

MX-NANO DUAL INTERFACE

Personalization equipment for contact and contactless smart cards dedicated to Datacard MX system.

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Abbreviations

ACT	Activation Protocol
APDU	Application Protocol Data Unit
BGT	Block Guard Time
BWT	Block Waiting Time
CID	Card Identifier
CLT	ContactLess Tunneling
CRC	Cyclic Redundancy Check
CWT	Character Waiting Time
EGT	Extra Guard Time
EOF	End Of Frame
ESD	Electrostatic Discharge
ETU	Elementary Time Unit
FDT	Frame Delay Time
FSCI	Frame Size Card Integer
FSDI	Frame Size Device Integer
FWT	Frame Waiting Time
I²C	Inter-Integrated Circuit
ICC	Integrated Circuit Card
LLC	Logical Link Control
NAD	Node Address
RFU	Reserved for Future Use
SLBUS	Smartware Local Bus
SHDLC	Simplified High Level Data Link Control
SFGT	Startup Frame Guard Time
SOF	Start Of Frame
SPI	Serial Peripheral Interface
SPU	Standard or Proprietary Use
SWP	Single Wire Protocol
WWT	Work Waiting Time

Glossary

24 V --- 3A: 24 Volt 3 Amp Direct Current (DC) power supply

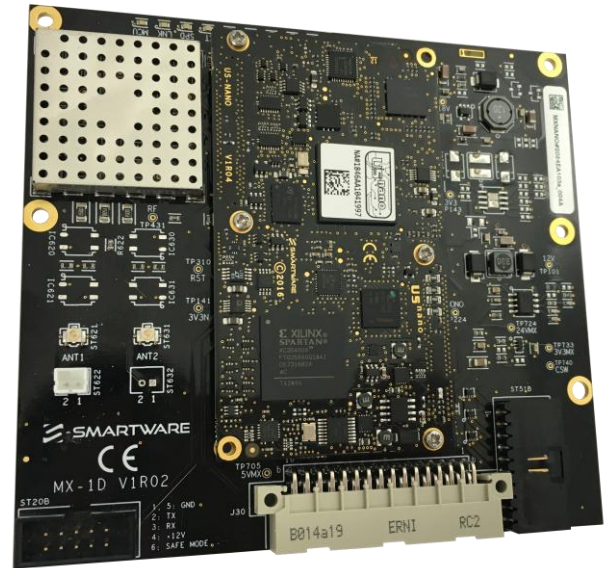
Modulation index: Defined as the voltage ratio $(V_{\max} - V_{\min}) / (V_{\max} + V_{\min})$.

1 OVERVIEW

MX-Nano is a Smartware assembly mainly design for the personalization of contact and contactless smart cards.

The MX-Nano is ideal for issuers of any market who wish to profit of latest technologies and top performance while having a reliable and flexible equipment

The MX-Nano is specially designed to fit into Datacard MX smart card module.



Core interface features

Hardware specification:

- 32-bit Freescale ColdFire® CPUs running at 240 MHz
- 64 MB of RAM / 8 MB of Flash memories

Contact interface features

Supported protocols:

- ISO/IEC 7816-3/4
- SWP – Single Wire Protocol
- Synchronous memory cards
- I²C – Inter-Integrated Circuit
- SPI – Serial Peripheral Interface
- Proprietary protocols

Key Programmable Parameters:

- Contacts voltage
- Card clock frequency
- Communication protocol parameters

Electrical tests:

- Continuity measurement

Contactless interface features

Supported protocols:

- ISO/IEC 14443-2/3/4
- ISO/IEC 15693-2/3
- MasterCard PayPass
- Sony FeliCa™
- NXP MIFARE™ and MIFARE Plus™
- Proprietary protocols

Key Programmable Parameters:

- RF output level
- Communication bit rate up to 848 kbps
- Communication protocol parameters

Other features

- In system firmware updates

Target Application

- Production environment
- Contact reader/encoder
- Contactless reader/encoder

Electrostatic discharge sensitivity



The MX-Nano uses semiconductors that can be damaged by electrostatic discharge (ESD). Observe precautions for handling. Damage due to inappropriate handling is not covered by the warranty.

2 FUNCTIONAL DESCRIPTION

MX-Nano is a Smartware assembly based on an US-NANO module.

It provides a CPU core and a dual communication interface for contact and contactless smart cards or smart objects.

