PERFECTION IN AUTOMATION
A MEMBER OF THE ABB GROUP

B&R wireless board "RFM-2-NF"

Standard Documentation for Radio Equipment Certification

Date: 2019-04-09

Project number: N/A

I Version information

Version	Date	Comment	Responsible
1.0	2018-10-24	First edition	Roland Sevcik
1.1.	2018-11-08	China Requirements added / Figure 8 refreshed	Roland Sevcik
1.2.	2018-12-04	Test Conditions in Chapter 2 added	Roland Sevcik
1.3	2018-12-20	Statement user manual added, Link of BOM corrected, Statement 8.2, 8.3 and 8.4 Canada update to issue 5, Chapter 10 Integration Guide separated, Typers corrected	Roland Sevcik
1.4	2019-04-09	Chapter 8.4 Canada update to issue 5 French version	Roland Sevcik

Table 1: Version information

II Distribution

Name	Company, Department	Quantity	Comment
Fr. Musat	CSA Group Bayern GmbH	1	N/A
Hr. Heinrichs	Phoenix Testlab GmbH	1	N/A

Table 2: Distribution

III Organization of safety notices

Safety notices in this document are organized as follows:

Safety notice	Description
Danger!	Disregarding these safety guidelines and notices can be life-threatening.
Warning!	Disregarding these safety guidelines and notices can result in severe injury or substantial damage to property.
Caution!	Disregarding these safety guidelines and notices can result in injury or damage to property.
Information:	This information is important for preventing errors.

Table 3: Organization of safety notices

IV Table of contents

1 Introduction

This document describes the structure, the basic specification, the main properties and main functionalities of the B&R wireless board “RFM-2-NF” as required for the certification of radio equipment. The optional annexes may contain additional papers like datasheets, certificates, declarations, power of attorney, and similar documentation.

Product marketing name and type designation:	RFM-2-NF
Hardware Version identifier:	RFM-2-NF (same as type designation)
Software Version identifier:	e.g. V1.0
Host marketing name: (final product containing the module RFM-2-NF)	B&R Automation Panels Series AP1000 and AP5000

2 Operational description

The B&R wireless board “RFM-2-NF” is used to add basic RFID functionality to a B&R Human-Machine-Interfaces and is integrated in a B&R Automation panel with or without optional expansion equipment (here called host). The electrical connection is realized via a host interface. The host in combination with the auxiliary equipment provide an isolated power supply and realize the data exchange between host and wireless board. The combination host plus auxiliary equipment act as master. The SRD controller enables the B&R wireless board “RFM-2-NF” to communicate with various passive transponders (TAG). The RF-control sequence depend on the type of transponder used. Details of supported transponder types and corresponding standards are listed below.

A B&R Human-Machine Interface can be realized by combining a B&R Automation Panel with optional extensions for e.g. push buttons and key switches and different auxiliary equipment like Panel PCs, B&R Automation PCs, Display Links, power supplies, data and power supply cables plus optional accessories like flexible swing arm mounting systems and handles. So a variety of Human-Machine-Interfaces are available, but the RFID functionality is exclusively realized by the B&R wireless board “RFM-2-NF”.

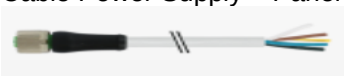
The end devices containing the RFM-2-NF are operated exclusively in an industrial environment. The main nominal RF characteristics are 13.56 MHz, low power device and short range of 2-10 cm.

