

NORDIC ID AR85

RAIN RFID OVERHEAD READER



USER GUIDE

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1. GETTING STARTED

1.1. GENERAL

Nordic ID AR85 fixed area reader brings powerful, automated UHF RFID performance with multiple connectivity options.

This fixed area reader contains Nordic ID NUR2-1W module and sophisticated antenna solution that allows to cover up to 120 m² of floor space at a reading speed of up to 1000 tags/s. Now even hard-to-read tags will be easier to detect. Thanks to its integrated computer with Linux OS 3rd party applications can be installed and run on reader.

Nordic ID AR85 is ideal for efficiently monitoring a designated area.

1.2. AVAILABLE VARIANTS

Nordic ID AR85 is available in 3 different variants, with different connectivity options:

CODE	DESCRIPTION
NPD00003	Nordic ID AR85 / UHF RFID (USB / LAN 10 /100&PoE)
NPD00004	Nordic ID AR85 / UHF RFID (USB / LAN 10 /100&PoE / WLAN)
NPD00005	Nordic ID AR85/ UHF RFID (USB / LAN 10 /100&PoE / WLAN / WWAN (3G))

1.3. AVAILABLE ACCESSORIES

CODE	DESCRIPTION
ACN00141	Nordic ID USB cable (Length 1.8m, type B male – type A male -connectors)
ACN00142	Nordic ID Power supply 100-240 VAC, 50-60 Hz / 24 VDC for Nordic ID AR and Sampo S2 readers, EU (Includes power supply and cable)
ACN00143	Nordic ID Power supply 100-240 VAC, 50-60 Hz / 24 VDC for Nordic ID AR and Sampo S2 readers, UK (Includes power supply and cable)
ACN00145	Nordic ID Power supply 100-240 VAC, 50-60 Hz / 24 VDC for Nordic ID AR and Sampo S2 readers, US (Includes power supply and cable)
CWH00045	Nordic ID External antenna cable (Length 1m, SMA-male -connectors)
CWH00020	Nordic ID External antenna cable (Length 3m, SMA-male -connectors)
CWH00019	Nordic ID External antenna cable (Length 5m, SMA-male -connectors)
CWH00042	Nordic ID External antenna cable (Length 10m, SMA-male -connectors)

1.4. PACKAGE CONTENT

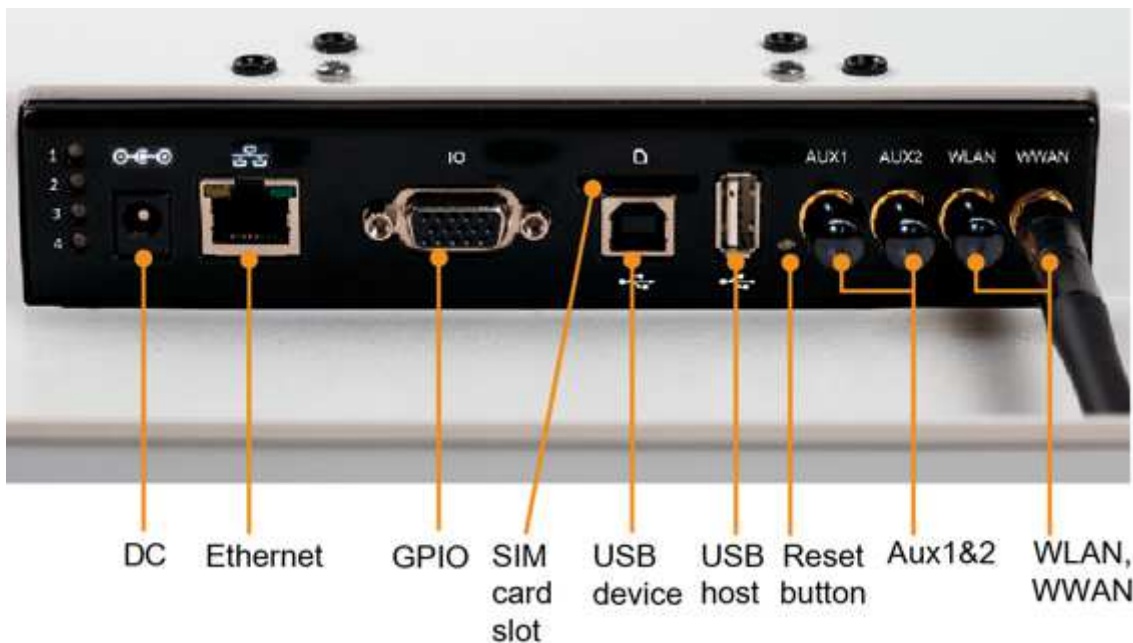
Nordic ID AR85 package contains following items

- Nordic ID AR85
- Installation kit
- Safety and regulations guide

NOTE! Power supply not included

1.5. FEATURES AND CONNECTORS OVERVIEW

WLAN and WWAN (3G) variants of Nordic ID AR85 UHF RFID include external WLAN and WWAN antennas that needs to be fastened to the reader before it's taken into use.



Picture 1 Connector panel of Nordic ID AR85

1.6. MOUNTING

Nordic ID AR85 UHF RFID reader can be mounted (usually horizontally overhead) with M5 threaded screws to any VESA 75 and VESA 100 mounting equipment (sold separately). More detailed information about location of VESA mounting holes can be find from Figure 1.

