ULTRASMART™ MULTIPLE DUAL INTERFACES FOR PRODUCTION

(USN1se, USN2se, USN3se)

Industrial equipment to personalize contact and contactless smart cards or modules.

Datasheet V1R01c

Date: December 2016

© 2016, Smartware

Copyright

All rights of translation adaptation and reproduction by any mean reserved for all the countries.

Any reproduction or any complete or partial representation of the pages published in this work, made without the written permission of SMARTWARE is illicit and constitutes an imitation, whatever mean is used. Only reproductions strictly reserved for the private use of the purchaser and not intended to be used collectively are authorized. So are the short quotations justified by the scientific or informative nature of the work which they are extracted from (art L.122-4 L. 122-5 and L. 335-2 of the French Code ruling on intellectual property).

© SMARTWARE, Les ULIS, France, 1999-2016

Disclaimers

Information in this document is subject to change without notice and does not represent a commitment on the part of SMARTWARE.

Contents

Abbreviations

ACT	Activation Protocol
APDU	Application Protocol Data Unit
BGT	Block Guard Time
BWT	Block Waiting Time
CID	Card Identifier
CLT	ContactLess Tunnelling
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
HCI	Host Controller Interface
LLC	Logical Link Control
NAD	Node Address
SHDLC	Simplified High Level Data Link Control
SFGT	Startup Frame Guard Time
SOF	Start Of Frame
SPU	Standard or Proprietary Use
SWP	Single Wire Protocol
WWT	Work Waiting Time

Glossary

12 V ⎓ 3A: 12 Volt 3 Amp Direct Current (DC) power supply

Modulation index: Defined as the voltage ratio (Vmax - Vmin) / (Vmax + Vmin).

 © 2016, Smartware

1 OVERVIEW

USN1se, USN2se and USN3se are industrial solutions dedicated to the personalization of contact and contactless smart cards and memory cards. These assemblies fulfill any integration based on Smartware industrial racks.

USN1se

USN2se

USN3se

Core interface features

Hardware specification:

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

Contact interfaces features

Supported protocols:

- ISO/IEC 7816-3/4
- SWP
- Synchronous memory cards
- Proprietary protocols

Key programmable parameters:

- Contacts voltage
- Card clock frequency up to 20 MHz
- Communication protocol parameters

Electrical tests:

- Continuity measurement

Contactless interfaces 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 applications