2.1 CORE INTERFACE

An US-NANO module embeds the last generation of 32-bit Freescale ColdFire® CPU running at 240 MHz, with 64 MB of RAM and 8 MB of Flash.

MLOS proprietary multitasking operating system provides all resources to connect and use the core interfaces such as the Ethernet and the Serial ports.

MLOS also manages additional user or system applications to drive all specific hardware resources like the contact and contactless interfaces.

2.2 CONTACT INTERFACE

2.2.1 ISO/IEC 7816-3/4 smart cards

CARD system application handles the standard ISO7816-3/4 smart card protocols. Its rich interface allows to perform fast communication exchanges and to subtly configure all protocol parameters.

List of main software features and configuration parameters:

- Smart card voltage configuration with support of class A, B and C
- Smart card clock frequency from 1 to 10 MHz
- Communication bit rate (ETU)
- Automatic T=0 or T=1 protocol handling
- Short and extended APDU exchanges
- Protocol timing specific parameters such as EGT, WWT, BGT, CWT, BWT, etc.
- Character and block error management and recovery
- Access to contact states for custom protocols

2.2.2 SWP interface

SWP system application handles the ETSI standards (TS 102 613 and TS 102 622) to support exchanges through the Single Wire Protocol.

List of main software features and configuration parameters:

- LLC layers support (ACT, SHDLC, CLT)
- Supply voltage configuration with support of class B and C
- Communication bit duration from 0.590 µs up to 10 µs
- Automatic CRC and bit stuffing management

2.2.3 I²C interface

ICCOM system application handles Inter Integrated Circuit (I²C) bus specification (UM1024 Rev. 6 — 4 April 2014) developed by NXP to communicate with chips and secure elements which are compliant with this protocol.

List of main software features and configuration parameters:

- Support standard-mode (100 kbit/s), fast-mode (400 kbit/s) and fast-mode plus (1 Mbit/s) bidirectional bus speeds
- Support 7-bit and 10-bit device addressing formats
- Interface working voltage configuration
- Easy API to manage read, write and combined data transfer formats

2.2.4 SPI interface

ICCOM system application handles SPI bus standard initially developed by Motorola to communicate with chips and secure elements which are compliant with this electrical interface.

List of main software features and configuration parameters:

- Clock frequency up to 25 MHz
- Interface working voltage configuration
- Support communication modes 0, 1, 2 and 3
- Bus endianness configuration to set the order of data samples bits
- Data samples bit size configuration
- Support an additional serial interrupt input signal
- Easy API to manage half-duplex and full-duplex communications

2.2.5 Hardware measurements

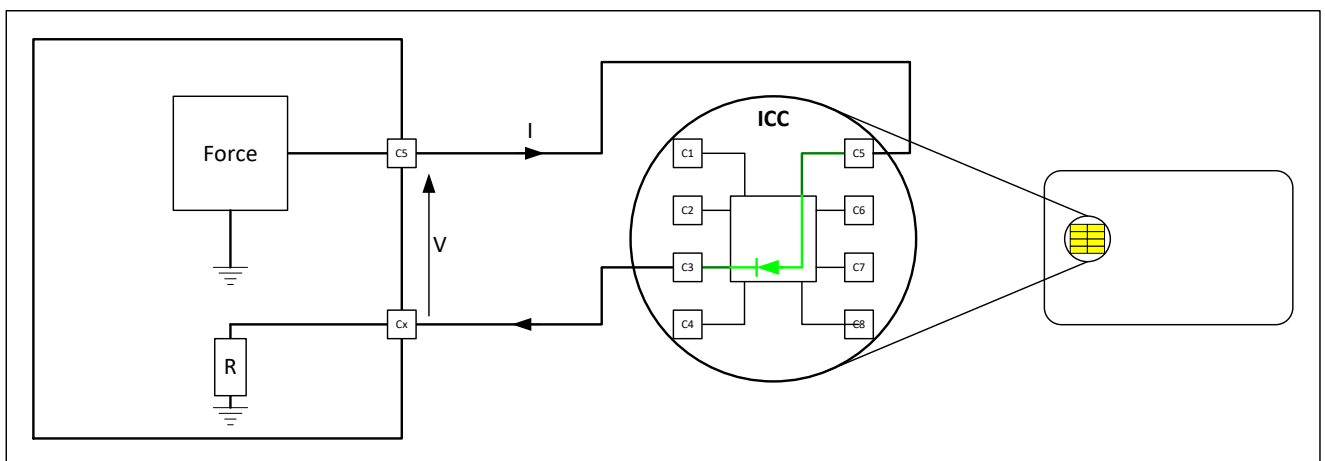
The contact interface has specific resources to perform electrical measurements on the ISO7816 smart cards pads.

