TEST REPORT

Electromagnetic Compatibility

Report Reference No. ..... :	**478882-3TRFEMC**
Date of issue ..... :	2022-10-21
Test Report Verdict ..... :	PASS
Testing Laboratory..... :	**Nemko S.p.A.**
Address..... :	Via Del Carroccio, 4
City ..... :	20853 Biassono (MB)
Country ..... :	Italy
Testing location..... :	Described at clause 1.4
Customer name..... :	**INPECO SA**
Customer information..... :	Via Torraccia, 26 – 6883 Novazzano – Switzerland
Reference standards..... :	**FCC CFR 47 Part 15 Subpart B**
Standard application ..... :	Full application
Equipment under test ..... :	**CANopen Antenna Board double – 13 MHz**
Trademark(s) ..... :	inpeco
Manufacturer..... :	INPECO SA
Model/Type reference ..... :	PSI0040 (described at clause 4.1)
Tests performed by ..... :	P. Barbieri
Report approved by..... :	D. Guarnone

CONTENTS

1. GENERAL INFORMATION

1.1 Project history

Report number	Modification to the report / comments	Date
478882-3TRFEMC	First release	2022-10-21
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1.2 Symbol used in the report

☒..... :	The crossed square indicates that the listed condition, standard or equipment is applicable for this report.
☐..... :	The empty square indicates that the listed condition, standard or equipment is not applicable for this report.
NP (Not performed)..... :	Test case not performed according to customer request
N (Not applicable) ..... :	Test case does not apply to the test object
P (Pass)..... :	Test object does meet the requirement
F (Fail) ..... :	Test object does not meet the requirement
☐ Comma (,) / ☒ Dot (.) ..... :	Symbol used as decimal separator throughout this report
Asterisk (*)	Symbol used to indicate a standard, a test or a verdict not accredited by ACCREDIA
EUT ..... :	Equipment Under Test

The results contained in this report reflect the results for this particular model(s) and serial number(s) and apply to the sample(s) as received. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

1.3 Date of sample(s) reception and tests

Date of receipt of test sample(s) .....:	2022-10-13
Testing start date .....:	2022-10-17
Testing termination date .....:	2022-10-21

1.4 Testing location

The tests have been performed in the place indicated below:	
☒ Nemko premises location .....:	Nemko S.p.A.
	Via Del Carroccio, 4
	20853 Biassono (MB) - Italy
	FCC site number: 682159
☐ Other location .....:	--
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1.5 Environmental conditions

The tests were carried out in the ranges of environmental conditions specified below:	
Ambient temperature .....:	18-33 °C [1]
Relative Humidity .....:	25-70 % [2]
Atmospheric pressure .....:	860-1060 hPa

Notes:
[1] For luminaire, temperature during tests was verified to be within 18 ÷ 30 °C
[2] During ESD test, humidity was verified to be within 30 ÷ 60 %

The following instruments are used to monitor the environmental conditions:

Equipment	Trademark	Model	Serial No.
Thermo-hygrometer	Testo	175-H2	20012380/305
Thermo-hygrometer	Testo	175-H2	38203337/703
Barometer	Castle	GPB 3300	072015

1.6 Measurement uncertainty and assessment of conformity

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2 and other specific test standard and is documented in Nemko Spa working manual WML1002. The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report:

P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit.

F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.

Hereafter Nemko's measurement uncertainties are reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Disturbance	Antenna distance 1 m, 3 m, 10 m 0.009 ÷ 200 MHz	5.0 dB	(1)
	Antenna distance 1 m, 3 m, 10 m 200 ÷ 1000 MHz	5.2 dB	(1)
	Antenna distance 1 m, 3 m, 10 m 1 ÷ 6 GHz	5.2 dB	(1)
	Antenna distance 1 m, 3 m 6 ÷ 18 GHz	5.5 dB	(1)
	Antenna distance 1 m, 3 m 18 ÷ 40 GHz	7.2 dB	(1)
Radiated Disturbance with large loop antenna system (LLAS)	0.009 ÷ 30 MHz	3.3 dB	(1)
Conducted Disturbance	0.02 ÷ 150 kHz with AMN	3.8 dB	(1)
	150 kHz ÷ 30 MHz with AMN	3.4 dB	(1)
	150 kHz ÷ 30 MHz with AAN	4.6 dB	(1)
	9 kHz ÷ 30 MHz with voltage probe	2.9 dB	(1)
	150 kHz ÷ 30 MHz with current probe	2.9 dB	(1)
Frequency	10 Hz ÷ 1 kHz	0.2 %	(1)
	1 kHz ÷ 40 GHz	10^{-6}	(1)
Electromagnetic fields (EMF)	Magnetic, Electric and Electromagnetic fields: 0 Hz ÷ 40 GHz	25 %	(1)
Electrical quantities (voltage, current, resistance)	AC/DC Voltage 10 mV ÷ 1000 V 0÷100 kHz AC/DC Current 0.1 mA ÷ 400 A 0÷1 kHz Resistance 100 mΩ ÷ 10 MΩ	2.5 %	(1)

NOTES:
(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %
(2) The instruments used for this immunity test is according to the tolerances requested by the applicable standard
(3) The reported expanded uncertainty of measurement is related to the stimulus quantity

1.7 Instruments calibration table

Instrument cited in the report and not listed in this paragraph are not subject to calibration. The calibration is valid up to the last day of the due date month.

