
# SM1250B-MINI / SM1251-SMD Datasheet

***Release 1.0.0***

**SonMicro Elektronik**

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# CONTENTS

CHAPTER

ONE

# 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.
- Ultra Compact Size 2.2 x 2.0 cm SMD20 package (appropriate for automated assembly) and Compact Size 2.7 x 2.2 cm MINI20 package with 2mm pitch low profile pins.
- Compatible pinout and package with different modules to support same mother board design (e.g. SM5210/SM5211-SMD Mifare Modules)
- 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

TWO

# INTRODUCTION

**Note:** SonMicro RFID modules exist in the market since 2004. The firmware and the hardware are designed and developed more than 10 years of experience by collecting customers' requirements and feedbacks. Final result is the reliable, robust design and long-term availability worldwide with the qualified support and resources.

SM1250B-MINI / SM1251-SMD is a second-generation module that is successor of the first generation 125KHz RFID module (SM125-M1) and chip (SM125-IC). It supports same functionality and communication interface with the first generation solutions with more features and comes with smaller size. They have also better integrated bootloader, lower current consumption specifications and wide input supply voltage between 3.3V and 5V.

SM1250B-MINI / SM1251-SMD is a 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 in a small form factor.

SM1250B-MINI / SM1251-SMD supports reading popular EM4100/02 (i.e. Unique) 5-byte read-only proximity cards and T55XX rewritable cards from Atmel/Temic (e.g. T5557/67/77) with Manchester RF/32 and Manchester RF/64 modulation. Writing to T55XX cards is also supported and these cards can be programmed to emulate EM4100/02 cards.

SM1250B-MINI / SM1251-SMD runs IP (intellectual property) firmware versions (standard and application specific) that performs all the required analog and digital signal processes to handle the 125 kHz RFID protocol and provide easy to use communication interface, UART & I2C[1] and command API. Standard firmware provides commands for reading/writing card blocks, controlling I/O and configuring the module. Different requirements such as Wiegand, RS485 interface are also supported with the application specific firmware versions.

Standard firmware also supports 'Auto Mode' as default so it can report card ID with protocol or ASCII output as soon as it is detected, or do some operations such as driving buzzer and LED without any need of an external controller for access control or similar applications.

SM1250B-MINI / SM1251-SMD is integrated with a bootloader program. It allows new firmware releases to be upgraded over UART. Application specific firmware versions (e.g. offline reader, access control for elevators) may be available or developed for such requirements. **See Limitations.**[2] Please check for the firmware manual documents at support page for different target applications if exist any.

[1] I2C is not enabled in default. It needs to be enabled thru configuration or it should be requested to be enabled when shipping from the factory.

[2] For custom firmware development or custom feature requests please contact with us. We are committed to develop new firmware versions for general industry requirements for different target applications to reduce overall system cost and provide flexibility and faster time to market. Please also check for the availability of the firmware versions for specific applications at our support page.

CHAPTER

# THREE

# CONNECTION PINOUT DIAGRAM

SM1250B-MINI / SM1251-SMD power supply, VDD, can be between 3.3V and 5V. Output signals are at VDD level and CMOS/TTL compliant. For best read range performance, LDO supply is recommended for the VDD instead of a switch mode regulator.

**Attention:** Maximum input voltage tolerance for the input and communication pins must not exceed VDD + 0.5 V. If the module is supplied with 3.3V, it must not directly interfaced with 5V signals without any protection.

Both SM1250B-MINI and SM1251-SMD have same pinout order and only the mechanical dimensions are different.