These measurements, called continuity tests, check the physical connection between the reader and the smart card to either detect a defective connection of the head (cable or pins), or a defective smart card internal bonding.

Through CARD system application interface, the continuity tests can:

- Check the connection from the reader's contact interface to the smart card pads.
- Measure the serial resistor (due to cable, test head, or deficient contact pin) for each smart card pad.
- Check the smart card clamp diodes between C1/2/3/4/6/7/8 and C5 and return their threshold voltage values. With such measurement, the contact can be declared:
 - Open (i.e.: no bonding, damaged diode).
 - Short (i.e.: wrong bonding, shortcut, damaged diode...).
 - Good (bonding and diodes are in conformity).

To properly test one contact, all others contacts shall be in high impedance state, and C5 contact must be driven by the reader (i.e. it should not be linked to the ground/earth).



Voltage measurement of the clamp diode for the example contact C3

2.3 CONTACTLESS INTERFACE

CARD system application handles all supported contactless smart cards standards or specifications.

It includes:

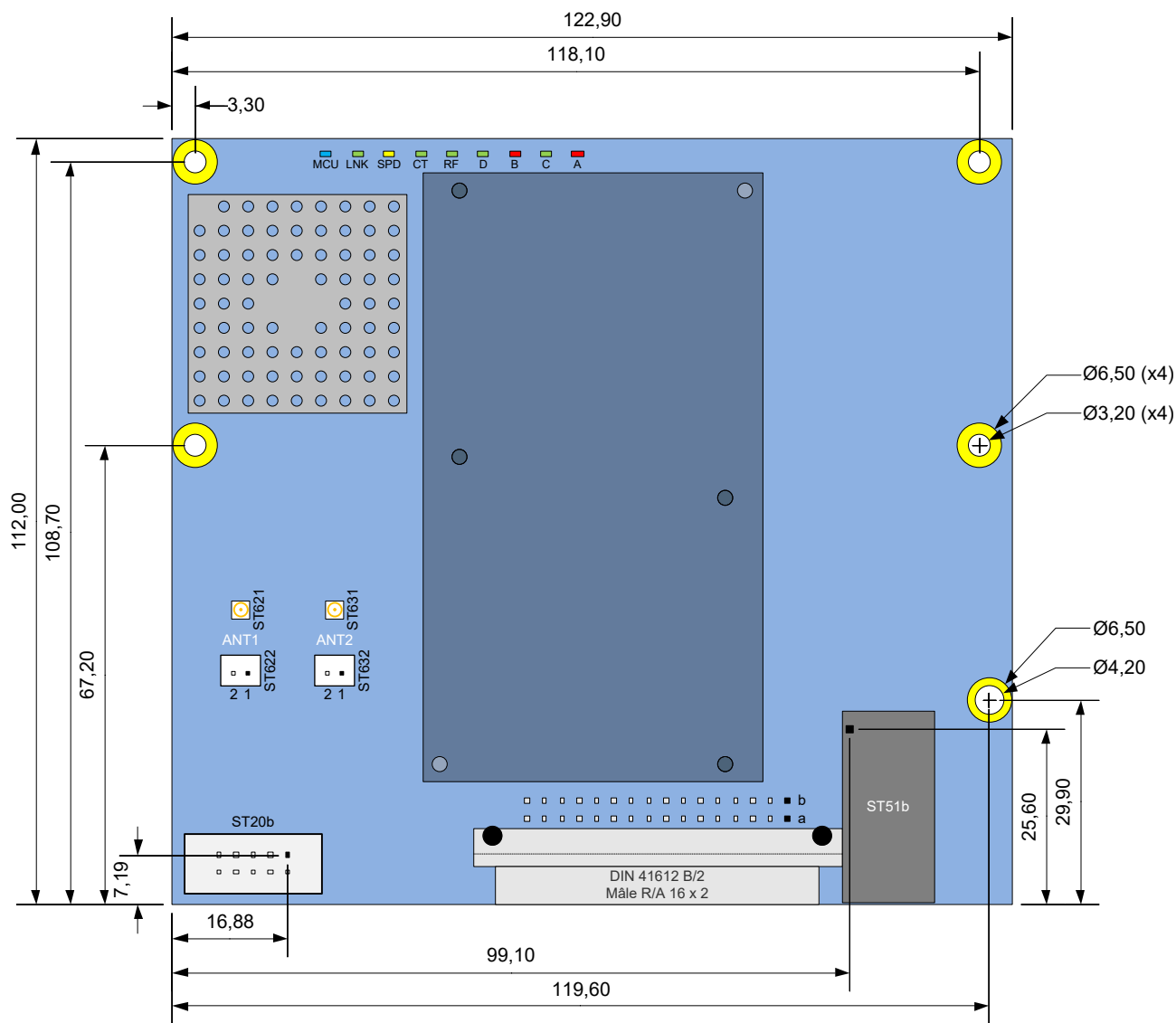
- ISO/IEC 14443 levels 2, 3 and 4, with the support of both type A and type B cards
- ISO/IEC 15693 levels 2 and 3
- MasterCard PayPass
- Sony FeliCa™
- NXP MIFARE™ and MIFARE Plus™