Description	Manufacturer	Model	Identifier	Cal Date	Due Date
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
EMI Receiver	Rohde & Schwarz	ESU8	100202	2022-09	2023-09
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2021-07	2024-07
Antenna Trilog 25-2000 MHz	Schwarzbeck Mess-Elektronik	VULB9168	9168-242	2021-06	2024-06
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2021-09	2024-09
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STPL 9148-123	2021-06	2024-06
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2020-04	2023-04
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2022-05	2023-05
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2022-03	2023-03
Preamplifier	Schwarzbeck Mess-Elektronik	BBV9718	BBV9718-137	2022-04	2023-04
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2021-09	2023-09
Common Mode Absorption Device	Schwarzbeck Mess-Elektronik	CMAD1614	00041	2022-05	2023-05
LISN	Rohde & Schwarz	ENV432	101714	2022-08	2023-08
V-network	Rohde & Schwarz	ESH3-Z5	840 731/004	2022-08	2023-08
Oscilloscope	Agilent	54846A	MY40000254	2022-07	2023-07
Multimeter	Rohde & Schwarz	HMC8012	101577	2022-07	2023-07
Barometer	Castle	GBP 3300	072015	2022-04	2023-04
Data logger con diagnosi in campo	Testo	175-H2	20012380/305	2020-12	2022-12
Data logger con diagnosi in campo	Testo	175-H2	38203337/703	2020-12	2022-12
Attenuator	Aeroflex / Weinschel	2	CC8577	2022-08	2023-08
3m Semi anechoic chamber	Comtest	SAC-3	1711-150	2022-09	2024-09

2. PRODUCT STANDARDS, TEST METHODS AND TECHNICAL PROCEDURES

2.1 Standard(s) applied

The following standard(s) or specifications, accredited by ACCREDIA, were applied:

FCC CFR 47 Part 15 Subpart B
Code of Federal Regulations – Title 47 – Part 15 Radio Frequency Devices – Subpart B Unintentional radiators

2.2 Test method(s) applied

The following documents are referred to in the standard(s) in such a way that some or all of their content constitutes requirements for the standard itself.

ANSI C63.4 (2014)
American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

2.3 Nemko technical procedures

WM L0177: General routines for using instruments at Nemko

WM L1002: Measurement Uncertainty - Policy and Statement

WM L0077: General procedure for conducting EMC tests

3. SUMMARY OF TEST RESULTS AND VERDICTS

3.1 Measurement of electromagnetic disturbances emitted by the equipment under test

Emission Tests		
Requirement / test	**Method Standard**	**Verdict**
Part §15.107 – Conducted emission	ANSI C63.4	P
Part §15.109 – Radiated emission	ANSI C63.4	P
Notes: --		

4. EQUIPMENT UNDER TEST

4.1 EUT Identification

Short description of the EUT
The EUT is a CAN Antenna board provided with two 13.56 MHz RFID radio modules. It's supplied by an external DC power source, and it's provided with a CAN BUS interface for the communication of the hosting device.

Copy of marking plate(s) (if present)

Sample ID ..... :	YYMM12345
Model/Type ..... :	PSI0040 – CANopen Antenna Board Double
Ratings ..... :	24 V DC
Equipment installation ..... :	Built-in
Accessories and detachable parts included .... :	None
Test performed..... :	All tests were performed on this sample
Software and/or firmware information ..... :	--

Product variants not tested:
--

4.2 EUT Power Supply

Used [1]	N° [2]	Type	Supply Voltage	Phases N°	Supplementary Information
☒	1	DC	24 V		

Notes:
[1] The crossed square indicates that the supply voltage is used in at least one test.
[2] This number will be used all over the report to identify the supply voltage(s) used for each test.

4.3 EUT Information declared by the Customer [1]

Information	Declaration
EUT highest frequency[2] .....:	fc = 27 MHz
Environment intended use.....:	Industrial
Equipment classification[3] .....:	B

Notes:
[1] Nemko S.p.A. declines all responsibility for the information above declared by the customer that may influence the validity of the results contained in this test report.
[2] For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation.
[3] Equipment class and category definitions are specified in the standard used.

4.4 EUT Operation Modes

N°	Description
1	Normal working reading a Brick-Tag and sending data to a PC via CAN BUS

Notes:
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4.5 EUT Configuration Modes

The EUT was configured to measure its highest possible radiation level. The test modes selected are according to EUT instruction manual.