## 3.1 SM1250B-MINI Pinout

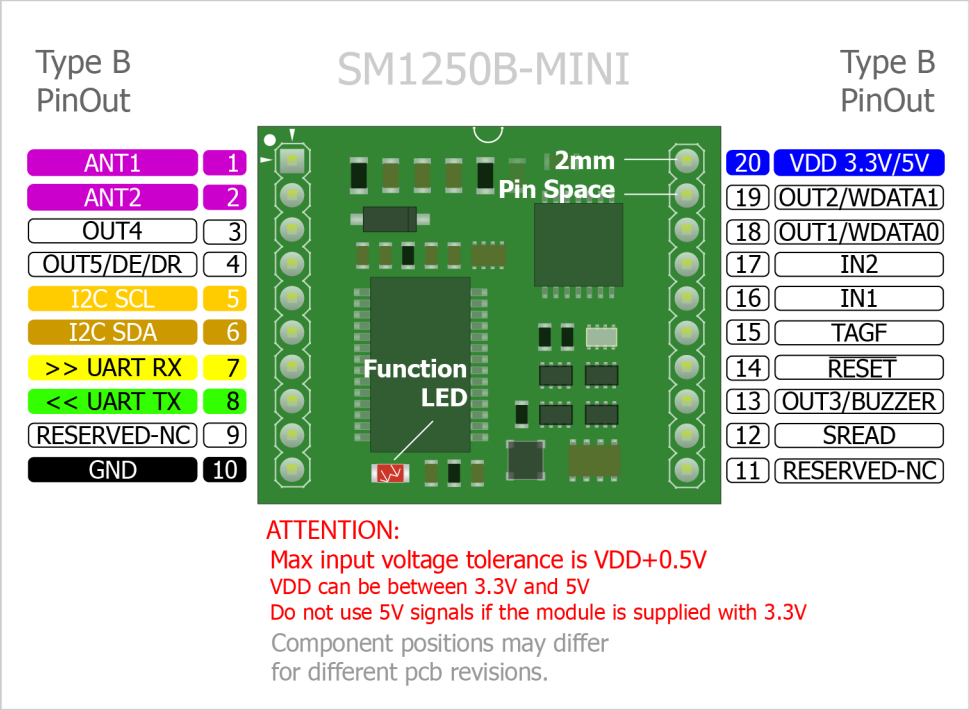


Figure **??** *SM1250B-MINI Module Pinout*

## 3.2 SM1251-SMD Pinout

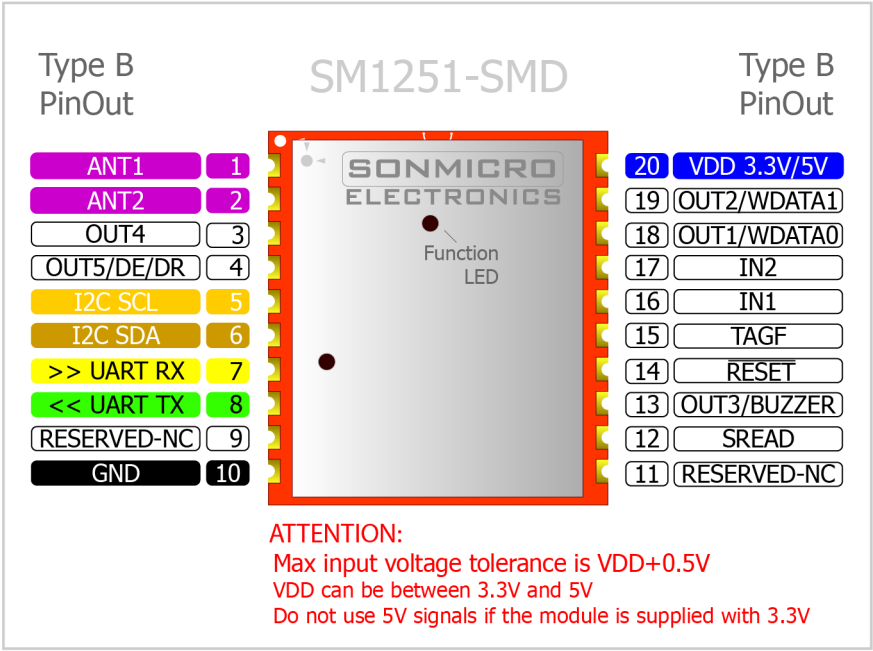


Figure **??** *SM1251-SMD Pinout*

## 3.3 PIN DESCRIPTIONS

**Attention:** Following pin descriptions are for standard firmware versions released. (i.e. stdProxB V1.x.x ) Pins behavior may vary depends on the custom or special firmware running on the module for different target applications. Internal module design permits most of the pins configurable as input or output or different behavior (not possible to change by the user). If any different firmware version is available then please reference the firmware manual documents for possible differences.

| 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 | ANT2 | Antenna Pin 2. (Coil antenna value should be 860uH %2) The second end of the coil wire antenna should be connected to this pin The other end of the antenna should be connected to ANT1 pin of the module. |
| 3 | OUT4 / *Output1 (previously named Output1)* | General Purpose Input Output. This pin matches with the Output1 of the previous generation module (SM125-M1 and SMRFID 3.0.7 software) It can be controlled with the supported firmware command CMD_WRITE_OUPUT_PINS. |
| 4 | OUT5/DE/DR *(previosly named DREADY)* | For RS485, this pin controls DE (Data Enable) pin of the RS485 IC. It is high when transmitting data.<br>For I2C, this pin is used (optional) to notify i2c master by asserting high to indicate that data is ready so that master can poll data. |
| 5 | I2C CLK | I2C Clock. External 4.7K pull-up resistor is required. I2C must be enabled thru configuration. |
| 6 | I2C SDA | I2C Data. External 4.7K pull-up resistor is required. I2C must be enabled thru configuration. |
| 7 | 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.<br>**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.**<br>**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.** |
| 8 | 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.<br>**It is strongly recommended to have connection to UART pins to support onboard upgrading, and/or configure settings by USB-UART converter.** |
| 9 | 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. |
| 10 | GND | Ground. |
| 11 | 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. |
| 12 | SREAD | Status Read. General Purpose Input Output.<br>This pin indicates with a logic high that 'Read is active' and module is searching for a tag. It flashes continuously while the tag is in RF field. It can be connected to a LED for visual effects. |

| Pin # | Name | Notes |
|---|---|---|
| 13 | OUT3/BUZZER *Output0 (previosly named Output0)* | General Purpose Input Output. This pin matches with the Output1 of the previous generation module (SM125-M1 and SMRFID 3.0.7 software) It can be controlled with the supported firmware command CMD_WRITE_OUTPUT_PINS. If configured in settings, this pin will be logic high (or generate PWM) for a determined period automatically when a card is detected to drive a DC or PWM buzzer |
| 14 | 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.<br>**ATTENTION! Previous generation module (SM125-M1 and SM1250 with B13 firmware) had Active High Reset pin. The new generation module (SM125-M2 and SM1250B) comes with Active Low Reset** |
| 15 | TAGF | Tag Found. General Purpose Input Output.<br>This pin will generate a single pulse when a valid tag is detected. It can be connected to a LED for visual effects or can be used to notify an external controller or circuit. |
| 16 | IN1 | General Purpose Input Output. IRQ is not supported on state change in standard firmware versions. Input state can be read by relevant command. |
| 17 | IN2 | General Purpose Input Output. IRQ is not supported on state change in standard firmware versions. Input state can be read by relevant command. |
| 18 | OUT1/WDATA0 | Weigand Data 0. General Purpose Input Output.<br>This pin can be used as general purpose output and can be controlled with the supported firmware command CMD_WRITE_OUTPUT_PINS<br>Alternatively, this pin can be used as Wiegand Data 0 output if Wiegand is enabled in device settings. Weigand signal can be inverted (Low or High) by configuration. |
| 19 | OUT2/WDATA1 | Weigand Data 1. General Purpose Input Output.<br>This pin can be used as general purpose output and can be controlled with the supported firmware command CMD_WRITE_OUTPUT_PINS<br>Alternatively, this pin can be used as Wiegand Data 1 output if Wiegand is enabled in device settings. Weigand signal can be inverted (Low or High) by configuration. |
| 20 | VDD | Input Supply voltage. It can be anywhere between 3.3V and 5V however read performance may vary depends on the VDD. 3.3V operation may provide better read range performance (1 or 2 centimeters more).<br>**I/O and communication input tolerances are defined as max VDD + 0.5V. 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 **??** *SM1250B/SM1251-SMD Pin Description Table for standard firmware versions (e.g. stdProxB)*

## 3.4 FLED (Function LED)

There is a red colored on-board LED on SM1251B-MINI and SM1251-SMD 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 valid card is detected successfully.
- FLED blinks continuously indicating that it is in boot mode and ready for the upgrade operation.