List of main software features and configuration parameters:

- Adjustable carrier field strength
- Communication bit rate up to 848 kbps
- Protocol timing specific parameters such as EGT, FWT, FDT, SFGT, etc.
- Protocol communication specific parameters such as NAD, CID, FSCI, FSDI, SOF, EOF, etc.
- ISO7816 short and extended APDU exchanges
- Protocol specific error detection and recovery
- Authentication mechanisms requiring cryptography and ciphered exchanges

3 TECHNICAL CHARACTERISTICS

3.1 MECHANICAL LAYOUTS



MX-Nano top side view

GENERAL	
Length	122.9 mm
Height	112.0 mm
Width	13 mm
Weight	100 g

The fixing attachment holes are connected to the MX-Nano ground.

3.2 PHYSICAL INTERFACES

3.2.1 Connectors

3.2.1.1 *ST51b description*

This MTE 1x10 position wire-to-board header provides the contact interface. The pins can support several protocols:

PIN	NAME	ISO7816-3	SWP	SD	I ² C	SPI
1	CSW	Detect	Detect			
2	GND					
3	CC5	GND	GND	VSS	GND	GND
4	CC6	SPU	SWIO			MISO
5	CC7	I/O		CMD	SDAT	MOSI
6	CC8	RFU2				
7	CC1	VCC	VCC	VDD	VCC	VCC
8	CC2	RST				CS
9	CC3	CLK		CLK	SCLK	SCLK
10	CC4	RFU1				SINT

3.2.1.2 *ST622, ST632 description*

This JST 1x2 position connector provides the contactless interface.

PIN	NAME	DESCRIPTION
1	Gnd	Ground
2	RF_ANT	RF output

3.2.1.3 *ST621, ST631 description*

This U.FL-R-SMT (01) connector provides the contactless interface.

PIN	NAME	DESCRIPTION
Center	RF_ANT	RF output
Body	Gnd	Ground

3.2.1.4 ST20b description

This 2x5 position ribbon cable connector provides access to a +12V power supply output, a serial port and safe mode.

PIN	NAME	DESCRIPTION
1	Gnd	Ground
2	Tx	RS232 serial port 2 transmit
3	Rx	RS232 serial port 2 receive
4	+12V	Output power supply
5	Gnd	Ground
6	Safe Mode	Safe mode input
7	NC	Not connected
8	NC	Not connected
9	NC	Not connected
10	NC	Not connected

3.2.1.5 J30 description

This DIN41612 connector provides powers, node base, module ID, serial port, ethernet port and card detect.

PIN	NAME	DESCRIPTION
A1, B1, A2, B2, A4, B4, A13, A15, B15	Gnd	Ground
A3, B3	+24V	Power supply (Input)
A5, B5	+5V	Power supply (Input, not used)
A10, B10	+3V3	Power supply (Input)
A6	IN2	Node base 2
B6	IN3	Node base 3
A7	IN0	Node base 0
B7	IN1	Node base 1
A8	L1TxLV	Serial port 1 transmit (LVTTL)
B8	L1RxLV	Serial port 1 receive (LVTTL)
A9	StandAlone	Stand Alone input
B9	CSW	Card detect
A11	IN7	Module ID 3
B11	IN8	Module ID 4
A12	IN5	Module ID 4
B12	IN6	Module ID 2
B13	IN4	Module ID 0
A14	ETH_TXP	Ethernet Pair 0+ (Tx+)
B14	ETH_TXM	Ethernet Pair 0- (Tx-)
A16	ETH_RXP	Ethernet Pair 1+ (Rx+)
B16	ETH_RXM	Ethernet Pair 1- (Rx-)