N°	Description
1	The EUT has been tested supplied by an external DC power source, with the CAN BUS connected to a PC and with the antenna A1 working.

Notes:
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4.6 EUT Input/Output Ports

Port	Name	Type [1]	Cable Max. >3m	Cable Shielded	Description
0	Enclosure	N/E	—	—	—
1	DC	DC	☒	☐	Two wires cable
2	CAN BUS	I/O	☒	☐	Three wires cable

Notes:
[1] Port type:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical ANT = Antenna Port
I/O = Signal/Control Input or Output Port TP = Wired network or telecommunication Port

4.7 EUT and Equipment Used During Test

Use [1]	Product Type	Manufacturer	Model	Comments
AE	PC	DELL	Latitude 7480	--
AE	CAN adapter	IXXAT	USB-to-CAN V2 compact	--
AE	AC/DC adapter	MW	HDR-60-24	--

Notes:
[1] Use
EUT - Equipment Under Test SIM - Simulator (Not Subjected to Test)
AE - Auxiliary/Associated Equipment (Not Subjected to Test)

4.8 EUT Electric/Block Diagram

Not applicable

4.9 Information about radio module(s)

Radio module 1	
Description	**Information**
Identification:	Model: PSI0040 Trademark: INPECO SA
Frequency band (MHz):	13.56 MHz
Modulation type:	Standard RFID
Antenna information:	Two integral loop antennas
Other information:	--

Notes:
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5 TEST RESULTS

5.1 Radiated Emission

5.1.1 Test result

Verdict:	☒ P ☐ F ☐ N[1] ☐ NP
Frequency range:	30 MHz – 40000 MHz [2]
Test site:	Semi anechoic chamber
Measurement distance:	3 m or 10 m [3]

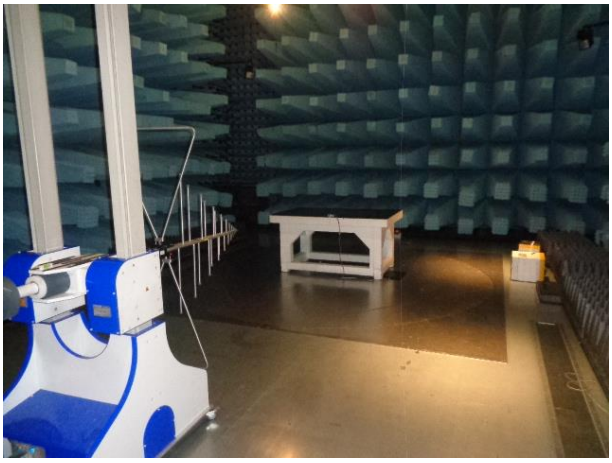
Notes:

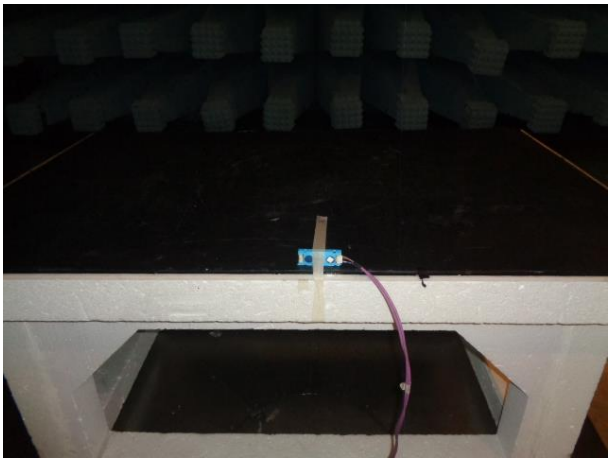
[1] If marked, the test is not applicable for the EUT.

[2] For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation.

[3] Test was performed at 10 m measurement distance for class A EUT in the frequency range from 30 to 1000 MHz; test was performed at 3 m measurement distance in all other cases.

5.1.2 Photo documentation of the test set-up





5.1.3 Test method

Method standard is reported at par. 3.1. Measurements were made on a semi anechoic chamber. Preliminary measurements were performed at an antenna to EUT separation distance of 3 or 10 meters with the receive antenna located at a fixed height (from 1 to 4 meter) in both horizontal and vertical polarizations. Final measurements were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 meters. All frequencies were investigated in both horizontal and vertical antenna polarization, where applicable.