CHAPTER

FOUR

# EXTERNAL DOCUMENTS & RESOURCES

## 4.1 Communication Interface & Protocol

For UART & I2C protocol details, frame structure and usage please check for the

- **125 kHz RFID Readers UART/I2C Communication Protocol**

You can reference this document if you want to communicate with the module over UART, including RS232, RS485 and virtual com port, or I2C by directly using low level command API that is provided with the firmware manual.

You can skip checking this document if you are using a software tool, SDK or ready-to-use microcontroller code library if provided. Software tools, SDK and MCU code library already handles with the communication protocol and serves higher level, easy to use API or examples to user by hiding inner details of the communication and the protocol.

## 4.2 Firmware and User Manuals

125 kHz RFID modules comes with standard and application specific firmware versions. Each firmware may differ by usage and has different user manual document. Please check for the relevant firmware manual document for full command API and functional behavior.

For the standard firmware manual document please check for the

- **stdProxB V1.X.X - Firmware & User Manual**

## 4.3 Reference Design & Schematics

You can use SM2251 board as a reference design:

- **SM2251 Hardware Manual (Evaluation Kit Board for MINI20 package type modules with Type B connection)**

## 4.4 Software Tools

There are software tools supporting full command API (hardware control, configuration and card operations) to quickly evaluate and test the 125 kHz RFID Modules and Readers.

- **SMRFID 3.0.7** is a software tool for Windows.
- **Prox Panel** is a cross platform software tool supports also new features comes with stdProxB
- **SBoot Upgrader** is a firmware upgrade tool for windows.

- **Firmware Upgrader** is a cross platform firmware upgrade tool.

*Firmware upgrade files are distributed by email upon request. They are not available for download.*

## 4.5 CAD/PCB Resources

AutoDesk Eagle, previously named Eagle CadSoft, PCB schematic and footprint library for SonMicro modules including the 3D step files can be downloaded at our support page.

Trimble Sketchup, formerly Google Sketchup, 3D .skp files and .step files for the SonMicro modules can be downloaded at our support page.

3D Sketchup files are also appropriate for eagleUp project which is a useful tool to convert Eagle PCB to the 3D Sketchup drawings.

CHAPTER

FIVE

# HARDWARE INTERFACE PRECAUTIONS

Please first read the precautions to protect your reader and external controller before you make any connections.

## 5.1 Signal Levels

All I/O and communication interface (e.g. UART/I2C) signals are at supplied VDD level (can be between 3.3V - 5V) and CMOS/TTL compliant. But they are **tolerant to VDD + 0.5V max**. Thus, when module is supplied with 3.3V, I/O and communication interface should be protected if interfaced with a 5V system directly.

UART communication bit level protocol is exactly same for RS232, RS485 and USB Virtual Com Port. **However, hardware interface is required for RS232, RS485 or USB Virtual Serial port.**

**Attention:** *Protect your external controller*

- Be aware that the evaluation kit or USB-UART converter with 5V supply may damage your external none-5V-tolerant controller e.g. **Raspberry Pi.**

**Attention:** *Protect SM1250B-MINI / SM1251-SMD Module*

- **Never connect SM1250B-MINI / SM1251-SMD UART pins (or any other pin) to an RS232 device directly.** RS232 have +/- 12V signals, shares the same bit level protocol with the UART but they have different electrical characteristics. Direct RS232 connection will damage the module. You should avoid connecting your module directly to the PC com port or any USB/RS232 converter. In such a requirement, USB To UART converter or UART To RS232 (e.g. st232/max232) hardware interface is required between the module-UART and RS232 (e.g. PC) sides.

## 5.2 RS485

RS485 interface is supported by using DE (Data Enable) signal and node address byte in the protocol frame if enabled in configuration.

SM1250B-MINI / SM1251-SMD can be connected to RS485 interface (e.g. ST485/MAX485). There are also ready to use RS485 readers and boards available with bias, diode protection and simple filter circuits integrated for MINI20 and SMD20 package RFID modules.

**Attention:**

- RS485 infrastructure (cabling, termination resistors etc.) is extremely important for reliable communication. It is assumed that you have understanding of RS485 interface and experience with the infrastructure. Extended support is not offered for RS485 caused problems. It is highly recommended to investigate RS485 networks. For example, a star or random style connections should be avoided. Even the application confirmed to be working good, you may have problems in midterm.
- **Upgrading the module firmware over RS485 is not supported.**

## 5.3 I2C

SM1250B-MINI / SM1251-SMD supports the I2C communication with provided command set and is disabled by default. **It requires to be enabled by relevant set configuration command (it is sent over UART) or it should be requested to be enabled in factory.**

Modules' I2C signal levels are at VDD level and CMOS/TTL level compliant. Maximum input tolerance is VDD + 0.5V. Depending on the pull up resistor circuit used on the mother board, the output signal level can be 3.3V or 5V. For SonMicro mother boards, please check relevant board's hardware manual document for the pull-up resistor connections.

