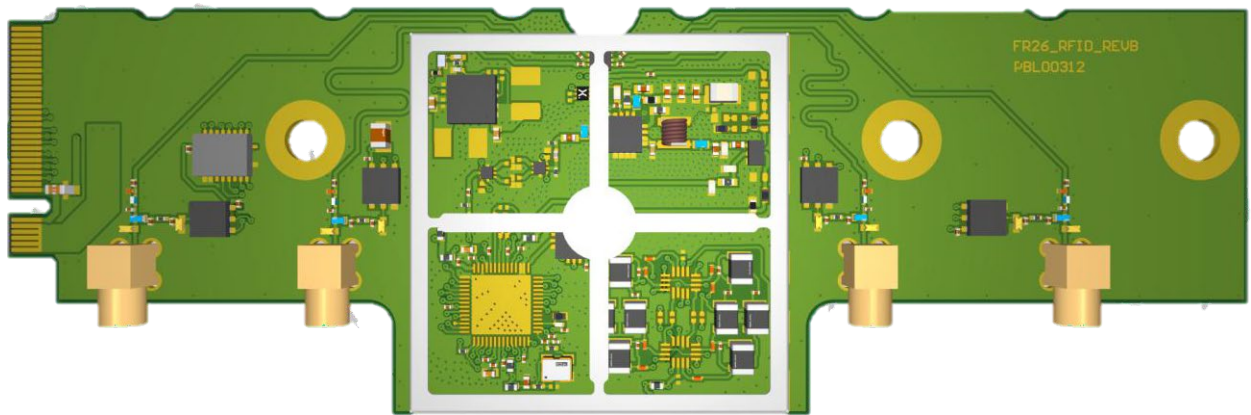




NORDIC ID NUR3-1W6-M2 HARDWARE IMPLEMENTATION GUIDE

CONTENTS

1. GENERAL DESCRIPTION.....	4
1.1. BLOCK DIAGRAM	4
1.2. KEY FEATURES.....	5
1.3. TYPICAL APPLICATION	5
2. ELECTRICAL SPESIFICATIONS.....	5
2.1. ABSOLUTE MAXIMUM RATINGS	5
2.2. DC CHARACTERISTICS	6
2.3. RF CHARACTERISTICS	6
2.4. PERFORMANCE CHARACTERISTICS.....	7
3. M.2 CONNECTOR ASSIGNMENTS	8
3.1. M.2 CONNECTOR DESIGNATION.....	8
3.2. SIGNAL-TO-PAD MAPPING.....	9
3.3. SIGNAL DESCRIPTIONS.....	10
4. END-DEVICE INTEGRATION CONSIDERATIONS	11
4.1. ANTENNA REQUIREMENTS	11
4.2. HEAT TRANSFER CONSIDERATIONS.....	12
4.3. POWER SUPPLY.....	12
4.4. SPI COMMUNICATION INTERFACE	12
4.5. I2C TO 1-WIRE INTERFACE	12
5. RF AND INVENTORY SETTINGS.....	13
5.1. RF SETTINGS	13
5.1.1. TX POWER LEVEL	13
5.1.2. RF PROFILES (UPDATE).....	13
5.1.3. RF-OUTPUT CONNECTORS.....	15
5.1.4. REGION.....	15
5.1.5. ANTENNA CONTROL.....	15
5.1.6. DYNAMIC POWER SAVE MODE	15
5.1.7. RSSI FILTERS	15
5.2. INVENTORY SETTINGS	16
5.2.1. Q-VALUE.....	16
5.2.2. SESSION.....	17
5.2.3. ROUNDS.....	17
5.2.4. TRANSMISSION TIME CONTROL.....	18
5.2.5. SELECTING THE RIGHT SETTINGS.....	18
6. TAG SIGNAL AND SYSTEM QUALITY INDICATORS.....	18
6.1. TAG REPLAY QUALITY INDICATORS.....	18

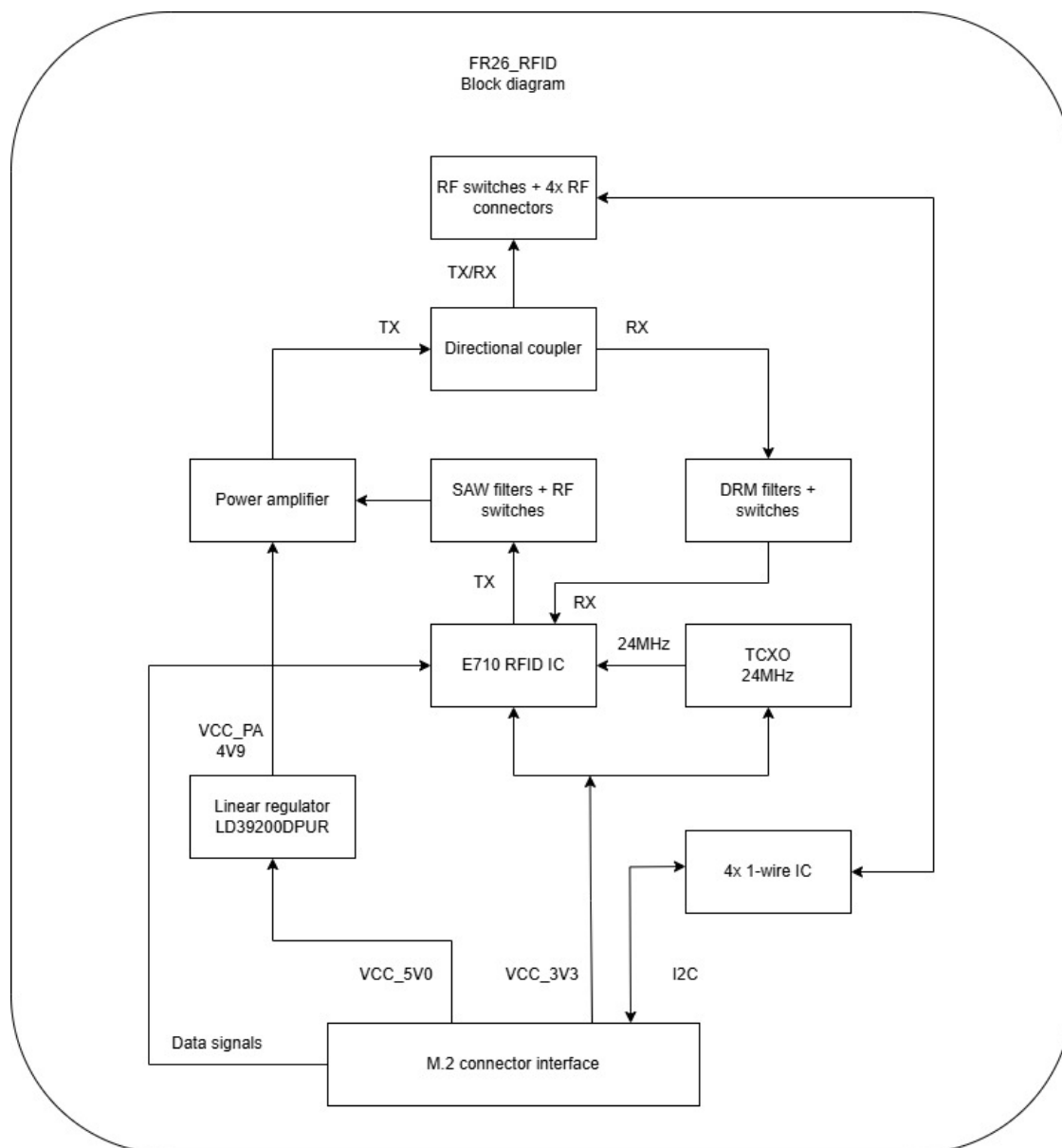
6.1.1.	TAG REPLAY RSSI VALUE (SIGNAL STRENGTH INDICATOR).....	18
6.1.2.	TAG REPLAY PHASE ROTATION VALUE.....	18
6.1.3.	TAG REPLAY PHASE DIFFERENCE VALUE.....	19
6.2.	REFLECTED POWER VALUE.....	19
7.	MECHANICAL DIMENSIONS	20
7.1.	MODULE DIMENSIONS	20
7.2.	PACKING.....	20
8.	REGULATORY INFORMATION	20
8.1.	EUROPEAN UNION AND EFTA COUNTRIES.....	21
8.2.	FCC	25
8.2.1.	USER'S GUIDE REQUIREMENTS.....	26
8.2.2.	LABELING REQUIREMENTS.....	27
8.2.3.	ANTENNA REQUIREMENTS	27
8.3.	ISED EN.....	27
8.3.1.	LABELLING REQUIREMENTS FOR THE HOST DEVICE	28
8.3.2.	ANTENNA REQUIREMENTS	28
8.4.	ISED FR	28
8.4.1.	EXIGENCES APPLICABLES AUX APPAREILS HÔTES.....	29
8.4.2.	EXIGENCES D'ANTENNE	29
8.5.	TELEC.....	29
8.5.1.	ANTENNA REQUIREMENTS	29
9.	ABOUT NORDIC ID.....	29
10.	VERSION HISTORY.....	31

