SM521X Datasheet

Version 1.2.0, July 2024

SM5210-MINI-HW1 / SM5210-MINI-HW20

SM5211-SMD-HW1 / SM5211-SMD-HW20

SM5212-uSMD-HW20

Sonmicro Mifare® Modules

Applications:

- Access Control Systems
- Public Transportation Systems
- Time and Attendance Systems
- Loyalty and Membership Programs
- Electronic Toll Collection
- Car Parking Management
- Event Access (Concerts, Sports Events)
- Vending Machines
- Smart Lock Systems (Hotels, Offices)

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CHAPTER 1

OVERVIEW

Sonmicro's SM521X series offers three high-performance, low-power 13.56MHz RFID reader modules: SM5210-MINI, SM5211-SMD, and SM5212-uSMD. Each module is based on the NXP® Mifare® Classic reader IC, providing read/write capabilities for Mifare® Classic 1K, Mifare® Classic 4K, and Mifare® Ultralight tags. These modules also read the Unique Identifier (UID) of various contactless cards compliant with ISO14443A standards, including Mifare® DESFire, Mifare® Plus, Mifare® Ultralight C, and NFC devices like smartphones.

Measuring 27x22 mm with a 2 mm pin spacing, the SM5210-MINI is designed as a DIP module for easy plug-and-play functionality. The even more compact SM5211-SMD (20x22 mm) is suited for SMT assembly. The smallest option, the SM5212-uSMD (15x15 mm with a 1.27 mm pin pitch), is optimized for ultra-small form factor applications and SMT assembly.

Equipped with a powerful ARM® Cortex® microcontroller, these modules enable advanced features, customization, and easy firmware updates via the built-in bootloader. They support UART and I2C communication for flexible integration and offer a rich API for seamless development. The modules interface with external devices through UART or I2C, accepting simple commands defined in the Sonmicro SPV1 Protocol & Firmware manual. Additionally, general-purpose inputs and outputs (GPIOs) enhance system functionality by enabling switch management and peripheral device operation.

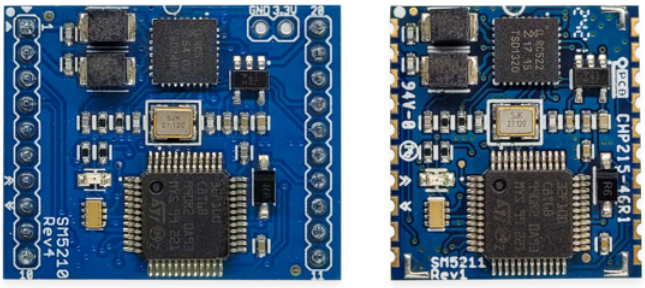
All modules (MINI20, SMD20, and uSMD20) share a standardized pinout for compatibility across 125 kHz and 13.56 MHz frequencies. This simplifies designs, allowing a single motherboard to work with different modules by simply swapping the module and antenna, reducing inventory and costs. Sonmicro's modular approach aids designers in streamlining hardware development and maintaining flexibility across diverse RFID applications.

The SM5210-MINI and SM5211-SMD come in HW1 and HW20 versions with slight variations in MCU, I/O voltage, and tolerances, while maintaining identical functionality.

Chipset	Module	VDD	I/O Level	Tolerance	Description
HW1	SM5210-MINI-HW1 SM5211-SMD-HW1	3.3V - 5V	3.3V Fixed	5V Tolerant	I/O operates at 3.3V Input pins can handle up to 5V
HW20	SM5210-MINI-HW20 SM5211-SMD-HW20 SM5212-uSMD-HW20	3.3V - 5V	Matches VDD (3.3V - 5V)	Matches VDD (3.3V - 5V)	I/O operates at VDD (either 3.3V or 5V) Pins can handle up to VDD If supplied with 3.3V, pins are not 5V tolerant

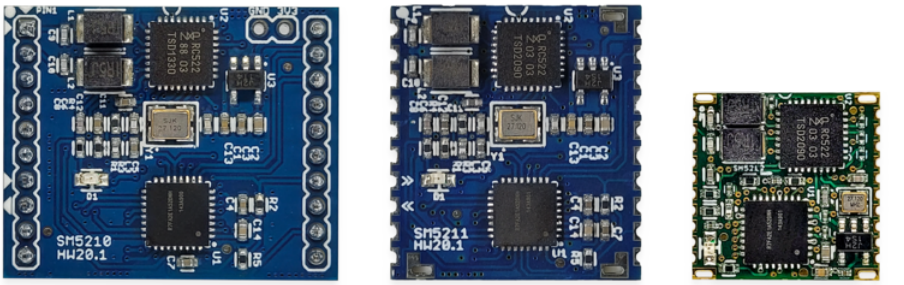
Features and Capabilities

- **Supported Tags**: The modules support read, write, and authentication operations for Mifare® Classic 1K, Mifare® Classic 4K, and Mifare® Ultralight tags. They can also read the Unique Identifier (UID) of all ISO14443A tags, including NFC Tags, Mifare® DESFire, Mifare® Plus, Mifare® Ultralight C, and NFC devices like smartphones.
- **Communication Interfaces**: The modules offer both UART and I2C communication interfaces, with a UART baud rate ranging from 9600bps to 115200bps and I2C support up to 400KHz. The UART also supports a DE pin for RS485 communication.
- **Read Range**: Typically around 7.5 cm (±2.5 cm) depending on the tag type and antenna size.
- **Advanced Features**: The SM521X series includes advanced non-blocking GPIO control, RGB LED support for customized board designs, and an integrated ARM® Cortex® microcontroller for enhanced functionality and customization. It also supports Wiegand output formats of 26-bit, 34-bit, and 42-bit through custom firmware options. The module is firmware upgradeable with an integrated bootloader, facilitating easy updates and the development of custom firmware.
- **Operating Voltage:** The SM521X series operate between 3.3V and 5V. The I/O voltage levels and tolerances may vary based on the chipset (HW1/HW20) employed. For more detailed information, please refer to the *Pin Descriptions* section.



SM5210-MINI-HW1 SM5211-SMD-HW1

Fig. 1.1: SM521X-HW1 Modules



SM5210-MINI-HW20 SM5211-SMD-HW20 SM5212-uSMD-HW20

Fig. 1.2: SM521X-HW20 Modules

CHAPTER 2

FEATURES

- **Complete** 13.56MHz ISO14443A Mifare® Classic Read/Write module
- Supports **read/write/auth** operations for Mifare® Classic 1K, 4K, Ultralight
- Supports **reading Unique Identifier (UID)** of all ISO1443A tags, including NFC Tags, Mifare® DESFire, Mifare® Plus, Mifare® Ultralight C, and NFC devices like smartphones.
- **UART** and **I2C** Communication Interfaces
- **Wide Operating Voltage Range**: 3.3V to 5V
- **Read Range**: Typically around 7.5 cm ($\pm$2.5 cm) depending on the tag type and antenna size
- **Wiegand** 26-bit / 34-bit / 42-bit output format support
- The SM521X series comes in **DIP**, **SMD**, and **uSMD** form factors to suit various application needs.

Firmware and Communication Interfaces

- The firmware is designed for efficient application integration, ensuring the module meets specific requirements.
- Integrated **bootloader** for easy **firmware updates** and custom firmware implementation
- Supports **UART** and **I2C** communication interfaces for seamless integration
- **UART** baud rate: 9600bps to 115200bps, **I2C** up to 400KHz
- UART supports DE pin for **RS485** communication
- Utilizes **SPV1** protocol and rich **API** for smooth integration and functionality

Advanced GPIO Control

- Advanced non-blocking **GPIO** control
- **Buzzer (DC and PWM)** support for audio feedback
- Configurable GPIOs for **custom applications**
- **RGB LED** support for customized board designs

Long-Term Availability and Support

- Long-term availability (10+ years) and continued support for legacy designs
- Comprehensive technical support, including updated documentation and firmware upgrades
- Customization services available for tailored solutions

CHAPTER 3

SM521X COMPARISON

3.1 Package Differences

Each module is tailored for specific application needs, offering a range of sizes and mounting options, with the same functionalities.

Table 3.1: Comparison of SM521X Modules

	SM5210-MINI (HW1/HW20)	SM5211-SMD (HW1/HW20)	SM5212-uSMD (HW20)
Package	MINI20	SMD20	uSMD20
Size	2.7 x 2.2 cm	2.0 x 2.2 cm	1.5 x 1.5 cm
Mount Type	Through-hole	SMD pads	SMD pads
Pitch Size	2 mm	2 mm	1.27 mm
125 kHz Pinout Compatibility	SM1250B-MINI	SM1251-SMD	SM1252-uSMD

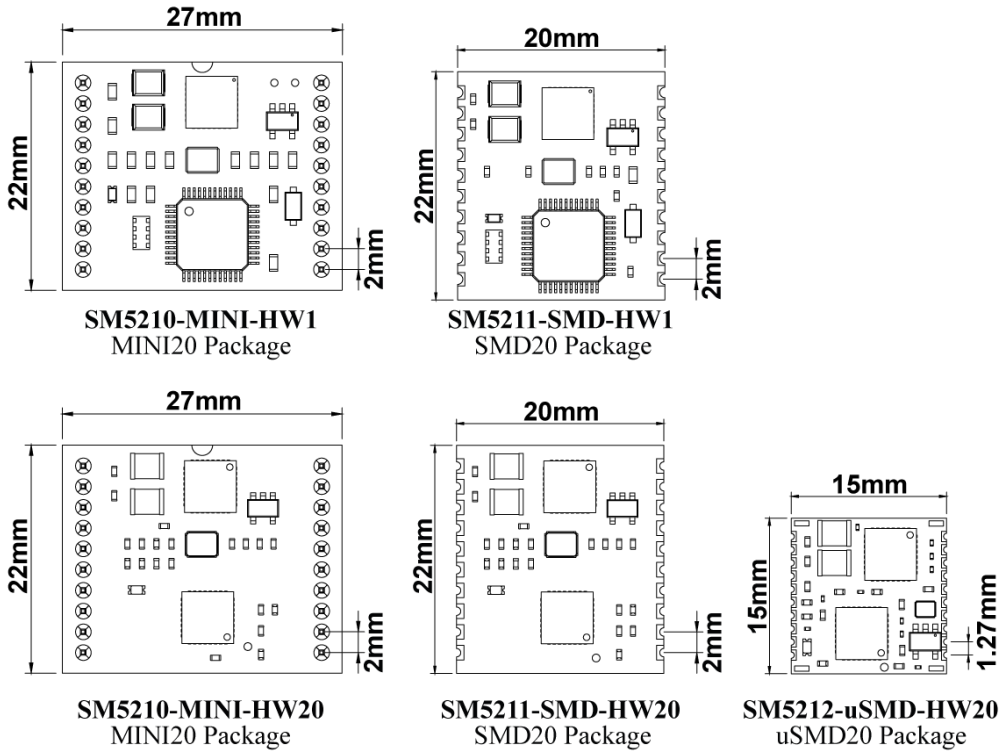


Fig. 3.1: SM521X Package Comparison

3.2 Chipset Differences

The SM5210-MINI and SM5211-SMD modules are available in two chipset configurations: HW1 and HW20, and the SM5212-uSMD module is available with the HW20 chipset. The HW1 and HW20 chipsets offer identical functionality and features, with differences in the MCU, I/O voltage levels, and tolerances.