**Attention:** *Protect your external controller*

- **It is important to know about if the pull up resistors is connected to 5V or 3.3V on the mother board to protect external none-5V-tolerant controller.**

CHAPTER

SIX

# DESIGN NOTES

## 6.1 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.**

## 6.2 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.

- SM1250B-MINI / SM1251-SMD is designed to work best with a 860uH coil wire antenna with %2 tolerance. SonMicro 125 kHz 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.
- SM1250B-MINI / SM1251-SMD 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.

## 6.3 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

SEVEN

# 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.

## 7.1 SM1250B-MINI Mechanical Drawings

### 7.1.1 SM1250B-MINI Top View

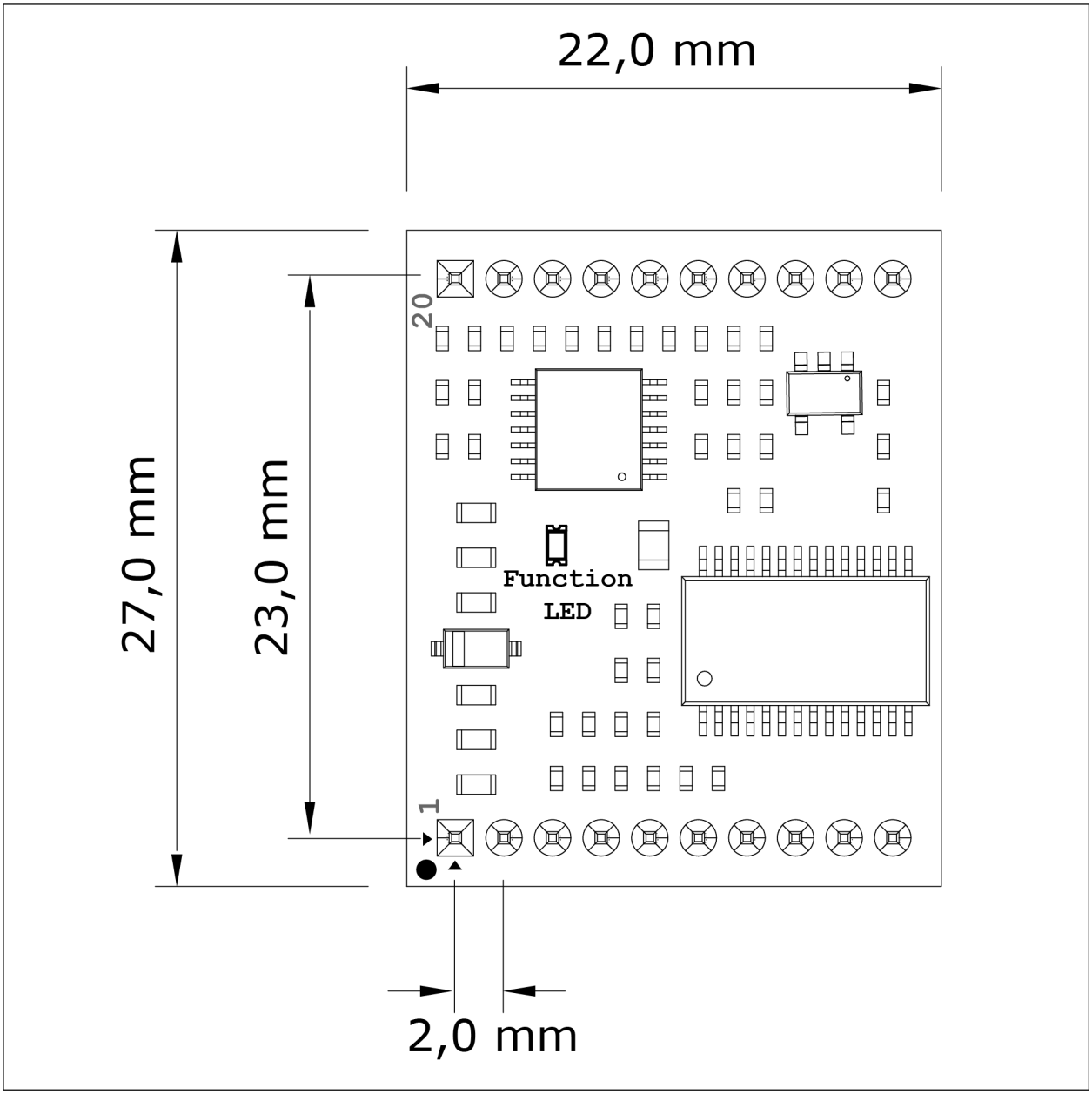


Figure **??** *SM1250B-MINI Top View*

### 7.1.2 SM1250B-MINI Side View

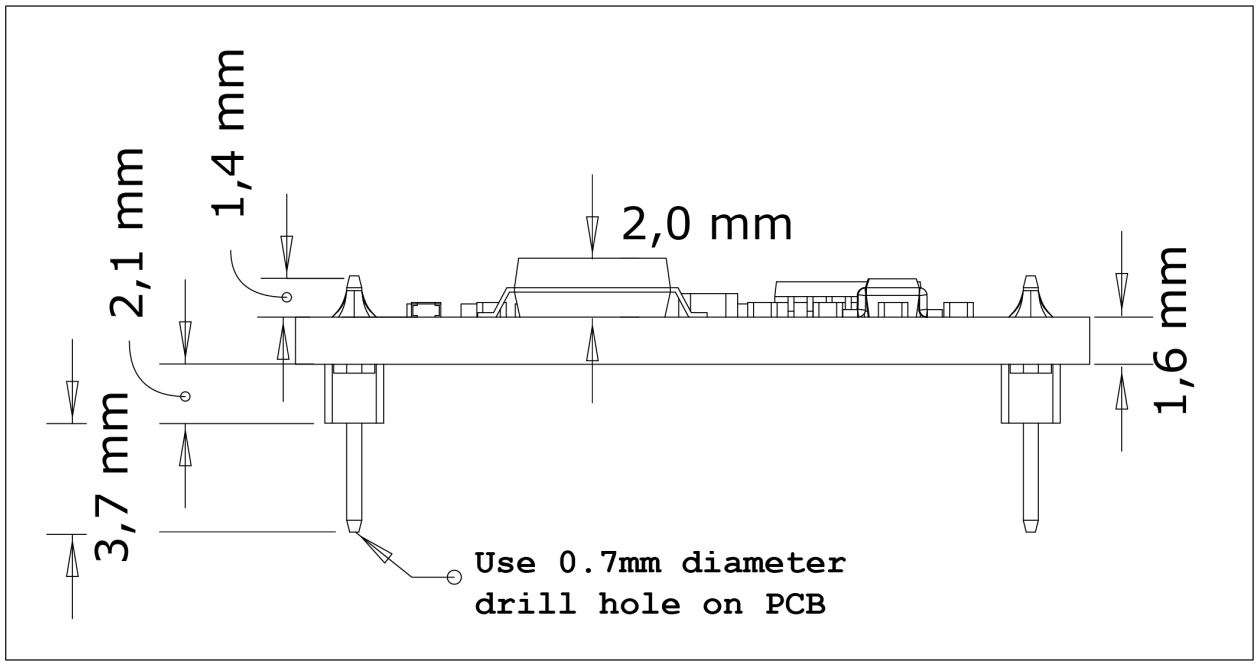


Figure **??** *SM1250B-MINI Side View*

### 7.1.3 SM1250B-MINI PCB Footprint (Mini20 Package)

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.