3.2.2 LEDS

NAME	COLOR	DESCRIPTION
MCU	Yellow	CPU status. Blink if CPU is running correctly
LNK	Green	Ethernet link status
SPD	Green	Ethernet speed (Off = 100Mbit, On = 10Mbit)
CT	Green	Contact interface power on status
RF	Green	Contactless interface power on status
A	Red	User LED 37a - Blink if TERM port is activated - User controlled
B	Red	User LED 37b - Switched off during boot phase - User controlled
C	Green	User LED 37c - Blink during boot phase - User controlled
D	Green	User LED 37d - Blink during boot phase - User controlled

3.3 ELECTRICAL CHARACTERISTICS

POWER SUPPLY	MINIMUM	TYPICAL	MAXIMUM
Input voltage (+24V)	21.8 V	24.0 V	26.4 V
Input current (@+24V)		150 mA	200 mA ¹
Input voltage (+3V3)	3.0 V	3.3 V	3.6 V
Input current (@+3V3)		5 mA	10 mA
ESD hardware immunity		4 kV	
Operating temperature	5°C	25°C	50°C

¹ ST20b +12V output current is not included

3.3.1 ISO/IEC 7816-3 smart cards interface

ST51b PIN №	PIN NAME	SIGNAL	DRIVING CAPABILITY
7	CC1	VCC	V_{CC} , V_{OL} , HiZ
8	CC2	RST	V_{OH} , V_{OL} , HiZ ¹
9	CC3	CLK	V_{OH} , V_{OL} , Clock, HiZ ¹
10	CC4	RFU1	V_{OH} , V_{OL} , HiZ ¹
3	CC5	GND	Gnd, HiZ
4	CC6	SPU	V_{OH} , V_{OL} , HiZ ¹
5	CC7	I/O	V_{OH} , V_{OL} , Pull-up ² , HiZ
6	CC8	RFU2	V_{OH} , V_{OL} , HiZ ¹

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
V_{CC} Range Resolution Precision Current limitation	1.65 V	10 mV ± 20 mV	5.50 V 200 mA
V_{OL}	0 V		0.10 V
V_{OH}	$V_{CC} - 0.1$ V		V_{CC}
V_{IL}			0.55 V
V_{IH}	$0.80 \times V_{CC}$		
Signals current limitation: 1.65 < V_{CC} < 1.95 2.30 < V_{CC} < 2.70 3.00 < V_{CC} < 3.60 4.50 < V_{CC} < 5.50			± 4 mA ± 8 mA ± 24 mA ± 32 mA
CC5 impedance to ground			50 m Ω
Clock Range Resolution Precision Duty cycle	1 MHz	1 kHz ± 10 kHz 50 %	10 MHz

¹ 470 k Ω internal pull-down

² 10 k Ω internal pull-up connected to CC1 contact

3.3.2 SWP interface

ST51b PIN №	PIN NAME	SIGNAL	DRIVING CAPABILITY
7	CC1	VCC	V _{CC} , V _{OL} , HiZ
3	CC5	GND	Gnd, HiZ
4	CC6	SWIO	V _{OL} , V _{SWIO} , HiZ

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
V _{CC} Range Resolution Precision Current limitation	1.65 V	10 mV ± 20 mV	5.50 V 200 mA
V _{OL}	0 V		0.10 V
V _{SWIO}		1.80 V	
CC5 impedance to ground			50 mΩ

3.3.3 I²C interface

ST51b PIN №	PIN NAME	SIGNAL	DRIVING CAPABILITY
7	CC1	VCC	V _{CC} , V _{OL} , HiZ
3	CC5	GND	Gnd, HiZ
9	CC3	SCLK	V _{OH} , V _{OL} , HiZ ¹
5	CC7	SDAT	V _{OH} , V _{OL} , Pull-up ² , HiZ