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

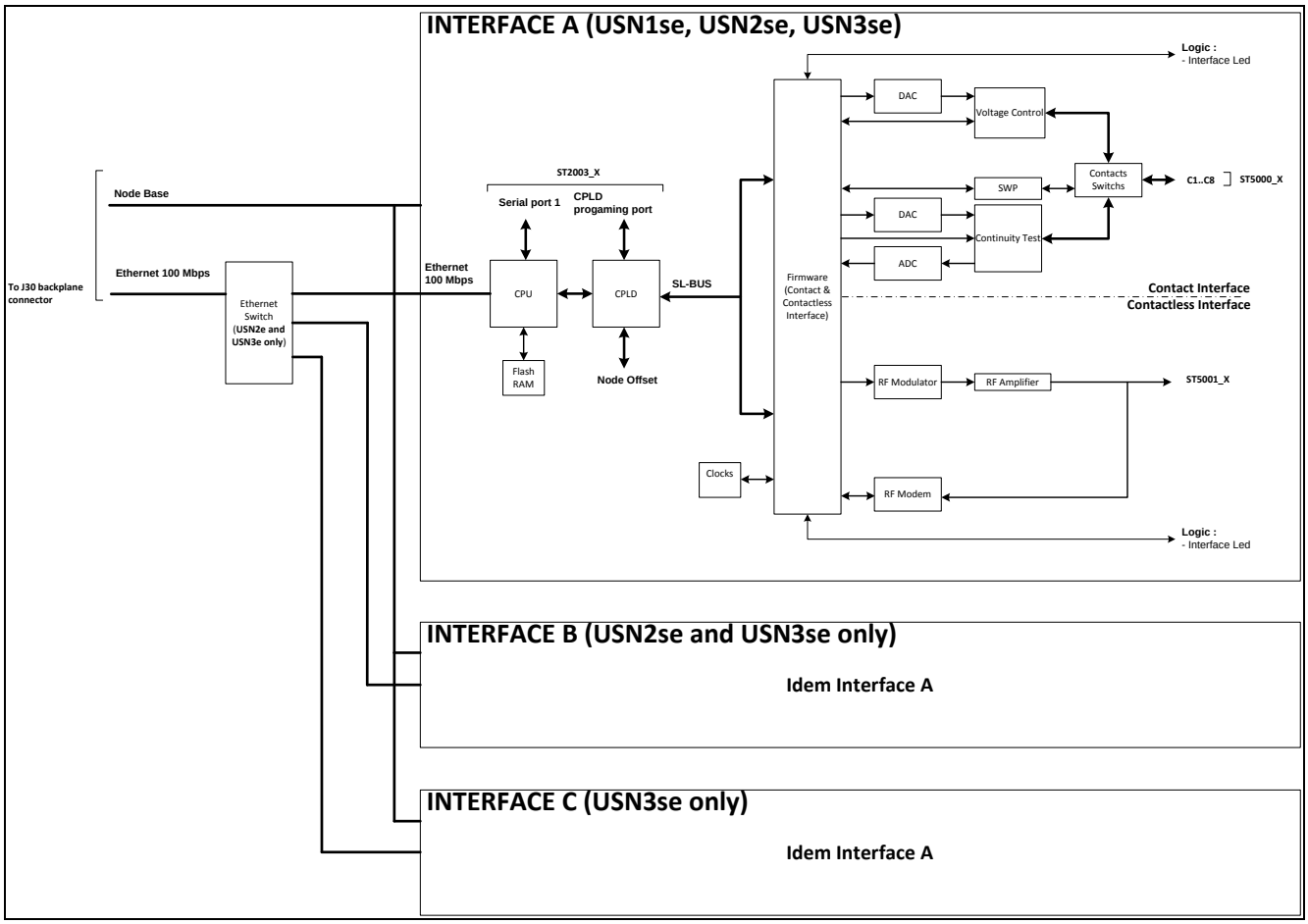
Electrostatic discharge sensitivity

The USN1se, USN2se and USN3se use semiconductors that can be damaged by electrostatic discharge (ESD). Observe precautions for handling. Damage due to inappropriate handling is not covered by the warranty.

Handling and connections should be done without power supply. This product includes a hot surface.

A fire enclosure must be provided in the end product.

2 BLOCK DIAGRAM



Synoptic chart of one communication interface

 © 2016, Smartware

3 FUNCTIONAL DESCRIPTION

USN1se, USN2se and USN3se are Smartware assemblies that include respectively one, two and three independent US-NANO modules.

Each US-NANO module provides a CPU core and a dual communication interfaces for contact and contactless smart cards or smart objects.

3.1 CORE INTERFACES

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

3.2 CONTACT INTERFACES

3.2.1 ISO/IEC 7816-3/4

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

Non-exhaustive list of software features and configuration parameters:

- Smart cards voltage configuration with support of class A, B and C.
- Smart card clock frequency from 1 to 20 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.

