ATSAMR21B18-MZ210PA

ATSAMR21 Smart Connect Module

PRELIMINARY DATASHEET

Description

The ATSAMR21B18-MZ210PA is a 19.7mm x 16.3mm wireless module. It integrates an ATSAMR21E18 IC together with a serial data FLASH. The design allows a variety of mounting positions with SMT as well as TH mounting. The extended temperature range with operation up to 125°C is a distinguishing feature.

Features

- ATSAMR21 Single-chip ARM® Cortex®-M0+ based 32-bit Microcontroller with Low Power 2.4GHz Transceiver for IEEE 802.15.4 and ZigBee Applications with 256KB Flash and 16 I/O's
    – Max. operating freq. 48 MHz
    – 128-bit AES crypto engine
    – 32-bit MAC symbol counter
    – Temperature sensor
    – Automatic transmission modes
- MX25L2006EZUK-12G 2-Mbit DataFlash
- Lowest cost RF front end design with PCB antenna
- FCC / ETSI compliant harmonic filter
- Single 2.7V - 3.6V supply
- Extended industrial temperature range -40°C to 125°C
- Easy access 2mm pin header with several alternative functions
    – 5 GPIO
    – 1 analog input (12-bit, 350ksps Analog-to-Digital Converter)
    – 4 PWM outputs
    – TWI (I2C up to 3.4MHz)
    – SPI
    – UART
- High precision 16MHz crystal oscillator

Table of Contents

1 Integrated Devices and Block Diagram

1.1 Module Block Diagram

The module has been optimized for minimum costs in lighting applications as a primary design goal. Therefore the list of peripheral devices is rather short with only a serial FLASH memory. Figure 1-1 shows the block diagram for the module.

The harmonic filter is purely capacitive and the antenna is integrated on the PCB. Beside some test points, the module interface is providing five GPIO lines only. See section 3 for detailed information.
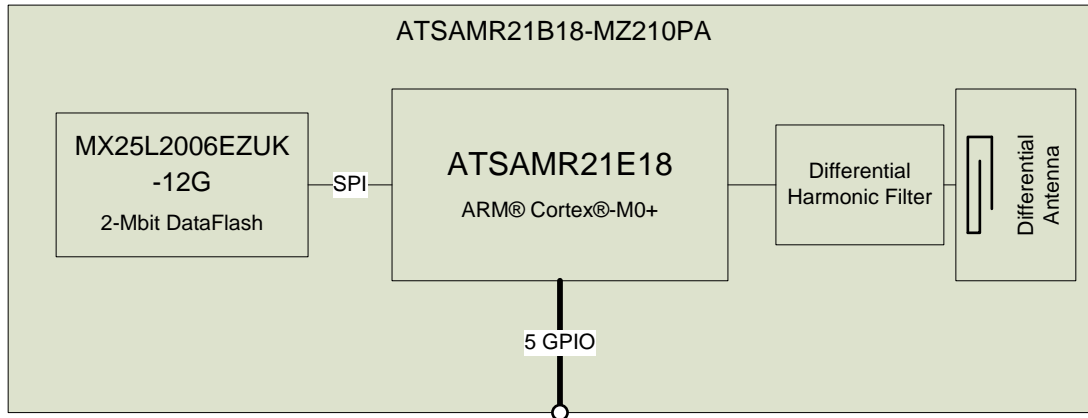

Figure 1-1.   Module Block Diagram

1.2 Integrated system peripherals

A serial FLASH memory has been integrated to support over-the-air software upgrade functions. The memory interface is using a SERCOM based SPI.

1.2.1 Serial Flash interconnect

DataFLASH Signal	uC Function	uC pin	Port & SERCOM Configuration
SO	MISO	22 / PA24	PA24 SERCOM3 PAD[2] DIPO=0x2
SI	MOSI	23 / PA25	PA25 SERCOM3 PAD[3] DOPO=0x2
SCK	SCK	27 / PA28	PA28 SERCOM3 PAD[1] DOPO=0x2
#CS	GPIO	25 / PA27	PA27 to be set low in software before SPI access

Table 1-1.   Microcontroller / data FLASH connection

The signals in this table are not available as module IO. More information about the FLASH IC can be found in its related datasheet in section 7. (Macronix)

1.2.2 Available UART interfaces

There are two UART interfaces available for external use. SERCOM2 is available at test points for debug use while SERCOM1 is available at connector X1 for application use.

