handling

Attention:

- SM1250B-MINI / SM1251-SMD is an Electrostatic Sensitive Device. Do not open, carry or handle except at a static-free environment.
- Do not carry or store the modules with Non-Antistatic bags such as nylon, plastic, Styrofoam type of general usage materials.
- **Please be aware that static electricity may cause partial damages inside the chips which cannot be observable at the time of misusage, and may result in failure in long term. ESD is one of the important source for damaged electronic devices.**

4.2 Antenna & Read Range

Read range depends on many factors. Please be aware and take care of the following guides. Please always test your setup or final product practically before going into the production.

- SM125-M2 is designed to work best with a 860uH coil wire antenna with %2 tolerance. SonMicro 125 kHz RFID module have RADF, Reader Antena Drive Frequency, parameter that can be used to calibrate the read range for the used antenna for fine tuning (inside the %2 tolerance range). Best RADF value for your custom antenna or application can be programmed in factory.
- SM125-M2 also comes **optionally** with a crystal oscillator for stable read range over ambient temperature changes.
- 3.3V operation may provide few centimeters better read range.
- Connecting the antenna outside of the module's board with a cable may result in poor performance (must be observed). It may also cause EMI problems affecting the other surrounding devices. Please test your setup practically in the applicaiton field or lab.
- Better read range can be achieved by using a bigger antenna and bigger tag. If you need to achieve maximum read range then consider using biggest antenna size that your design permits.
- Antenna and card communicates each other with magnetic field variations. **Thus, communication between the reader and the card is affected by the metallic objects.** Metallic objects surrounding the antenna including the printed circuit board, copper, LCD will decrease the read range. Try to place antenna as far as possible away from such metallic objects or components. Please be aware that it is not possible to read a card completely

below a metal plane. If the surrounding is a metal frame then using the antenna even 1 cm away from it yields better results. Please test your setup practically in such a case.

None metallic objects, such as plastic, wood, acrylic, glass etc. has no effect on read range performance. **You can place the antenna below none metallic planes reliably.**

- RFID card also has integrated antenna that is tuned by the card manufacturer. Unfortunately, small variations of the tuning may vary by the card manufacturers and this may result in different read ranges. Thus, **the type of the card, or the manufacturer, other than the size, is also important for read range performance.**
- Try to use linear low dropout voltage regulators where as possible. LDO regulators if compared with switch mode regulators, have less signal noise ratio and yields better results for the read range. If you are using switch mode power regulator please make sure you have back EMF and voltage protection diode or circuit to prevent transient high voltage ramping to prevent damage to the module or your system.

4.3 General Notes

- Use a 10uF tantalum capacitor close to the module VDD on your board. In addition to this, please be aware it is experienced that other ICs on your board, especially the ST232/MAX232 or FT232 may add noise to the overall system. **It is strongly recommended to use a 10uF tantalum and 100nF bypass capacitors close to these chips.** Otherwise you may experience communication problems, functional failures or poor read range performance.
- Critical components just beneath the antenna may cause unwanted signal disturbances or failures. One of the affected component is DC Buzzer. If you have to use a buzzer just beneath the antenna then it is strongly recommended to use a PWM Buzzer (supported TypeB pinout modules). Otherwise you can observe weak or deformed buzzer sounds.

CHAPTER

FIVE

MECHANICAL DRAWINGS

Note: Please notice that the following files are provided at our support page to ease your design progress.

- 3D .step file
- Sketchup 3D Drawing(.skp) file which is useful for eagleUp project to convert Eagle PCB to 3D
- Eagle PCB Schematic & Footprint Library.