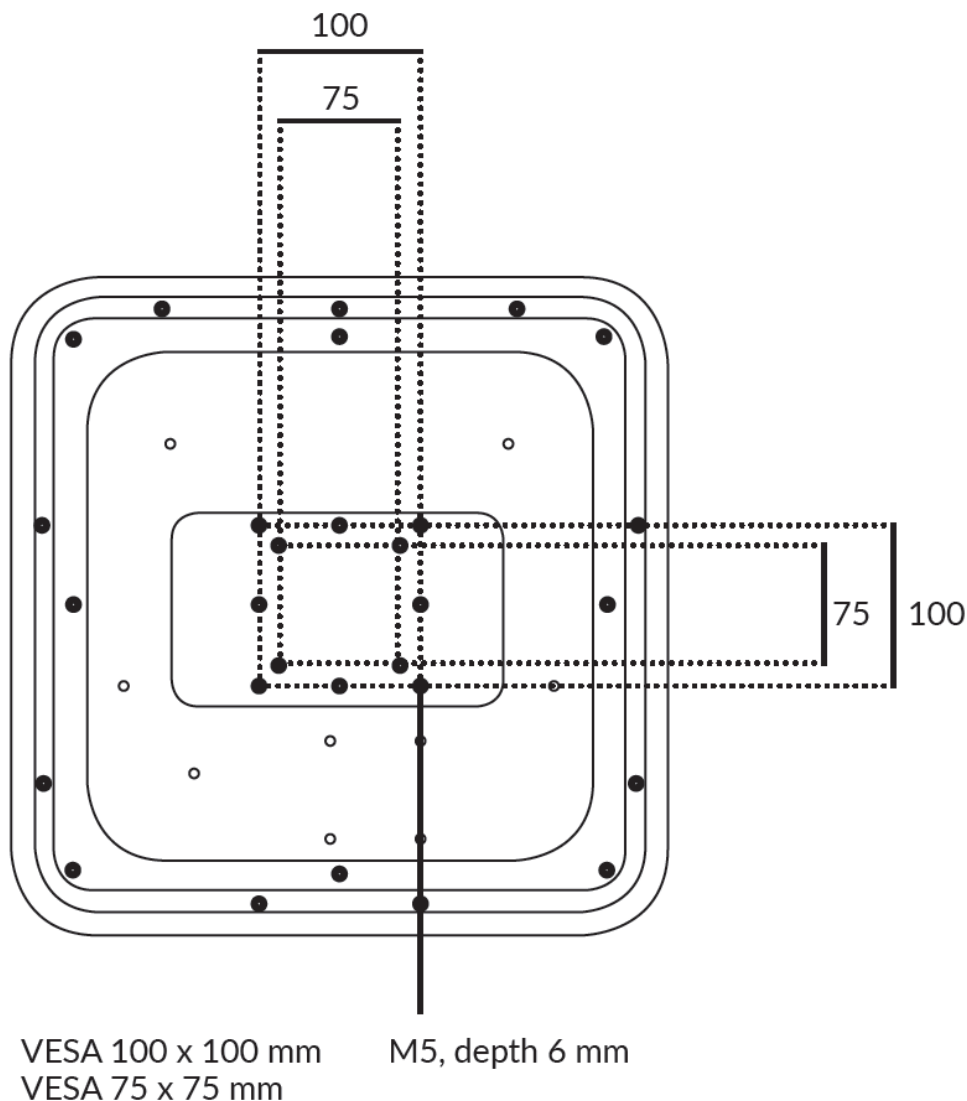


Figure 1 VESA mounting holes of Nordic ID AR85

1.7. POWERING THE READER

Nordic ID AR85 can be powered via DC power supply (sold separately) or Ethernet port if the network supports power over Ethernet (PoE) feature or PoE injector is being used. Regardless of what powering method is used, the data communication can be handled via USB connection or if IP connectivity is required then via WWAN, WLAN or ethernet. Nordic ID AR85 powers up automatically when connected to DC power supply or PoE.

The rated maximum power consumptions for Nordic ID AR85 reader are:

- Powered via 802.3af PoE: 12W
- Powered via DC power supply (sold separately): 20W (12-24V DC)

NOTE! WLAN and 3G are disabled if the reader is powered via the PoE. 802.3af PoE can't provide enough power to the reader to keep WLAN and 3G features working as expected.

1.8. PHYSICAL CONNECTORS

Nordic ID AR85 includes the following physical connectors:

- DC connector for supplying power if PoE capability is not used (power supply sold separately)
- GPIO connector (4 optically isolated inputs and outputs)
- 2 pcs SMA female antenna connectors for connecting external antennas to the reader
- USB 2.0 device Type B connector (USB HID profile supported)
- USB 2.0 host Type A connector
- Ethernet 10/100Mbps with 802.3af support
- Dual band WLAN (optional)
- WWAN cellular connectivity (optional)
- Slot for mini SIM card (optional)

1.8.1. DC CONNECTOR

DC connector is used to power up the reader using Nordic ID provided power supplies. More information about the Nordic ID power supplies can be found from table 1.3. Supported input voltage is 12 - 24V DC.

1.8.2. GPIO CONNECTOR

Nordic ID AR85 includes a multipurpose GPIO connector that contains the following functionalities:

- RS-232 serial port
- 4 x opto-isolated inputs
- 4 x opto-isolated outputs
- +5VDC supply (output)
- 12VDC / 24 VDC supply (output)

12VDC if the reader is powered via PoE and 24VDC if the reader is powered via external power supply. The multipurpose GPIO connector can be accessed via DE15 connector located on rear panel of the reader. Pin-out of the DE15 connector can be seen in Figure 2. Functions and electrical specification of the GPIO connector can be found from

Table 1 and **Table 2**.