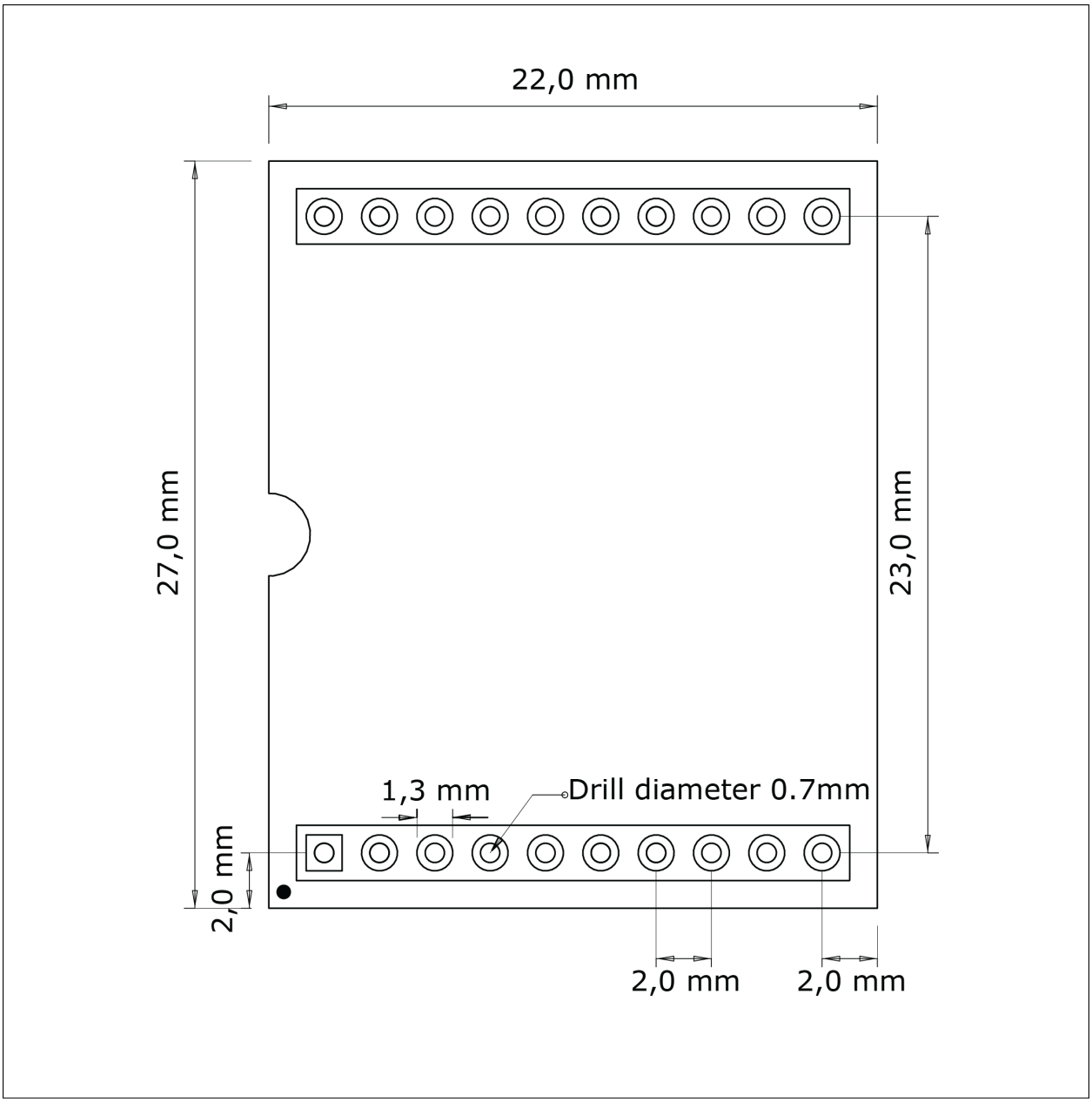


Figure **??** *Recommended PCB layout for SM1250B-MINI module (Mini20 package)*

## 7.2 SM1251-SMD Mechanical Drawings

### 7.2.1 SM1251-SMD Top View

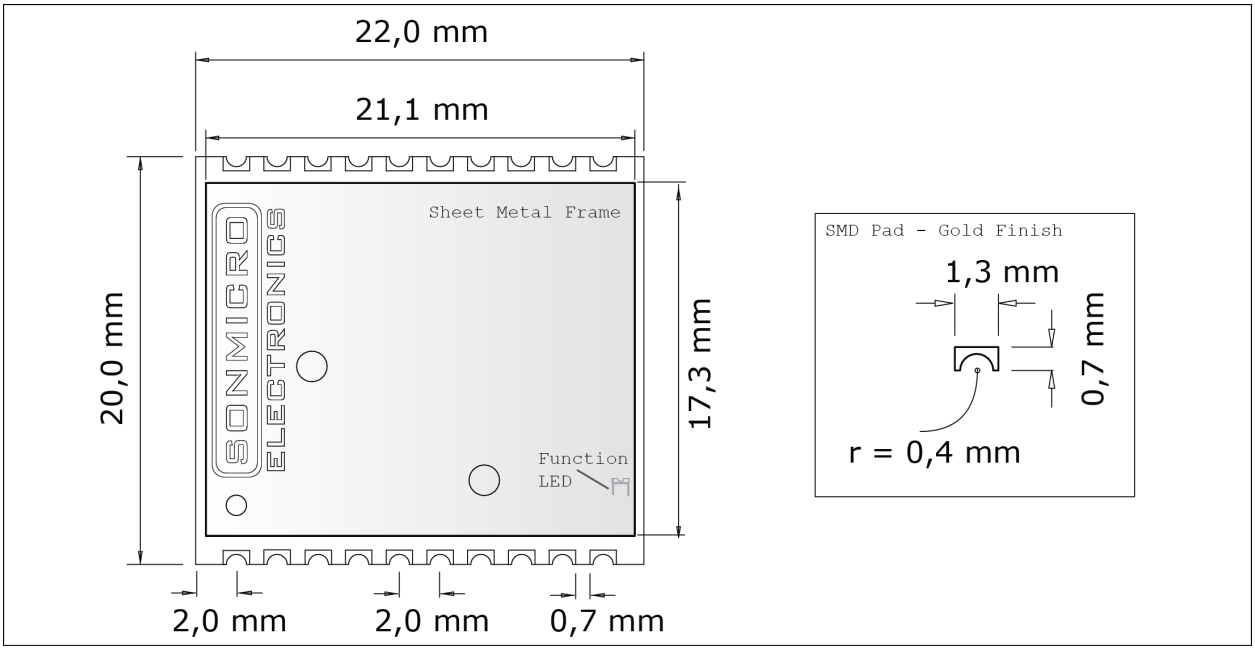