1. GENERAL DESCRIPTION

Nordic NUR3-1W6-M2 is a state-of-the-art RAIN UHF RFID reader / writer module. It is compatible with ISO18000-63 standard. Module complies for CE/RED (ETSI), FCC and IC/ISED radio regulations. It is also compatible with DRM (dense reader mode) requirements. Maximum output power is +32dBm (region dependant) and it can be adjusted via SW API with 1 dB steps. Maximum sensitivity is -85dBm when measured according to RAIN recommendations.

1.1. BLOCK DIAGRAM

Nordic ID NUR3-1W6-M2 block diagram shows the building blocks of the module.



Picture 1. Block diagram of NUR3-1W6-M2 module.

1.2. KEY FEATURES

- High-end RAIN UHF RFID engine module
- ISO 18000-63 full protocol support
- DRM compatible with high channel selectivity
- High performance with up to 32dBm output power (region dependant)
- Pre-programmed regulatory profiles (regions)
- SPI-interface for host control over M.2 interface
- High sensitivity due to automatic self-jammer cancelation
- Tag replay quality indicators (RSSI, scaled RSSI, phase rotation angle and phase difference)
- Accurate RF output due to individual TX-calibration

1.3. TYPICAL APPLICATION

Typical application for the module is to be embedded into high performance fixed UHF RFID reader. The module in question will implement the UHF RFID functionality whereas the dedicated host part will form the platform for the end-product.

2. ELECTRICAL SPESIFICATIONS

This section provides information about the DC-, RF- and performance characteristics of the Nordic ID NUR3-1W6-M2 module.

2.1. ABSOLUTE MAXIMUM RATINGS

Violating below values may cause permanent damage to the module. Also, correct operation of the module is not guaranteed if operating outside of the absolute maximum limits. NUR3-1W6-M2 is ESD sensitive component so it must be handled with care.

Absolute maximum rating	Value
Operating temperature	-20°C to +55°C
Storage temperature	-30°C to +85°C
Supply voltage VCC_5V0	+6 V
Supply voltage VCC_3V3	+3.6V
Control and data signal pads	+3.6 V

Other pads	+3.6V
------------	-------

Table 1. Absolute maximum ratings of the NUR3-1W6-M2 module.

2.2. DC CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Units
V _{VCC_5V0}	Supply voltage VCC_5V0	5.0	5.0	6.0	V
I _{VCC_5V0}	Supply current (reading 32dBm TX power)	-	2.5	3	A
V _{VCC_3V3}	Supply voltage VCC_3V3	3.2	3.3	3.4	V
I _{VCC_3V3}	Supply current	-	10	100	mA
I _{source}	Control and data signal pad source current	-	0.5	1	mA
I _{sink}	Control and data signal pad sink current	-	0.5	1	mA
V _{low}	Control and data signal pad input low-level voltage	-	0	0.15	V
V _{high}	Control and data signal pad input high-level voltage	3.2	3.3	3.4	V

Table 2. DC characteristics of the NUR3-1W6-M2 module (typical VCC's and ambient temp +25°C).

2.3. RF CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Units
Sens	Receiver sensitivity (S11 better than 15dB)	-	-	-88	dBm
P _{out}	Output power range	3	-	32	dBm
P _{tolHigh}	TX range from 27 to 32dBm	-0.5	P _{out}	+0.5	dB
P _{tolMed}	TX range from 17 to 26dBm	-1	P _{out}	+1	dB
P _{tolLow}	TX range from 1 to 16dBm	-2	P _{out}	+2	dB

P _{tolTemp}	TX variation over full temperature range	-1.5	P _{out}	+1.5	dB
P _{adj}	TX power adjustment step	1	1	1	dB
S ₁₁	VSWR requirement	-	1.5:1	-	50Ω
D _{r→t}	Reader-to-tag data rates	-	TBD	-	kbps
D _{t→r}	Tag-to-reader data rates	-	TBD	-	kbps

Table 3. RF characteristics of the NUR3-1W6-M2 module (typical VCC's and ambient temp +25°C).

2.4. PERFORMANCE CHARACTERISTICS

The performance of the NUR3-1W6-M2 reader module is highly dependent on the test environment, used reader antenna, tag antenna and tag IC. In addition, interferences from other radio sources operating in the same frequency range may decrease the performance. Selected radio and inventory parameters do have a big influence to reading performance as well and those should be optimized to the size of the tag population in question.