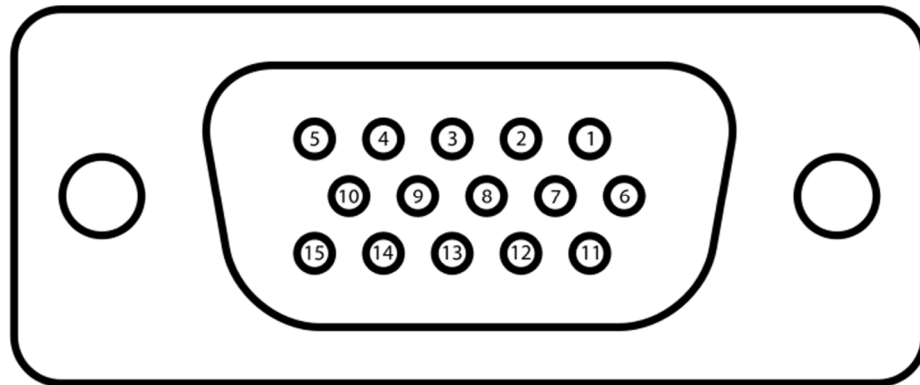


Figure 2 Pin-out of DE15 connector

Table 1 Signal of GPIO connector

PIN	SIGNAL NAME	DESCRIPTION
1	5V output	5V DC output, switchable on/off
2	RS232 TX	RS232 output
3	RS232 RX	RS232 input
4	Ground	Ground
5	Output 0	Isolated output 0
6	Output 1	Isolated output 1
7	Output 2	Isolated output 2
8	Output 3	Isolated output 3
9	V-	Isolated ground for inputs and outputs
10	Input 0	Isolated input 0
11	Input 1	Isolated input 1
12	Input 2	Isolated input 2
13	Input 3	Isolated input 3
14	V+	Pull-up voltage for outputs, 10kΩ pull up resistors
15	12V / 24V output	12V out with POE powered and 24V out with external power supply

Table 2 Electrical specifications of the signals

SIGNAL NAME	VOLTAGE MIN (V)	VOLTAGE NOMINAL (V)	VOLTAGE MAX (V)	CONDITIONS
5V out		5		<200mA
RS232 TX, high	5	5,4		3KΩ load to Ground
RS232 TX, low		-5,4	-5	3KΩ load to Ground
RS232 RX, high	2,4		25	
RS232 RX, low	-25		0,6	
Ground		0		
Outputs 0 - 3, high			30	10KΩ pull up to V+
Outputs 0 - 3, low		0	0,6	max 25mA, max 150mW
V-		0		
Inputs 0 - 3, high	3		30	Between V+ and V-, max 6mA at 30V
Inputs 0 - 3, low	0		0,7	Between V+ and V-
V+			30	Between V+ and V-
12V / 24V output		12 / 24		<200mA

Example schematics about how to create non-isolated and isolated solutions can be found from section 11.1.

NOTE! If 5V or 12V / 24V output is used, connect pins 4 and 9 together.

1.8.3. ANTENNA PORTS

Nordic ID AR85 includes 2pcs SMA female antenna connectors for connecting external antennas to the reader. Impedance of antenna ports is 50Ω and maximum radiated output power is 30dBm. The antenna ports can be configured independently via NUR API.

1.8.4. USB 2.0 DEVICE WITH TYPE B CONNECTOR

Nordic ID AR85 includes USB 2.0 device Type B connector for connecting reader to host device. Nordic ID AR85 supports also USB HID class which means the reader can act as a standard USB input device for host devices.

NOTE! Web management interface can't be access using USB connector. Web management interface can be accessed only using ethernet, WLAN and WWAN connections.

1.8.5. USB 2.0 HOST WITH TYPE A CONNECTOR

Nordic ID AR85 includes USB 2.0 host Type A connector for connecting peripheral USB devices to the reader. The USB 2.0 host Type A connector can be used to connect needed USB peripherals to the reader to expand its functionalities. Maximum current out from the USB 2.0 host Type a connector is 500mA.

1.8.6. ETHERNET

Nordic ID AR85 includes standard RJ-45 ethernet connector. The reader supports 10/100Mbps speed class and 802.3af PoE.

1.8.7. DUAL BAND WLAN (OPTIONAL)

Certain variants of Nordic ID AR85 include dual band WLAN supporting 2.4GHz and 5.0GHz frequency bands. External dual band WLAN antenna needs to be attached to the reader to make WLAN perform and work as specified. As a unique feature, Nordic ID AR85 can work as a WLAN access point to other WLAN devices thus enabling simple and cost-efficient network of several readers and devices.

1.8.8. WWAN CELLULAR CONNECTIVITY (OPTIONAL)

Certain variants of Nordic ID AR85 include WWAN connectivity supporting 2G and 3G cellular networks. External WWAN antenna needs to be attached to the reader to make WWAN perform and work as specified. WWAN connectivity needs a SIM card to be functional. Please find more information about how the SIM card is inserted to the Nordic ID AR85 from section 1.8.9.