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
V _{CC} Range Resolution Precision Current limitation	1.65 V	10 mV ± 20 mV	5.50 V 200 mA
V _{OL}	0 V		0.10 V
V _{OH}	V _{CC} - 0.1 V		V _{CC}
V _{IL}			0.55 V
V _{IH}	0.80 x V _{CC}		
Signals current limitation: 1.65 < V _{CC} < 1.95 2.30 < V _{CC} < 2.70 3.00 < V _{CC} < 3.60 4.50 < V _{CC} < 5.50			± 4 mA ± 8 mA ± 24 mA ± 32 mA
CC5 impedance to ground			50 mΩ

¹ 470 kΩ internal pull-down

² 10 kΩ internal pull-up connected to CC1 contact

3.3.4 SPI interface

ST51b PIN №	PIN NAME	SIGNAL	DRIVING CAPABILITY
7	CC1	VCC	V _{CC} , V _{OL} , HiZ
3	CC5	GND	Gnd, HiZ
8	CC2	CS	V _{OH} , V _{OL} , HiZ ¹
9	CC3	SCLK	V _{OH} , V _{OL} , HiZ ¹
5	CC7	MOSI	V _{OH} , V _{OL} , HiZ
4	CC6	MISO	HiZ ¹
10	CC4	SINT	HiZ ¹

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
V _{CC} Range Resolution Precision Current limitation	1.65 V	10 mV ± 20 mV	5.50 V 200 mA
V _{OL}	0 V		0.10 V
V _{OH}	V _{CC} - 0.1 V		V _{CC}
V _{IL}			0.55 V
V _{IH}	0.80 x V _{CC}		
Signals current limitation: 1.65 < V _{CC} < 1.95 2.30 < V _{CC} < 2.70 3.00 < V _{CC} < 3.60 4.50 < V _{CC} < 5.50			± 4 mA ± 8 mA ± 24 mA ± 32 mA
CC5 impedance to ground			50 mΩ

¹ 470 kΩ internal pull-down

3.3.5 Digital inputs and outputs

ST51b PIN №	PIN NAME	SIGNAL	DRIVING CAPABILITY
1	CSW	Detect	HiZ ¹ (connect to Gnd for card presence)
2	Gnd	Ground	Gnd

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
V _{OH}		+ 3.3 V	
V _{OL}		0 V	
V _{IH}	2 V		5.5 V
V _{IL}	0 V		0.8 V
Current limitation		±20 mA	

3.3.6 Hardware measurements

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
Contact resistor R _{MEAS} Range Precision R _{MEAS} < 1 kΩ R _{MEAS} > 1 kΩ	0 Ω	±100 Ω ±10 %	10 kΩ
Contact diode threshold Range Precision Input source current	0.1 V	±0.1 V 2.5 mA	2.5 V 3.2 mA

¹ 4.7 kΩ internal pull-up connected to +3.3 V

3.3.7 Contactless interface

PARAMETER	MINIMUM	TYPICAL	MAXIMUM	PRECISION
RF signal amplitude ($R = \infty$)	2 Vpp		20 Vpp	$\pm 2\% \pm 0.05$ Vpp
RF signal power ($R = 50 \Omega$)			250 mW (+ 24 dBm)	
RF output impedance		50 Ω		$\pm 5 \Omega$
RF signal offset			0	
RF frequency		13.56 MHz		± 7 kHz
Modulation index				
ISO14443 A / Mifare	90 %	100 %	100 %	
ISO14443 B	10 %	12 %	14 %	
ISO15693	10 %	12 %	14 %	
FeliCa™	10 %	12 %	14 %	
Current limitation				
Short circuit current ($R = 0 \Omega$) RMS			150 mA	
Full power short circuit max duration			60 s	

4 INSTALLATION INSTRUCTIONS

This device has been specifically designed for customized integration within various systems. For proper installation and configuration, please refer to the detailed instructions provided by your supplier.

5 REGULATORY

5.1 WARNINGS

USN3se and MX3se-3I3P models are CE, FCC / IC modular approval, and RoHS compliant.

Les modèles USN3e, et MX3e-3I3P sont certifiés CE, FCC / IC approbation modulaire, et RoHS.



WARNING TO USERS

Warning 1: The MX-Nano-1I1P models is considered as a component that will be operated in combination with the final equipment. Then, the final equipment (including power supply system) still needs to re-confirm that the whole system complies with the local EMC directives.