Symbol	Parameter	Min	Typ	Max	Units
R _{dist}	Typical read distance with 5dBi antenna*	-	15	-	M
R _{rateLow}	Maximum read rate (Robust RF profile)	-	-	80	tags/s
R _{rateMed}	Maximum read rate (Nominal RF profile)	-	-	350	tags/s
R _{rateHigh}	Maximum read rate (High speed RF profile)	-	-	1100	tags/s
O _{temp}	Operation ambient temperature range	20-	-	+55	°C
H _{rel}	Relative humidity	10	-	95	%

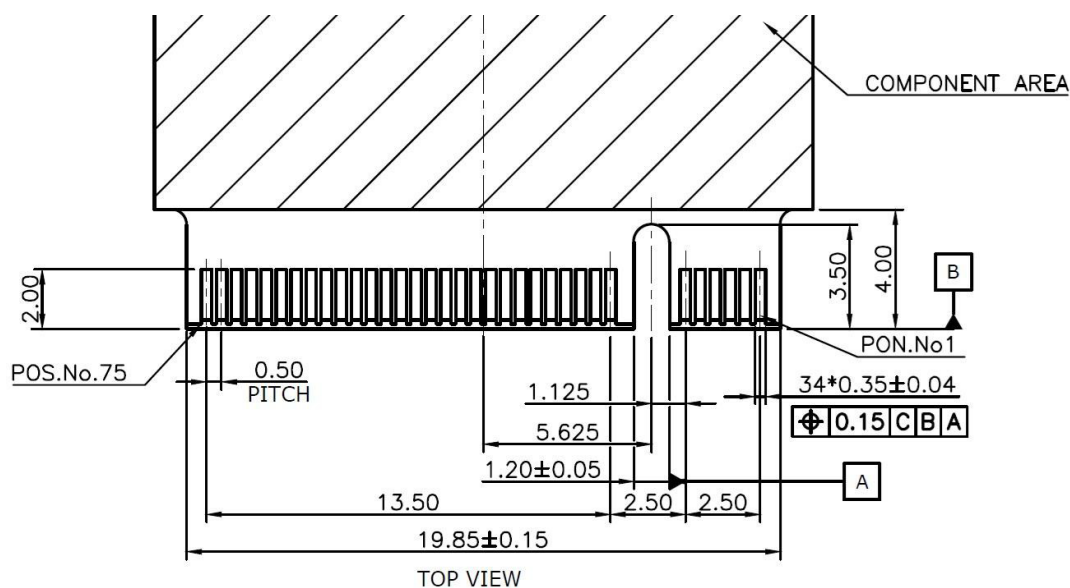
Table 4. Performance characteristics of the NUR3-1W6-M2 module (typical VCC's and ambient temp +25°C).

*Measured using Avery Dennison Belt tag (with Impinj R6 IC)

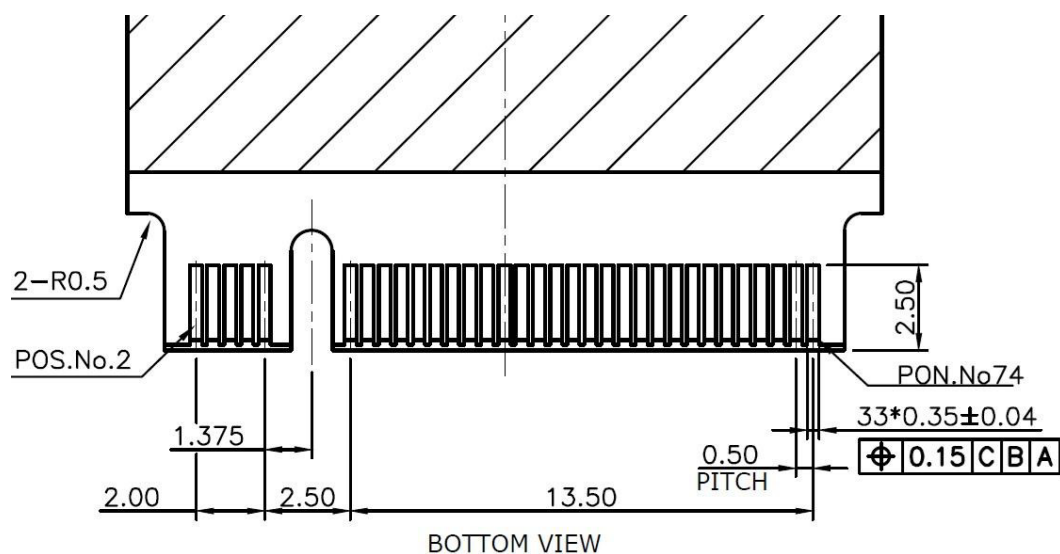
3. M.2 CONNECTOR ASSIGNMENTS

3.1. M.2 CONNECTOR DESIGNATION

The PCB has edge fingers for M.2 B-key connector. For example ATTEND Technology 123A-30B00 is suitable.



Picture 2. *NUR3-1W6-M2 pad numbering (top view).*



Picture 3. NUR3-1W6-M2 pad numbering (bottom view).

3.2. SIGNAL-TO-PAD MAPPING

M.2 Interface signal to pad mapping is shown in a below table.

Pad number	Signal name	Type	Description
1	VCC_5V0	Supply input	5V0 Main supply
2	GND	Supply	Ground
3	VCC_5V0	Supply input	5V0 Main supply
4	GND	Supply	Ground
5	VCC_5V0	Supply input	5V0 Main supply
6	GND	Supply	Ground
7	VCC_5V0	Supply input	5V0 Main supply
8	GND	Supply	Ground
9	VCC_5V0	Supply input	5V0 Main supply
10	GND	Supply	Ground
11	VCC_3V3_SYS	Supply input	3V3 supply
21	VCC_3V3_SYS	Supply input	3V3 supply
23	VCC1V8_SYS	Supply input	Reserved for future use
25	E710_SPI_MOSI	Input	RFID SPI interface to module
27	E710_SPI_MISO	Output	RFID SPI interface to module
29	E710_SPI_CLK	Input	RFID SPI interface to module
31	E710_SPI_IRQ	Output	RFID SPI interface to module
33	E710_SPI_SS	Input	RFID SPI interface to module
35	GND	Supply	Ground
37	E710_READY_N	Output	RFID control signal to module
39	E710_RESET	Input	RFID control signal to module
41	E710_ENABLE	Input	RFID control signal to module
43	GND	Supply	Ground
45	MCU_I2C0_SCL	Input	Data interface to 1-wire interface
47	MCU_I2C0_SDA	Bidirectional	Data interface to 1-wire interface
49	GND	Supply	Ground
51	USBDM4_M2_RFID	Bidirectional	Reserved for future use

53	USBDP4_M2_RFID	Bidirectional	Reserved for future use
55	GND	Supply	Ground
57	MCU_UART0_RXD	Output	Reserved for future use
59	MCU_UART0_TXD	Input	Reserved for future use
61	GND	Supply	Ground
63	SOC_I2C2_SDA	Bidirectional	Reserved for future use
65	SOC_I2C2_SCL	Input	Reserved for future use

Table 5. M.2 interface signal-to-pad mapping of the NUR3-1W6-M2 module.