1.8.9. SLOT FOR MINI SIM CARD (OPTIONAL)

The WWAN variant of Nordic ID AR85 includes a slot for mini SIM card. Mini SIM card is to be inserted in the slot in a right orientation to be functional. The correct insertion orientation of mini SIM card can be seen from the Picture 2.



SIM orientation

Picture 2 Insertion orientation of mini SIM card

1.9. USER INTERFACE

User interface of Nordic ID AR85 consists of 4 LED indicators and a reset button on the back of the reader.

1.9.1. LED INDICATORS

Nordic ID AR85 has four programmable LEDs for user indications. Location of the LEDs can be seen in

Picture 3. It's possible to enable/disable all the LEDs via web management UI and/or reader API. By default the LEDs are enabled. LEDs of the reader are:

1. Power LED
2. Connection LED
3. RFID LED
4. Indication LED



LEDs

Picture 3 Location of LEDs on back panel



Picture 4 Location of LEDs on top cover

1.9.1.1. POWER LED

By default, Power LED indicates if the power is supplied to the device via DC power supply or PoE.



1.9.1.2. CONNECTION LED

Connection LED indicates whether the reader has established USB, ethernet, WLAN or WWAN connection. Functionality of the Connection LED can be configured via NUR API if needed. Functionality of the Connection LED differs depending on whether USB or TCP/IP (ethernet, WLAN and WWAN) connection is used.

- USB connection in use
 - LED off: The USB cable is unplugged.
 - LED on: The USB cable is connected.

- Ethernet, WLAN or WWAN connection in use
 - LED off: The reader has no IP address. In addition, the red error LED is blinking.
 - LED blinking: The reader has IP address, but the host application is not connected
 - LED on: The reader has IP address and the host application is connected.



1.9.1.3. RFID LED

RFID LED indicates whether the RFID reading is ON or OFF. Functionality of the RFID LED can be configured via NUR API if needed.



1.9.1.4. INDICATION LED

Indication LED is used to indicate different reset states. See section 1.9.2 for more information.

1.9.2. RESET BUTTON

Reset button of Nordic ID AR85 contains the following functionalities:

- Rebooting the reader
 - Press the reset button 2s (red INDICATION LED starts blinking once the reset button is pressed) and release it once 3 green LEDs are turned on.

- Boot to recovery mode*
 - If reset button is not released, green CONNECTION and RFID LEDs turn off and green Power LED is on. INDICATION LED starts blinking in red. After a while green RFID LED is turned on.
 - Release the reset button when the RFID LED has turned on to enter to the recovery mode. This mode can be entered within 5s after the RFID LED has been turned on.
- Factory reset
 - If reset button is not released red INDICATION LED starts blinking even faster and green CONNECTION LED is turned on
 - Release the reset button when the CONNECTION LED has turned on to enter to the factory reset mode. This mode can be entered within 5s after the CONNECTION LED has turned on.

* Recovery mode can be used to repair the reader

NOTE! If reset button is pressed over 5s after the CONNECTION LED has turned on and the red INDICATION LED has started blinking even faster, releasing the reset button will perform a normal reboot.

1.10. RF PROFILES

Nordic ID NUR2-1W UHF RFID module supports three different kind of RF profiles. The profiles are Robust, Nominal and High speed. 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**
 - Robust RF profile is intended to be used in challenging environments. It provides the best filtering against the interfering signals coming from nearby reader(s), other signal sources and from reflective environment. This profile uses link frequency of 250 kHz and Miller 4 coding scheme providing read rates up to 200 tags/s. Due to the low data speed and best filtering the Robust RF profile provides the best sensitivity.
- **Nominal**
 - Nominal RF-profile is the default setting of readers containing Nordic ID NUR2-1W UHF RFID module, such as Nordic ID AR85. It uses link frequency of 300 kHz and Miller 2 coding providing read rates up to 350 tags/s.
- **High speed**
 - High speed RF profile is intended to be used in use cases where the highest read rates are required. It uses link frequency of 400 kHz and FM0 coding and provides read rates up to 1000 tags/s. Due to the high data speed this profile is quite sensitive to interferences.

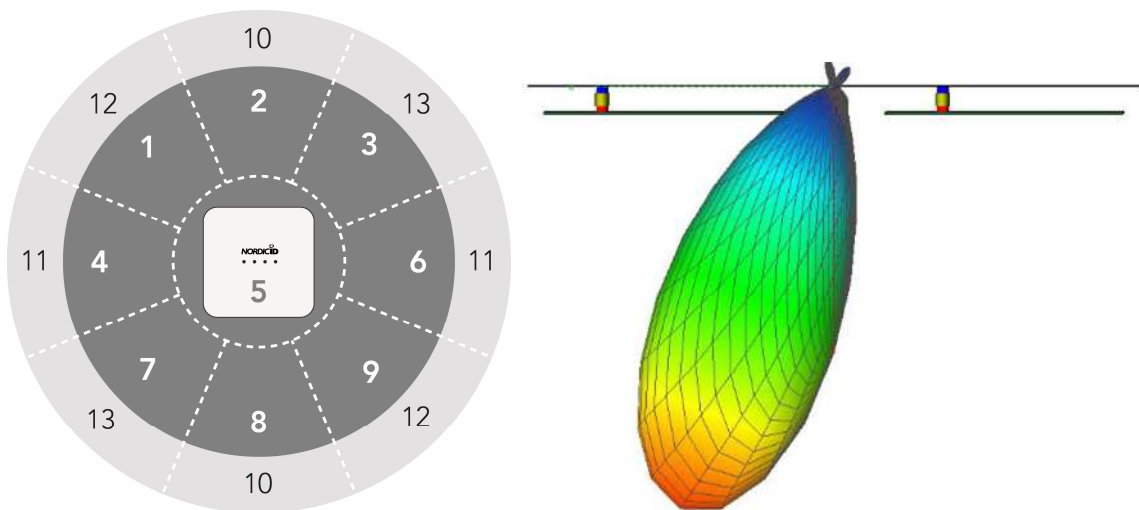
NOTE! Read rates will depend from the environment, reader settings, tag population and tag type.