HW1 and HW20 modules are pin-compatible, allowing for easy migration between the two chipsets.

Table 3.2: Comparison of HW1 and HW20 Chipsets

	HW1	HW20
Supply Voltage (VDD)	3.3V - 5V	3.3V - 5V
I/O Level	3.3V Fixed	Matches VDD (3.3V - 5V)
I/O Tolerance	5V Tolerant	Matches VDD (3.3V - 5V)
Firmware	HW1 type firmware	HW20 type firmware

CHAPTER 4

POWER DOMAIN

While the HW1 and HW20 modules are pin-to-pin compatible, the I/O voltage levels and tolerances may vary depending on the supplied power and specific module.

Table 4.1: Comparison of HW1 and HW20 Chipsets Power Domain

	HW1	HW20
Supply Voltage (VDD)	3.3V - 5V	3.3V - 5V
I/O Level	3.3V Fixed	Matches VDD (3.3V - 5V)
I/O Tolerance	5V Tolerant	Matches VDD

HW1 Power Domain

HW1 modules (SM5210-MINI-HW1 and SM5211-SMD-HW1) feature an internal 3.3V LDO regulator and can be powered with either 3.3V or 5V. The 3.3V LDO regulator output is connected to both the internal mixed signal chip and the MCU. The I/O level is fixed at 3.3V and is 5V tolerant. This means the HW1 chipset can be used with both 3.3V and 5V systems without any special considerations for 5V tolerance.

HW20 Power Domain

HW20 modules (SM5210-MINI-HW20, SM5211-SMD-HW20, and SM5212-uSMD-HW20) feature an internal 3.3V LDO regulator and can be powered with either 3.3V or 5V. Unlike the HW1 modules, the 3.3V LDO regulator output is connected only to the internal mixed signal chip, and the MCU is powered directly from the VDD pin. The I/O level and tolerance are dependent on the VDD voltage, ensuring compatibility with various applications.

The SM5210-MINI-HW20, SM5211-SMD-HW20, and SM5212-uSMD-HW20 modules are designed to offer flexibility in power supply options, allowing users to select between 3.3V and 5V based on their application requirements. The module's I/O level and tolerance are directly linked to the VDD voltage, ensuring compatibility with various applications.

Attention: HW20 Power Considerations

- If the module is supplied with 3.3V, the pins are not 5V tolerant.
- If the module is supplied with 5V, the supply voltage should not exceed **5.1V**. Therefore, it's strongly recommended to use a diode to protect the module from overvoltage as systems may have tolerances exceeding this limit, such as USB ports and power adapters.

CHAPTER 5

CONNECTION PINOUT DIAGRAM

Note: Depending on the firmware version, the SM521X modules can be configured to operate in two different pinout configurations, Type A and Type B. Type B configuration, used in newer firmware versions, supports driving a PWM buzzer in addition to a DC buzzer. For new designs, it is recommended to use Type B.

5.1 SM5210-MINI Pinout

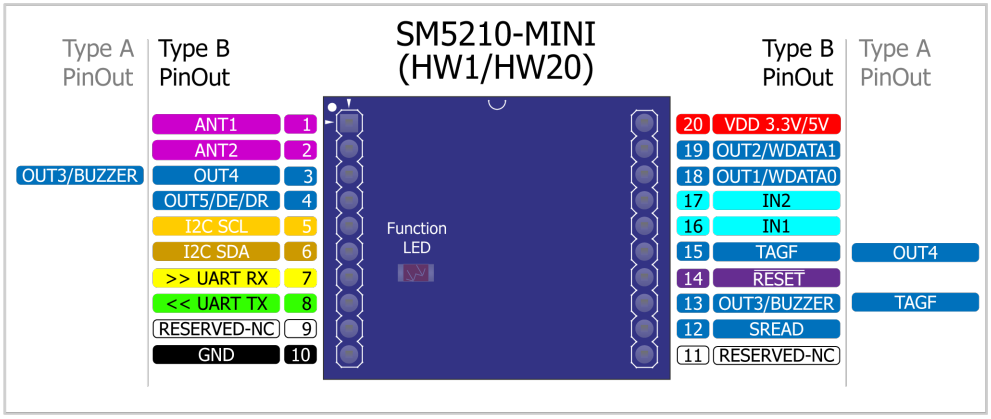


Fig. 5.1: SM5210-MINI Connection Pinout Diagram

5.2 SM5211-SMD Pinout

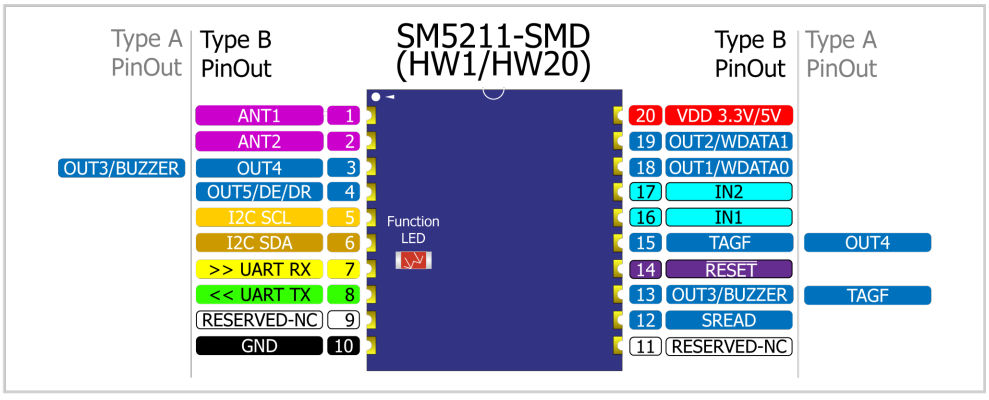


Fig. 5.2: SM5211-SMD Connection Pinout Diagram

5.3 Pin Description for SM5210-MINI and SM5211-SMD

Pin #	Name	Level/Tolerance		Description
		HW1 Chipset	HW20 Chipset	
1	ANT1	-	-	Antenna Drive Pin 1: Connect to either the Ant1 or Ant2 pin of the PCB antenna.
2	ANT2	-	-	Antenna Drive Pin 2: Has a 180-degree phase difference with ANT1. Connect to the other pin of the PCB antenna.
* 3	**TypeA:** OUT3/BUZZER	**3.3V / 3.3V**	**VDD / VDD**	For a Type A connection, this pin can be used to drive a DC buzzer with supported firmware commands and features, or as a general-purpose output pin, with its states controlled by the ADVANCED_OUTPUT command. For PWM buzzer option TYPE B connection is required. See Pin# 13.
	TypeB: OUT4			For a Type B connection, this pin functions as a general-purpose output pin, and its states can be controlled by the ADVANCED_OUTPUT command.
4	OUT5/DE/DR	**3.3V / 5V**	**VDD / VDD**	This pin is multifunctional. It can be used for RS485, I2C, or as a general-purpose output. In RS485 mode, it functions as a DE (Data Enable) pin compatible with an RS485 transceiver IC. For I2C, it can optionally be used to signal the master (by setting it High) that data is ready for polling.
5	I2C SCL	**3.3V / 5V**	**VDD / VDD**	I2C Clock. External pull-up resistor is required. I2C must be enabled thru configuration.
6	I2C SDA	**3.3V / 5V**	**VDD / VDD**	I2C Data. External pull-up resistor is required. I2C must be enabled thru configuration.
7	UART RX	**3.3V / 5V**	**VDD / VDD**	UART RX. This pin receives data from the UART interface. It should be connected to the designated transmit (TX) pin of the external controller or the transmit (TX) pin of the RS232/RS485/FT232 interface chip. If not used, connect a pull-up resistor to prevent it from floating and processing random noise. To enable onboard upgrading and configuration via a USB-UART converter, it is recommended to isolate the module's UART RX/TX pins from your external MCU using jumpers (or 0 Ω resistors)
8	UART TX	**3.3V / 5V**	**VDD / VDD**	UART Transmit pin of the module. It should be connected to the UART RX (Receive) pin of the external controller or the relevant pin of an RS232/RS485/FT232 interface chip. It is recommended to connect the UART pins and isolate the UART RX/TX pin of the module using jumpers (or 0 Ω resistors) from your external MCU. This supports onboard upgrading and/or configuring settings via a USB-UART converter.
9	RESERVED NC	-	-	Reserved - No Connection. This pin is reserved for internal use only and must be left floating.
10	GND	-	-	Ground.
11	RESERVED NC	-	-	Reserved - No Connection. This pin is reserved for internal use only and must be left floating.
12	SREAD	**3.3V / 3.3V**	**VDD / VDD**	Status Read. This pin can be connected to an LED for visual feedback or used as a general-purpose I/O. Its behavior may change depending on the firmware version. Standard firmware options include: indicating the search for a tag, flashing on tag detection, or having no effect, allowing the user to use it as a general-purpose output controlled by the ADVANCED_OUTPUT command.
* 13	**TypeA:** TAGF	**3.3V / 3.3V**	**VDD / VDD**	Tag Found. For a Type A connection, this pin can be connected to an LED for visual feedback or used as a general-purpose I/O. Its behavior may change depending on the firmware version. Standard firmware options include: a single pulse on tag detection, success/failure indication for tag activation, or no effect, allowing the user to use it as a general-purpose output controlled by the ADVANCED_OUTPUT command.
	TypeB: OUT3/BUZZER			For a Type B connection, this pin can be used to drive a DC or PWM buzzer with supported firmware commands and features, or as a general-purpose output pin, with its states controlled by the ADVANCED_OUTPUT command.
14	RESET	**3.3V / 5V**	**VDD / VDD**	Active Low Reset Pin: A logic low pulse will reset the module. It can be left floating as it has an internal resistor and capacitor circuit to prevent parasitic resets, or it can be connected to the external microcontroller output pin.
* 15	**TypeA:** OUT4	**3.3V / 3.3V**	**VDD / VDD**	For a Type A connection, this pin functions as a general-purpose output pin, and its states can be controlled by the ADVANCED_OUTPUT command.
	TypeB: TAGF			Tag Found. For a Type B connection, this pin can be connected to an LED for visual feedback or used as a general-purpose I/O. Its behavior may change depending on the firmware version. Standard firmware options include: a single pulse on tag detection, success/failure indication for tag activation, or no effect, allowing the user to use it as a general-purpose output controlled by the ADVANCED_OUTPUT command.
16	IN1	**3.3V / 5V**	**VDD / VDD**	This pin is an input pin. Input state can be read by relevant command.
17	IN2	**3.3V / 5V**	**VDD / VDD**	This pin is an input pin. Input state can be read by relevant command.
18	OUT1/WDATA0	**3.3V / 3.3V**	**VDD / VDD**	This pin can be used as an output pin, with its states controlled by the ADVANCED_OUTPUT command. Alternatively, this pin can be used for Wiegand Data 0 output with supporting firmware. Standard firmware versions may not support Wiegand output; please request Wiegand-enabled firmware if needed.
19	OUT2/WDATA1	**3.3V / 3.3V**	**VDD / VDD**	This pin can be used as an output pin, with its states controlled by the ADVANCED_OUTPUT command. Alternatively, this pin can be used for Wiegand Data 1 output with supporting firmware. Standard firmware versions may not support Wiegand output; please request Wiegand-enabled firmware if needed.
20	VDD	**VDD (3.3V-5V)**	**VDD (3.3V-5V)**	Input Supply Voltage (3.3V-5V).