3.3. SIGNAL DESCRIPTIONS

Signal name: GND	Pads: 2, 4, 6, 8, 10, 35, 43, 49, 55, 61
These pads are used for grounding and to improve the thermal performance. They should be connected to Host board GND net.	
Signal name: VCC_5V0	Pads: 1, 3, 5, 7, 9
These pads are used for powering RFID IC and power amplifiers. When you have relative high impedance power source it is recommended to use 200µF (low ESR), 100nF and 100pF capacitors near the VCC_5V0 input pads to maintain stable operating voltage for the reader module.	
Signal name: E710_RESET_N	Pad: 39
This pad is used for resetting RFID IC. (Active low)	
Signal name: E710_ENABLE	Pad: 41
This pad is used for enabling the interface to the module. (Active high)	
Signal name: E710_READY_N	Pad: 37
This pad is used for recognizing when the RFID IC is ready for communication. (Active low)	
Signal name: E710_SPI_SS	Pad: 33
This pad is has slave select function when using SPI interface. (Active low)	
Signal name: E710_SPI_IRQ	Pad: 31
This pad is has interrupt function when using SPI interface. (Active low)	
Signal name: E710_SPI_CLK	Pad: 29
This pad is clock input when using SPI interface. (max. 4MHz).	
Signal name: E710_SPI_MISO	Pad: 27
This pad is master in slave out when using SPI interface.	
Signal name: E710_SPI_MOSI	Pad: 25

This pad is master out slave in when using SPI interface.	
Signal name: MCU_I2C0_SDA	Pad: 47
This pad is I2C data signal.	
Signal name: MCU_I2C0_SCL	Pad: 45
This pad is I2C clock signal.	
Signal name: VCC_3V3_SYS	Pad: 11, 21
This pad is 3V3 input for RFID chip and peripherals.	
Signal name: VCC_1V8_SYS	Pad: 23
This pad is 1V8 input and reserved for future use.	
Signal name: USBDM4_M2_RFID	Pad: 51
This pad is reserved for future use.	
Signal name: USBDP4_M2_RFID	Pad: 53
This pad is reserved for future use.	
Signal name: MCU_UART0_RXD	Pad: 57
This pad is reserved for future use.	
Signal name: MCU_UART0_TXD	Pad: 59
This pad is reserved for future use.	
Signal name: SOC_I2C2_SDA	Pad: 63
This pad is reserved for future use.	
Signal name: SOC_I2C2_SCL	Pad: 65
This pad is reserved for future use.	

Table 6. Signal descriptions of NUR3-1W6-M2 module.

4. END-DEVICE INTEGRATION CONSIDERATIONS

This section covers end-device integration considerations. Design guidance's presented below needs to be followed to guarantee a proper operation of the Nordic ID NUR3-1W6-M2 UHF RFID module.

4.1. ANTENNA REQUIREMENTS

Poor VSWR of the antenna leads to situation where significant portion of the transmitted signal will reflect to the module from the antenna. NUR3-1W6-M2 module has automatic self-jammer cancellation system that decreases the effect of the reflected signal. This system can handle up to 10dBm power levels at the receiver port (up to 20dBm at the module's antenna port). The automatic leakage cancellation is automatically on, when module is operating in normal mode.

4.2. HEAT TRANSFER CONSIDERATIONS

For NUR3-1W-M2 module to operate normally in different ambient temperatures, a proper heat dissipation design needs to be followed. Recommendation is that heat transfer material is used to maximize the heat transfer from the module into the mother/carrier board of the end device. In below picture you can see the reference implementation. 1,75mm thick heat transfer material is used between the boards. LAIRD Tflex HD7.5,1.75 is tested to be good a material for this purpose.



Picture 4. Reference heat mitigation implementation of the NUR3-1W6-M2 module.

4.3. POWER SUPPLY

The NUR3-1W6-M2 has internal linear power regulators for improving the power supply noise rejection capabilities. However, it is still important to supply low noise and stable power for the NUR3-1W6-M2 module. The voltage ripple should be kept under 200mVpp, and it is recommended to add a minimum of 200µF low ESR, 100nF and 100pF capacitors next to the power supply feed contact.

4.4. SPI COMMUNICATION INTERFACE

Host control is established via SPI interface exposed thru NUR3-1W6-M2 modules M.2 contacts. Max SPI clock speed is 4Mhz.

4.5. I2C TO 1-WIRE INTERFACE

NUR3-1W6-M2 provides a I2C to 1-wire interfaces on the 4 RF output ports. These are for future use.

5. RF AND INVENTORY SETTINGS

Using a proper set of RF and inventory settings is mandatory for reaching the optimal reading performance.

5.1. RF SETTINGS

RF settings are mainly the ones which influences how RF transmitter operates within the Nordic ID NUR3-1W6-M2 UHF reader module. There are certain settings which user can change like TX output power level and the used RF-profile.

5.1.1. TX POWER LEVEL

Nordic ID NUR3-1W6-M2 UHF RFID module has the maximum TX output power of 32dBm (1.6W). Note that max TX power is region dependent (please see the table 8). The TX power can be adjusted by 1dB steps via Nur API. In total, there are 30 steps yielding the minimum output power value of 3dBm.

If you have configured more than one antenna to be used, you can set and store individual output power level for each of the antennas in question. This per antenna output power setting is also available via Nur API. Note that if per antenna power level is set this overrides the general TX power level setting.

Region in use	Max TX power
EU lower band	+32dBm (TBD)
EU upper band	+32dBm (TBD)
FCC	+30dBm
Others	+32dBm (TBD)

Table 7. Maximum TX power level for different regions.

5.1.2. RF PROFILES (UPDATE)

Nordic ID NUR3-1W6-M2 UHF RFID module supports multiple different RF profiles. The profiles are Robust, Nominal, Fast, High speed, High speed 2 and Autose. It's important to select the correct RF profile based on use case and environment. More detailed description about the RF profiles can be found below:

Robust

- Link frequency: 160 kHz

- Coding: Miller 8
- Read rate: Up to 50 tags/s

Optimized for maximizing the sensitivity through slower data speed. Ideal for use cases where maximum sensitivity is required.

Nominal

- Link frequency: 250/300 kHz
- Coding: Miller 4
- Read rate: Up to 250 tags/s

The default profile for the NUR3-1W6-M2. This profile is recommended for DRM use cases.

Fast

- Link frequency: 640 kHz
- Coding: Miller 4
- Read rate: Up to 500 tags/s

Provides a balance between speed and sensitivity.

High speed

- Link frequency: 640 kHz
- Coding: FM0
- Read rate: Up to 900 tags/s

Optimized for speed at the cost of sensitivity. Good for environments where little interference is expected and high read rates are required.

High speed _2

- Link frequency: 640 kHz
- Coding: FM0
- Read rate: Up to 1000 tags/s or more

The High speed 2 profile further optimizes for speed by reducing the Tari value for the pulse interval encoded (PIE) data.

Autoset

The Autoset profile used 4 different RF-profiles internally. It always starts with the fastest, least sensitive one and iterates thru to the most sensitive one. Profile is set when no new tags are discovered anymore.

5.1.3. RF-OUTPUT CONNECTORS

NUR3-1W6-M2 module has 4 RF-outputs ports equipped with MMCX connectors. One antenna port is used at the time. There is a RF-switch selecting the port in use. The switch is controlled by the firmware. Intended use is not to expose the MMCX connectors directly to end-user, but to use internal coaxial cables with panel-type of the connector at the end.