The test points for SERCOM2 are duplicated on the PCB top layer and on the bottom layer. See Table 1-2 for detailed information.

Module pin	uC Function	uC pin	Port & SERCOM Configuration
TP7 & TP5	UART RX	16 / PA15	SERCOM2; MUX=C; PAD[3] RXPO=0x3
TP4 & TP6	UART TX	15 / PA14	SERCOM2; MUX=C; PAD[2] TXPO=0x1
X1.6	UART RX	20 / PA19	SERCOM1; MUX=C; PAD[3] RXPO=0x3
X1.5	UART TX	19 / PA18	SERCOM1; MUX=C; PAD[2] TXPO=0x1

Table 1-2.   Access to UART IO's

1.3   RF front end

The module implements a lowest cost RF front end with a differential PCB antenna and a purely capacitive harmonic filter as far as assembled parts are considered. This approach is saving the costs for inductive or MLCC parts. The RF front end components are designated in Figure 1-2.
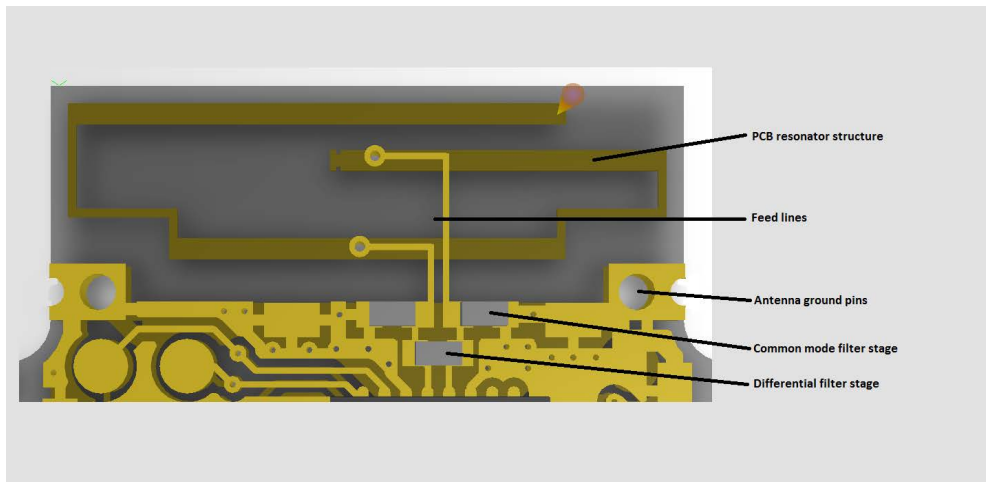

Figure 1-2.   RF front end sections

The integrated antenna is the cause of a number of design constraints for the base board. Please regard the drawings and suggestions in section 2.2 when designing the base board. The same section does also contain more information about the ground design.

2 Mechanical Description

If not otherwise noted a tolerance of 0.1mm shall be considered for all dimensions.