5.4 SM5211-uSMD Pinout

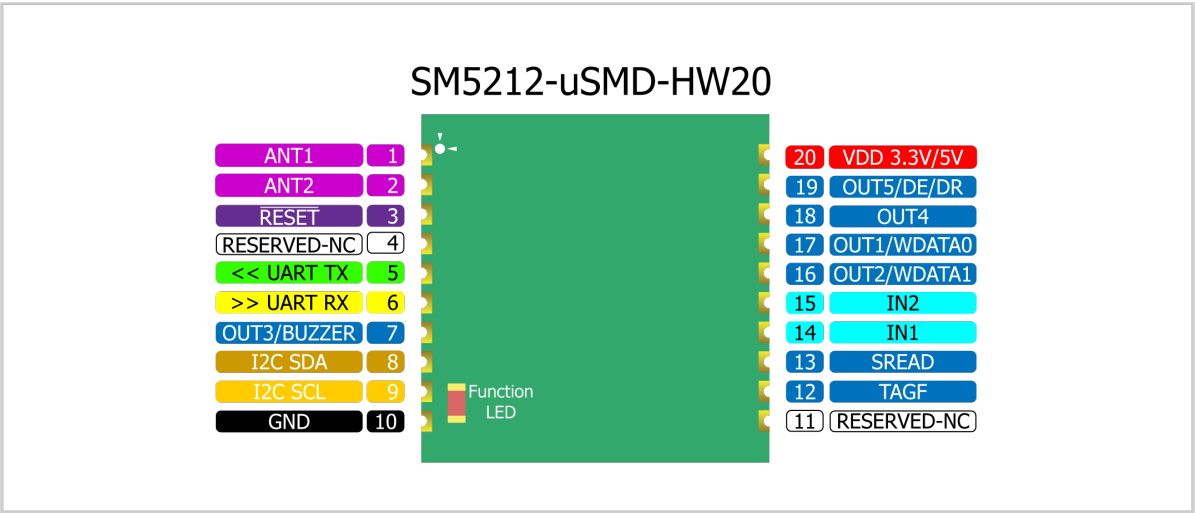


Fig. 5.3: SM5212-uSMD Connection Pinout Diagram

5.5 SM5212-uSMD Pin Descriptions

Pin #	Name	Level/Tolerance	Description
1	ANT1	-	Antenna Drive Pin 1: Connect to either the Ant1 or Ant2 pin of the PCB antenna.
2	ANT2	-	Antenna Drive Pin 2: Has a 180-degree phase difference with ANT1. Connect to the other pin of the PCB antenna.
3	RESET	**VDD / VDD**	Active Low Reset Pin: A logic low pulse will reset the module. It can be left floating as it has an internal resistor and capacitor circuit to prevent parasitic resets, or it can be connected to the external microcontroller output pin.
4	RESERVED NC	-	Reserved - No Connection. This pin is reserved for internal use only and must be left floating.
5	UART TX	**VDD / VDD**	UART Transmit pin of the module. It should be connected to the UART RX (Receive) pin of the external controller or the relevant pin of an RS232/RS485/FT232 interface chip. It is recommended to connect the UART pins and isolate the UART RX/TX pin of the module using jumpers (or 0 Ω resistors) from your external MCU. This supports onboard upgrading and/or configuring settings via a USB-UART converter.
6	UART RX	**VDD / VDD**	UART RX. This pin receives data from the UART interface. It should be connected to the designated transmit (TX) pin of the external controller or the transmit (TX) pin of the RS232/RS485/FT232 interface chip. If not used, connect a pull-up resistor to prevent it from floating and processing random noise. To enable onboard upgrading and configuration via a USB-UART converter, it is recommended to isolate the module's UART RX/TX pins from your external MCU using jumpers (or 0 Ω resistors)
7	OUT3/BUZZER	**VDD / VDD**	This pin can be used to drive a DC or PWM buzzer with supported firmware commands and features, or as a general-purpose output pin, with its states controlled by the ADVANCED_OUTPUT command.
8	I2C SDA	**VDD / VDD**	I2C Data. External pull-up resistor is required. I2C must be enabled thru configuration.
9	I2C SCL	**VDD / VDD**	I2C Clock. External pull-up resistor is required. I2C must be enabled thru configuration.
10	GND	-	Ground.
11	RESERVED NC	-	Reserved - No Connection. This pin is reserved for internal use only and must be left floating.
12	TAGF	**VDD / VDD**	Tag Found. This pin can be connected to an LED for visual feedback or used as a general-purpose I/O. Its behavior may change depending on the firmware version. Standard firmware options include: a single pulse on tag detection, success/failure indication for tag activation, or no effect, allowing the user to use it as a general-purpose output controlled by the ADVANCED_OUTPUT command.
13	SREAD	**VDD / VDD**	Status Read. This pin can be connected to an LED for visual feedback or used as a general-purpose I/O. Its behavior may change depending on the firmware version. Standard firmware options include: indicating the search for a tag, flashing on tag detection, or having no effect, allowing the user to use it as a general-purpose output controlled by the ADVANCED_OUTPUT command.
14	IN1	**VDD / VDD**	This pin is an input pin. Input state can be read by relevant command.
15	IN2	**VDD / VDD**	This pin is an input pin. Input state can be read by relevant command.
16	OUT2/WDATA1	**VDD / VDD**	This pin can be used as an output pin, with its states controlled by the ADVANCED_OUTPUT command. Alternatively, this pin can be used for Wiegand Data 1 output with supporting firmware. Standard firmware versions may not support Wiegand output; please request Wiegand-enabled firmware if needed.
17	OUT1/WDATA0	**VDD / VDD**	This pin can be used as an output pin, with its states controlled by the ADVANCED_OUTPUT command. Alternatively, this pin can be used for Wiegand Data 0 output with supporting firmware. Standard firmware versions may not support Wiegand output; please request Wiegand-enabled firmware if needed.
18	OUT4	**VDD / VDD**	For a Type B connection, this pin functions as a general-purpose output pin, and its states can be controlled by the ADVANCED_OUTPUT command.
19	OUT5/DE/DR	**VDD / VDD**	This pin is multifunctional. It can be used for RS485, I2C, or as a general-purpose output. In RS485 mode, it functions as a DE (Data Enable) pin compatible with an RS485 transceiver IC. For I2C, it can optionally be used to signal the master (by setting it High) that data is ready for polling.
20	VDD	**VDD (3.3V-5V)**	Input Supply Voltage (3.3V-5V).

5.6 FLED (Function LED) Indication

The SM5210-MINI, SM5211-SMD and SM5212-uSMD modules feature a red on-board LED (FLED) that assists in indicating operational states:

- **Power-up**: Upon initial power-on, the FLED blinks once, signifying that the module is successfully running the firmware.
- **Command Reception**: The FLED blinks once when a command is successfully received via UART or I2C.
- **Boot Mode**: Continuous blinking of the FLED indicates that the module is in boot mode and ready for firmware upgrades.

The FLED is not user-configurable and is solely intended for system status indication.

CHAPTER 6

HARDWARE INTERFACE PRECAUTIONS

6.1 UART Interface

Attention:

- Never connect the UART pins directly to an RS232 device, as RS232 signals (+/-12V) can damage the module. If necessary, use a USB to UART or UART to RS232 interface.

6.1.1 HW1 UART Interface

HW1 modules (SM5210-MINI-HW1 and SM5211-SMD-HW1) UART I/O signals are CMOS/TTL level compliant and 5V tolerant:

- **UART TX Output**: The output signal level is 3.3V.
- **UART RX Input**: Can be connected to any 3.3V or 5V controller's UART TX output as it is 5V tolerant.

6.1.2 HW20 UART Interface

HW20 modules (SM5210-MINI-HW20, SM5211-SMD-HW20, and SM5212-uSMD-HW20) UART I/O signals are VDD level compliant: 3.3V or 5V.

- **UART TX Output**: The output signal level is VDD. If supplied with 5V, the UART RX input of the external controller must be 5V tolerant.
- **UART RX Input**: Tolerant to VDD level. If the module is supplied with 3.3V, the UART TX output of the external controller must be 3.3V or provide level shifting to protect the module.

Attention:

- Consider using level shifters if the external controller's VDD level is different from the module's VDD level.

6.2 RS485 Interface

6.2.1 RS485 Interface for SM521X Modules

The modules support RS485 using the DE (Data Enable) signal and a node address byte in the SPV1 protocol frame:

- Ensure proper RS485 infrastructure, such as cabling and termination resistors, for reliable communication.
- Firmware upgrades over RS485 are not supported.

Attention: It is crucial to have a proper understanding of the RS485 interface and infrastructure setup. Random or star-style connections can lead to communication issues in midterm even if initially successful.

6.3 I2C Interface

6.3.1 HW1 I2C Interface

The HW1 modules support I2C communication, which is disabled by default and can be enabled via configuration commands or software tools:

- I2C signal levels are CMOS/TTL level compliant and 5V tolerant.
- External pull-up resistors are required for I2C communication.

6.3.2 HW20 I2C Interface

The HW20 modules support I2C communication, which is disabled by default and can be enabled via configuration commands or software tools:

- I2C signal levels are **VDD level compliant**: 3.3V or 5V.
- External pull-up resistors are required for I2C communication.

Attention:

- Consider using level shifters if the external controller's VDD level is different from the module's VDD level.

CHAPTER 7

DESIGN NOTES

7.1 Antenna & Read Range

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

- **Capacitors:** Use a 10uF tantalum capacitor close to the module VDD on your board. Additionally, be aware 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:** Critical components just beneath the antenna may cause unwanted signal disturbances or failures. One affected component is the DC Buzzer. If you have to use a buzzer just beneath the antenna, it is strongly recommended to use TypeB connection and a PWM Buzzer. Otherwise, you may observe weak or deformed buzzer sounds.
- **Antenna Placement:** The Mifare module design uses directly matched PCB antennas. Try to place the antenna as close as possible to the module antenna pins. Keep the antenna tracks parallel to each other and ensure they have almost the same length and bending style.
- **External Antenna Connection:** Connecting the antenna outside the Mifare module's board with a cable may result in poor performance. In such a case, EMI effects are reduced by the filter circuit on the module side. However, it may still cause EMI problems affecting other surrounding devices. If the antenna needs to be placed away from the module, try not to exceed 30 cm in length. The type of cable used between the antenna and the module is very important. Some cables may cause extremely reduced performance. Flex data cables give better results and have less effect on read range performance compared to other types of cables. Please test your cables practically.
- **Antenna Size:** Better read range can be achieved by using a bigger antenna and a bigger tag. If you need to achieve maximum read range, consider using the biggest PCB antenna size that your design permits.
- **Metallic Interference:** The antenna and card communicate with each other through magnetic field variations. Thus, communication between the reader and the card is affected by metallic objects. Metallic objects surrounding the antenna, including the printed circuit board, copper, LCD, or metal frames, will decrease the read range. Try to place the antenna as far as possible from such metallic objects or components. Please note that it is not possible to read a card completely below a metal plane. If the surroundings include a metal frame, then using the antenna even 1 cm away from it yields better results. Please test your setup practically in such cases. Non-metallic objects, such as plastic, wood, acrylic, glass, etc., have no effect on read range performance. You can place the antenna below non-metallic planes reliably.
- **Card Variability:** Mifare cards or tags have integrated antennas tuned by the card manufacturer. Unfortunately, small variations in the tuning may vary by the card manufacturers, resulting in different read ranges. Thus, the type of the card, or the manufacturer, other than the size, is also important for read range performance. Sonmicro Mifare module and PCB antennas are designed to match by collecting the averages of different types of cards, so similar results for different manufacturers' tags are expected.
- **Voltage Regulators:** Try to use linear low dropout (LDO) voltage regulators where possible. LDO regulators, compared with switch-mode regulators, have less signal noise and yield better results for read range. If you are using a switch-mode power regulator, please ensure you have a back EMF and voltage protection diode or circuit to prevent transient high voltage ramping that can damage the module or your system.