Figure **??** *SM1251-SMD Top View & SMD Pad Dimensions*

### 7.2.2 SM1251-SMD Side View

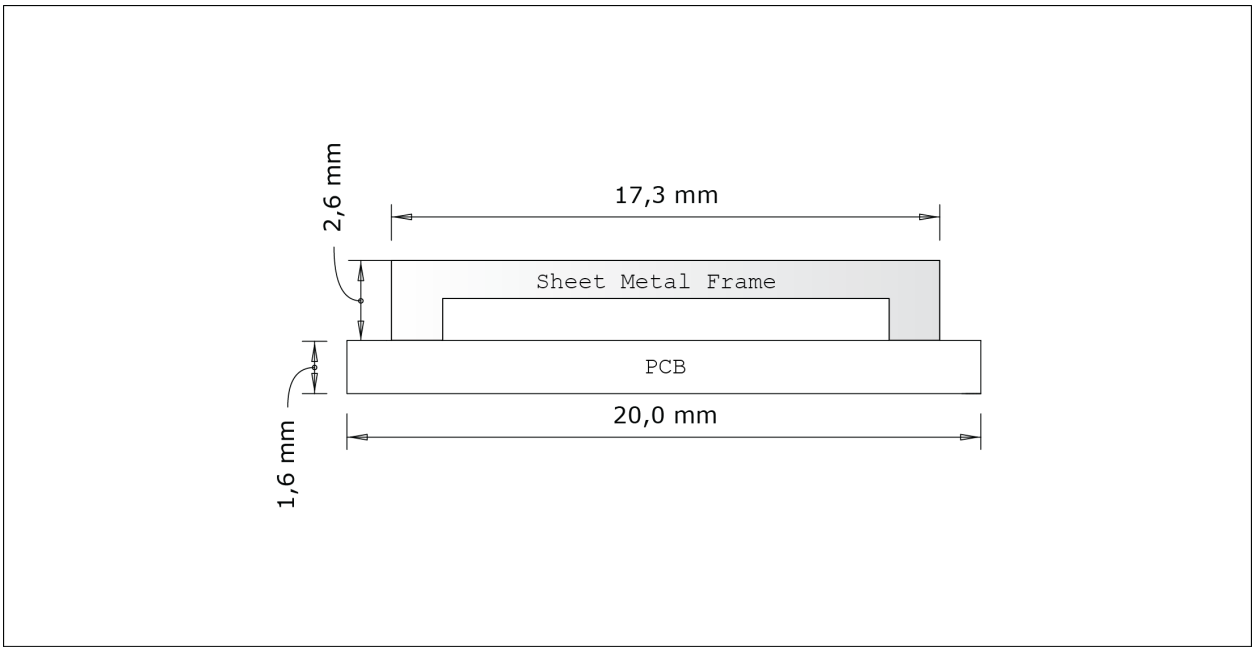


Figure **??** *SM1251-SMD Side View*

### 7.2.3 SM1251-SMD PCB Footprint (SMD20 Package)

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.