The following conditions and constructional data apply:

☐ General (-20°C to 55°C
☐ Portable (-10°C to 55°C)
☑ Equipment for normal indoor use (0°C to 55°C)

The radio equipment RFM-2-NF and auxiliary equipment is operated with the following set of cables:

Name of the cable [1)]	Digital	Length [m]	Shielded	Remark
USB interface cable to board	yes	approx. 15	yes	Internal connection (not relevant for EMC testing)
USB cable on service interface	yes	max. 3 m	yes	Optional, temporary connection. Service purpose only.
Power cord (input, L, N, PE optional)	no	N/A	no	Not relevant for EMC testing
Cable Power Supply – PC and Cable Power Supply – Panel (output, 24Vd.c., 2 core wire. with connector) 	no	> 3m	no	black: -24V d.c black/red: +24V d.c
Cable PC-Panel (SDL4) 	yes	> 3 m	yes	

Cable Power Supply – Panel 	no	>3m	no	brown: +24V d.c white: +24V d.c blue: -24V d.c black: -24V d.c grey: PE/FE
Cable PC – Panel (DVI-D) 	no	>3m	no	
Wiring for PE/FE-connections (to panel and PC)	no	N/A	no	Wires of the PE/FE-network should be as short as possible and must be prepared by the test house in respect to the local test environment.

1) Not all test jigs need the full set of cables as described above. See separate documentation of test jig's for details.

A typical connection of a swing arm variant with SDL4 connection or with DVI-D-Panel link is:

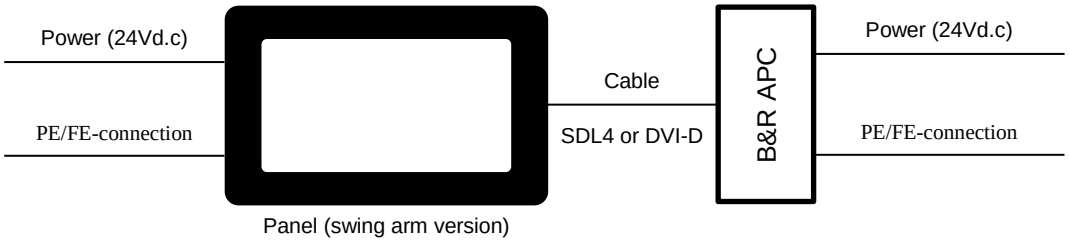


Figure 1: Swing arm version test jig (typical connection scheme)

A typical connection of a cabinet version is:

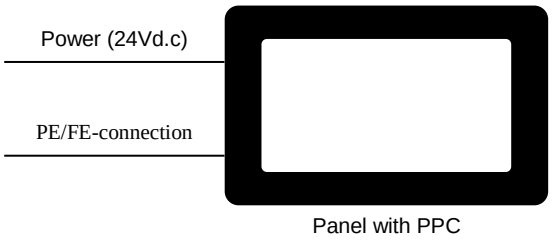


Figure 2: Cabinet version test jig (typical connection scheme)

Remark: Each test jig contains a B&R power supply. If necessary this power supply can be replaced with a comparable power supply provided by the test house.

3 Block diagram

The block diagram shows the basic elements of the RFM-2-NF, the standardized interface (USB), the on board voltage regulator and the used parts of the SRD controller. Permanently disabled or not used elements of the SRD controller are pictured in grey color and are not relevant for radio equipment compliance

assessment. Same for auxiliary, ancillary equipment and accessories. Optical interface, RC-Network and Host Interface Connector should be considered as interchangeable components.