1.11. ANTENNA CHARACTERISTICS

Nordic ID AR85 reader includes a sophisticated beamforming antenna which provides significant advantages over a conventional UHF RFID reader that are wider coverage and a capability to determine the location of any tag in the reading area. By monitoring the changes in tag location over time allows an easy way for determine the direction of movement in real time which might be desired e.g. in gate solutions.

1.11.1. ANTENNA BEAMS

The area Nordic ID AR85 UHF RFID reader covers is divided into 13 sectors based Picture 5. Each sector is covered with a horizontal and vertical polarized beam summing up to 26 separate logical beams which are used in turns when scanning operations are conducted. Which beam is used and in which order is entirely software controllable via NUR API. It's worth to note that the reader can provide an XY -coordinate for each tag only when they are in sectors 1-9. Sectors 10-13 can be used for inventory purposes for enhancing the reading coverage while XY -coordinate is not required.



Picture 5 Nordic ID AR85 antenna beams

Each separate beam is 45° in width and can be deflected approx. ±40° from centre the point in the horizontal plane. This sums up to approximately 110-120° of effective beam width from the device. How large of an area the device covers depends also on the installation height. A rule of thumb is that in ceiling setups the floor coverage has a diameter of two times that of the installation height. E.g. if the installation height is 2.5m, on the floor the device covers an area 2.5 meters in every direction measured from underneath the reader. Same information in visual format can be found from Picture 8.

1.11.2. USING EXTERNAL ANTENNAS WITH NORDIC ID AR85

Sometimes there can be challenging areas in the reading environment that needs extra coverage. For this purpose, there are 2 SMA female connectors (AUX1 & AUX2) in the Nordic ID AR85 reader. The external antennas can be enabled/disabled just as the 26 logical beams of the Nordic ID AR85 reader and be used to improve reading performance and accuracy if needed.

The next section (2. Installation information) describes some common use cases and how reader beams can be configured.

1.12. THERMAL MANAGEMENT

Nordic ID AR85 reader includes sophisticated thermal management features that do prevent overheating issues if reader is used in too warm environments. The reader monitors temperatures of onboard computer and UHF RFID module and adjusts operation points based on the temperature information.

Onboard computer starts mitigation scheme (for example clock frequencies of CPUs are dropped) when temperature of the onboard computer reaches 85°C.

Thermal mitigation scheme of the UHF RFID module follows following temperatures:

- 80°C – UHF RFID reading operations are suspended for 100ms. Suspend time is increased 20ms by every °C temperature rises until the temperature reaches 90°C. The thermal mitigation scheme is turned off once the temperature drops below 80°C. High temperature warning message (TEMP_HIGH) is sent via NUR API to host. The warning message contains also current temperature information.
- 90°C – UHF RFID reading operations are shut down until temperature goes below 90°C. Once the temperature is below 90°C, above mentioned mitigation scheme is taken in use. Over temperature warning message (TEMP_OVER) is sent via NUR API to host. The warning message contains current temperature information.

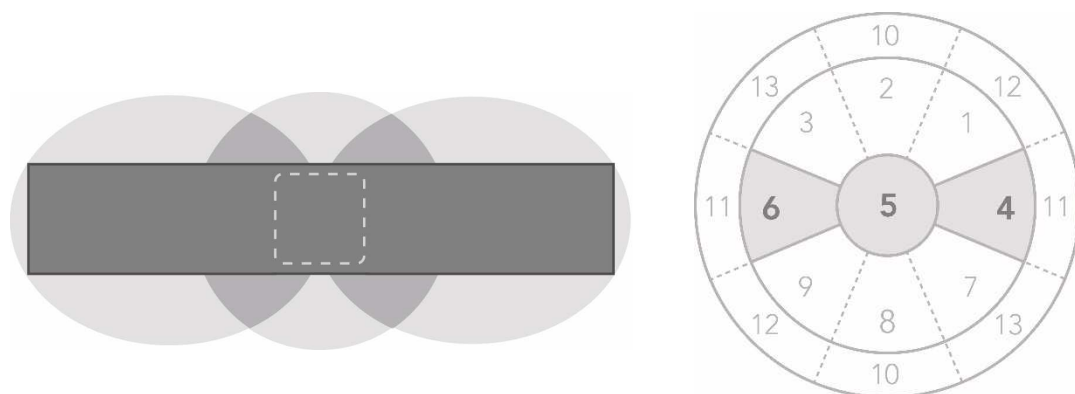
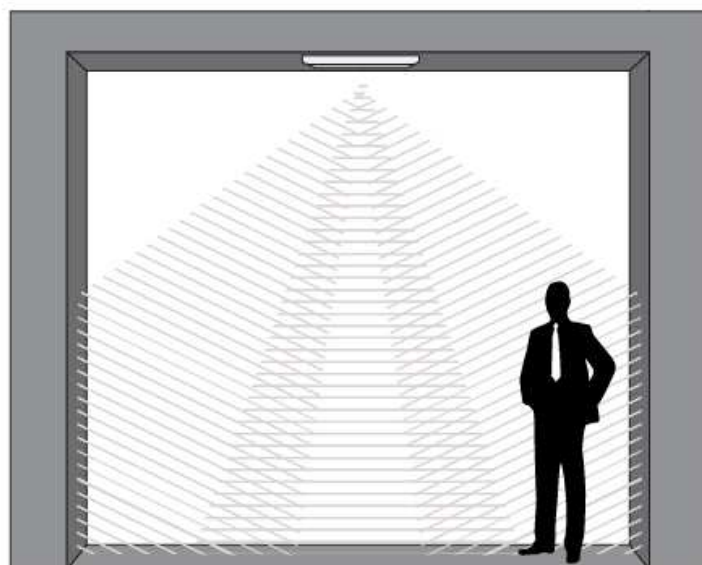
2. INSTALLATION INFORMATION