7.2 ESD Handling

Electrostatic Discharge (ESD) precautions are essential for the safe handling of the SM130, SM130-M2-HW1, and SM130-M2-HW20 modules. The following guidelines must be followed to prevent any potential damage due to static discharge:

Attention:

- These modules are Electrostatic Sensitive Devices. Handle only in a static-free environment.
- Avoid using non-antistatic materials such as nylon, plastic, or Styrofoam for carrying or storing the modules.
- Be aware that static electricity can cause subtle, internal damage to chips, leading to potential long-term failures. ESD is a significant source of damage to electronic devices.

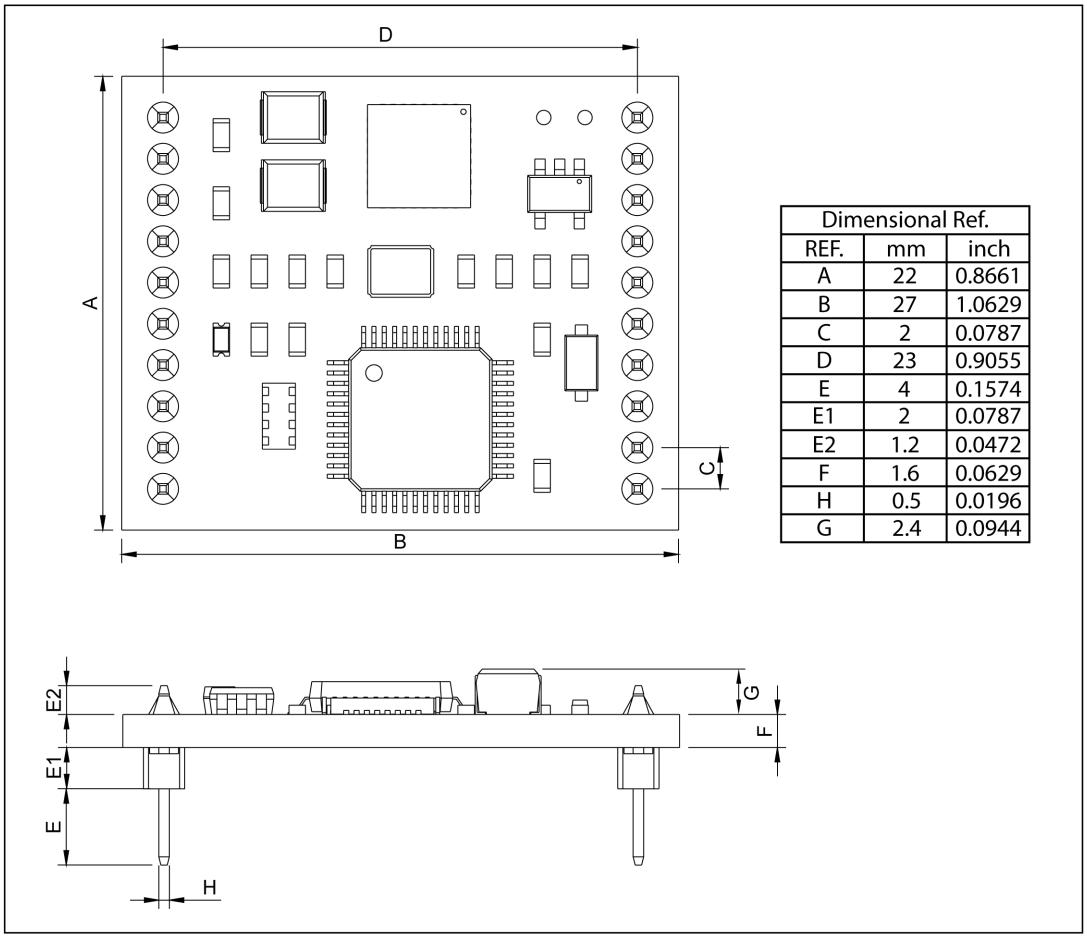
CHAPTER 8

MECHANICAL DRAWINGS

Note: Component positions may vary between different PCB revisions.

8.1 SM5210-MINI Mechanical Drawing

8.1.1 SM5210-MINI Module - MINI20 Package



Dimensional Ref.		
REF.	mm	inch
A	22	0.8661
B	27	1.0629
C	2	0.0787
D	23	0.9055
E	4	0.1574
E1	2	0.0787
E2	1.2	0.0472
F	1.6	0.0629
H	0.5	0.0196
G	2.4	0.0944

Fig. 8.1: SM5210-MINI Mechanical Drawing (MINI20 Package)

8.1.2 SM5210-MINI Module - Pin Header (2.0mm) Technical Drawing

It is recommended to use a matching 2mm female socket for plug-and-play applications. The figure below shows the technical drawing of the 2mm pin header used in the SM5210-MINI module.

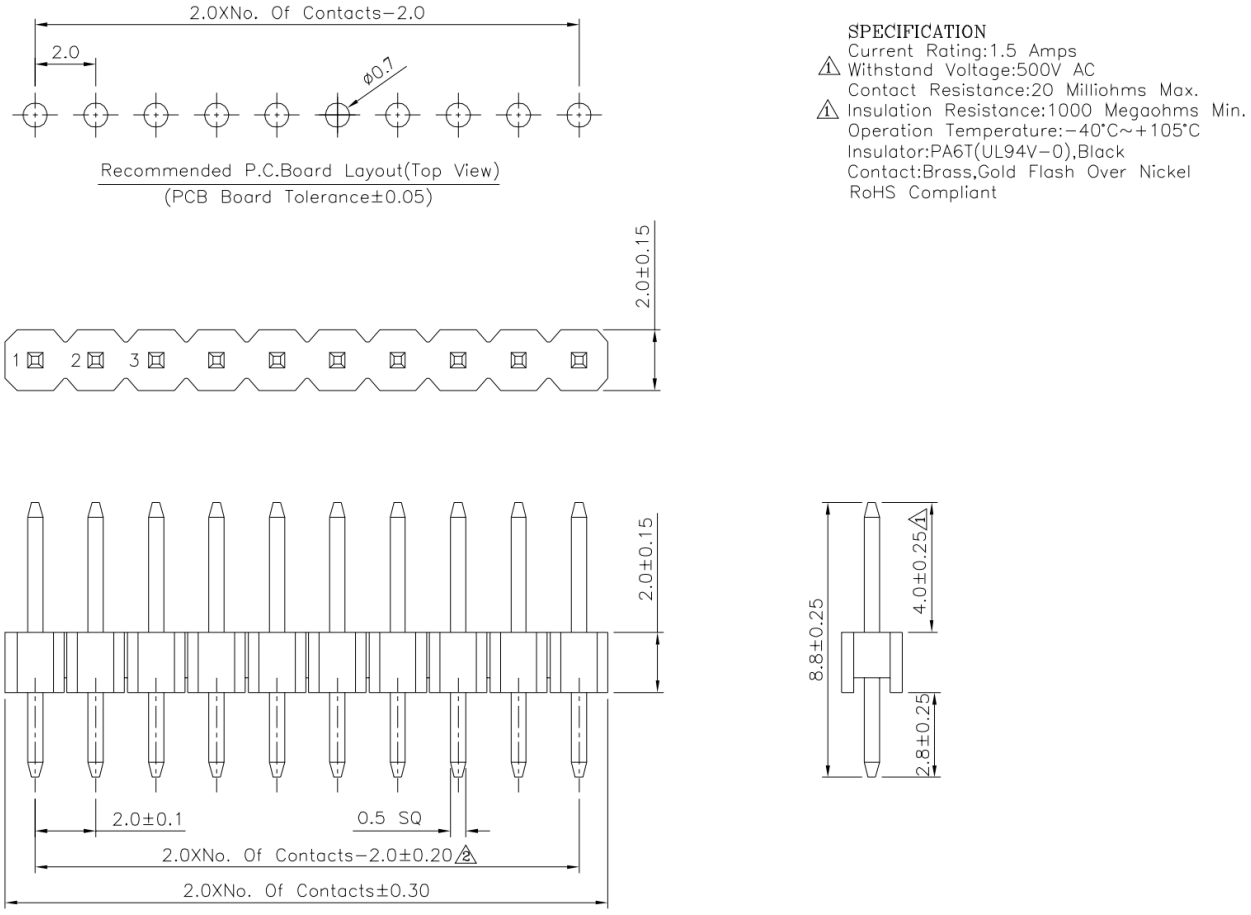
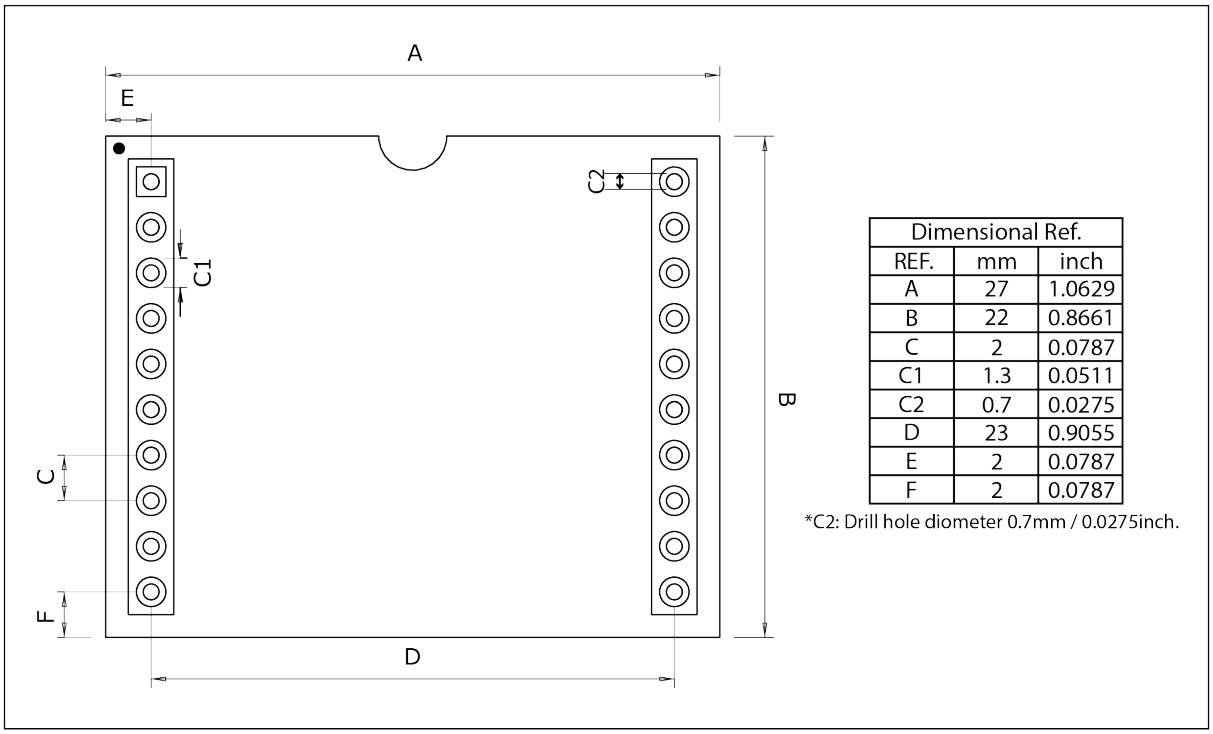


Fig. 8.2: 2mm Pin Header Technical Drawing (for SM5210-MINI)

8.1.3 SM5210-MINI PCB Footprint - MINI20 Package



Dimensional Ref.		
REF.	mm	inch
A	27	1.0629
B	22	0.8661
C	2	0.0787
C1	1.3	0.0511
C2	0.7	0.0275
D	23	0.9055
E	2	0.0787
F	2	0.0787

*C2: Drill hole diometer 0.7mm / 0.0275inch.