2.1 Mechanical Dimensions

The module pins are arranged with a 2mm pitch distance. Figure 2-1 shows the actual dimensions and pin locations within the module design.
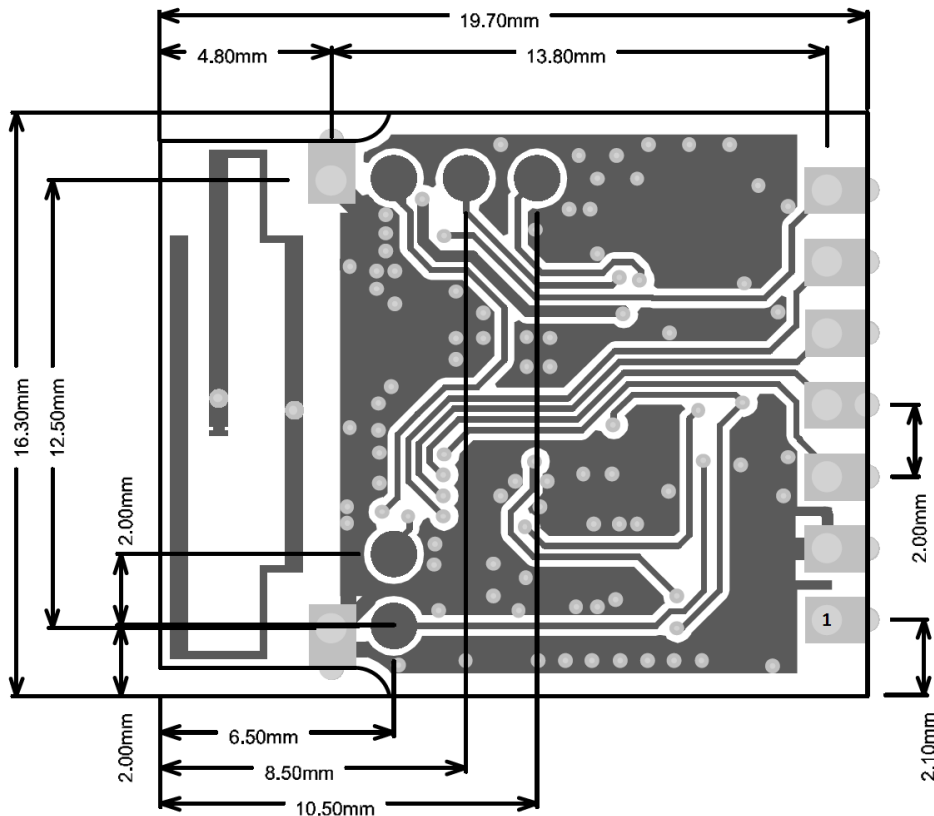

Figure 2-1.   Module Bottom dimensions, seen from a CAD top perspective

The module can be solder mounted directly to a base board. Provision is made for direct SMT mounting and for true hole mounting on a pin header with 2mm pitch. The module is delivered with true-hole pads. The pin header is supposed to be part of the base board.

2.2 Footprint Recommendation

Since the antenna is integrated, a number of design constraints have to be considered for the base board design.

2.2.1 Pin header mounting

The module can be mounted on pin headers with 2mm pitch like the SAMTEC TMM series. This mounting scheme requires a 7-pin single row header and two single pins next to the antenna. The pins are supposed to be assembled on the base board in the normal top assembly process.

It is required to mount the module at the outline of the base board and to orient the antenna towards the board edge. See Figure 2-2 for the placement range in relation to the base board edge. The area underneath the antenna shall not be filled with copper.

The area underneath the module plus a margin of additional six millimeters shall be filled with copper on the base board and tied to the ground plane with additional vias.
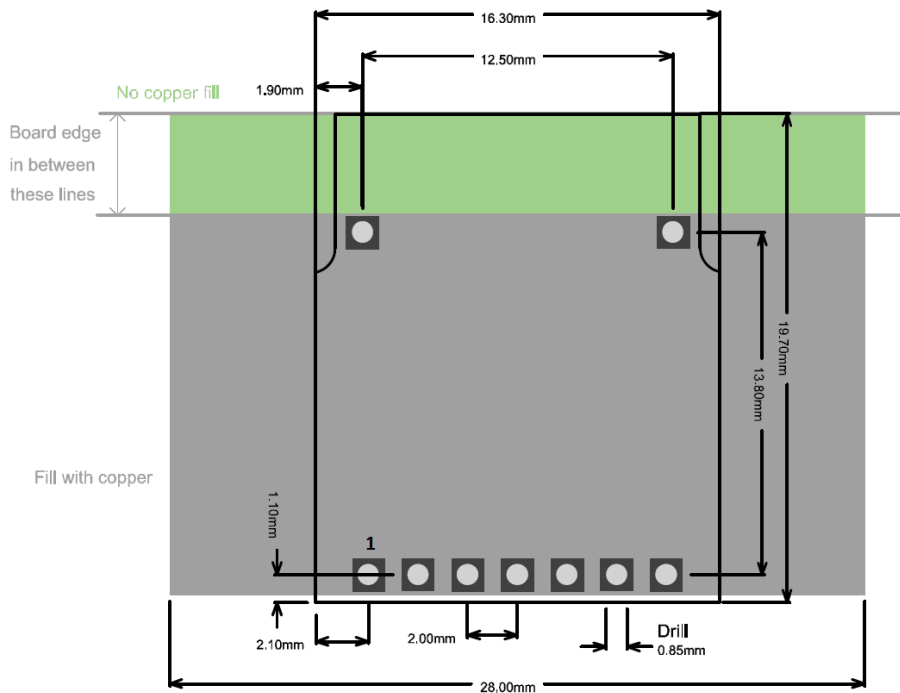