5.1 SM125-M2 Mechanical Drawings

5.1.1 SM125-M2 Top View

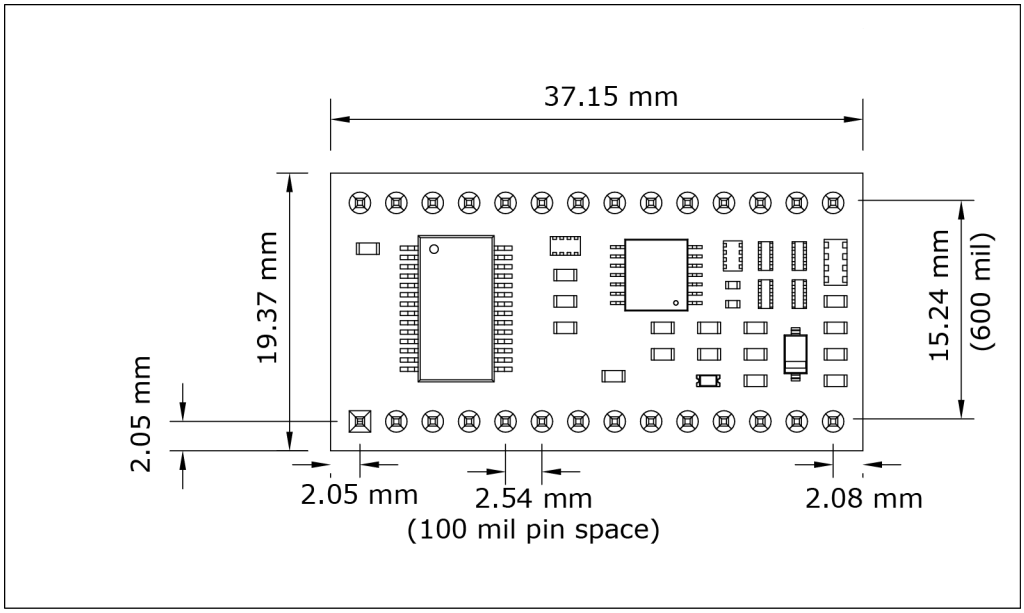

Figure 5.1.1 *SM125-M2 Top View*

5.1.2 SM125-M2 Side View

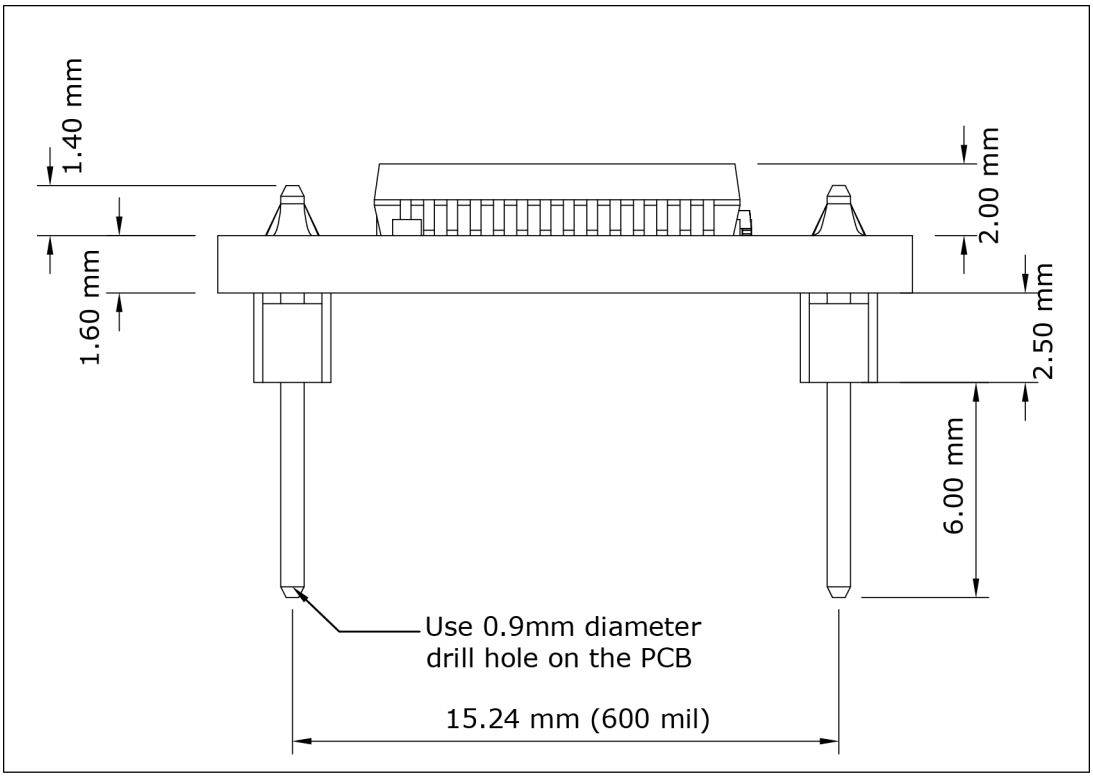

Figure 5.1.2 *SM125-M2 Side View*

5.1.3 SM125-M2 PCB Footprint

Please notice that there is a ready to use Autodesk Eagle, previously named Eagle CadSoft, PCB Library provided for SonMicro modules. You can reference the following footprint for different PCB layout software.

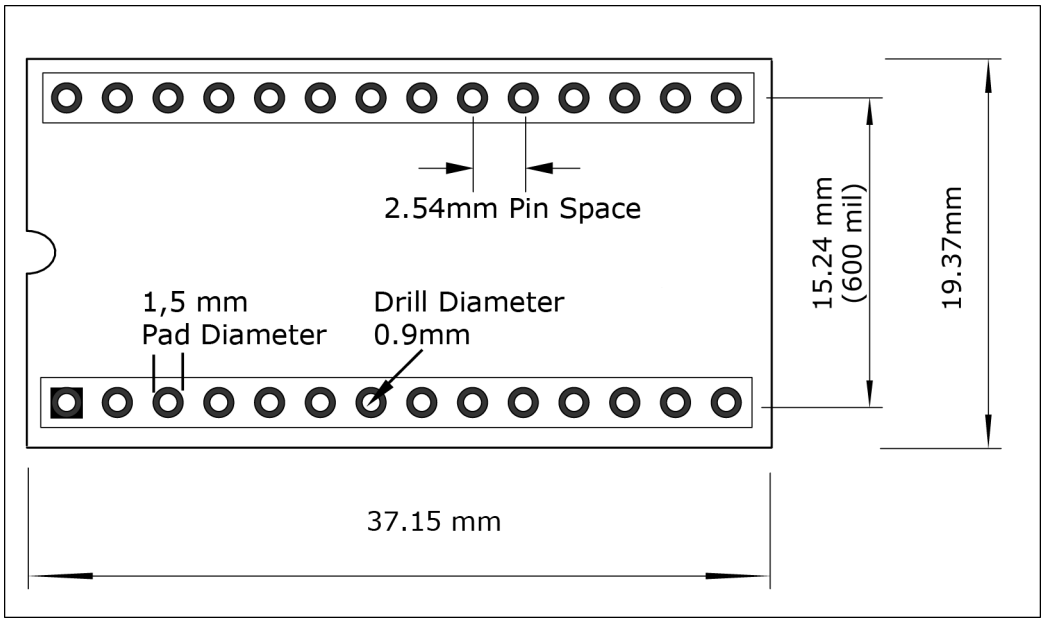

Figure 5.1.3 *Recommended PCB layout for SM125-M2 module*

CHAPTER

SIX

HARDWARE SPECIFICATIONS

6.1 DC ELECTRICAL CHARACTERISTICS

Symbol	Name	Min	Typ	Max	Units	Notes
VDD	Supply Voltage	3.0	3.3V - 5V	5.5	V	Performance may vary depends on VDD. 3.3V operation provides 1-2 centimeters better read range
Io-5V	Supply Current @5V	20	40	100	mA	Supply current may vary depends on the VDD, antenna and I/O used
Io-3V3	Supply Current @3.3V	15	25	100	mA	Supply current may vary depends on the VDD, antenna and I/O used
It	Input Tolerance	-0.5	VDD	VDD +0.5	V	I/O & Comm pins max input voltage tolerance
Imax	Max I/O Current	-25	•	25	mA	Maximum I/O current per GPIO
Trst	Reset Pulse	1	•	•	uS	Reset pulse signal width
ESD	ESD_HBM	2000	•	•	V	Electrostatic discharge human body model