Fig. 8.3: Recommended PCB layout for SM5210-MINI module (MINI20 package)

8.2 SM5211-SMD Mechanical Drawing

8.2.1 SM5211-SMD Module without Shield - SMD20 Package

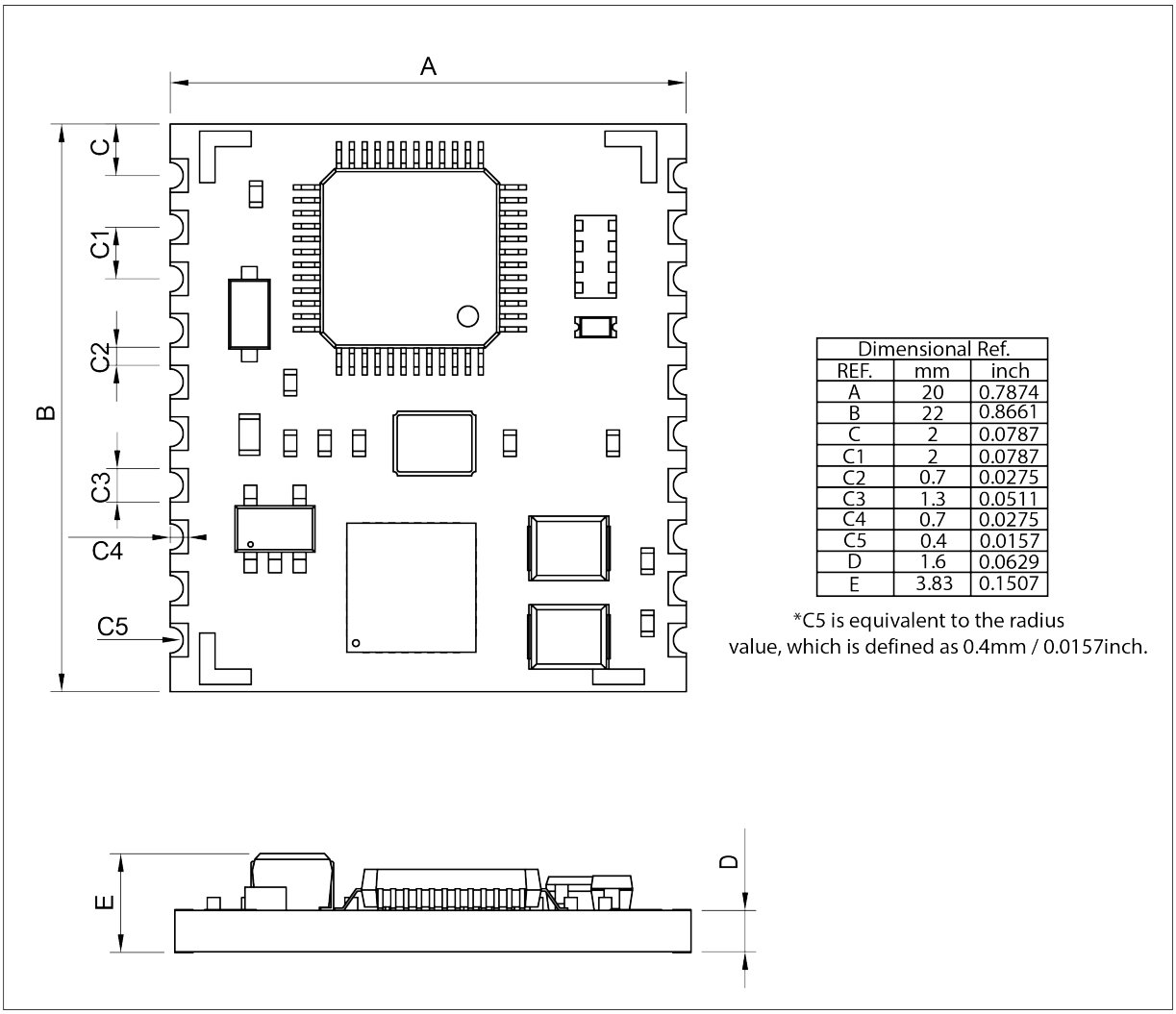
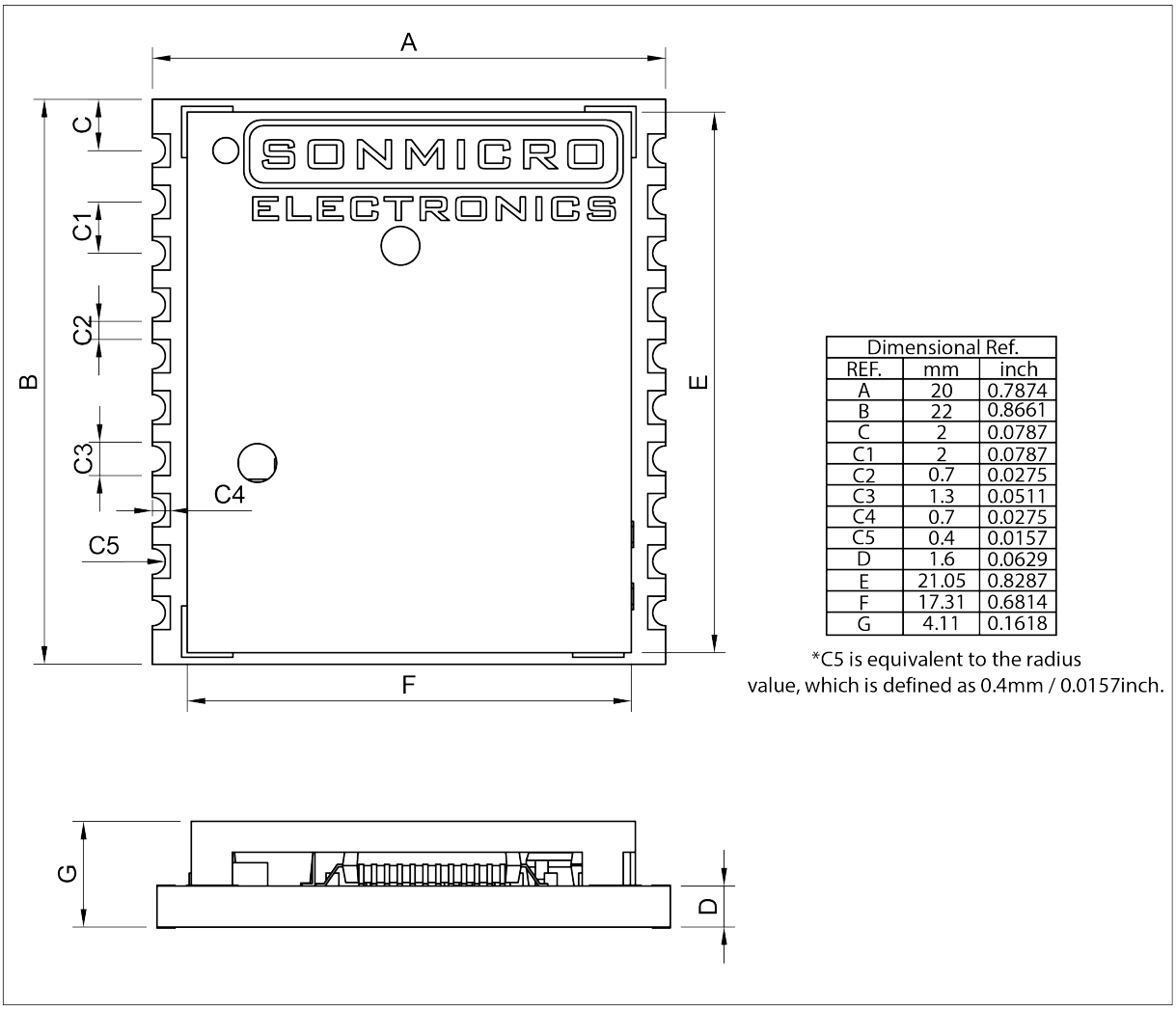


Fig. 8.4: SM5211-SMD Mechanical Drawing without Shield (SMD20 Package)