2.1. WIDE GATE WITH SINGLE READER

A wide gate setup, no need to detect the direction of movement.

- The Nordic ID AR85 reader is installed in the middle of the gate pointing downwards
- Beams number 4, 5 and 6 are enabled to cover just the gate area
- Beams 1, 2, 3, 7, 8, 9, 10, 11, 12 and 13 are disabled to avoid tags in the environment not going through the gate

Additionally, disabling unnecessary beams makes the monitored area significantly smaller thus making it faster to scan



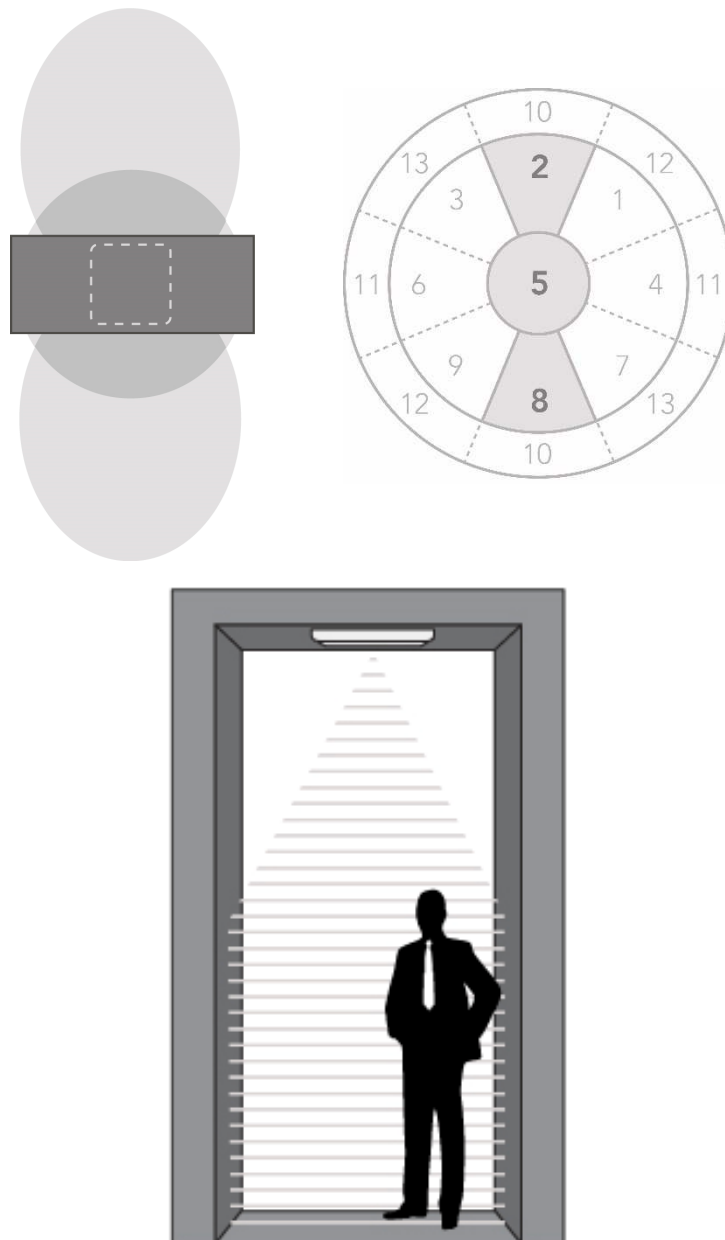
Picture 6 Top and front views of wide gate setup

2.2. NARROW GATE WITH SINGLE READER

A narrow gate setup, needed to detect the direction of movement.

- The Nordic ID AR85 reader is installed in the middle of the gate pointing downwards
- Beams number 2, 5 and 8 are enabled to cover just the gate area along the path of moving tags
- Beams 1, 3, 4, 6, 7, 9, 10, 11, 12 and 13 are disabled to avoid tags in the environment not going through the gate

Additionally, disabling unnecessary beams makes the monitored area significantly smaller making it faster to scan and the reader able to detect the movement of tags quicker and more accurately.