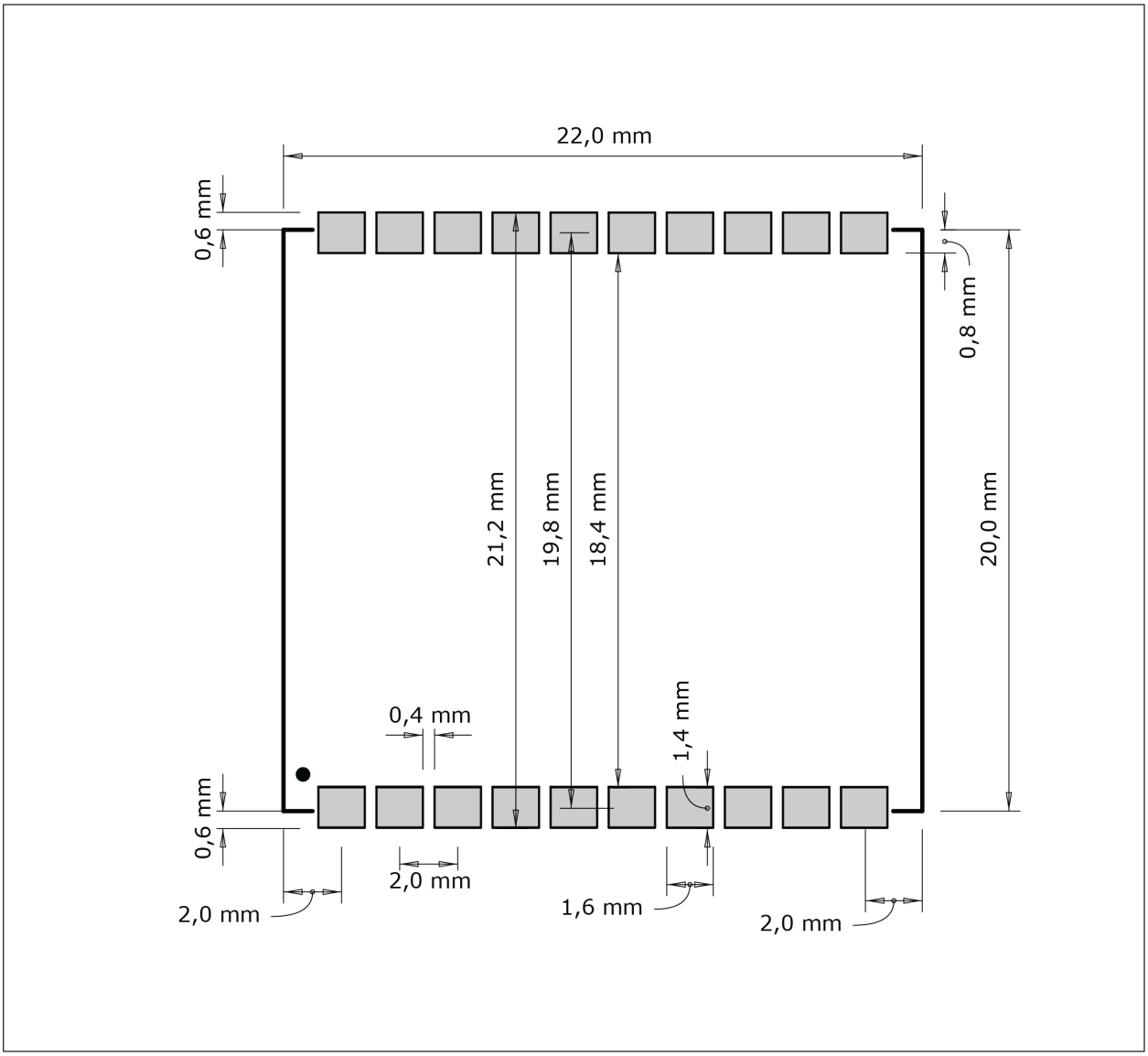


Figure **??** *Recommended PCB layout for SM1251-SMD module (SMD20 package)*

CHAPTER

EIGHT

# PACKING INFORMATION

## 8.1 SM1250 Packing Information

SM1250 Modules are placed on **ESD Dissipative Pink PE Foam** sheet which protects modules from static electricity and also protects 2mm pin headers from external forces. Later, the foam sheet is packaged with antistatic shielding bag. There is no standardized number of modules per package, they are created manually by the ordering quantity.

Figure **??** *SM1250B-MINI Packing*

## 8.2 SM1251-SMD Packing Information

SM1251-SMD modules are packaged with **Antistatic ESD PET trays contains 25 of each** or shipped as bulk packing with antistatic shielding bags. While the ESD tray option protects the module, they are also useful for automated assembly machines to pick up.