Figure 2-2.   **Thru hole footprint drawing**

Best way is to install the module with the antenna area to protrude beyond the board edge. If the system design does not allow the antenna area to stand out, the module can be positioned in line with the board edge. Installing the module further inside may cause a degradation in performance.

The mounting distance in between the module and the base board shall be in between 1mm and 2mm. For lower distances the design rules for the SMT mounting according to Figure 2-3 will apply.

Surface solder mounting

For lowest cost, the module can be surface mounted to the base board. This saves the costs for the pin header. The drawing in Figure 2-3 shows the recommended base board foot print.

The antenna shall not be influenced by the base board material. Any metal or dielectric material as FR-4 or similar would tune the antenna out of band. The module has to be mounted with the antenna end to protrude beyond the board edge. The area underneath the module shall be filled with a grounded copper fill.

As an alternative, the base board can be cut out as shown in Figure 2-3. This solution can help to keep the base board outline by avoiding an antenna frequency deviation.

The SMT pads in the base board shall exceed the module outline at least by 0.45mm to achieve a controlled solder result.

Figure 2-3.   Base board design for SMT module mounting

3   Module pin assignment

3.1   Application pins

The module pin assignment is shown in Table 3-1 . The Column "uC pin" is a reference to the ATSAMR21 datasheet (SAMR21). The column "Pin function" shows a selection of alternative IO functions. Please refer to the ATSAMR21 datasheet for the complete IO multiplexer description.

Module pin	Function	uC pin	Pin function / Port Configuration
1	Vcc	4 / 24	Power supply pin
2	GND	3 / 6 / 11 / 14 / 28 / paddle	Ground pins
3	PA16	17	PWM1 SPI SS I2C SDA GPIO
4	PA17	18	PWM2 SPI SCK I2C SCK GPIO
5	PA18	19	PWM3 SPI MISO UART Tx GPIO
6	PA19	20	PWM4 SPI MOSI UART Rx GPIO
7	PA07	8	Analog In GPIO

Table 3-1.   **Module main connector pin assignment**

The location of pin 1 is shown with the mechanic drawings in section 2.

3.2 Test points

For test and development use, the module is equipped with a number of test points. The bottom test points are easy accessible in conjunction with the module development tool. The top test points can be probed while the module is installed on the final application board.

3.2.1 Top layer test points

The test points on top layer can be used as a debug serial interface or as GPIO. Figure 3-1 shows the test point locations while the test point function is documented in Table 3-2.

TP reference	Signal	uC pin	Pin function / Port Configuration
TP6	PA14	15	UART Tx, GPIO
TP7	PA15	16	UART Rx, GPIO