Table 6.1 *DC Electrical Characteristics of SM125-M2 Module*

6.2 OPERATING TEMPERATURE

Symbol	Name	Min	Typ	Max	Units	Notes
TA	Ambient Temperature	-40	•	+85	°C	Can be extended to [-40°C,+125°C] with custom production

Table 6.2 *Operating Temperature ofSM125-M2 Module*

6.3 PERFORMANCE SPECIFICATION

Read distance depends on many factors. Please read the *Design Notes Section* for best practices.

Performance tests are done in ideal conditions with SM-USB-UART Converter (to supply 3.3V and 5V power).

Performance may also vary depending on the power supply signal-noise quality.

Modules have RADF, Read Antenna Drive Frequency, parameter that changes the antenna driving frequency. By changing RADF the best read range can be obtained for the target system (be aware the tolerances of the componenets and antenna value) Modules are calibrated in the factory. RADF value most time is set between 93 ands 96.

SM125-M2 module comes optionally with an integrated crystal oscillator to acheive stable read range over ambient temperature changes for critical applications or though conditions.

6.3.1 IND125-1 (65x35mm Coil Wire Antenna) and Card Size RFID Tag

Read Distance	Min	Typ	Max	Units	Notes
For VDD = 3.3V	•	8	10	cm	Best RADF value is required to be calibrated for the custom antenna within the 860uH %2 tolerance range
For VDD = 5V	•	7	8	cm	Best RADF value is required to be calibrated for the custom antenna within the 860uH %2 tolerance range

Table 6.3.1 *Read Range - SM125-M2 Module with IND125-1 Coil Wire Antenna and credit card size EM4100 tag.*

6.3.2 IND125-2 (90x45mm Coil Wire Antenna) and Card Size RFID Tag

Read Distance	Min	Typ	Max	Units	Notes
For VDD = 3.3V	•	9	11	cm	Best RADF value is required to be calibrated for the custom antenna within the 860uH %2 tolerance range
For VDD = 5V	•	8	9	cm	Best RADF value is required to be calibrated for the custom antenna within the 860uH %2 tolerance range

Table 6.3.2 *Read Range - SM125-M2 Module with IND125-2 Coil Wire Antenna and credit card size EM4100 tag.*

6.3.3 IND125-3 (42x18mm Coil Wire Antenna) and Card Size RFID Tag

Read Distance	Min	Typ	Max	Units	Notes
For VDD = 3.3V	•	6	8	cm	Best RADF value is required to be calibrated for the custom antenna within the 860uH %2 tolerance range
For VDD = 5V	•	5	6	cm	Best RADF value is required to be calibrated for the custom antenna within the 860uH %2 tolerance range

Table 6.3.3 *Read Range - SM125-M2 Module with IND125-3 Coil Wire Antenna and credit card size EM4100 tag.*

CHAPTER

SEVEN

TRADEMARKS

- ARM® and Cortex are registered trademarks of ARM Limited (or its subsidiaries) in the EU and/or elsewhere. All rights reserved.
- MIFARE® is a registered trademark of NXP B.V. and is used under license.

CHAPTER

EIGHT

DOCUMENT REVISON HISTORY

Version 1.1.0 (26 Dec 2017)

Additional information and sections added.

Following important notices added

- 3.3V operation yields few centimeters better read range.
- SM125-M1 and SM125-M2 is not provided for new designs. SM125-M2 is designed only for existing designs to provide second generation module features to existing designs. For new designs please check SM1250B-MINI or SM1251-SMD module

Version 1.0.0 (28 Aug 2017)

Initial release. Short form of datasheet.