Note that NUR3-1W6-M2 module is not sold to third parties, so module is only used in-house. This means that Nordic ID has full control for the antennas used together with the module. It is strongly forbidden to use antennas outside of the types/parameters mentioned in the NUR3-1W6-M2 HW integration guide document,

5.1.4. REGION

Nordic ID NUR3-1W6-M2 has pre-defined region settings defining frequency and channel sets for operating under different radio regulations. Globally the regulations vary depending on the country or part of the world. Refer to Nur API documentation for list of pre-defined countries. When module ships from production it is locked to the pre-selected region setting (based on SKU) and cannot be changed by the user.

5.1.5. ANTENNA CONTROL

Used antenna port can be selected via NurApi. Also, automatic antenna setting is available. When used, module will automatically switch between enabled antenna ports.

5.1.6. DYNAMIC POWER SAVE MODE

NUR3-1W6-M2 module has dynamic power save modes which can be enabled via NurApi. By default, the power save is off. There are three depths for the dynamic power save mode to select from: 100ms, 500ms and 1000ms. The power save mode works in a way that when module reads continuously (applies only when using inventory stream -command) it goes to sleep if there are no tags in the field. The sleep time is defined by the depth value. After the sleep period is elapsed module starts to read again and so on. If there are one or more tags in the field the module will not go into sleep.

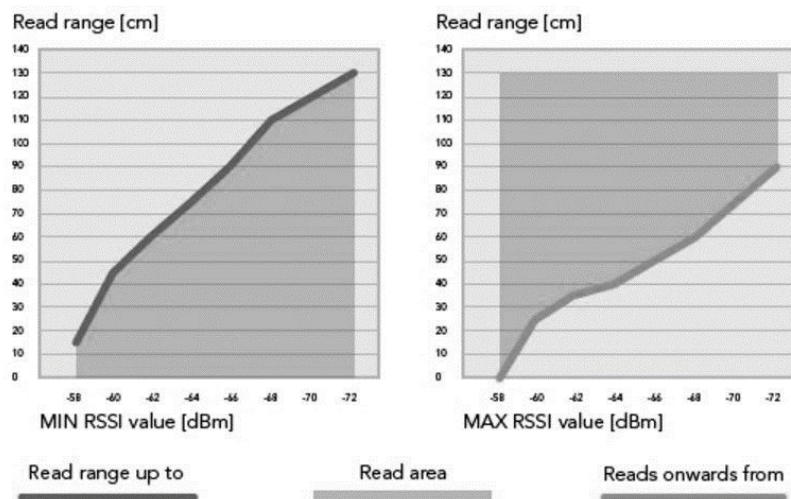
Using dynamic power saving is highly recommended in use cases where reader is reading continuously. This will decrease the interferences to other readers and helps heat mitigation in high ambient temperature environments.

5.1.7. RSSI FILTERS

Nordic ID NUR3-1W6-M2 module has internal RSSI filters which can be used to limit the read range. By applying the filters, you can set the limits which tag replay must met to be registered. MIN RSSI – value means that tag replay signal needs to be equal or stronger than the defined value. Otherwise, tag is not read. MAX RSSI value in other hand means that signal strength must be lower than the filter value.

There are separate RSSI filter values for inventory, read and write operations. These can be set individually.

MIN RSSI setting defines the minimum tag reply power level
MAX RSSI setting defines the maximum tag reply power level



Picture 5. Read range limited by RSSI filters (100mW TX power level with 0dBi antenna gain used).

5.2. INVENTORY SETTINGS

By selecting the proper RFID inventory parameters, you can optimize the modules reading performance for different tag populations and use cases.

5.2.1. Q-VALUE

The Q-value defines the amount of open response slots that tags can use per one inventory round. Number of slots can be calculated by formula 2^Q . It is advised to use twice as many slots compared to number of tags that you have in your readers reading field simultaneously. Selectable values are 0 – 15 where 0 means automatic Q-value adjustment. In this automatic mode the reader will adjust Q-value between sequential rounds based on the number of found tags and collisions. By default, the Q-value is set to 0.

Q-value	Response slots	Q-value	Response slots
0	Automatic	8	256
1	2	9	512
2	4	10	1024
3	8	11	2048
4	16	12	4096
5	32	13	8192
6	64	14	16384

7	128	14	32768
---	-----	----	-------

Table 8. Relation between the Q-value and the number of response slots for a round.

5.2.2. SESSION

There are 4 session options which you can use when initializing inventory round. Every session has two target states A and B. By default, Gen2 tags are at state A if tag has not been read recently. When tag is read it flips to state B and does not reply to readers query made using a target A. The table below describes the persistence of tag's state machine when using different session values. For example, when using session 0 the tag will come back to state A immediately when tag power is lost. Usually, tag loses the power when reader stops the inventory round or changes the channel.

Persistence when tag power is ON is not defined by the ISO18000-63 when using session settings S0, S2 and S3. With session 1 the tag will keep it state over 500ms but less than 5s. With session values 2 and 3 tags will keep it states over 2s when tag power is lost. Time can vary depending what tag IC is used.

Session flag	Persistence: Tag powered	Persistence:
S0	Indefinite	None
S1	500ms < t < 5s	500ms < t < 5s
S2	Indefinite	t > 2s
S3	Indefinite	t > 2s

Table 9. Persistence characteristics of ISO18000-63 tags.

5.2.3. ROUNDS

The rounds setting defines how many query rounds is done inside one inventory round. After every inventory round, the reader will send data to the Host. Selectable values are 0 – 10. By default, rounds setting is set to 0. In legacy modules, that was an automatic adjustment, but that feature is not supported anymore. In NUR3-1W6-M2 module, rounds setting of 0 is internally changed to 1. Also, note that the rounds setting will not have any impact when Autoset RF-profile is used or in case of Auto-Q (Q-value is 0).

As a summary, rounds settings will only have an impact when fixed Q value is used.

Inventory round		
Query round 1	Query round 2	Query round n

Table 10. Relation between inventory round and query round (Rounds setting).

5.2.4. TRANSMISSION TIME CONTROL

The NUR3-1W-M2 module has fixed maximum channel times defined by the radio regulations. While operating under ETSI following regions the maximum channel time is 3950ms and under FCC it is 395ms. Note that Q- and Rounds-values do not change these maximum limits. Channel usage is also randomized.

5.2.5. SELECTING THE RIGHT SETTINGS

General guidance is that Q-value should be adjusted so that there are 1.5 – 2 times more response slots compared to the number of tags simultaneously on the readers field-of-view. If reader will face many different tag populations than automatic Q-adjustment (Q=0) setting will be a good choice.

Besides Q-value one important parameter is session. In general, it could be stated that if the size of tag population is measured in thousands rather than in hundreds it is wise to use sessions 2 or 3. Because then every tag will be read only once making the mass inventory efficiency much better. Rounds 1 setting is also advised to be used with session 1 or 2 or 3.