Table 3-2. Top layer test points

Please refer to the ATSAMR21 datasheet for the complete IO multiplexer description for these port pins.
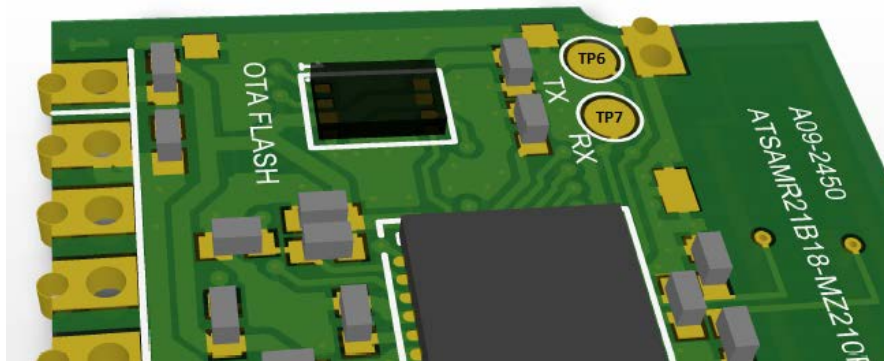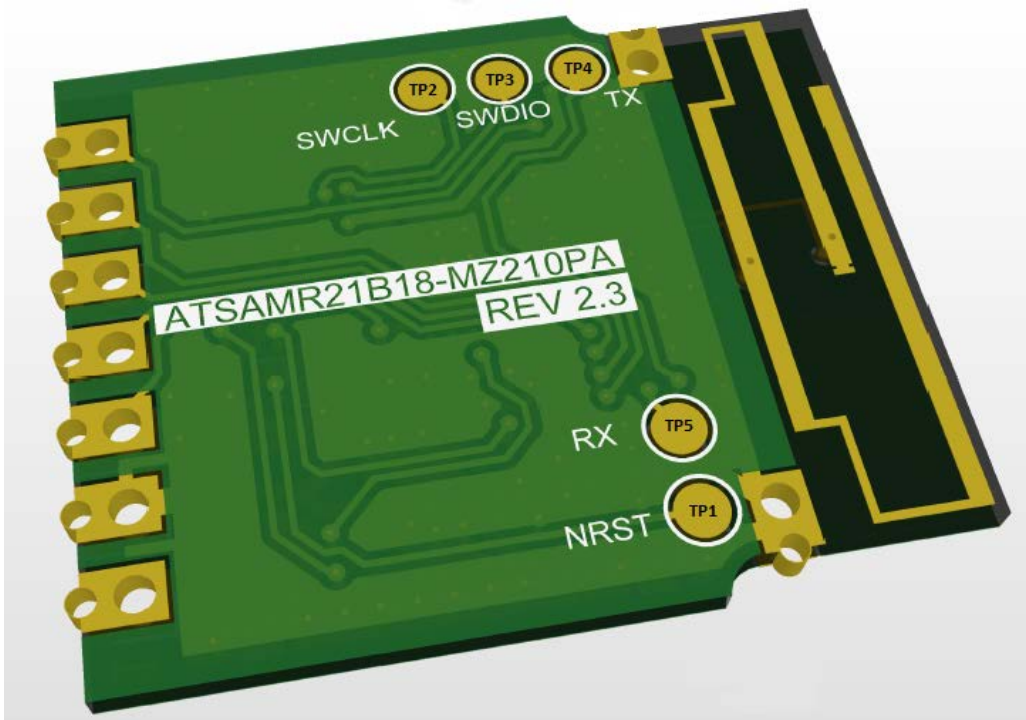

Figure 3-1. Top layer test point locations

3.2.2 Bottom layer test points

The bottom layer test points allow the programming interface access as well as the same UART connection as the top layer test points.

TP reference	Signal	uC pin	Pin function / Port Configuration
TP1	#RESETN	26	Microcontroller reset
TP2	PA30	31	Programming interface SWCLK, GPIO
TP3	PA31	32	Programming interface SWDIO, GPIO
TP4	PA14	15	UART Tx, GPIO
TP5	PA15	16	UART Rx, GPIO

Table 3-3. Top layer test points

Please refer to the ATSAMR21 datasheet for the complete IO multiplexer description.

Figure 3-2.   **Bottom layer test point locations**

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4 Electrical Characteristics

This section outlines the main parameters required to build applications. The module characteristics are determined by the implemented components. Section 7 provides the required datasheet references for more information.

4.1 Absolute Maximum Ratings

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
T_{STOR}	Storage Temperature		-40		+125	°C
V_{PIN}	Pin voltage with respect to GND and V_{DD}		GND -0.3V		Vcc+0.3V	V
V_{ESD}	ESD robustness	Module IO's routed to ATSAMR21 Human Body Model Charged Device Model	4 550			kV V
P_{RF}	Input RF level	Level at ATSAMR21 pins			+10	dBm

4.2 Recommended Operating Conditions

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
T_{OP}	Operating temperature range		-40		125	°C
V_{cc}	Supply voltage	Operating range for full serial FLASH operation.	2.7		3.6	V