8.2.2 SM5211-SMD Module with Shield - SMD20 Package

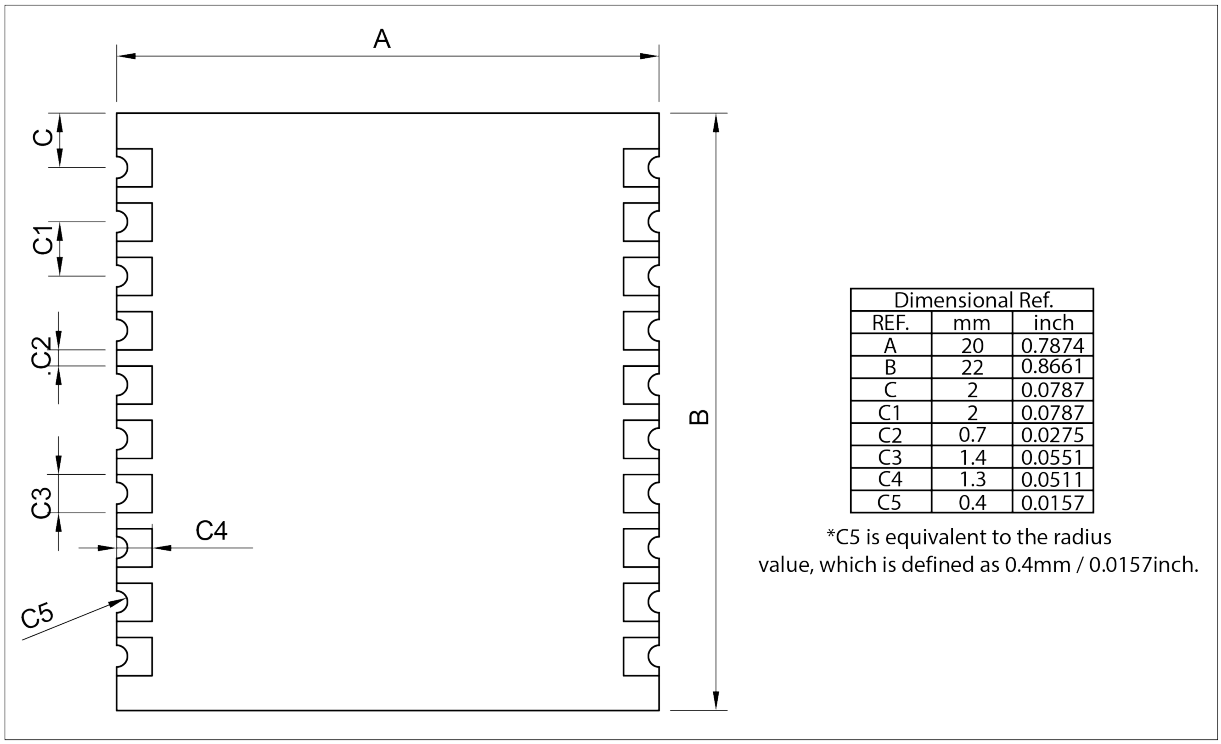


Dimensional Ref.		
REF.	mm	inch
A	20	0.7874
B	22	0.8661
C	2	0.0787
C1	2	0.0787
C2	0.7	0.0275
C3	1.3	0.0511
C4	0.7	0.0275
C5	0.4	0.0157
D	1.6	0.0629
E	21.05	0.8287
F	17.31	0.6814
G	4.11	0.1618

*C5 is equivalent to the radius value, which is defined as 0.4mm / 0.0157inch.

Fig. 8.5: SM5211-SMD Mechanical Drawing with Shield (SMD20 Package)

8.2.3 SM5211-SMD Bottom View - SMD20 Package

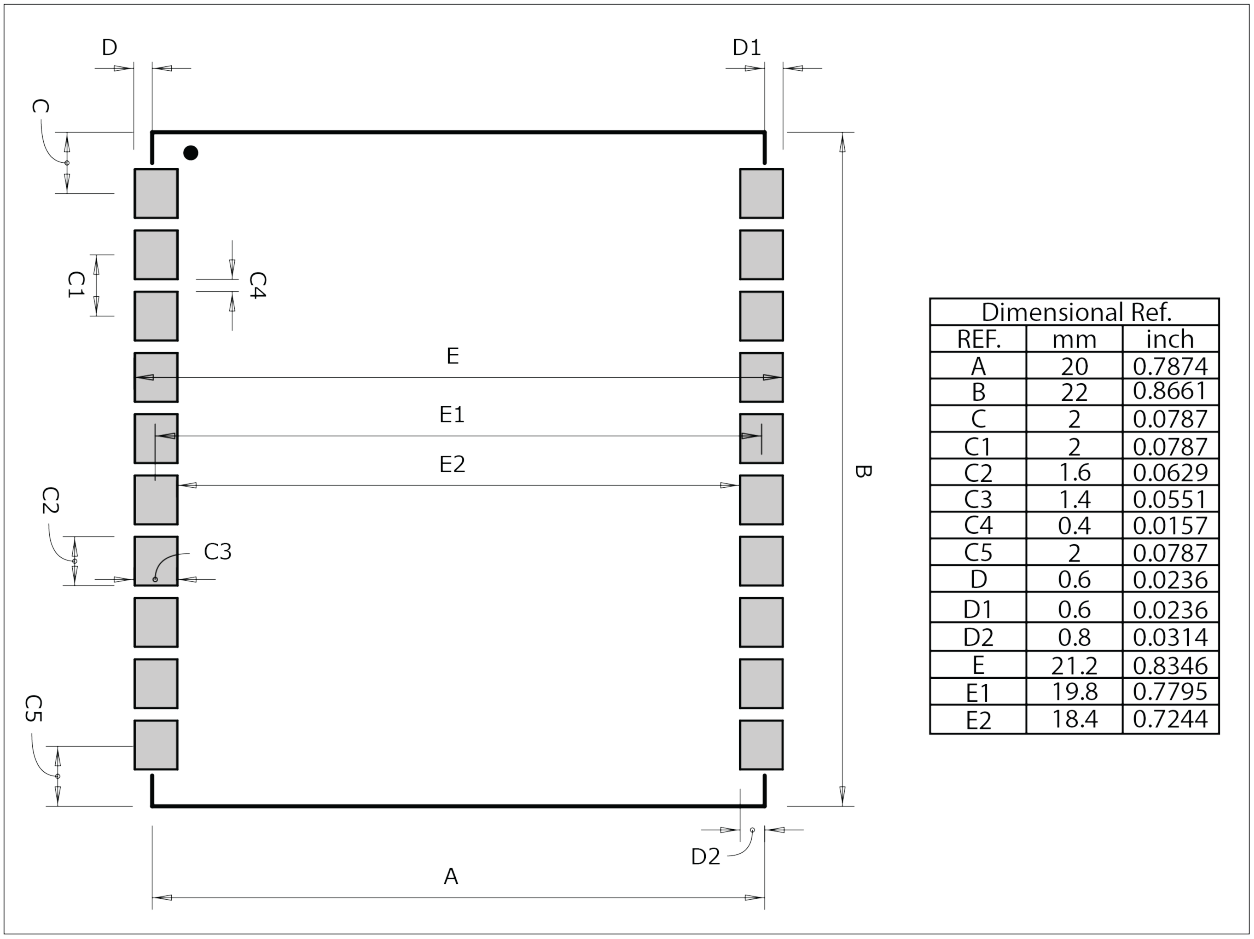


Dimensional Ref.		
REF.	mm	inch
A	20	0.7874
B	22	0.8661
C	2	0.0787
C1	2	0.0787
C2	0.7	0.0275
C3	1.4	0.0551
C4	1.3	0.0511
C5	0.4	0.0157

*C5 is equivalent to the radius value, which is defined as 0.4mm / 0.0157inch.

Fig. 8.6: SM5211-SMD Bottom View (SMD20 Package)

8.2.4 SM5211-SMD PCB Footprint - SMD20 Package



Dimensional Ref.		
REF.	mm	inch
A	20	0.7874
B	22	0.8661
C	2	0.0787
C1	2	0.0787
C2	1.6	0.0629
C3	1.4	0.0551
C4	0.4	0.0157
C5	2	0.0787
D	0.6	0.0236
D1	0.6	0.0236
D2	0.8	0.0314
E	21.2	0.8346
E1	19.8	0.7795
E2	18.4	0.7244

Fig. 8.7: Recommended PCB layout for SM5211-SMD module (SMD20 package)

8.3 SM5212-uSMD Mechanical Drawing

8.3.1 SM5212-uSMD Module without Shield - uSMD20 Package

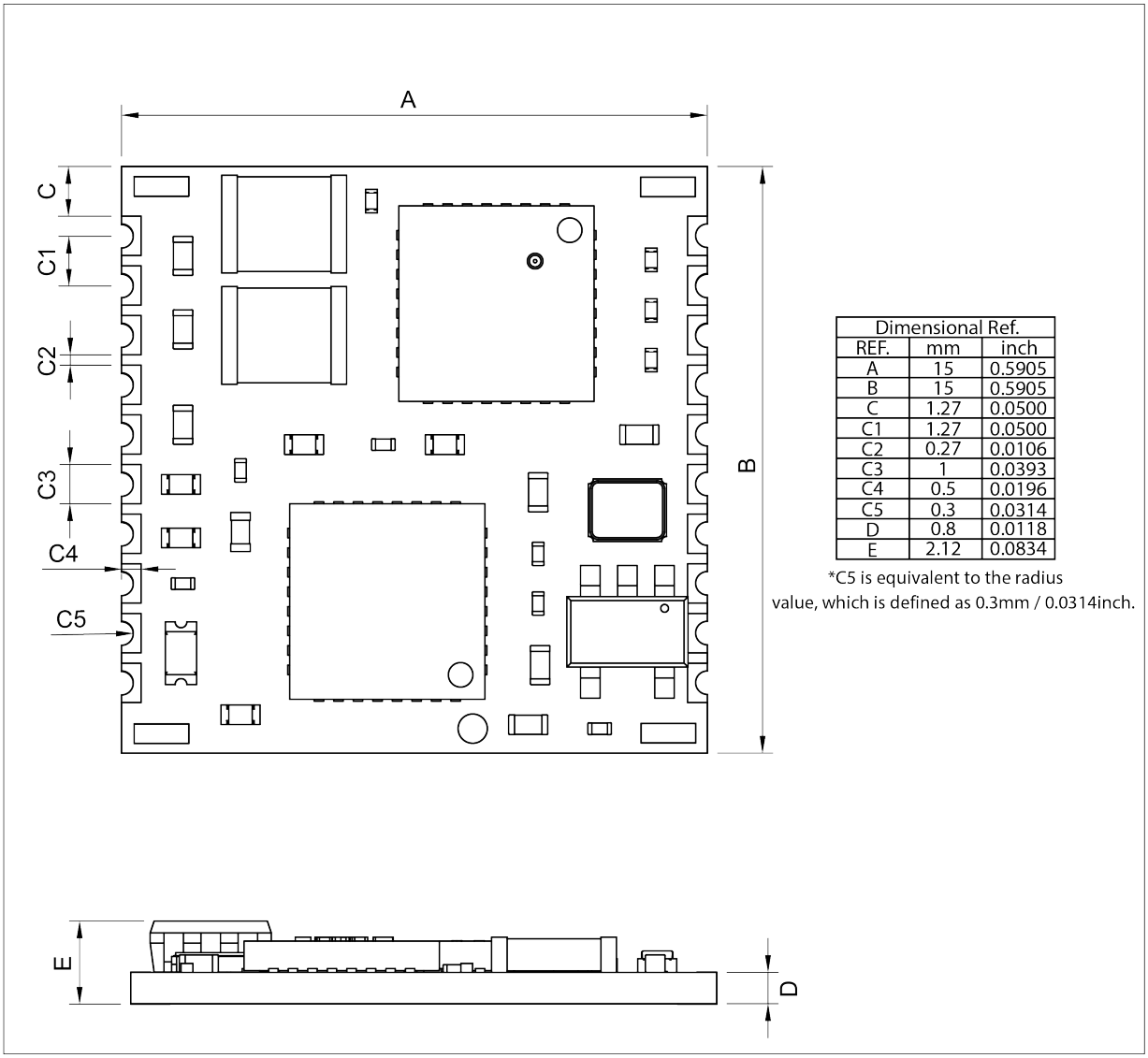
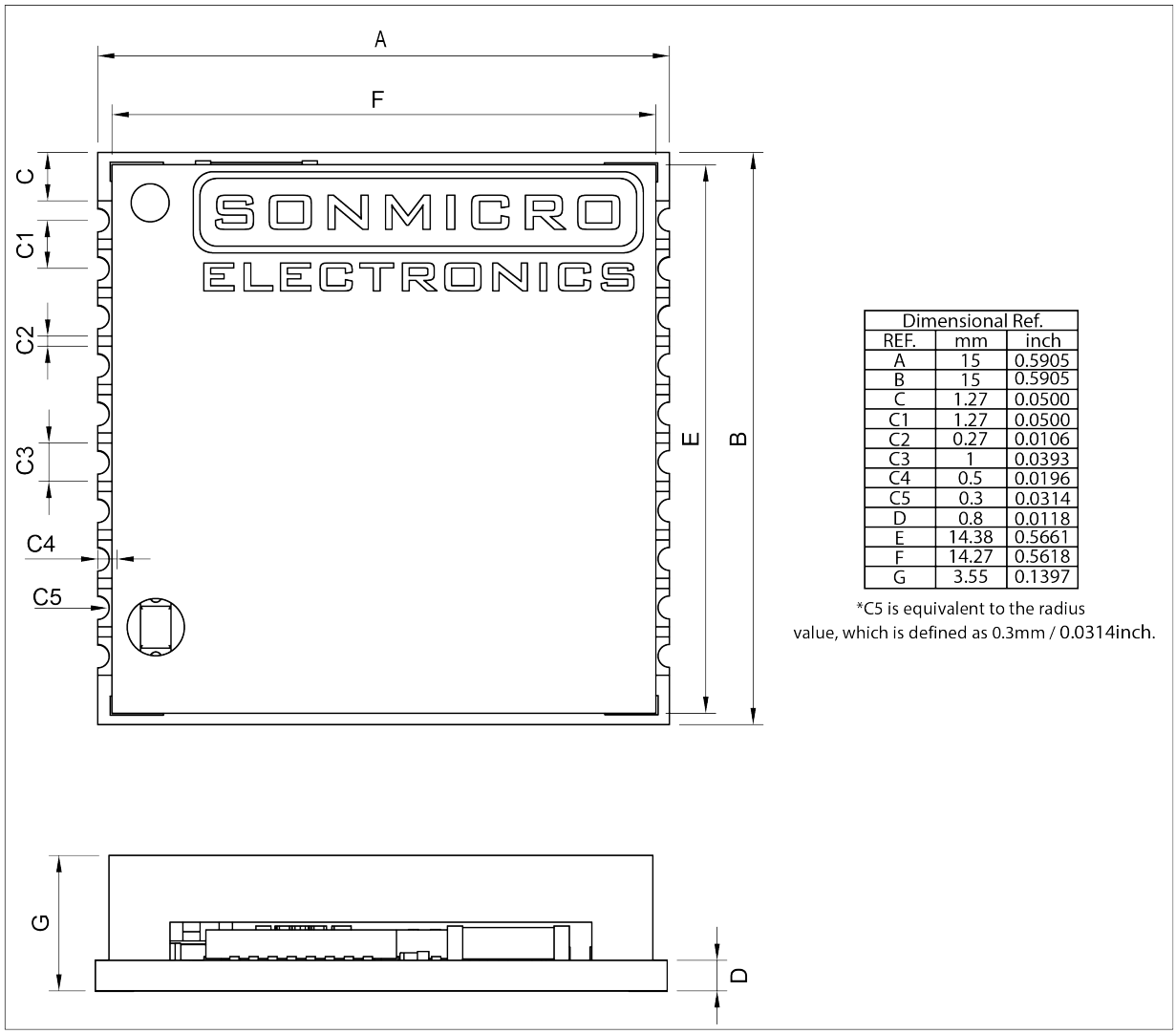