3.2.2 SWP

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

Non-exhaustive list of software features and configuration parameters:

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

3.2.3 Hardware measurements

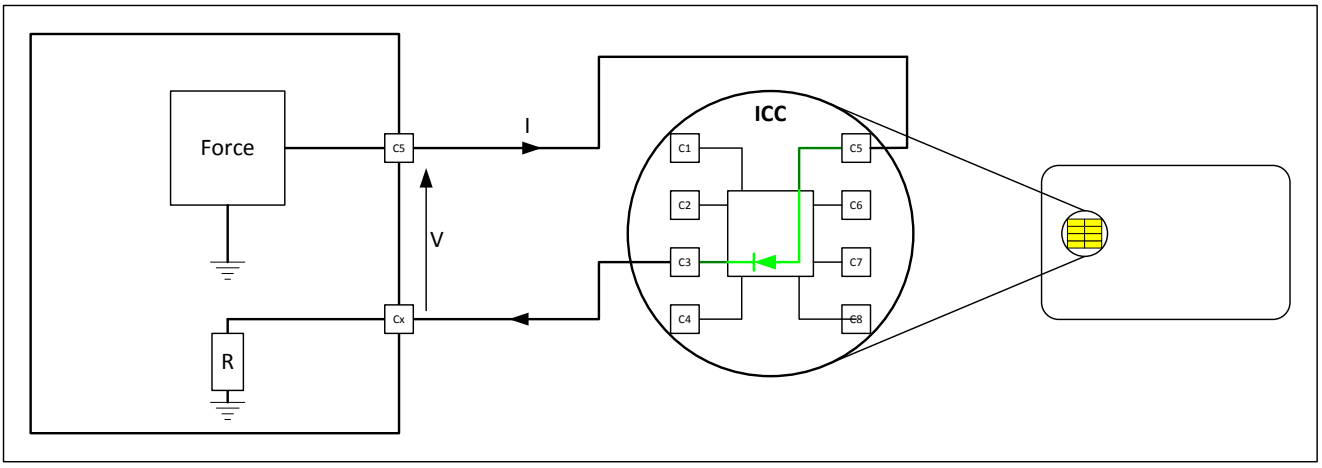
Each contact interface has specific resources to perform electrical measurements on the ISO7816 smart cards pads.

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 contact C3

 © 2016, Smartware

3.3 CONTACTLESS INTERFACES

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™

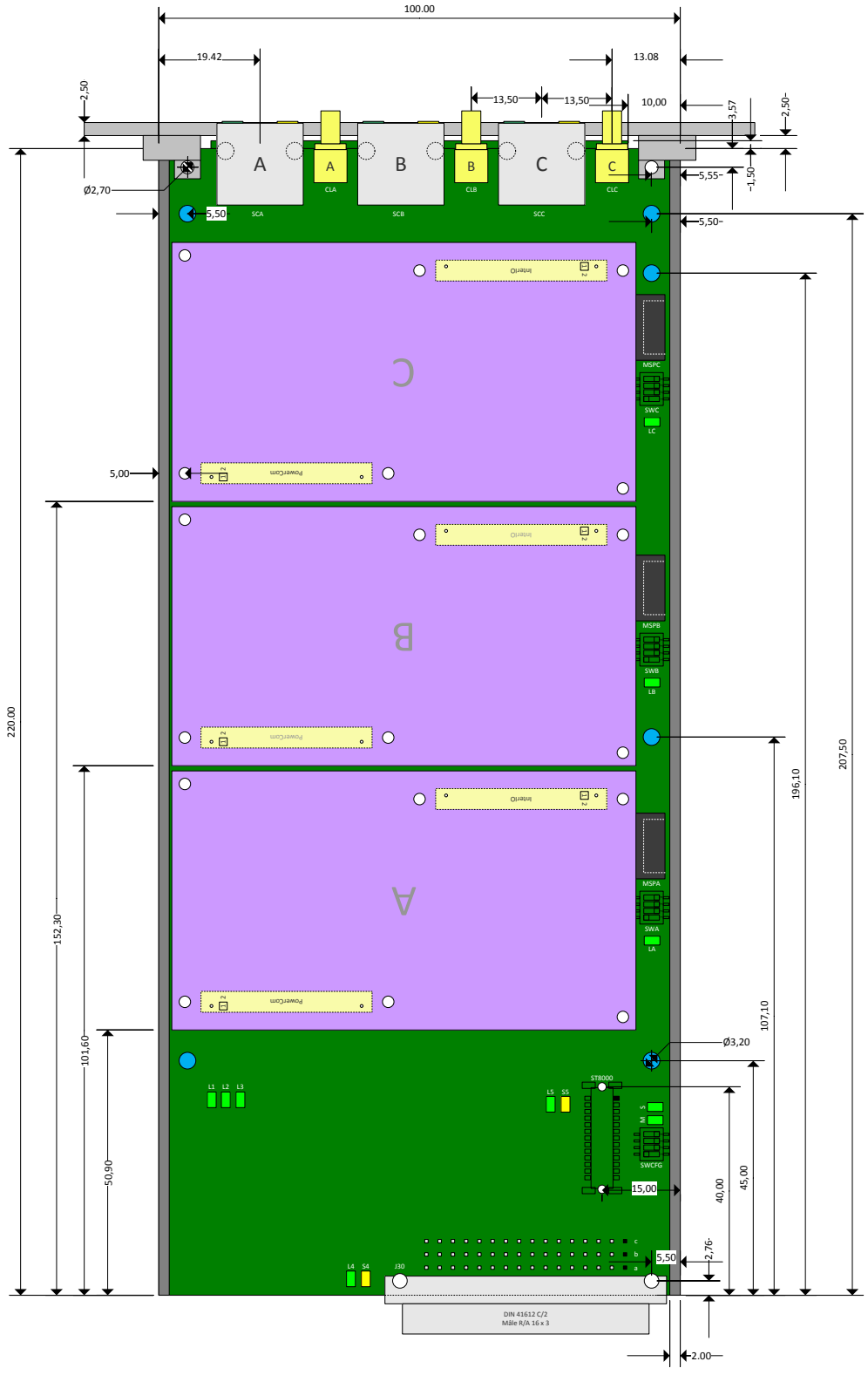
Non-exhaustive list of software features and configuration parameters:

- 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.

At last, contactless interfaces support both contactless smart cards with inductive coupling to an antenna and contactless modules with a direct connection to the RF pads.

4 TECHNICAL CHARACTERISTICS

4.1 MECHANICAL LAYOUTS



USN3se top side view

GENERAL	
Height	100 mm (3U)
Length	220 mm
Width (USN3se, USN2se)	20.3 mm (4 TE)
Width (USN1se)	17.6 mm (3.5 TE) or 20.3 mm (4 TE)
Weight	360 g (USN3se) – 330 g (USN2se) – 300 g (USN1se)

Components on bottom side are lower than 2 mm.

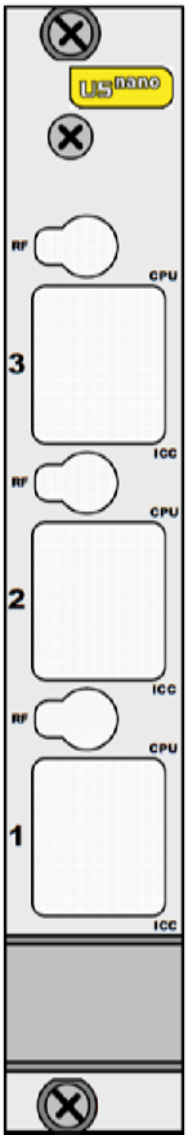
The fixing attachment holes and side strips are connected to the USN3se and MX3se-3I3P electrical ground.

USN3se includes all US-NANO interfaces A, B and C.

USN2se includes US-NANO interfaces A and B

USN1se includes US-NANO interface A only.