Receiver reading P_R, reported in tables at clause 5.1.6, was achieved adjusting the input signal P_{IN} by a correction factor CF, to take into account of the insertion loss due to cables and attenuators, the antenna factor, the external preamplifier gain. This correction factor was pre-inserted in the firmware of the receiver and was applied by the instrument during the test. The relationship between P_R and P_{IN}, expressed in dB, is:

$$P_R = P_{IN} + CF$$

5.1.4 Limits for enclosure

Radiated emission[1]				
Frequency (MHz)	Limit for Class A EUT		Limit for Class B EUT	
	µV/m	dBµV/m	µV/m	dBµV/m
30 to 88	90	39.0	100	40.0
88 to 216	150	43.5	150	43.5
216 to 960	210	46.4	200	46.0
960 to 1000	300 [2]	49.5 [2]	500 [2]	54.0 [2]
Above 1000[3]	1000 [2]	59.5 [2]	500 [2]	54.0 [2]

Notes:
[1] For frequency range between 30 to 1000 MHz Quasi-Peak detector is used. For frequency range above 1000 MHz Average and Peak detector are used.
[2] Above 1000 MHz, the limit reported refers to measurement s performed with Average detector. For measurements performed with Peak detector the limit is 20 dB greater.
[3] For Class A radiated emission above 1 GHz, a measurement distance of 3 m can be used, with the limits increased by 10 dB.

5.1.5 Test equipment used[1]

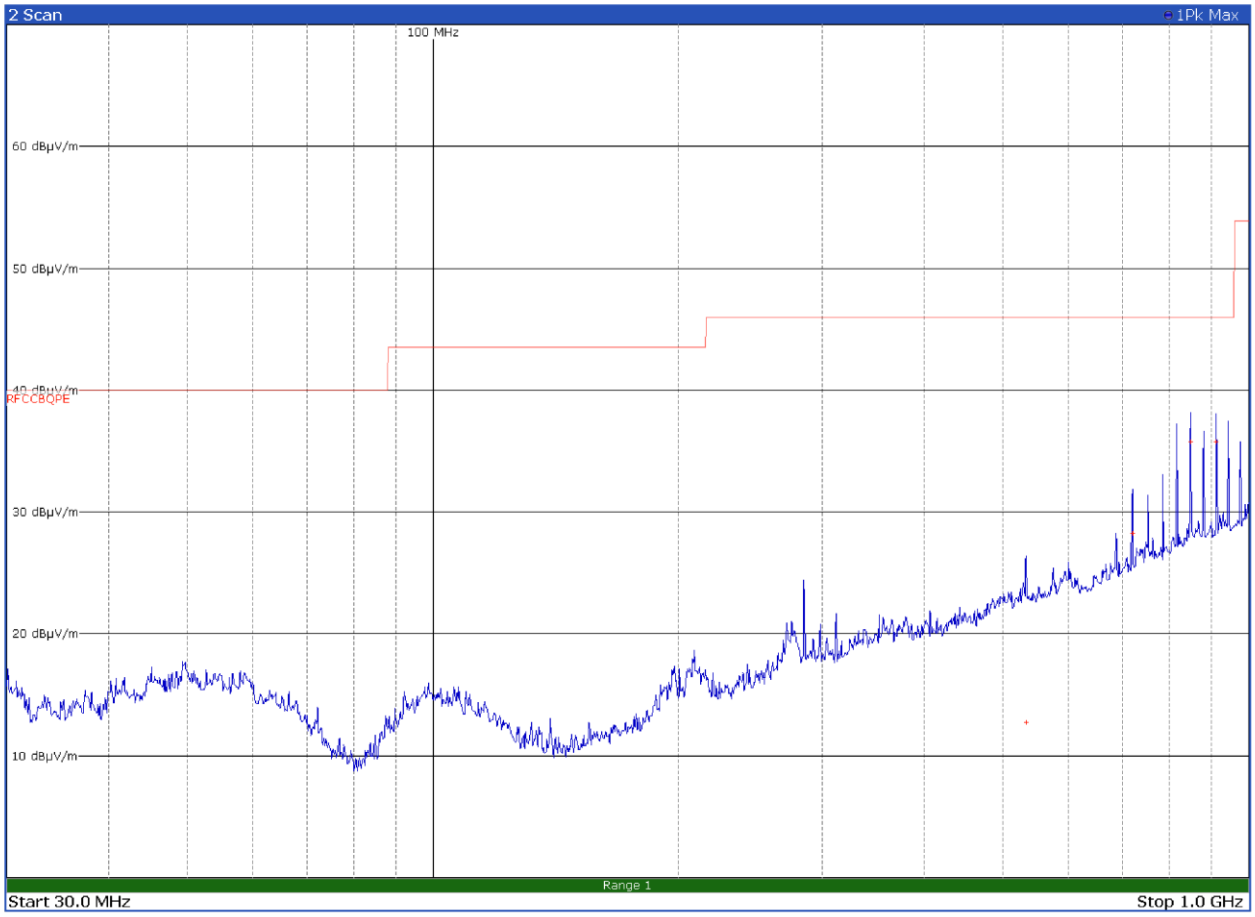
Used [2]	Description	Manufacturer	Model	Identifier
☒	SAC	Nemko Spa	10m SAC	530
☐	SAC	Comtest	3m SAC	1711-150
☒	EMI receiver	Rohde & Schwarz	ESW44	101620
☐	EMI receiver	R&S	ESU8	100202
☒	Antenna	Schwarzbeck	VULB9162	VULB9162-025
☐	Antenna	Schwarzbeck	STLP9148	STLP9148-123
☐	Antenna	Schwarzbeck	STLP9148	STLP9148-152
☐	Antenna	RF Spin	DRH40	061106A40
☐	Preamplifier	Schwarzbeck	BBV9718C	00121
☒	Controller for turntable and antenna mast	Maturo	FCU3.0	10041
☒	Tilt antenna mast	Maturo	TAM4.0-E	10042
☒	Turntable 4.5 t	Maturo	TT4.0-5T	2.527

Notes:
[1] See clause 1.7 for calibration information.
[2] If crossed, the instrument was used during tests.