Fig. 8.8: SM5212-uSMD Mechanical Drawing without Shield (uSMD20 Package)

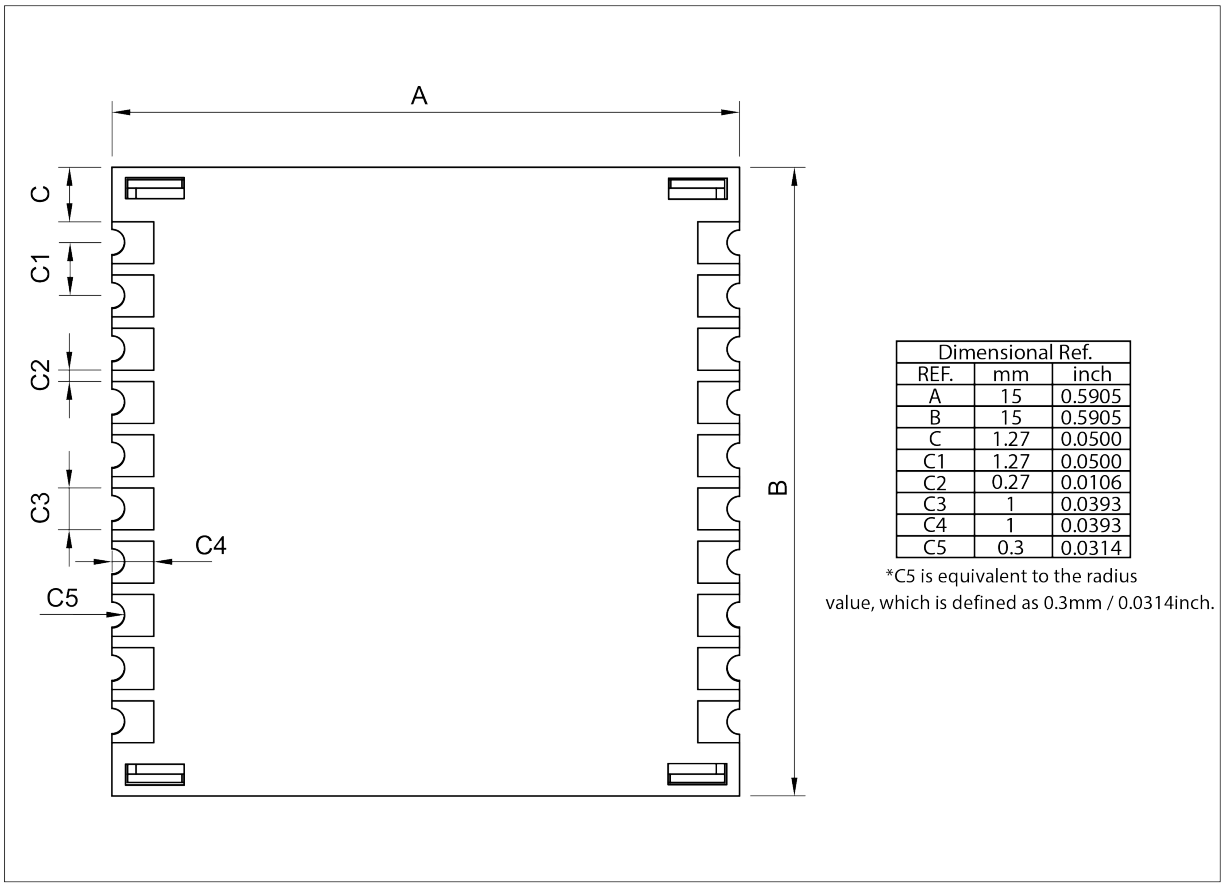
8.3.2 SM5212-uSMD Module with Shield - uSMD20 Package



Dimensional Ref.		
REF.	mm	inch
A	15	0.5905
B	15	0.5905
C	1.27	0.0500
C1	1.27	0.0500
C2	0.27	0.0106
C3	1	0.0393
C4	0.5	0.0196
C5	0.3	0.0314
D	0.8	0.0118
E	14.38	0.5661
F	14.27	0.5618
G	3.55	0.1397

Fig. 8.9: SM5212-uSMD Mechanical Drawing with Shield (uSMD20 Package)

8.3.3 SM5212-uSMD Bottom View - uSMD20 Package

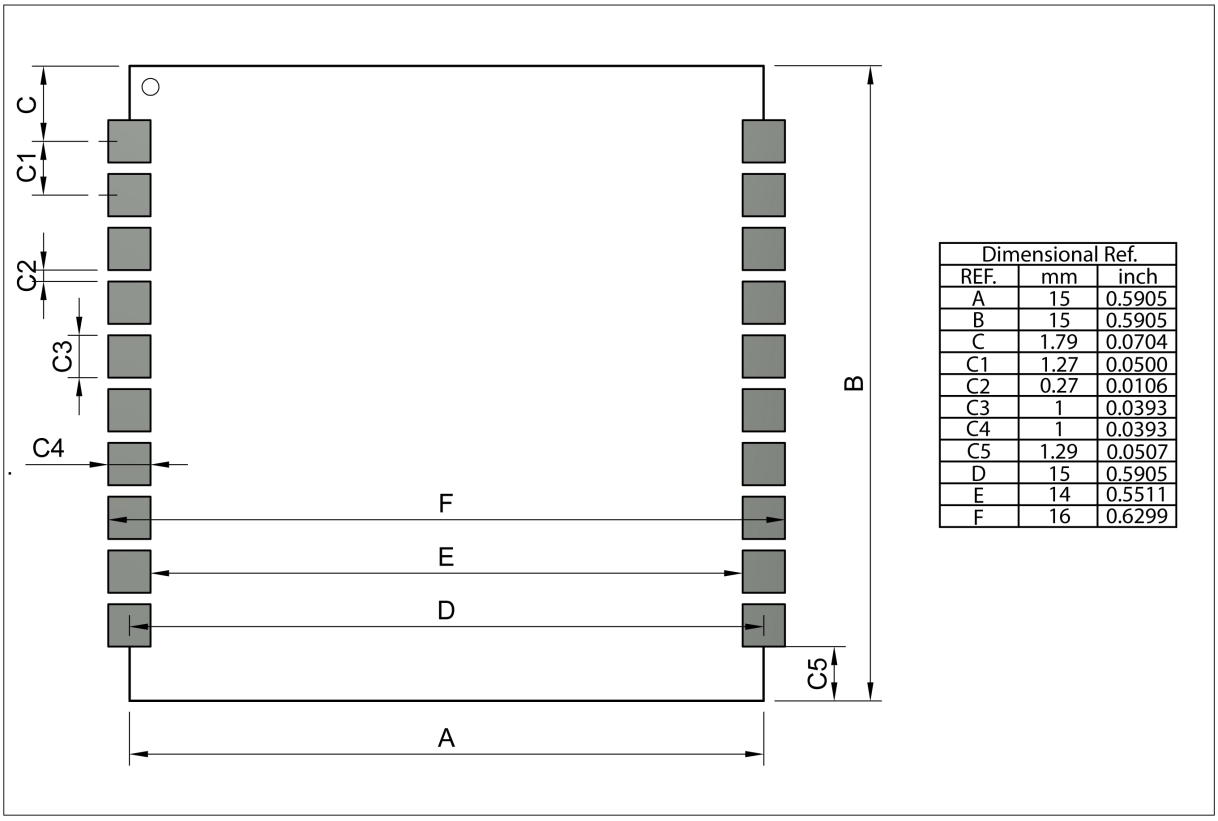


Dimensional Ref.		
REF.	mm	inch
A	15	0.5905
B	15	0.5905
C	1.27	0.0500
C1	1.27	0.0500
C2	0.27	0.0106
C3	1	0.0393
C4	1	0.0393
C5	0.3	0.0314

*C5 is equivalent to the radius value, which is defined as 0.3mm / 0.0314inch.