4.2 FRONT PANELS

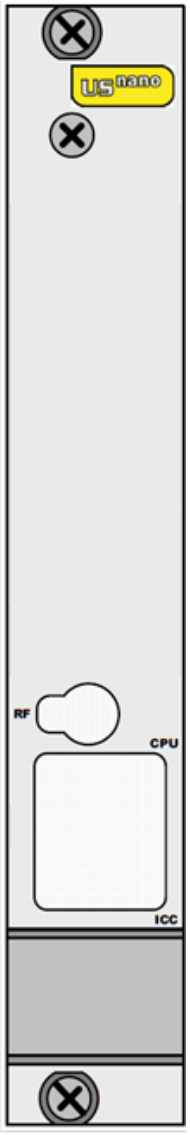


USN3se and USN2se

3U / 4TE

USN1se

3U / 3.5TE



USN1se

3U / 4TE

USN3se and USN2se have the same front panel. Nevertheless, USN2se has sealing caps on interface 3.

 © 2016, Smartware

4.3 PHYSICAL INTERFACES

4.3.1 Connectors

NAME	CONNECTOR TYPE	DESCRIPTION
SC1	RJ45	Contact interface from US-NANO A
SC2	RJ45	Contact interface from US-NANO B
SC3	RJ45	Contact interface from US-NANO C
CL1	SMB	Contactless interface from US-NANO A
CL2	SMB	Contactless interface from US-NANO B
CL3	SMB	Contactless interface from US-NANO C
J30	DIN41612	Backplane interface

4.3.1.1 SC1, SC2 and SC3 description

SC1, SC2 and SC3 connectors provide signals of the contact interfaces. The following table describes the pinout for all interfaces:

PIN	NAME	TYPE	DESCRIPTION
1	CC3	I/O	C3 smart card contact (CLK)
2	CC5	GND	C5 smart card contact (GND)
3	CC4	I/O	C4 smart card contact (RFU1)
4	CC8	I/O	C8 smart card contact (RFU2)
5	CC1	O	C1 smart card contact (VCC)
6	CC6	I/O	C6 smart card contact (SPU)
7	CC2	I/O	C2 smart card contact (RST)
8	CC7	I/O	C7 smart card contact (I/O)
Shield	GND	GND	Ground

4.3.1.2 CL1, CL2 and CL3 description

CL1, CL2 and CL3 connectors provide signals of the contactless interfaces. The following table describes the pinout for all interfaces:

PIN	NAME	TYPE	DESCRIPTION
Center	RF_ANT	O	RF output
Body	GND	GND	Ground

4.3.1.3 J30 description

The DIN41612 connector provides power, node identifier, serial ports, Ethernet port, safe mode, and LEDs.

PIN	NAME	DESCRIPTION
A1, A4, B15, C15, B16, C16	Gnd	Ground
A2, B2, C2, A3, B3, C3, A7, B7, A8, B8, C8, A9, A10, B10, C10, C11, A14, B14, C14	NC	Not connected
A15, A16	+Vaa	Main Power Supply (+12V)
B1	L1Tx	Line 1 RS232 transmit (US-Nano A)
C1	L1Rx	Line 1 RS232 receive (US-Nano A)
B4	Node0	Node Base bit 0
C4	Node1	Node Base bit 1
A5	Node2	Node Base bit 2
B5	Node3	Node Base bit 3
C5	Node4	Node Base bit 4
A6	Node5	Node Base bit 5
B6	Node6	Node Base bit 6
C6	Node7	Node Base bit 7
C7	Safe_Mode	Active low Safe Mode[1]
B9	+3V3	Internal +3.3V output
C9	LiLed	Active Low Link Led [2]
A11	ETH_BP_3P	Ethernet Pair 3 + [3]
B11	ETH_BP_3M	Ethernet Pair 3 - [3]
A12	ETH_BP_1P	Ethernet Pair 1 +
B12	ETH_BP_2P	Ethernet Pair 2 + [3]
C12	ETH_BP_0P	Ethernet Pair 0 +
A13	ETH_BP_1M	Ethernet Pair 1 -
B13	ETH_BP_2M	Ethernet Pair 2 - [3]
C13	ETH_BP_0M	Ethernet Pair 0 -

[1] Internal pull up resistor

[2] Internal serial resistor for current limiting function

[3] Termination only

 © 2016, Smartware

4.3.2 Configuration and address switches

4.3.2.1 SWCFG

This micro switch defines specific configuration modes.