5.1.7 Test protocol

Antenna Polarization	Supply Voltage[1]	Test Mode		Remarks	Verdict
		Operation[2]	Configuration[3]		
Horizontal	1	1	1	--	P

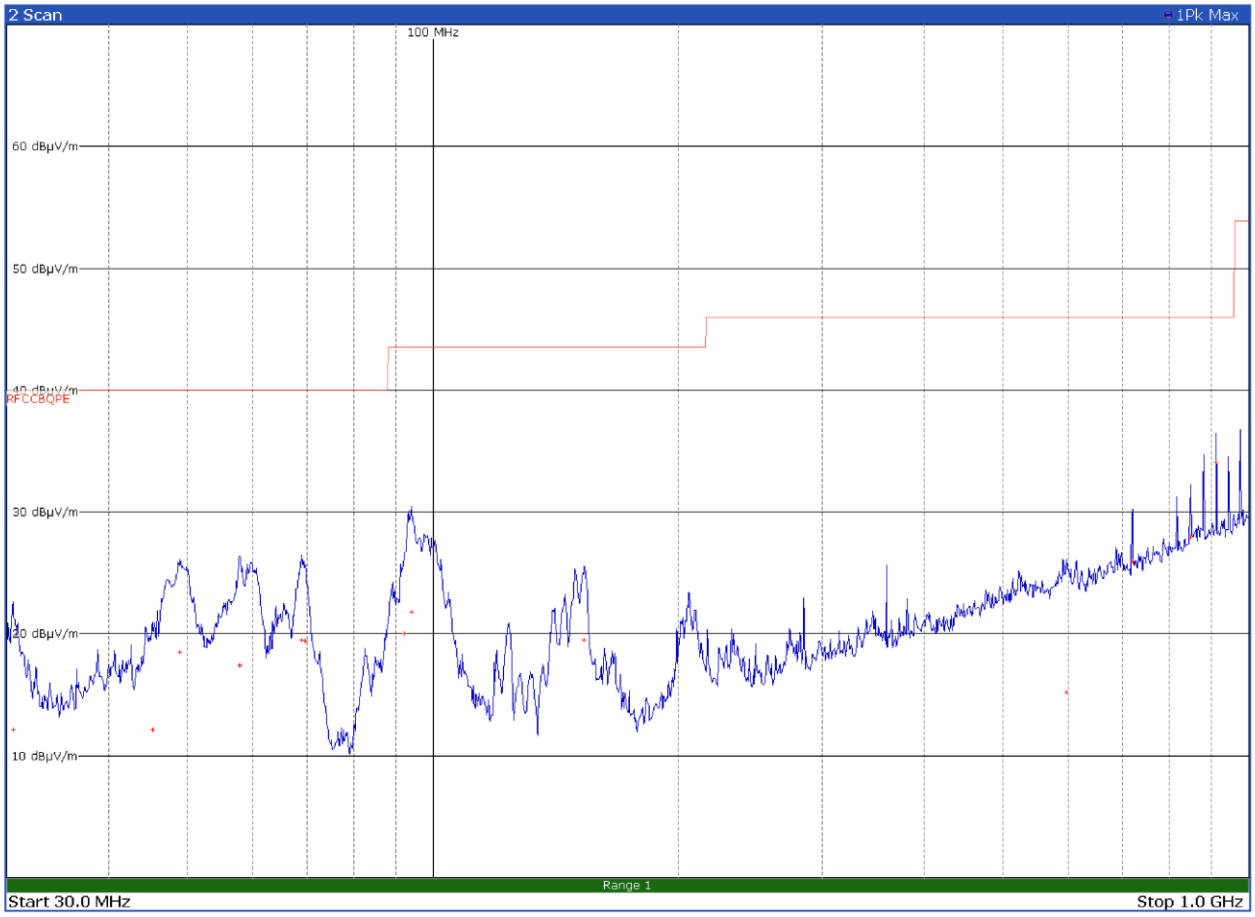
Notes:
[1] See clause 4.2 EUT Power Supply
[2] See clause 4.4 EUT Operation Modes
[3] See clause 4.5 EUT Configuration Modes



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
532.7700	12.8	46.0	-33.2	QP
720.0000	28.3	46.0	-17.7	QP
848.0100	35.8	46.0	-10.2	QP
912.0000	35.8	46.0	-10.2	QP