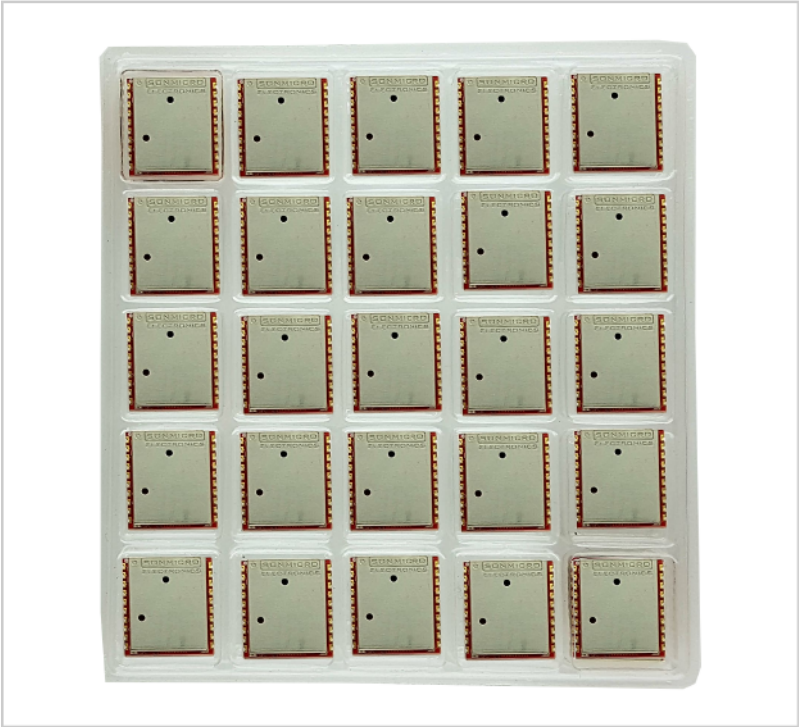

Figure **??** *SM1251-SMD Antistatic ESD Tray Packing.*

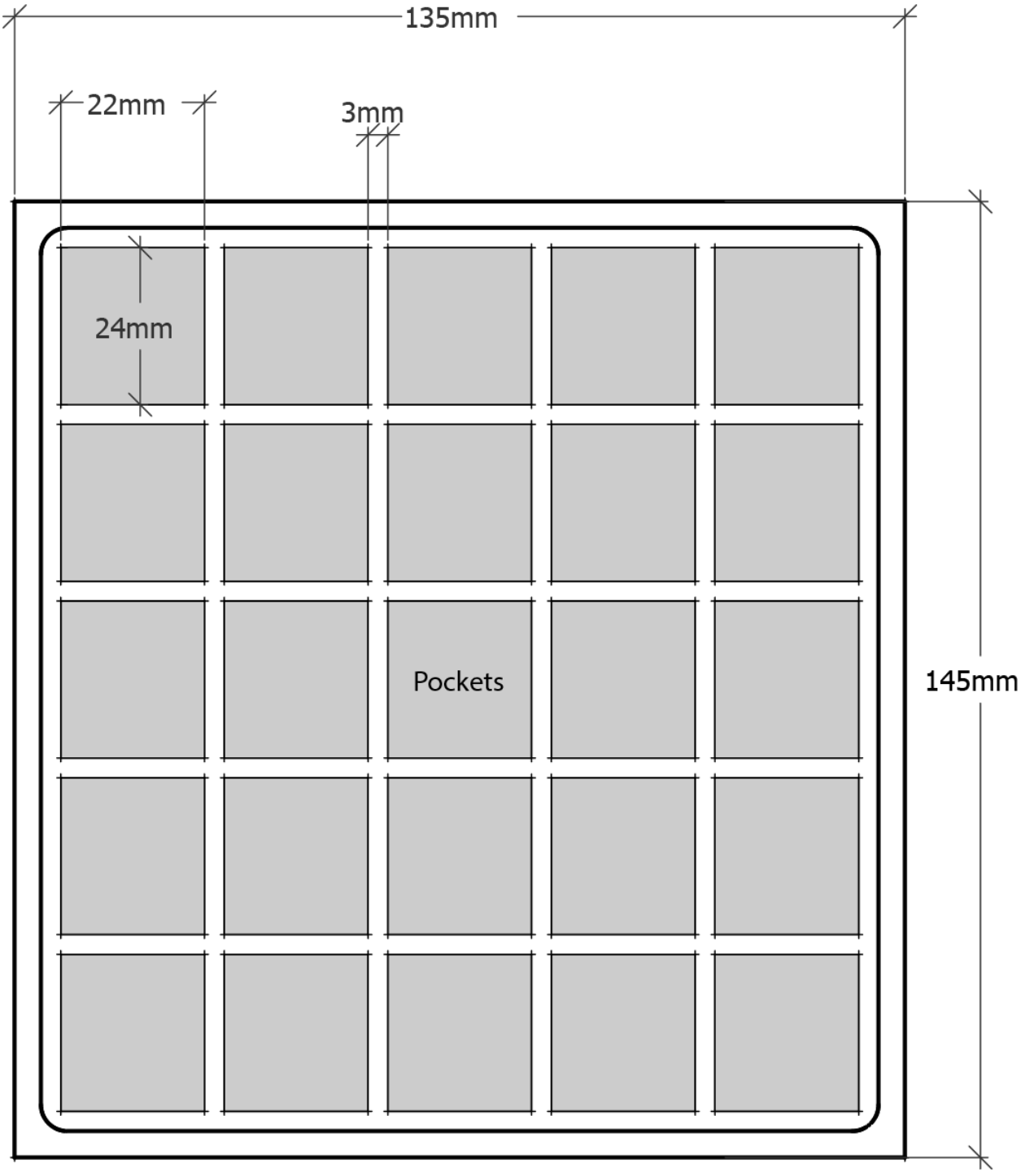


Figure **??** *SM1251-SMD Antistatic ESD Tray Dimensions for 5x5 pcs*

CHAPTER

NINE

# HARDWARE SPECIFICATIONS

SM1250B-MINI and SM5211-SMD shares exactly the same design thus they have same electrical characteristics and performance specifications.

## 9.1 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 **??** *DC Electrical Characteristics of SM1250B-MINI and SM1251-SMD Module*

## 9.2 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 **??** *Operating Temperature of SM1250B-MINI and SM1251-SMD Module*

## 9.3 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 SM2251 Evaluation Kit Board and 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.

SM1250B-MINI / SM1251-SMD module comes optionally with an integrated crystal oscillator to acheive stable read range over ambient temperature changes for critical applications or though conditions.

### 9.3.1 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 **??** *Read Range - SM1250B-MINI / SM1251-SMD Module with IND125-1 Coil Wire Antenna and credit card size EM4100 tag.*

### 9.3.2 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 **??** *Read Range - SM1250B-MINI / SM1251-SMD Module with IND125-2 Coil Wire Antenna and credit card size EM4100 tag.*

### 9.3.3 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 **??** *Read Range - SM1250B-MINI / SM1251-SMD Module with IND125-3 Coil Wire Antenna and credit card size EM4100 tag.*

CHAPTER

TEN

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CHAPTER

# ELEVEN

# DOCUMENT REVISON HISTORY

**Version 1.0.0 (26 Dec 2017)**

Initial release.