PIN	NAME	DESCRIPTION
1	Node 7	Node Base (bit 7)
2	Node 6	Node Base (bit 6)
3	Mono Mode	**ON** : MLOS system in mono mode **OFF** : Normal operation
4	Safe Mode	**ON** : MLOS system in safe mode **OFF** : Normal operation

The Safe Mode starts MLOS operating system normally. However, the system uses a default MLOS.INI configuration file, and does not start any system and user applications.

The Mono Mode does not start MLOS operating system. It only allows to boot the CPU cores, and to communicate through a Serial port to reload an MLOS operating system.

4.3.2.2 SWA, SWB and SWC

These micro switches set US-NANO A, B and C boards node offset respectively.

An US-NANO unique node value is made from the global node base value (from J30 and SWCFG), and a specific offset (from SWX switch).

US-Nano Node (interface X) = Node base + Node offset (interface X)

PIN	NAME	DESCRIPTION
1	Node offset b0	Node offset bit 0
2	Node offset b1	Node offset bit 1
3	Node offset b2	Node offset bit 2
4	RFU	

The default configurations of the node offsets are:

MODEL	INTERFACE	NODE OFFSET VALUE
USN3se, USN2se, USN1se	A	0
USN3se, USN2se	B	1
USN3se	C	2

4.3.3 LEDS

NAME	DESCRIPTION
SCX_Green	Contact interface power on status LED
SCX_Yellow	CPU status LED. Blink if CPU is running correctly
CLX_Green	Contactless interface power on status LED
S	Safe Mode Status • ON if Safe Mode is activated
M	Mono Mode Status • ON if Mono Mode is activated
L1, LA	US-Nano A Ethernet link status • ON if link is established
L2, LB	US-Nano B Ethernet link status • ON if link is established
L3, LC	US-Nano C Ethernet link status • ON if link is established
L4	Backplane Ethernet link status • ON if link is established
S4	Backplane Ethernet speed • ON (100 Mbps) • OFF (10 Mbps)
L5	Not used for models USN3se and MX3se-3I3P
S5	Not used for models USN3se and MX3se-3I3P

 © 2016, Smartware

4.4 ELECTRICAL CHARACTERISTICS

GENERAL	
Operating environment	0 °C to 40 °C

4.4.1 Power Supply

An USN3se, USN2se or USN1se assembly shall be powered by a 12 Volt 3 Amp Direct Current (DC) power supply.

POWER SUPPLY	ASSEMBLY	TYPICAL	PRECISION
Rating Voltage (12 V ⎓ 3A)		12 V DC	±1.2V
Idle Current (V_{aa} = 12 V)	USN1se	280 mA	
	USN2se	670 mA	
	USN3se	950 mA	
Maximum Current (V_{aa} = 12 V, RF output short circuited)	USN1se	550 mA	
	USN2se	1300 mA	
	USN3se	1850 mA	

4.4.2 Contact interfaces

4.4.2.1 Pin drivers

CONTACT DRIVING CAPABILITY				
C1 (VCC)	V_{cc}, HiZ			
C2 (RST)	V_{OH}, V_{OL}, HiZ[1]			
C3 (CLK)	V_{OH}, V_{OL}, Clock, HiZ[1]			
C4 (RFU1)	V_{OH}, V_{OL}, HiZ[1]			
C5 (GND)	Gnd, HiZ[1]			
C6 (SPU)	V_{OH}, V_{OL}, SWIO, HiZ[1]			
C7 (I/O)	V_{OH}, V_{OL}, Pull-up[2], HiZ			
C8 (RFU2)	V_{OH}, V_{OL}, HiZ[1]			
CONTACT SIGNAL CAPABILITY	Min	Max	Resolution	Precision
V_{cc}	1.65 V	5.50 V	10 mV	±20 mV
Icc limitation				
ISO/SWP Mode		200 mA		
V_{OH}	V_{cc} - 0.1 V	V_{cc}		
V_{OL}	0 V	0.1 V		
V_{IH}	0.8 x V_{cc}			
V_{IL}		0.55 V		
Current limitation				
1.65 < Vcc < 1.95		±4 mA		
2.30 < Vcc < 2.70		±8 mA		
3.00 < Vcc < 3.60		±24 mA		
4.50 < Vcc < 5.50		±32 mA		
Clock				
ISO Mode	1 MHz	20 MHz		
C5 impedance to ground		50 mΩ		