Antenna Polarization	Supply Voltage[1]	Test Mode		Remarks	Verdict
		Operation[2]	Configuration[3]		
Vertical	1	1	1	--	P

Notes:
[1] See clause 4.2 EUT Power Supply
[2] See clause 4.4 EUT Operation Modes
[3] See clause 4.5 EUT Configuration Modes



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
30.5400	12.2	40.0	-27.8	QP
45.2400	12.2	40.0	-27.8	QP
48.9300	18.6	40.0	-21.4	QP
57.8400	17.5	40.0	-22.5	QP
68.8800	19.5	40.0	-20.5	QP
69.7200	19.5	40.0	-20.5	QP
92.1000	20.1	43.5	-23.4	QP
94.0500	21.8	43.5	-21.7	QP
153.0900	19.5	43.5	-24.0	QP
597.3300	15.3	46.0	-30.7	QP
720.0000	26.0	46.0	-20.0	QP
848.0100	28.0	46.0	-18.0	QP
912.0000	34.2	46.0	-11.8	QP

5.2 Conducted emission

5.2.1 Test result

Verdict for AC mains port[2]:	☒ P ☐ F ☐ N[1] ☐ NP
Frequency range:	0.15 MHz – 30 MHz
Kind of test site:	Shielded room

Notes:

[1] If marked, the test is not applicable for the EUT, according to 15.107 (c)(1) or (d).

[2] If applicable, KDB 174176D01 criterion was used for devices powered from a computer or any other external power source via a USB connection.

5.2.2 Photo documentation of the test set-up

5.2.3 Test method

Method standard is reported at par. 3.1. Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. All power was connected to the system through Line Impedance Stabilization Networks (LISN). Conducted voltage measurements on mains lines were made at the output of the LISN.

Receiver reading P_R, reported in tables at clause 5.2.6, was achieved adjusting the input signal P_{IN} by a correction factor CF, to take into account of the insertion loss due to LISN and cables. This correction factor was pre-inserted in the firmware of the receiver and was applied by the instrument during the test. The relationship between P_R and P_{IN}, expressed in dB, is:

$$P_R = P_{IN} + CF$$

5.2.4 Limits

Conducted emissions from AC mains power ports				
Frequency (MHz)	Quasi-Peak limit (dBµV)		Average limit (dBµV)	
	Class B	Class A	Class B	Class A
0.15 to 0.50	66 to 56 [1]	79	56 to 46 [1]	66
0.50 to 5	56	73	46	60
5 to 30	60	73	50	60

Notes:
[1] The limit level in dBµV decreases linearly with the logarithm of frequency