4.3 Power Consumption

V_{cc}=3.0V

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I_{cpuA}	Module current with active CPU	CPU running a 48MHz while(1) loop Transceiver in sleep mode FLASH disabled		3.3		mA
I_{SbyRTC}	Module current with CPU in standby and running RTC	CPU in sloop mode Transceiver in sleep mode FLASH disabled XOSC32k running RTC running at 1kHz		4		uA
I_{SbyRTC}	Module current with CPU in standby and RTC off	CPU in sloop mode Transceiver in sleep mode FLASH disabled XOSC32k and RTC stopped		2.7		uA
I_{TRX_Rx}	Additional current for transceiver in active receive mode	Delta in between TRX sleep and TRX rx.		11.8		mA

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I_{TRX_Tx}	Additional current for transceiver in active transmit mode.	Delta in between TRX sleep and TRX rx. Maximum Tx power setting		13.8		mA

4.4 Module performance data

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
T_{OP}	Operating temperature range		-40		125°C	°C
P_{RF}	RF transmit power	T = 25°C, band center		-1		dBm EIRP
P_{SPUR_TX}	Transmitter spurious emissions	All operating conditions			-41	dBm EIRP
	Observed 50m link receive level	Operation over 50m flat grass land 1m antenna height Result based on 50 PER measurements 1000 frames per PER measurement No frame loss in 50 PER measurements	-85		-79	dBm
f_{Ref_0}	Reference crystal deviation	T = 25°C default XTAL_TRIM setting T = 25°C NV memory XTAL_TRIM setting	-5 -5		+20 +5	ppm
f_{Ref_T}	Reference crystal drift over temperature	-40°C <T_{OP}< +125°C	-25		+15	ppm
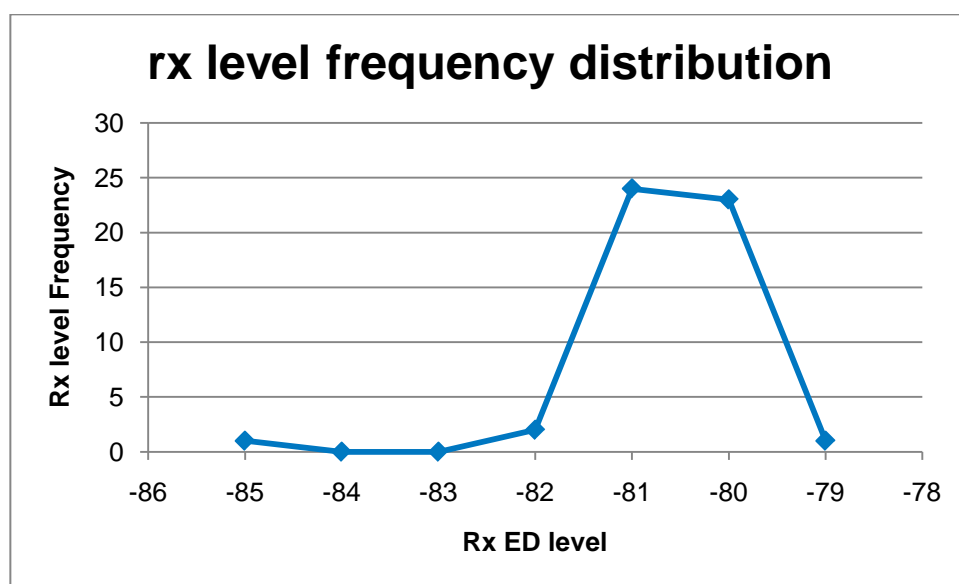
Figure 4-1.   Distribution of average rx levels observed in 50 PER tests with 1000 frames each.

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5   NV Memory Information

The ATSAMR21 provides a user readable NV memory space called user row in the data sheet. The base address for the application is 0x804008. Table 5-1**Error! Reference source not found.** shows the implemented data structure.

Addr. offset	Field name	Field description	Length
BaseAddr. + 0x00	MIB_REVISION	Data structure revision. 0x1501	2 Byte
+ 0x02	MAC_IEEE_ADDRESS	Module specific IEEE MAC Address	8 Byte
+ 0x0a	BOARD_SERIAL	Module specific serial number	10 Byte
+ 0x14	ATMEL_PART_NO	Product specific part number	8 Bytes
+ 0x 1c	PCBA_REV	Product PCB/assembly revision	1 Byte
+ 0x1d	XTAL_TRIM	Reference crystal calibration value	1 Byte
+ 0x1e	CRC16	Checksum for this data structure	2 Byte

Table 5-1.   **NV Memory (user row) Data**

Two data fields have to be copied to radio transceiver registers. The data in MAC_IEEE_ADDRESS have to be copied to the registers IEEE_ADDR_0 to _7.