4.4.2.2 Hardware measurements

CONTINUITY TEST	**Conditions**	**Min**	**Typical**	**Max**
Resistor measurement range		0 Ω		10 kΩ
Resistor measurement precision	R < 1 kΩ		±100 Ω	
	R > 1 kΩ		±10 %	
Current to measure a clamp diodes voltage			2,5 mA	3,2 mA
Diode threshold voltage range		0.1 V		2.5 V
Diode threshold voltage precision			0.1 V	

[1] 470 kΩ internal pull-down

[2] 10 kΩ and 4.7 kΩ software selectable internal pull-ups connected to V_{cc}

 © 2016, Smartware

4.4.3 Contactless interfaces

CONTACTLESS DRIVING CAPABILITY				
RF output	Modulated RF Signal			
CONTACTLESS SIGNAL CAPABILITY	**Min**	**Max**	**Typical**	**Precision**
RF Offset			400 mV	
RF Signal peak to peak (R = ∞)	2 Vpp	20 Vpp		± 2% ± 0.05 Vpp
RF Signal power (R = 50 Ω)		250 mW (+24 dBm)		
RF Output Impedance			50 Ω	± 5 Ω
Current limitation				
Short circuit current (R = 0 Ω) RMS			150 mA	
Recommended full power short circuit max duration		60 s		
RF Frequency			13.56 MHz	± 7 kHz
Modulation Index				
ISO14443 A / PayPass A / Mifare	90 %	100 %	100 %	
ISO14443 B / PayPass B	9.5 %	12.5 %	11 %	
ISO15693	9.5 %	12.5 %	11 %	
FeliCa™	9.5 %	12.5 %	11 %	

5 REGULATORY

USN1se, USN2se and **USN3se** models are CE, FCC modular approval, and RoHS compliant.

WARNING TO USERS

Warning 1: The USN1se, USN2se and USN3se models are considered as components 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.

Warning 2: The USN1se, USN2se and USN3se models are low power radiofrequency emitters, 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.

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.

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

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):

- *T77x49x2*

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

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

Warning 8: In case of collocated transmitters, the maximum number of transmitters in a small place should be 48.

Warning 9: 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.

Warning 10: The end product's sticker should mention that it "contains a FCCID: RPM-USN3D201 product.

 © 2016, Smartware

Warning 11:

WARNING TO USERS IN THE UNITED STATES

Federal Communication Commission Interference

Section 15.105 Information to the user

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device (USN1se, USN2se and USN3se models) 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.

NO UNAUTHORIZED MODIFICATIONS

47 CFR Section 15.21

CAUTION: This equipment may not be modified, altered, or changed in any way without signed written permission from *Smartware*. Unauthorized modification may void the equipment authorization from the FCC and will void the *Smartware* warranty.

This device complies with FCC RF radiation exposure limits set forth for general population (uncontrolled exposure). This device must be installed to provide a separation distance of at least 20cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter other than authorized in the present document.

6 CONTACT INFORMATION

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

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

7 REVISION HISTORY

VERSION	DATE	AUTHOR	CHANGES
V1R01c	December 2016	DM	Update Overview chapter
V1R01b	November 2016	DM	Add Regulatory section. Editorial corrections
V1R01a	July 2016	SHM	Original version

 © 2016, Smartware