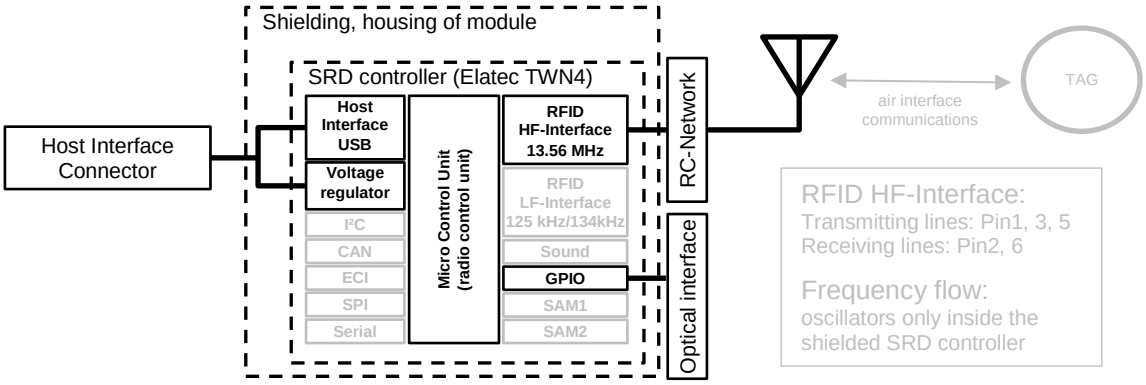


Figure 3: B&R wireless board "RFM-2-NF" block diagram

4 Board description

4.1 Dimensions and main components

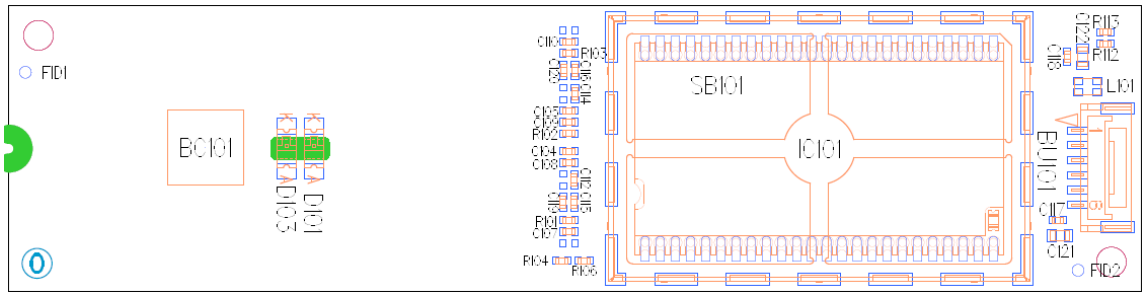


Figure 4: B&R wireless board "RFM-2-NF" front view (component side), L x W = 95 x 24 mm

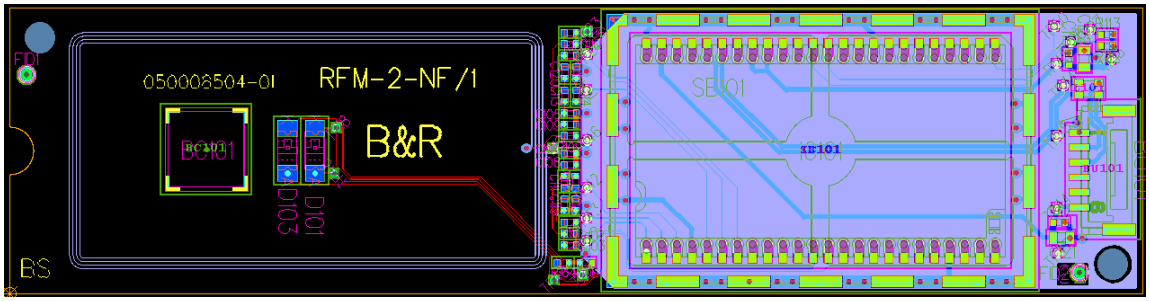


Figure 5: B&R wireless board "RFM-2-NF" diaphanous view (solder side and component side)

The main components are:

ID	Manufacturer	Type/Material	Remarks
SRD controller	ELATEC	TWN4 multitech nano	
Host connector	interchangeable	interchangeable	Not a standard USB connector
LEDs	interchangeable	interchangeable	Optical user interface (status LED's)
Printed pattern antenna	N/A	N/A	PCB material FR4, 1,6 mm
Shielding	interchangeable	interchangeable	

4.2 Short range device (SRD: NFC/RFID)

Short range interface between PC systems and passive transponders (tags) designed for communication in an industrial environment. Data rate and type of modulation are in respect to the supported standards.