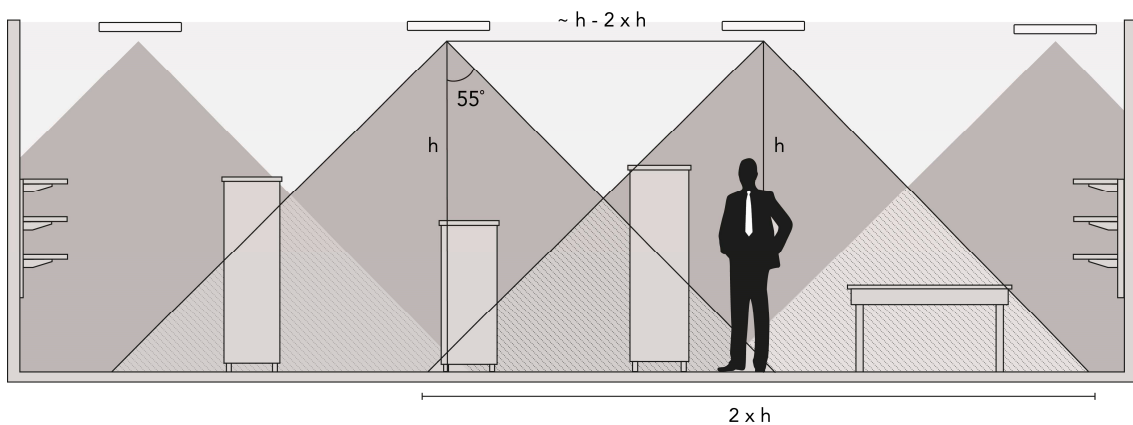
Picture 7 Top and front views of narrow gate setup

2.3. MULTI-READER SETUP

To cover larger area, several Nordic ID AR85 readers might be needed. Below are some recommendations regarding the installation pattern. Do note that the optimum setup depends on several variables e.g. tag density, tag alignment, tag RF performance and metallic objects in the area.

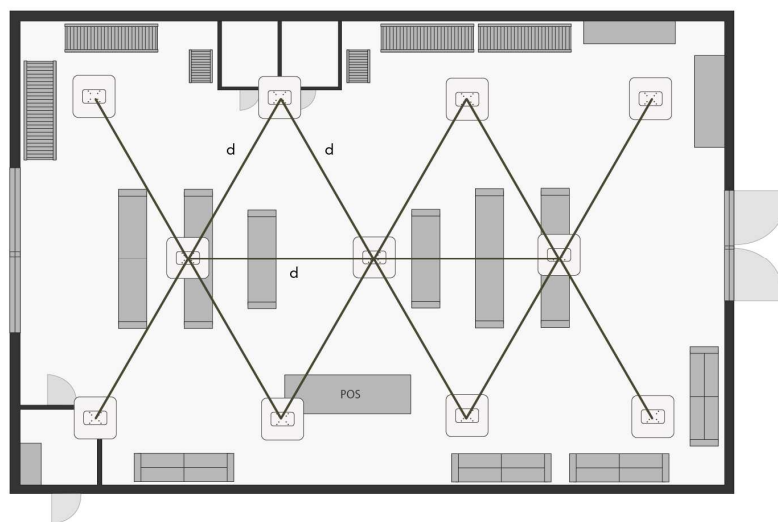
Typically, the distance between two Nordic ID AR85 readers in the ceiling in challenging environment is equal to the installation height. In less challenging environment it can be doubled. Note that more densely the readers are installed in the ceiling, the better they cover also the space above the floor plane. This is important in cases where high shelves are being used in the area.

- Typical installation height 3.5 – 5 m
- Maximum beam angle ca. 110 degrees



Picture 8 Side view of multi-reader setup

Depicted from above, a triangular or diamond shaped installation pattern is the most efficient way of mounting the readers. Arranging readers this way ensures the most evenly distributed RF field towards the scanning area.



Picture 9 Top view of multi-reader setup

3. SOFTWARE

All documentation about SW, SW features and application development can be found from GitHub.

https://github.com/NordicID/ar8x_samples

3.1. NORDIC ID RFID APPLICATIONS FOR NORDIC ID AR85

Nordic ID provides following Windows tools to test and configure the reader. The tools are available via Nordic ID Support pages:

<http://www.nordicid.com/en/downloads/>

3.1.1. NORDIC ID RFID DEMO

Nordic ID RFID Demo application is for conducting the reading tests. It allows connecting the devices and commencing the reading procedure. The application provides statistics on the reading performance and logging capabilities for more thorough evaluation. As the Nordic ID RFID Configurator, this application also allows adjusting the RFID parameters on the fly for better understanding how they impact on the reading performance. The difference however is that altered settings cannot be stored permanently into the device. The settings are reverted to defaults upon power cycle.

3.1.2. NORDIC ID RFID CONFIGURATOR

Nordic ID RFID Configurator is meant for configuring the reader settings. The settings can be e.g. related to network settings or RFID reading parameters and stored into the device as new defaults. Note that e.g. the RFID reading parameters can be assigned to the reader by the host application after successfully connected to the device also. The RFID Configurator is also the tool for updating the device firmware if seen necessary.

3.1.3. NORDIC ID AR8X APPLICATION SIGNING TOOL

To provide more security to the SW platform, the application zip-files need to be signed with Nordic ID provided signing tool. The public key generated to the zip-file will be then verified against the list of files when installing the zip-file to the reader. This makes sure that only valid content from the zip-file can be installed.

The tool in question is called Nordic ID Application Signing Tool. The tool can be used to sign pre-built zip-files, as also to create new zip-files from scratch.