Fig. 8.10: SM5212-uSMD Bottom View (uSMD20 Package)

8.3.4 SM5212-uSMD PCB Footprint - uSMD20 Package



Dimensional Ref.		
REF.	mm	inch
A	15	0.5905
B	15	0.5905
C	1.79	0.0704
C1	1.27	0.0500
C2	0.27	0.0106
C3	1	0.0393
C4	1	0.0393
C5	1.29	0.0507
D	15	0.5905
E	14	0.5511
F	16	0.6299

Fig. 8.11: Recommended PCB layout for SM5212-uSMD module (uSMD20 package)

CHAPTER 9

PACKING INFORMATION

9.1 SM5210-MINI Packing Information

Attention: It is crucial to adhere to ESD handling precautions when using these products to prevent any potential damage due to static discharge.

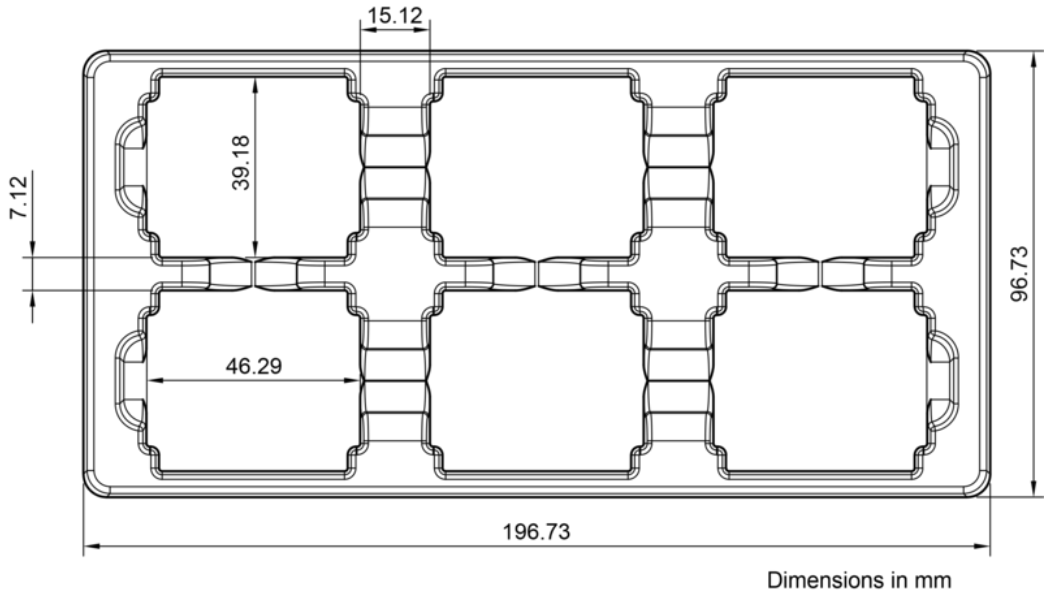


Fig. 9.1: Antistatic ESD Tray Packing Dimensions for SM5210-MINI

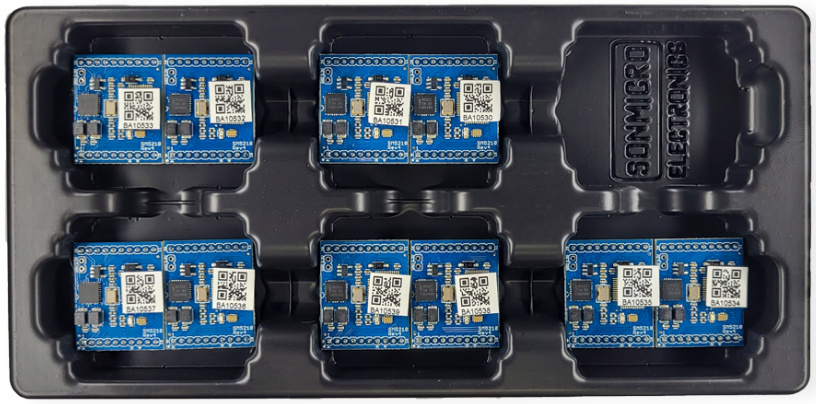


Fig. 9.2: Antistatic ESD Tray Packaging for SM5210-MINI

9.2 SM5211-SMD Packing Information

Attention: It is crucial to adhere to ESD handling precautions when using these products to prevent any potential damage due to static discharge

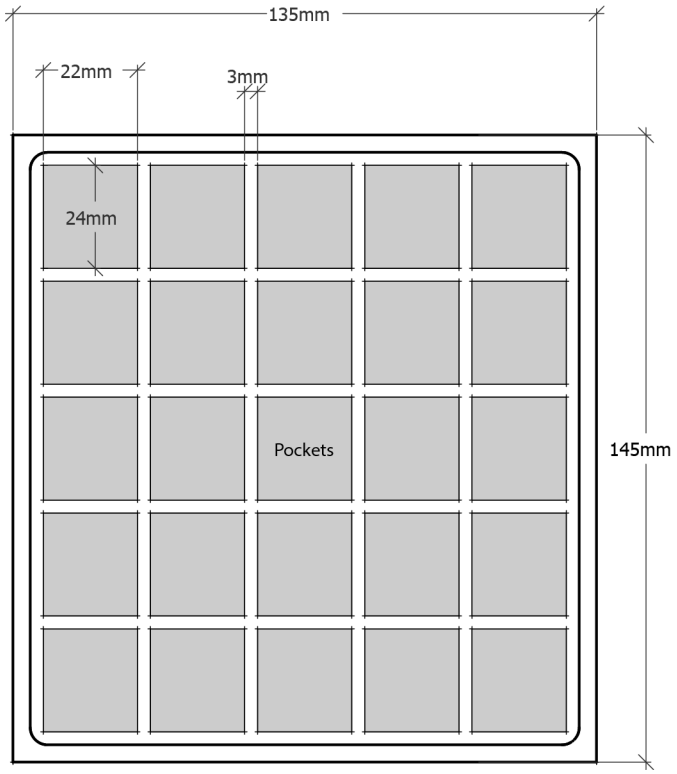


Fig. 9.3: Antistatic ESD Tray Packing Dimensions for SM5211-SMD

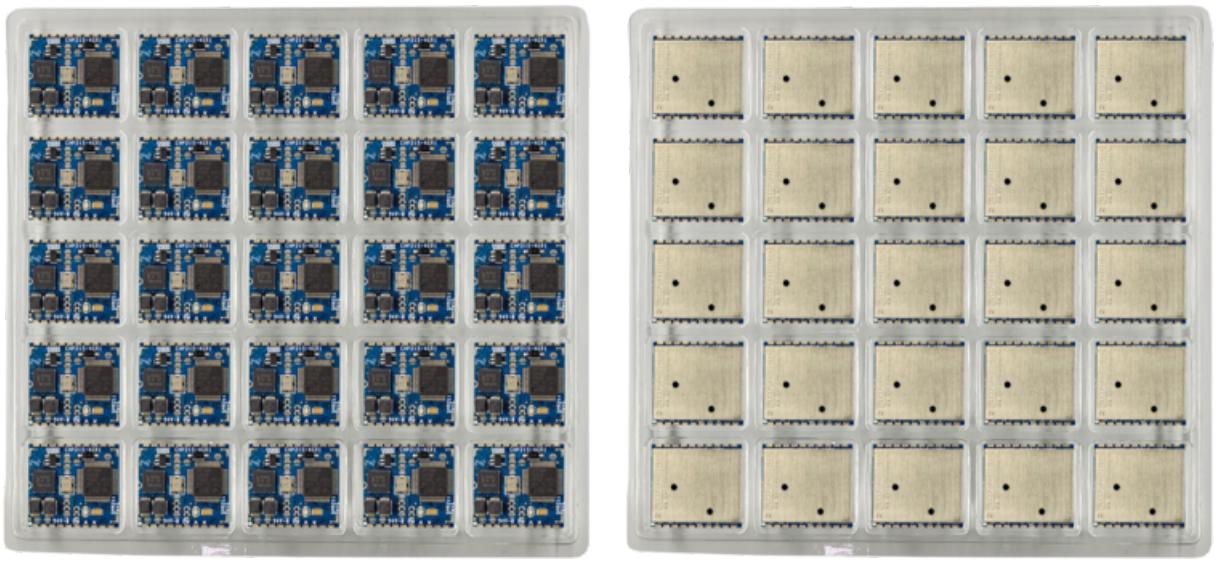


Fig. 9.4: Antistatic ESD Tray Packaging for SM5211-SMD, showing both shielded and unshielded versions.

CHAPTER 10

HARDWARE SPECIFICATIONS

10.1 DC Electrical Characteristics

Symbol	Name	HW20 Module			HW1 Module			Notes
		Min	Typ.	Max	Min	Typ.	Max	
VDD	Supply Voltage	3.0V	3.3V-5V	5.1V	3.0V	3.3V-5V	5.5V	Performance remains the same between 3.3V and 5V. For the HW20 module with a 5V supply, consider using a series diode to drop the voltage under 5.1V.
$V_{I/O}$	I/O Voltage Level		VDD		3.0V	3.3V	3.3V	
V_{IT}	Input Voltage Tolerance		VDD			5V		
I_{3V3}	Supply Current at 3.3V (RF Field On)		30-60mA	100mA		30-60mA	100mA	Supply current may vary depending on the antenna and I/O used.
I_{5V}	Supply Current at 5V (RF Field On)		30-60mA	100mA		30-60mA	100mA	Supply current may vary depending on the antenna and I/O used.
$I_{RF\text{-}field\text{-}off\text{-}3V3}$	Supply Current at 3.3V (RF Field Off)		5mA			13mA		
$I_{RF\text{-}field\text{-}off\text{-}5V}$	Supply Current at 5V (RF Field Off)		7mA			15mA		

10.2 Operating Temperature

Table 10.1: Operating Temperature

Symbol	Name	Min	Typ	Max	Units	Notes
TA	Ambient Temperature	-10	-	+70	°C	Range can extend to [-25°C, +85°C] with custom production.

10.3 Read Range

The read distance varies based on multiple factors. For best practices, refer to the *Design Notes section*.

SM521X modules (HW1/HW20) offer the same read range performance.

Read range tests are conducted under ideal conditions using the SM-USB-UART Converter to provide 5V power and a UART communication interface, with a credit card-sized Mifare tag.

Note:

- The read range may be affected by the power supply's signal noise quality.
- UID reading performance can be 0.5 cm to 1.0 cm better than the authenticate/read/write data block.

Table 10.2: Read Range Comparison

Antenna Model	Dimensions (mm)	Typical Range (cm)	Maximum Range (cm)
PA5555	55x55	7.5	8.5
PA4550	45x50	7.0	8.0
PA2645	26x45	6.5	7.5
PA3030	30x30	6.0	7.0
PA2020	20x20	3.5	4.5
PA1520	15x20	3.0	3.5

CHAPTER 11

REVISION HISTORY

Revision	Date	Changes
1.2.0	2024-07-22	Added SM5212-uSMD module specifications
1.1.1	2022-10-01	Added SM5211-SMD module specifications
1.1.0	2017-11-03	Minor document fixes
1.0.0	2017-05-01	Initial release

CHAPTER 12

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