Modulation Scheme:

Standard	Typ	Modulation and data rate/decoding	Direction
ISO 14443	A	ASK: 100%, amplitude shift keying with modified Miller-Coding, data rate up to 848 kbit/s (106, 212, 424, 848)	Downlink (reader to tag)
		ASK: modulated 847.5 kHz (load modulation) with Manchester-Coding data rate up to 848 kbit/s (106, 212, 424, 848)	Uplink
	B	10% ASK with NRZ coding, data rate up to 848 kbit/s (106, 212, 424, 848)	Downlink
		BPSK: modulated 847.5 kHz (load modulation) with binary phase shift keying, data rate up to 848 kbit/s (106, 212, 424, 848)	Uplink
ISO 15693		ASK: 10% or 100%, 26.48 kbit/s (1 out 4 pulse modulation) or 1.65 kbit/s (1 out 256 pulse modulation)	Downlink
		FSK: with 423.75 kHz or 484.25 kHz subcarrier and 6.67 kbit/s (low) or 26.69 kbit/s (high)	Uplink
ISO 18092/NFC: NFCIP-1		See ISO 14443 but with peer-to-peer functionality and active and passive communication modes (different command protocols)	

Frequency: 13.56 MHz
Antenna: printed pattern antenna
Transmitter power: max. 1dBm radiated

Standards supported (tags):

ISO14443A: MIFARE Classic 1k & 4k EV1, Mini, DESFire EV1, Plus S&X, SmartMX, Ultralight, Ultralight EV1, Ultralight C, SLE44R35, SLE66Rx, Legic Advant, PayPass, NTAG2XX.

ISO14443B: Calypso incl. Innovatron radio protocol 14443-B, CEPAS, HID iClass, Moneo, PicoPass, SRI512, SRT512, SRI4K, SRIX4K

ISO15693: EM4x33, EM4x35, HID iCLASS, ICODE SLI, LEGIC Advant, M24LR16/64, Tag-it, SRF55Vxx (my-d vicinity), PicoPass

ISO18092 / NFC: NFCIP-1: Active and passive communication mode, peer-to-peer, NFC Forum Tag Type 1-4, Sony FeliCa

4.3 Antenna details

Manufacturer: B&R
Dimensions: outline dimension 20 x 40 mm (see also figure 3)
Type: wire loop implemented as printed pattern antenna (see also figure 3)
Gain [dBi]: N/A
Radiation pattern: omnidirectional

Remark: Module can be used in co-location with other radio equipment.

4.4 Schematics

N/A

4.5 Part list / BOM

See section 4.1 (main components)

5 Host interface description

5.1 Hardware

The host interface provides isolated power supply 5 VDC ±5%, power consumption max. 500 mA (typically 120 mA with RF field on) and the data exchange interface lines (USB protocol) to a B&R Industrial PC. Non-standardized cable between RFM-2-NF and PC.

5.2 Software

The USB-software interface and its corresponding part inside the firmware of the chipset is only for data exchange [1)]. It can't be used to change any settings that may affect the properties and functionality of the radio equipment. The firmware image on the short range device is within the scope of delivery of the module manufacturer. Standard windows drivers for "USB Serial Device" for Ports (COM & LPT) are used. Buffered modulation/data inputs inside the firmware to avoid excessive data rates or over-modulation.

[1)] End-user can't change the settings of the radio equipment. Manufacturers may use this interface during e.g. the assembly process for loading firmware or making settings.

6 Air interface description

The air interface can't be used to change any settings that may affect the properties and functionality of the radio equipment because the system do not accept any type of configuration cards.

7 Auxiliary equipment

This section describes the used auxiliary equipment and refers to hardware, software and instructions for conducting RF testing and is addressed to inspection engineers. It is not part of the ordinary user manual bundled with the product, but describes the test jig. It provide the necessary information together with the sample(s) to ensure that the required RF testing can be conducted.

The test equipment (test jigs) containing the device under test but also the necessary ancillary and auxiliary equipment and the accessories have an own set of accompanying documents that is part of the delivery or is provided electronically to the test house. The setup of the test jigs is done in a manner that that testing can be done effectively. So modifications or a reduced degree of protection is acceptable.

Danger!