The XTAL_TRIM value has been determined during production test and needs to be copied to the transceiver XTAL_TRIM section inside the XOSC_CTRL register. This will reduce the absolute deviation for the 16MHz reference crystal. See section 4.3 for detailed parameters.

6   Boot loader

The module will be delivered with a pre flashed boot loader. Please refer to the boot loader manual for detailed information. It is online available under the Application Note code AVR2054.

7   Radio Certification

The module ATSAMR21B18-MZ210PA in combination with the integrated antenna has received regulatory approvals for modular devices in the United States, Canada and European countries.

7.1   United States (FCC)

The module ATSAMR21G18-MR210UA complies with the requirements of FCC part 15. To fulfill FCC Certification requirements, an OEM manufacturer must comply with the following regulations:

- The modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.

- This exterior label can use wording such as the following. Any similar wording that expresses the same meaning may be used.

Sample Label for integration of ATSAMR21B18-MZ210PA:

> Contains FCC-ID: VNR-ATSAMZ210PA-0

> *This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation (FCC 15.19). The antenna used for this mobile transmitter must provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. This device is approved as a mobile device with respect to RF exposure compliance, and may only be marketed to OEM installers. Use in portable exposure conditions (FCC 2.1093) requires separate equipment authorization.

Modifications not expressly approved by this company could void the user's authority to operate this equipment (FCC section 15.21).

7.2   Europe (ETSI)

The module ATSAMR21B18-MZ210PA is conform for use in European Union countries. If the ATSAMR21B18-MZ210PA module is incorporated into a product, the manufacturer must ensure the compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

The manufacturer must maintain a copy of the ATSAMR21B18-MZ210PA module documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

The CE marking must be affixed to a visible location at the OEM product. The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions must be respected.

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- The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

More detailed information about CE marking requirements can be found at "DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" on 9 March 1999 at section 12. For the operation in Europe, there is no power setting limit.

7.3 Industry Canada (IC) Compliance statements

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with radio frequency exposure limits set forth by Industry Canada for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the device and the user or bystanders.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par Industrie Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre le dispositif et l'utilisateur ou des tiers

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

The OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). This Module is labelled with its own IC ID. If the IC ID Certification Number is not visible while installed inside another device, then the device should display the label on it referring the enclosed module. In that case, the final end product must be labelled in a visible area with the following:

"Contains Transmitter Module IC: 20266-ATSAMZ210PA0"

OR

"Contains IC: 20266-ATSAMZ210PA0"

Ce module est étiqueté avec son propre ID IC. Si le numéro de certification IC ID n'est pas visible lorsqu'il est installé à l'intérieur d'un autre appareil, l'appareil doit afficher l'étiquette sur le module de référence ci-joint. Dans ce cas, le produit final doit être étiqueté dans un endroit visible par le texte suivant:

"Contains Transmitter Module IC: 20266-ATSAMZ210PA0"

OR

"Contains IC: 20266-ATSAMZ210PA0"

8   Ordering Information

Module Type	Packaging[1]	Ordering Code	Package	Operational Range
ATSAMR21B18-MZ210PA	Tape&Reel	ATSAMR21B18-MZ210PA-T	16.3mm x 19.7mm	Industrial (-40°C to +85°C)

Note:

1. MOQ is a reel with 200 modules.

9   References

[1] Macronix. (n.d.). *Macronix International Co., Ltd.* Retrieved from MX25L2006E (K-Grade) Datasheet: http://www.macronix.com

[2] Atmel SAM R21. (n.d.). *www.atmel.com.* Retrieved from http://www.atmel.com/Images/Atmel-42223-SAM-R21_Datasheet.pdf

10   Revision History

Doc Rev.	Date	Comments
42486B	09/2015	• Updated section 6: Added reference to application note code of "AVR2054: Serial Bootloader User Guide". • Added section 7 Radio Certification. • Added section 8 Ordering Information.
42486A	07/2015	• Initial document release.