6. TAG SIGNAL AND SYSTEM QUALITY INDICATORS

Tag signal quality indicators can be used for multiple use cases like assessment of the distance between the reader antenna and the tag. When parameters are used in a statistical way you could use these to assess if tag is stationary or not. Also, you could prevent certain operations, like tag writing, if signal strength is not high enough.

Reflected power value can be used to verify that matching of the system and antenna is in proper level.

6.1. TAG REPLAY QUALITY INDICATORS

Tag replay quality indicator values are reported to the host system together with read data of the tag. Note, that to also obtain the tag phase rotation value or phase difference value, you need to enable this functionality first via NurApi. Please refer to Nur API documentation for more detailed information.

6.1.1. TAG REPLAY RSSI VALUE (SIGNAL STRENGTH INDICATOR)

When reading a tag NUR3-1W6-M2 module also returns received signal strength indication values. Two values are returned for each read tag. One is the absolute power level (dBm) and second is the scaled RSSI value of the tags backscatter signal. Scaled RSSI value is scaled between 0 – 100. 0 corresponds to minimum signal level the module can receive and 100 with maximum.

6.1.2. TAG REPLAY PHASE ROTATION VALUE

Nordic ID NUR3-1W6-M2 UHF RFID module can provide the tag phase rotation value of the tags replay signal (in relation to the transmitted signal). Dynamic range for this value is from 0 to 360 degrees.

6.1.3. TAG REPLAY PHASE DIFFERENCE VALUE

Nordic ID NUR3-1W6-M2 UHF RFID module can measure tag phase value at the beginning of the EPC reception and at the end of that same reception. Phase difference is then calculated and provided to host via NurApi. Phase difference value other than zero is an indication that tag in relation to the reader is moving (or something in the nearby environment is changing).

6.2. REFLECTED POWER VALUE

This measurement can be used to check what is the matching of the antenna(s) and feed line(s). When this function is triggered NUR3-1W6-M2 module puts carrier wave ON at full power and measures the absolute power level that is coming to the receiver port of the module. For the backwards compatibility reasons there is a fixed difference in actual reflected power level and the level reported by the module. You can calculate the real absolute reflected power level coming to the RF port of the module by using below formula:

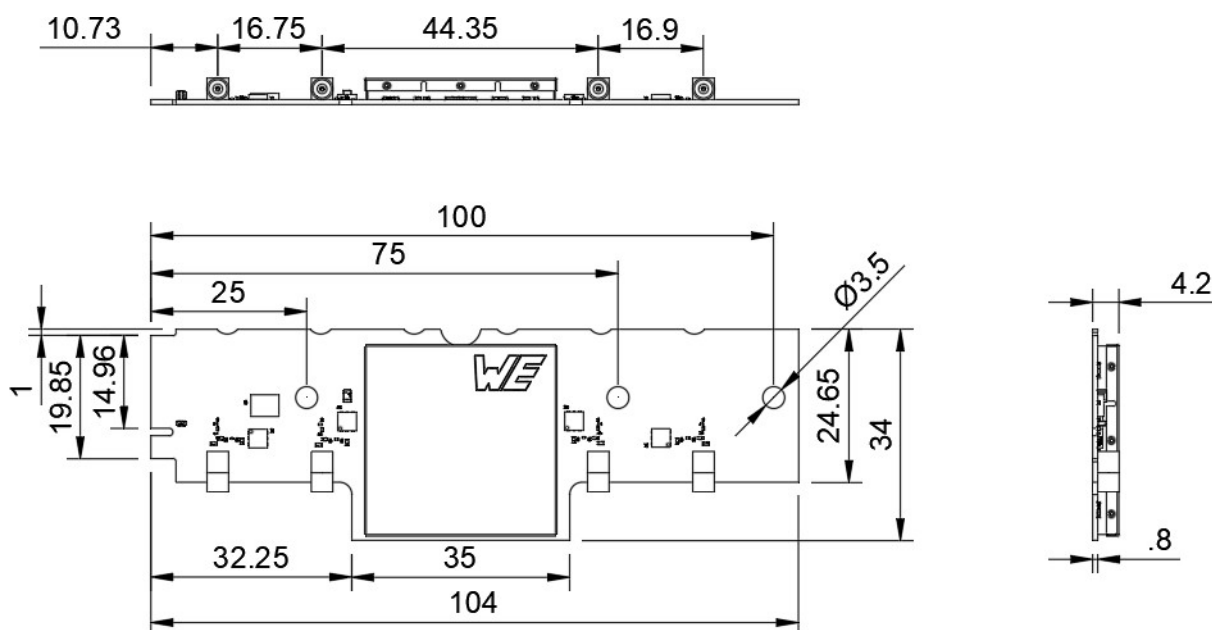
$$\text{Reflected power level (in dBm)} = (\text{Reported reflected power level by the module}) + 25$$

This feature can also be used for antenna detection. If there is no antenna connected to the port, the reflected power value will be close to the level of transmitted signal.

7. MECHANICAL DIMENSIONS

Mechanical dimensions are presented in this section. 3D step model of the NUR3-1W6-M2 module is available on request. Please contact Nordic ID support if needed.

7.1. MODULE DIMENSIONS



Picture 6. Mechanical dimension top view of the NUR3-1W6-M2.

7.2. PACKING

TBD

8. REGULATORY INFORMATION

When OEM prefers to leverage Nordic ID's grants and certifications of the NUR3-1W6-M2 UHF RFID module, the host device documentation shall include regulatory compliance information on the NUR3-1W6-M2 module. Corresponding to the applicable regulatory agencies the following sections outline regulatory compliance information needed in the user documentation and external labels for the host devices into which the NUR3-1W6-M2 is integrated.

When leveraging Nordic ID's grants and certifications, antenna shall be considered, in view of the fact, that the NUR3-1W6-M2 module has met the essential regulatory requirements with the maximum antenna gain stated in the context of particular regulatory compliance information (Antenna

requirements). Using the antenna which meets the requirements, OEM integrator may demonstrate with less effort that the device with the integrated NUR3-1W6-M2 module complies with the requirements.

8.1. EUROPEAN UNION AND EFTA COUNTRIES

USER GUIDE REQUIREMENTS

This apparatus complies the essential requirements of the Radio Equipment Directive (RED) 2014/53/EU. In order to prove presumption of conformity with the essential requirements of the Radio Equipment Directive (RED) 2014/53/EU, following requirements and test methods have been applied to the apparatus:

- article 3.2: ETSI EN 302 208 v3.3.0
 - Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W and in the band 915 MHz to 921 MHz with power levels up to 4 W; Harmonised Standard for access to radio spectrum
- article 3.1b: ETSI EN 301 489-1 v2.2.0
 - Tests must be performed when module is integrated in host product.
- article 3.1b: ETSI EN 301 489-3 v2.1.1
 - Tests must be performed when module is integrated in host product.
- article 3.1a: EN 60950-1:2006 + A1:2010 + A11:2009+A12:2011+ A2:2013
 - Tests must be performed when module is integrated in host product.