Please note that some of the components including the wiring of the test jigs need additional means of protection or are designed to be operated in an electrical cabinet to have safe (galvanic) electrical separation from mains. Same for possible thermal or mechanical hazards. So installing, handling, operating and disassembling of these components for the testing as stand alone or in combination must only be carried out by qualified technicians.

TWN4 Director Tool V1.30: The Director is a tool used to easily test the functionality of Elatec's TWN4 RFID reader. Basic functionality see: https://www.youtube.com/watch?v=GcXP-vA7SQs.

For testing the normal operation mode start the application “Director.exe” via the desktop icon, select the tab “Simple Test”, if tab has not been preselected and then press the button “Connect”. The application proves successful linking to RFM-2-NF module by showing the Status: Connected to USB (COM 4). Place the RFID passive transponder in front of the SRD antenna and tick the checkbox “Cycle” Now the application permanently reads the transponder (approximately every second). Ticking the checkboxes “Cycle” and “Display New ID only” is recommended to have the following or similar test setup as shown in figure 4:

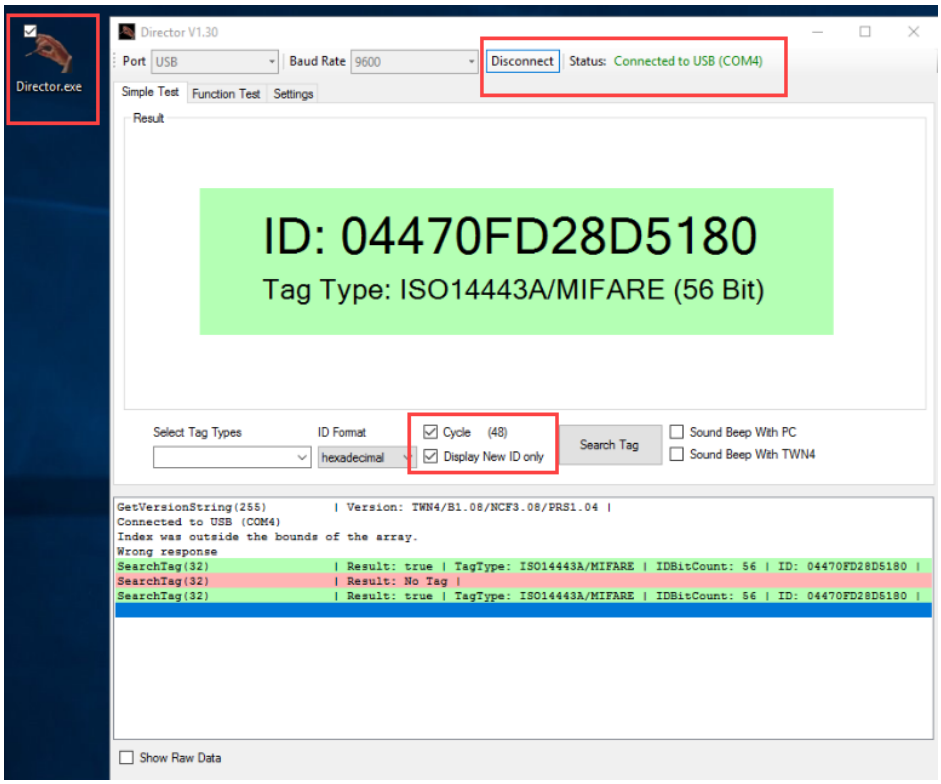


Figure 6: GUI for B&R wireless board “RFM-2-NF” normal testing mode

If testing under special environment conditions is necessary, the software BurnIn Test V8.1 Pro can be used to force the system to process graphic data. The following settings in the menu item “Configuration” are recommended for testing. To start the test, click the green symbol with the hint “Start selected test” in the symbol bar of the main window.