4. WEB MANAGEMENT INTERFACE

Nordic ID AR85 includes a web management interface which can be accessed with a web browser. The web management interface is used to configure the reader and manage applications. Documentation about web management interface can be found from GitHub.

https://github.com/NordicID/ar8x_samples

NOTE! Web management interface cannot be accessed using USB connectors. Web management interface can be accessed only using ethernet, WLAN and WWAN connections.

5. REGIONAL SETTINGS

Nordic ID UHF RFID readers support operating frequency range between 860 - 960MHz. Some of the readers cover full operating frequency band and some of them have two sub bands that are 868 ETSI band (865.6 - 867.6 MHz) and 915 FCC band (902 - 928 MHz). Regional organizations as ETSI and FCC have set rules and requirements for operating frequencies, output power and other RF parameters for the UHF RFID readers to comply local regional requirements.

Nordic ID has created a set of regional settings in order to fulfil local regulations. Nordic ID is required to ensure that compliance of Nordic ID products will remain after production. Solution for this is that products including UHF RFID functionality are set and locked in production based on customer order e.g. if a product is ordered to Europe, it will be locked to ETSI region. And, if a product is ordered to Australia region, it is locked to Australia region. When a product is locked to individual region, it will comply local regulations of the region.

6. SERVICE AND SUPPORT

For technical enquiries regarding Nordic ID devices or software development, please contact our Technical Support:

E-mail: support@nordicid.com
Telephone: +358 2 727 7790

As a manufacturer, Nordic ID stands responsible for providing repair services for its devices during and after the warranty period. Together with partners Nordic ID serves customers globally. When your Nordic ID device needs repair, always use Nordic ID Service or our authorized service partners. We want to make sure that your Nordic ID product serves you the best possible way, and by using our preferred service partners the quality of the service is trustworthy and the spare parts are original. This way the existing product warranty remains, and you receive a 3-month service warranty for the repaired devices.

Nordic ID works together with full support and primary support partners. Full support partners can handle both warranty and non-warranty repairs on behalf of Nordic ID in their own regions. In addition, Nordic ID has a network of smaller repair centers, primary support partners, who offer the first line of support to their customers locally.

For any enquiries about Nordic ID repair service please contact:

E-mail: service@nordicid.com
Telephone: +358 2 727 7791

7. WARRANTY

Nordic ID warrants that the Products are at the time of delivery free from defects in materials and workmanship, provided the Products remain unmodified and are operated under normal and proper conditions. **Warranty period is the longer of twenty-four (24) months** from the date of delivery in case the Customer is end-customer or twenty-seven (27) months from the date of manufacture in case the Customer is reseller. Spare parts are warranted against defects in workmanship and materials for a period of ninety (90) days from the date of delivery to Customer.

For more detailed information about the warranty can be found from [Nordic ID Sales Terms](#).

8. RELATED DOCUMENTS AND CONTENT

Documents mentioned below can be found from Nordic ID Support pages ([link](#)):

- Nordic ID AR85 Datasheet
- Nordic ID AR85 Quick Guide
- Nordic ID Safety and Regulations Guide
- Nordic ID GitHub account for developers (<https://github.com/NordicID>)

9. ABOUT NORDIC ID

Nordic ID is at the center 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.

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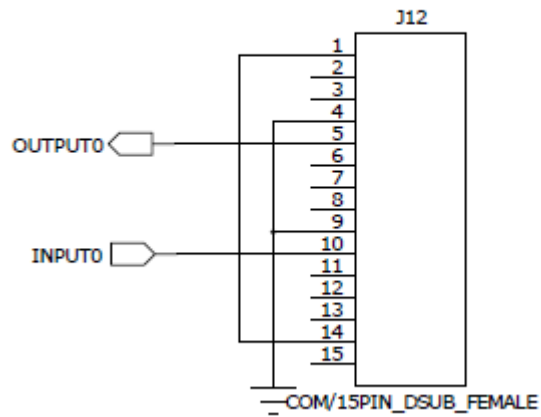
10. VERSION HISTORY

<u>Version</u>	<u>Date</u>	<u>Modifications</u>
1.0	28.11.2017	The first version
1.1	13.12.2017	Application signing tool and reset button sections updated. Thermal management section added.
1.2	25.1.2018	LED locations on top cover picture added
1.3	9.4.2018	Reset button and indication LED sections updated
1.4	9.5.2018	Minor modifications and formatting changes

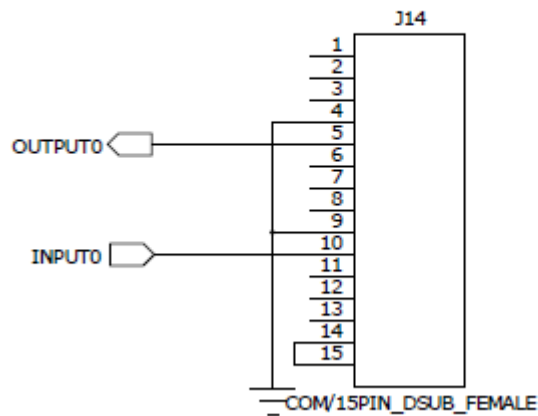
11. APPENDICES

11.1. EXAMPLE SCHEMATICS OF GPIO INTERFACE

No isolation, 5V pull up voltage



No isolation, 12V / 24V pull up voltage



Isolated inputs and outputs, 12V / 24V pull up voltage