EN 62479: 2010

- Human exposure

EN 62311: 2008

- Human exposure limits

This apparatus complies EU Directive 2011/65/EU, Reduction of Hazardous Substances (RoHS).

Česky

[Czech]

[Nordic ID] tímto prohlašuje, že tento [RFID Radio module NUR3-1W6-M2] je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 2014/53/ES.

Dansk

[Danish]

Undertegnede [Nordic ID] erklærer herved, at følgende udstyr [RFID Radio module NUR3-1W6-M2] overholder de væsentlige krav og øvrige relevante krav i direktiv 2014/53/EF.

Deutsch

[German]

Hiermit erkläre [Nordic ID], dass sich das Gerät [RFID Radio module NUR3-1W6-M2] in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 2014/53/EG befindet.

Eesti

[Estonian]

Käesolevaga kinnitab [Nordic ID] seadme [RFID Radio module NUR3-1W6-M2] vastavust direktiivi 2014/53/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.

English

Hereby, [Nordic ID], declares that this [RFID Radio module NUR3-1W6-M2] complies with the essential requirements and other relevant provisions of Directive 2014/53/EU.

Español

[Spanish]

Por medio de la presente [Nordic ID] declara que el [RFID Radio module NUR3-1W6-M2] cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2014/53/EU.

Ελληνική

[Greek]

ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ [Nordic ID] ΔΗΛΩΝΕΙ ΟΤΙ [RFID Radio module NUR3-1W6-M2] ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 2014/53/ΕΚ.

Français

[French]

Par la présente [Nordic ID] déclare que l'appareil [RFID Radio module NUR3-1W6-M2] est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 2014/53/EU.

Italiano

[Italian]

Con la presente [Nordic ID] dichiara che questo [RFID Radio module NUR3-1W6-M2] è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2014/53/EU.

Latviski

[Latvian]

Ar šo [Nordic ID] deklarē, ka [RFID Radio module NUR3-1W6-M2] atbilst Direktīvas 2014/53/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.

Lietuvių

[Lithuanian]

Šiuo [Nordic ID] deklaruoja, kad šis [RFID Radio module NUR3-1W6-M2] atitinka esminius reikalavimus ir kitas 2014/53/EB Direktyvos nuostatas.

Nederlands

[Dutch]

Hierbij verklaart [Nordic ID] dat het toestel [RFID Radio module NUR3-1W6-M2] in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 2014/53/EG.

Malti

[Maltese]

Hawnhekk, [Nordic ID], jiddikjara li dan [RFID Radio module NUR3-1W6-M2] jikkonforma mal-htigijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 2014/53/EU.

Magyar

[Hungarian]

Alulírott, [Nordic ID] nyilatkozom, hogy a [RFID Radio module NUR3-1W6-M2] megfelel a vonatkozó alapvető követelményeknek és az 2014/53/EU irányelv egyéb előírásainak.

Polski

[Polish]

Niniejszym [Nordic ID] oświadcza, że [RFID Radio module NUR3-1W6-M2] jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 2014/53/EU.

Português

[Portuguese]

[Nordic ID] declara que este [RFID Radio module NUR3-1W6-M2] está conforme com os requisitos essenciais e outras disposições da Directiva 2014/53/EU.

Slovensko

[Slovenian]

[Nordic ID] izjavlja, da je ta [RFID Radio module NUR3-1W6-M2] v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 2014/53/ES.

Slovensky

[Slovak]

[Nordic ID] týmto vyhlasuje, že [RFID Radio module NUR3-1W6-M2] spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 2014/53/ES.

Suomi

[Finnish]

[Nordic ID] vakuuttaa täten että [RFID Radio module NUR3-1W6-M2] on direktiivin 2014/53/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

Svenska

[Swedish]

Härmed intygar [Nordic ID] att denna [RFID Radio module NUR3-1W6-M2] står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 2014/53/EG.

LABELING REQUIREMENTS

The 'CE' marking must be in a visible area on the OEM product.

ANTENNA REQUIREMENTS

Maximum allowed ERP power is 33dBm when operating in ETSI lower band. NUR3-1W6-M2 has maximum output power of 32dBm. Meaning that 3dBi is the maximum allowed antenna gain without cable losses (ETSI lower band). When module is set to operate in ETSI upper band, maximum ERP power is 36dBm. This means maximum antenna gain of 6dBi.

Formula how to calculate maximum allowed antenna gain when operating in ETSI lower band:

$$32 \text{ dBm} - 2.15 \text{ (dipole gain)} + [\text{antenna gain dBi}] - [\text{cable attenuation dB}] < 33 \text{ dBm}$$

Formula how to calculate maximum allowed antenna gain when operating in ETSI upper band:

$$32 \text{ dBm} - 2.15 \text{ (dipole gain)} + [\text{antenna gain dBi}] - [\text{cable attenuation dB}] < 36 \text{ dBm}$$

Beamwidth restrictions while operating in ETSI lower band:

For transmissions ≤ 500 mW e.r.p. there shall be no restriction on beam width.

For transmissions of > 500 mW e.r.p. to $\leq 1\,000$ mW e.r.p. beam widths shall be $\leq 180^\circ$

For transmissions of $> 1\,000$ mW e.r.p. to $2\,000$ mW e.r.p. beam widths shall be $\leq 90^\circ$

Beamwidth restrictions while operating in ETSI upper band:

For transmissions ≤ 1000 mW e.r.p. there shall be no restriction on beam width.

For transmissions of > 1000 mW e.r.p. to $\leq 2\,000$ mW e.r.p. beam widths shall be $\leq 180^\circ$

For transmissions of $> 2\,000$ mW e.r.p. to $4\,000$ mW e.r.p. beam widths shall be $\leq 90^\circ$

8.2. FCC

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 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 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.

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.

Note: User of the module cannot change the region setting of the module. When FCC region is set, the module operates in frequency band of 902 – 928Mhz.

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

This NUR3-1W6-M2 transmitter module is authorized to be used in other devices only by OEM Integrators under the following conditions:

Note: The antenna must be installed such that the 24cm (9.5 inch) minimum separation distance can be maintained between the antenna (radiator) and user's/nearby people's body at all times.

1. The transmitter module must not be co-located with any other transmitter, except with those that are within the limits shown in the NUR3-1W6-M2 filing.
2. The transmitter module can only be used when host integration is done according to strict compliance with the OEM instructions provided.

Host product manufacturers are responsible to follow the integration guidance and to perform a limited set of transmitter module verification testing, to ensure the end product is in compliance with the FCC rules. Also host product manufacturers are responsible for all additional equipment authorization and testing for technical requirements not covered by the module grant (e.g., unintentional radiator Part 15 Subpart B requirements, or transmitters used in the host that are not certified modules)."

Note: In the event that these conditions can't be met (for certain configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid, and the FCC ID can't be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the host product (including the transmitter) and obtaining a separate FCC authorization.

The OEM integrator must be aware not to provide information to the end user regarding how to install or remove this RF module in the user manual of the host product.