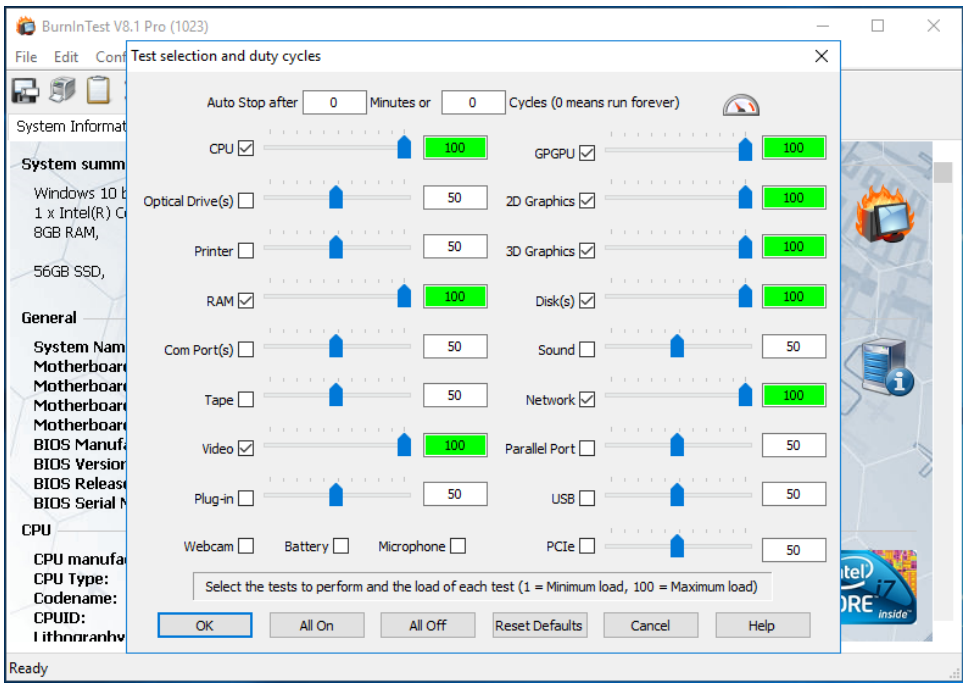


Figure 7: GUI (Settings) for B&R BurnIn-Test

8 Labeling

This section describes the labeling, means marking of the module, the end-device (product that incorporates the module), the packaging and requirements for the manual in respect to the requirements for radio equipment. The final labels can have additional information, due to other requirements.

8.1 Module-Marking

Domain/Country	Marking	Remarks
all	RFM-2-NF	Type designation (unique identification) E.g. §2.1074 and §2.1077 for USA
EU	CE	Highly recommended when shipped as spare part.
USA	FCC ID: 2ADFV-RFM-2-NF	N/A
Canada	IC: 12444A-RFM2NF	N/A
Japan		none
China		none

Size: various (typ. L x W = 30 x 20 mm)
Color: black on white
Material: printed in indelible ink on permanent adhesive (various materials for ink, label and glue)
Location: on metal housing (shield of SRD controller)
Sample: see device under test

A possible layout of the module marking may look like this:

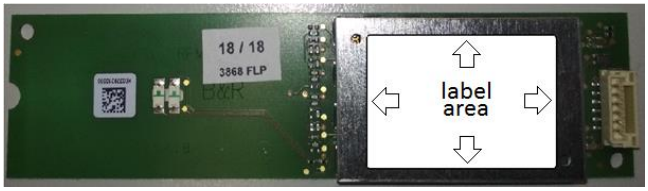


Figure 8: B&R wireless board "RFM-2-NF" label area for module marking

RFM-2-NF
FCC ID: 2ADFV-RFM-2-NF
IC: 12444A-RFM2NF
CE

Figure 9: Layout proposal marking B&R wireless board "RFM-2-NF"

The label of the module shows the type designation, CE mark, FCC ID, IC ID plus additional data for/from production. Optional the label can contain a QR code for internal handling.