Les modèles MX-Nano-1I1P est considéré comme un composant qui sera intégré dans un équipement hôte. Le fabricant de l'équipement hôte (système d'alimentation inclus) devra alors reconfirmer que le système complet répond toujours aux différentes normes locales.

Warning 2: The MX-Nano-1I1P model is a low power radiofrequency emitter, and then specific precaution should be taken to restrict the human presence near the antennas.

We recommend that persons should be at least at 20 cm far from the emitting antennas. This information also has to be mentioned in the end product.

Access should only be authorized to qualified personal.

If the product is not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications.

Le modèle MX-Nano-1I1P intègrent un émetteur radiofréquence. Des précautions particulières doivent être prises pour contrôler la présence humaine près de l'antenne.

Nous recommandons qu'aucune personne ne puisse se situer à une distance inférieure à 20 cm de l'antenne. Cette information doit également être mentionnée sur l'équipement hôte.

L'accès doit être restreint au personnel qualifié.

Si le produit n'est pas installé et utilisé tel que décrit dans la notice, il peut engendrer des perturbations radioélectriques.

Warning 3: To reduce the risk of fire or injury to persons, follow these instructions:

All maintenance and servicing of this device must be performed in a safe area away from hazardous locations. Disconnect all power before servicing.

Use an earthed bracelet to avoid ESD damages.

Power supply must be SELV, no energy hazard.

Afin de réduire les risques de feu ou blessure aux personnes, suivez les instructions suivantes :

Toutes les opérations de service et de maintenance doivent être réalisées dans un endroit sécurisé. Déconnectez toutes les alimentations avant manipulation.

Utilisez un bracelet relié à la terre pour éviter des dommages liés aux ESD.

L'alimentation doit être SELV, aucun danger énergétique.

Warning 4: To comply with directives, the backplane Ethernet cable length should be less than 3 meters.

Pour être en conformité avec les normes, le câble du connecteur Ethernet du fond de panier doit avoir une longueur inférieure à 3m.

Warning 5: This device has been designed to operate with the antenna(s) listed below. Antennas not included in this list are strictly prohibited for use with this device

List of acceptable antenna(s):

- T78x51x2 v1r01

Ce dispositif a été conçu pour fonctionner avec les antennes énumérées ci-dessous. Les antennes non incluses dans cette liste sont strictement interdites pour l'exploitation de ce dispositif.

Liste des antennes acceptables :

- T78x51x2 v1r01

Warning 6: Use of shielded contact cable (with ferrite ref Würth 74271733) is mandatory to comply with standards.

L'utilisation d'un câble d'interface contact blindé (accompagné d'une ferrite Würth 74271733) est nécessaire pour se conformer aux limites réglementaires.

Warning 7: To comply with directives, RF power may be set from power 0 to power 10.

Pour être en conformité avec les normes, la consigne de puissance RF peut être réglée de puissance 0 à puissance 10.

Warning 8: The product shall not be modified without written authorisation of Smartware. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Le produit ne doit pas être modifié sans l'autorisation écrite de Smartware. Changements et modifications non approuvés par l'organisme responsable de la conformité pourrait annuler l'autorité de l'utilisateur à opérer cet équipement.

Warning 9: The end product's sticker should mention that it "contains a FCC ID: RPM-MXNANO111P and IC: RPM-MXNANO111P" product.

L'étiquette du produit hôte doit mentionner « Contient un FCC ID: RPM-MXNANO111P et IC: RPM-MXNANO111P ».

5.2 MANDATORY INFORMATION

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 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.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

6 APPENDIX

6.1 HEAD DESIGN RECOMMENDATIONS

6.1.1 Contact head

Care has to be taken when designing the contact head and cables. The contact head should provide following functionalities:

- Proper contact with the chip
- ESD protection and evacuation
- Passive components for signal filtering and power decoupling
- Card presence switch

6.1.2 Contactless head

Care should be taken for reader antenna integration or chip card module contact head specifically for multi-head applications.

The use of 50 ohms matched antenna is recommended for contactless applications.

To obtain more detailed information about head design recommendations, please send an email to: support@smartware.fr

7 CONTACT INFORMATION

For more information, please send an email to: support@smartware.fr

For ordering information, please send an email to: sales@smartware.fr

8 REVISION HISTORY

VERSION	DATE	AUTHOR	DESCRIPTION OF CHANGES
V1R03b	June 2025	YP	Add of regulatory paragraph
V1R03a	November 2020	SHM	Original version