In case that OEM integrator / host product manufacturer that integrate NUR3-1W6-M2 module into their product and would like to change defined parameters of the antenna trace as instructed in this document, they must notify Nordic ID for further instructions. In this case, either Nordic ID can make class 2 permissive change or OEM integrator / host product manufacturer can make change in id procedure (new application) followed by a class 2 permissive change application. If host product manufacturer / OEM integrator is responsible of external antenna connector for their product, they must contact Nordic ID for further instructions. Nordic ID will provide list of acceptable unique connectors that must be used.

For the User's Guide the required FCC statements outlined in the User's Guide Requirements section must be in a prominent location.

8.2.1. USER'S GUIDE REQUIREMENTS

The texts in quotation marks below are the required FCC statements in the user's guide. The note given in brackets is not an FCC statement, but it gives the required information on the first required FCC statement.

"To comply with FCC's RF radiation exposure requirements in general population environment, the antenna(s) used for this transmitter must be installed such that a minimum separation distances of 24 cm (9.5 inch) is maintained between the radiator (antenna) & user's/nearby people's body at all times and must not be co-located or operating in conjunction with any other antenna or transmitter."

"This device complies with Part 15 of the FCC Rules"

"Any changes or modifications to the transmitting module not expressly approved by Nordic ID Oy could void the user's authority to operate this equipment"

8.2.2. LABELING REQUIREMENTS

The host product must be labelled with the following identification information in a visible area:

"Contains Transmitter Module FCC ID: SCCNUR31W6M2"

or

"Contains FCC ID: SCCNUR31W6M2"

8.2.3. ANTENNA REQUIREMENTS

Maximum allowed antenna gain is 7dBiC / 4.5dBi.

8.3. ISED EN

This device contains licence-exempt transmitter / receiver that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS. 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.

Under regulations of Science and Economic Development Canada, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Science and Economic Development Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropic radiated power (e.i.r.p.) is not more than that necessary for successful communication.

To leverage the Nordic ID's grant given by ISED, the device with the integrated NUR3-1W6 module shall be met the following conditions:

1. Maximum allowed antenna gain is stated later in this document. User of this device or nearby people must not compromise the minimum separation distance of 35.5cm (14 inch), in any situation.
2. The antenna(s) used with the NUR3-1W6-M2 module must not be co located in conjunction with any other transmitter or its antenna that is capable of transmitting at the same time, except the transmitter-antenna configurations that are within the limits of the NUR3-1W6-M2's grant given by ISED.
3. The integration of the module into the host shall comply with the OEM design instructions provided.

Host product manufacturers are responsible to follow the integration guidance and to perform a limited set of transmitter module verification testing, to ensure the end product is in compliance with the FCC rules. Also host product manufacturers are responsible for all additional equipment authorization and testing for technical requirements not covered by the module grant (e.g., unintentional radiator Part 15 Subpart B requirements, or transmitters used in the host that are not certified modules)."

There are no user's documentation requirements other than are required by Science and Economic Development Canada statements outlined in the ISED section in a prominent place in the user's guide.

Note: User of the module cannot change the region setting of the module. When ISED region is set, the module operates in frequency band of 902 – 928Mhz.

8.3.1. LABELLING REQUIREMENTS FOR THE HOST DEVICE

The host product must be labelled with the following identification information in a visible area:

"Contains ISED: 5137A-NUR31W6M2"

8.3.2. ANTENNA REQUIREMENTS

Maximum allowed antenna gain is 7.5dBiC / 4.5dBi.

8.4. ISED FR

Cet appareil contient un émetteur / récepteur exempt de licence conforme à la norme RSS d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférences et (2) cet appareil doit accepter toute interférence, y compris les interférences pouvant entraîner un fonctionnement non souhaité de l'appareil.

En vertu de la réglementation de Science et Développement économique Canada, cet émetteur radio ne peut fonctionner qu'avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Science et Développement économique Canada. Pour réduire le risque d'interférences radio avec d'autres utilisateurs, le type d'antenne et son gain doivent être choisis de manière à ce que la puissance rayonnée isotrope équivalente (p.i.r.e.) ne soit pas supérieure à celle nécessaire au succès de la communication.

Pour tirer parti de la subvention accordée par l'ISED au Nordic ID, l'appareil avec le module intégré NUR3-1W6-M2 doit remplir les conditions suivantes:

1. Le gain d'antenne maximal autorisé est indiqué plus loin dans ce document. L'utilisateur de cet appareil ou les personnes à proximité ne doivent en aucun cas compromettre la distance de séparation minimale de 35.5cm (14 inch).
2. La ou les antennes utilisées avec le module NUR3-1W6-M2 ne doivent pas être placées en même temps que tout autre émetteur ou son antenne capable d'émettre en même temps, à l'exception des configurations émetteur-antenne qui sont dans les limites de la subvention NUR3-1W6-M2 accordée par ISED.

3. L'intégration du module dans l'hôte doit être conforme aux instructions de conception OEM fournies.

Les fabricants de produits hôtes doivent suivre les directives d'intégration et effectuer un ensemble limité de tests de vérification des modules émetteurs, pour s'assurer que le produit final respecte les règles de l'ISED. De plus, les fabricants de produits hôtes sont responsables de toute autorisation d'équipement et de tout test supplémentaire pour les exigences techniques non couvertes par l'autorisation du module (par exemple, les exigences pour les radiateurs involontaires de la partie 15, sous-partie B, ou les émetteurs utilisés dans le produit hôte qui ne sont pas des modules certifiés).

Il n'existe aucune exigence en matière de documentation utilisateur autre que celle requise par les déclarations de Sciences et Développement économique décrites dans la section ISED à un endroit bien en vue dans le guide de l'utilisateur.

Observation:

L'utilisateur du module ne pourra pas changer les paramètres région du module. Quand le paramètre région ISED est sélectionné, le module fonctionne sur la bande de fréquence 902-928Mhz.

8.4.1. EXIGENCES APPLICABLES AUX APPAREILS HÔTES

Le produit fini doit disposer d'étiquette mentionnant les information suivantes d'identification sur une surface visible:

"Contains ISED: 5137A-NUR31W6M2"

8.4.2. EXIGENCES D'ANTENNE

Le gain d'antenne maximum autorisé est de 7.5dBiC / 4.5dBi.

8.5. TELECOM

TBD

8.5.1. ANTENNA REQUIREMENTS

TBD

9. ABOUT NORDIC ID

Nordic ID is at the centre of today's real-time item tracking and reliable RFID technology. We help organizations fight the damaging effects of item loss, facilitate streamlined business procedures, and stay ahead of the competition.

We are ready to help you take advantage of our wide range of products and services designed to fit

your needs. Contact us now, and we will help you to tackle your challenges and get your business to the next level.

Nordic ID

Joensuunkatu 7
24100 Salo
FINLAND

tel. +358 2 727 7700
fax +358 2 727 7720

www: www.nordicid.com
E-mail: info@nordicid.com

10. VERSION HISTORY

<u>Version</u>	<u>Date</u>	<u>Modifications</u>
0.6	20 th Feb 2026	Draft
0.7	5 th Mar 2026	Multiple section updated