8.2 End-Device-Marking

The end-device (host) containing the B&R wireless board (RFM-2-NF) must show the following markings:

Domain/Country	Marking	Remarks
EU		CE mark covers also the marking requirements for radio equipment
USA Canada	This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s) and part 15 of the FCC Rules. 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. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment contains FCC ID: 2ADFV-RFM-2-NF contains IC: 12444A-RFM2NF	§15.19 §15.21 Further to § 2.1077 (c) as described in "**GENERAL GUIDELINES FOR LABELING AND OTHER INFORMATION REQUIRED TO BE PROVIDED TO USERS**" § 2.925 font size: 4 to 8 points, Canadian requirements in RSS-Gen Section 4 ff and §7.1.3.
Japan		Not required: RFM-2-NF is rated as Extremely Low Power Device
China		Not required: RFM-2-NF with 13.56 MHz needs no type approval.

Size: Label: L x W = approx. 63 x 38 mm (size for text and symbol see remarks in table)

Color: Various for symbols and text, various for background. Visibility is assured through either contrast with the background color or marking in relief (for example, moulding or engraving).

Material: *Version for "clean design" environment*: laser marking (no specification of material and glue necessary)

Version for standard environment: security foil (material: metal-coated polyester sheet, glue: Acrylics)

Location: On prominent location (easily visible to the user) or in user manual

Sample: See device under test

A possible layout of the end-device marking for a B&R Automation Panel Series 1000 and 5000 incl. OEM Versions may look like this:

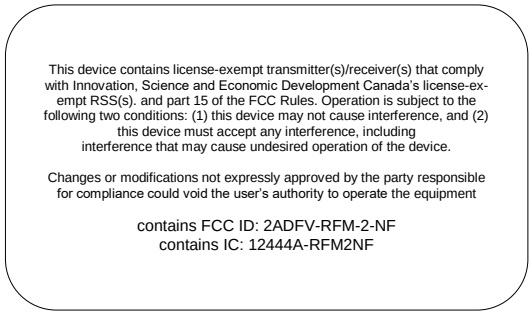


Figure 10: Layout proposal marking Automation Panel Series 1000 and 5000 hosting RFM-2-NF

8.3 Packaging-Marking

This section describes the necessary information on the packaging (sticker) of a B&R end-device that contains an RFM-2-NF but also for the packaging (sticker) of the B&R wireless board RFM-2-NF when shipped for retrofit or as spare part. In case of retrofitting the labeling requirements of an end-device must be taken into account.

Domain/Country	Marking	Remarks
EU	None	
USA	This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). and part 15 of the FCC Rules. 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.	"GENERAL GUIDELINES FOR LABELING AND OTHER INFORMATION REQUIRED TO BE PROVIDED TO USERS" Clause 5 and Appendix A
Canada		N/A
Japan		None
China		None

8.4 User Manual Information

This section provides regulatory information that have to be addressed to the end user.

Domain/Country	Information	Remarks
EU	This product is in conformity with the protection requirements of the EU Council Directive 2014/53/EU.	
USA	This device complies with Part 15 of the FCC rules. Operation is subjected 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. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. NOTE: This equipment has been tested and found comply with the limits of Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a resident area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.	Section 15.21 Section 15.105 (a)
Canada	This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire	RSS-Gen issue 5 Clause 8.4

	de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.	
Japan		none
China		none

The information for the end-user described above is implemented in the user manuals of the end-device(s). There is no user manual for the module RFM-2-NF.

9 Quality System/Management System Requirements

https://www.br-automation.com/en/downloads/certificates/iso-9001/iso-90012015/

B&R wireless board RFM-2-NF production side(s): A-5142 Eggelsberg, B & R Straße 1

10 Integration Manual

Please see separate documentation B&R wireless board “RFM-2-NF” Integration Guide.

11 List of approvals

The short range device TWN4 and/or the assembly RFM-2-NF has the following approvals:

Country	Approval	Remarks
N/A [1)]	N/A [1)]	N/A [1)]

[1)] Extremely low power device

12 RF-Exposure

Due the low transmit power and the intended use a RF-Exposure assessment is not necessary.

13 Figure index

Table index

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