5.2.5 Test equipment used[1]

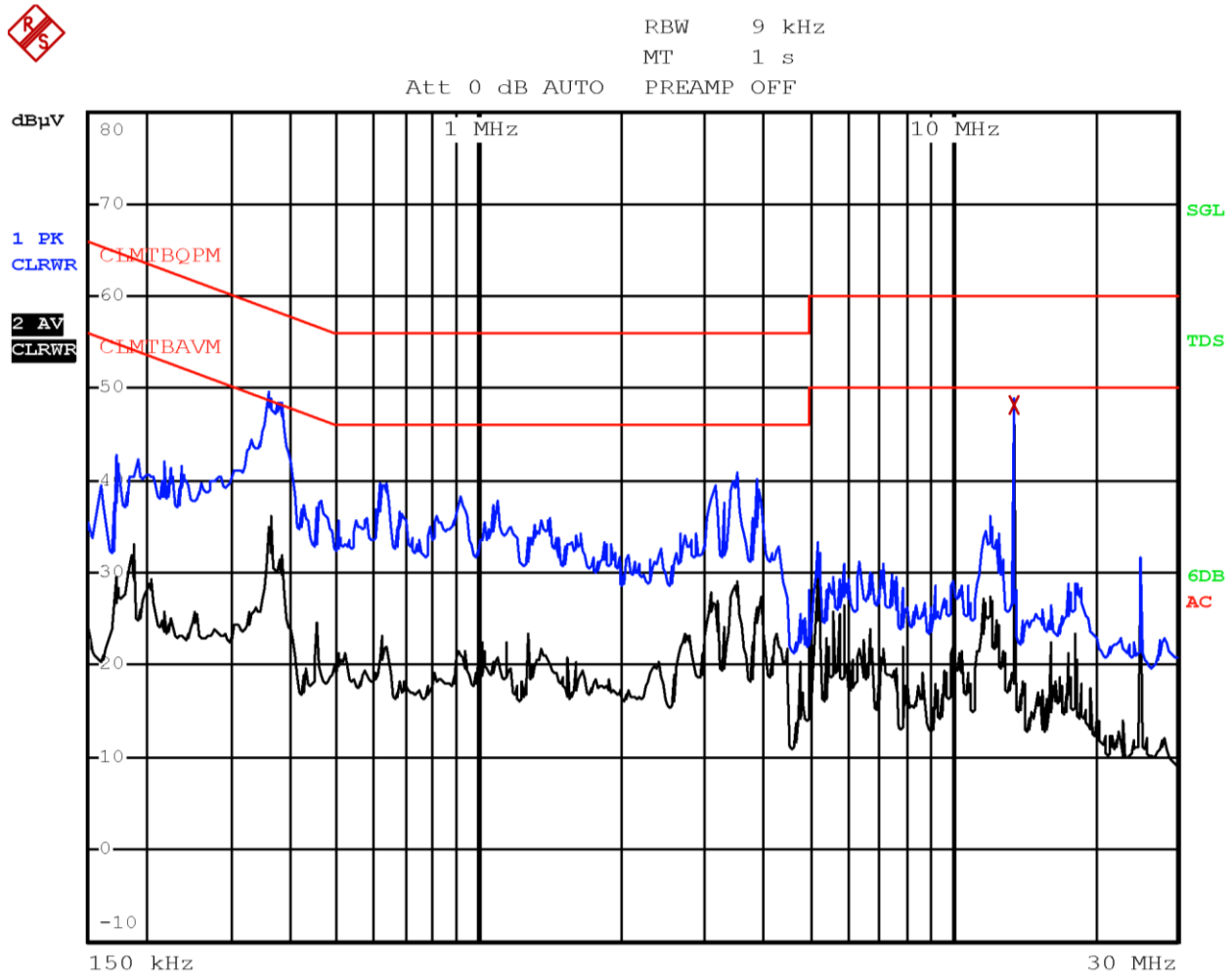
Used [2]	Description	Manufacturer	Model	Identifier
☒	EMI receiver	R&S	ESU8	100202
☐	EMI receiver	Rohde & Schwarz	ESW44	101620
☒	Attenuator	Aeroflex / Weinschel	2	CC8577
☐	LISN 9 kHz ÷ 30 MHz	R&S	ESH2-Z5	872 460/041
☒	LISN 9 kHz ÷ 30 MHz	R&S	ENV432	101714
☐	LISN 9 kHz ÷ 30 MHz	R&S	ESH3-Z5	840 731/004
☒	Shielded room	Siemens	Conducted emission test room	1862

Notes:
[1] See clause 1.7 for calibration information.
[2] If crossed, the instrument was used during tests.

5.2.6 Test protocol

Test Port		Supply Voltage[2]	Test Mode		Remarks	Verdict
EUT[1]	Line		Operation[3]	Configuration[4]		
1	Phase	1	1	1	--	P

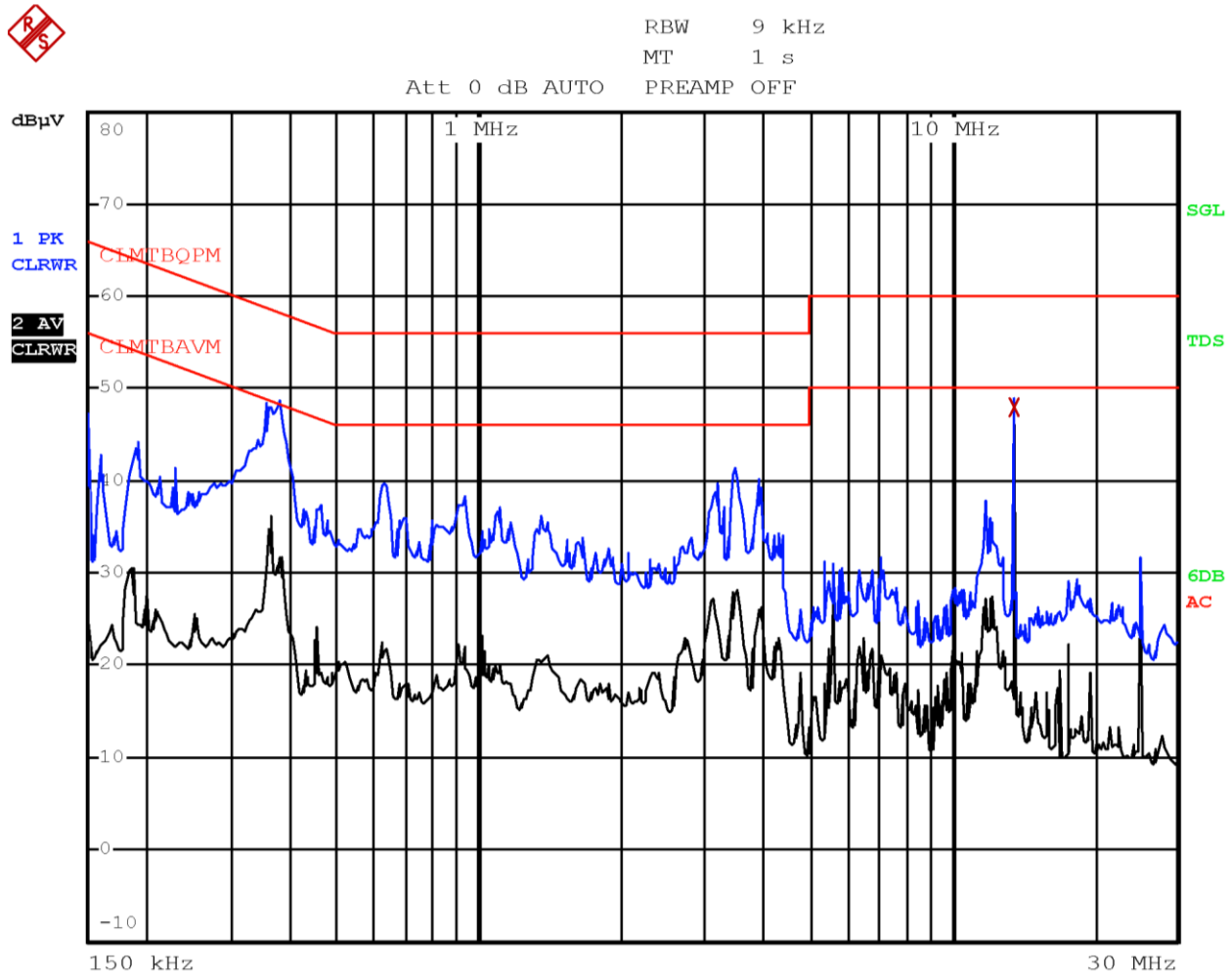
Notes:
[1] See clause 4.6 EUT Input/Output Ports
[2] See clause 4.2 EUT Power Supply
[3] See clause 4.4 EUT Operation Modes
[4] See clause 4.5 EUT Configuration Modes



Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
13.5620	48.2	50.0	-1.8	Av

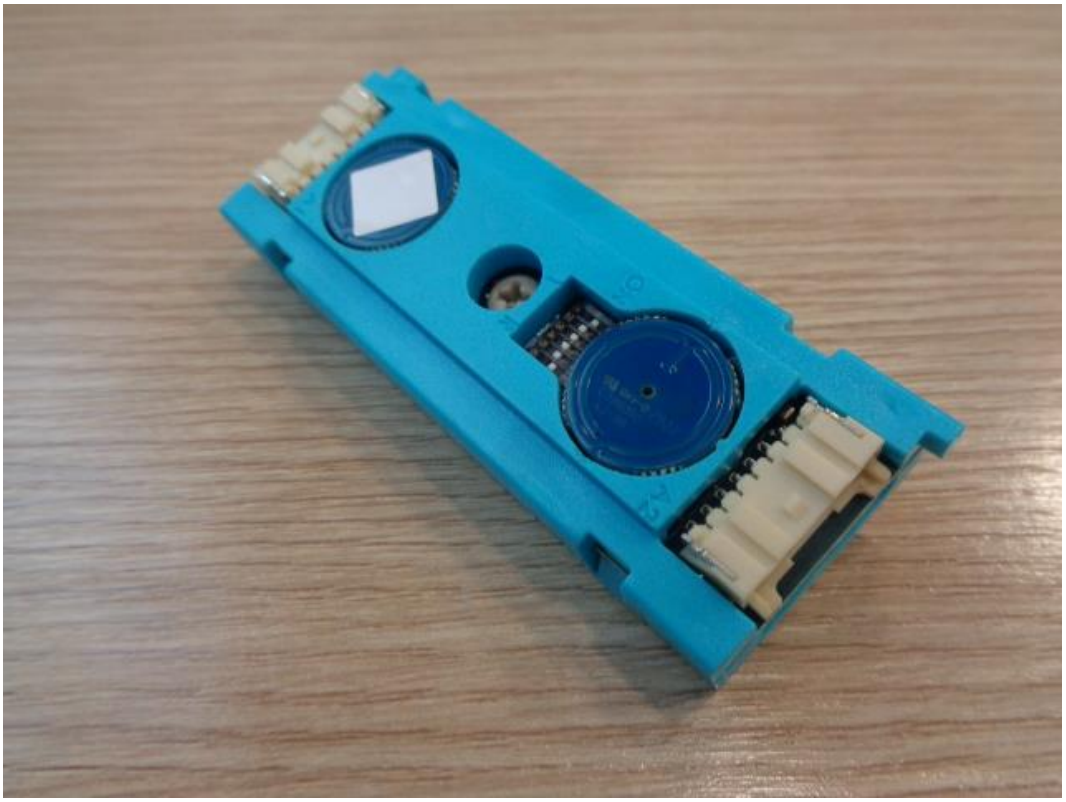
Test Port		Supply Voltage[2]	Test Mode		Remarks	Verdict
EUT[1]	Line		Operation[3]	Configuration[4]		
1	Neutral	1	1	1	--	P

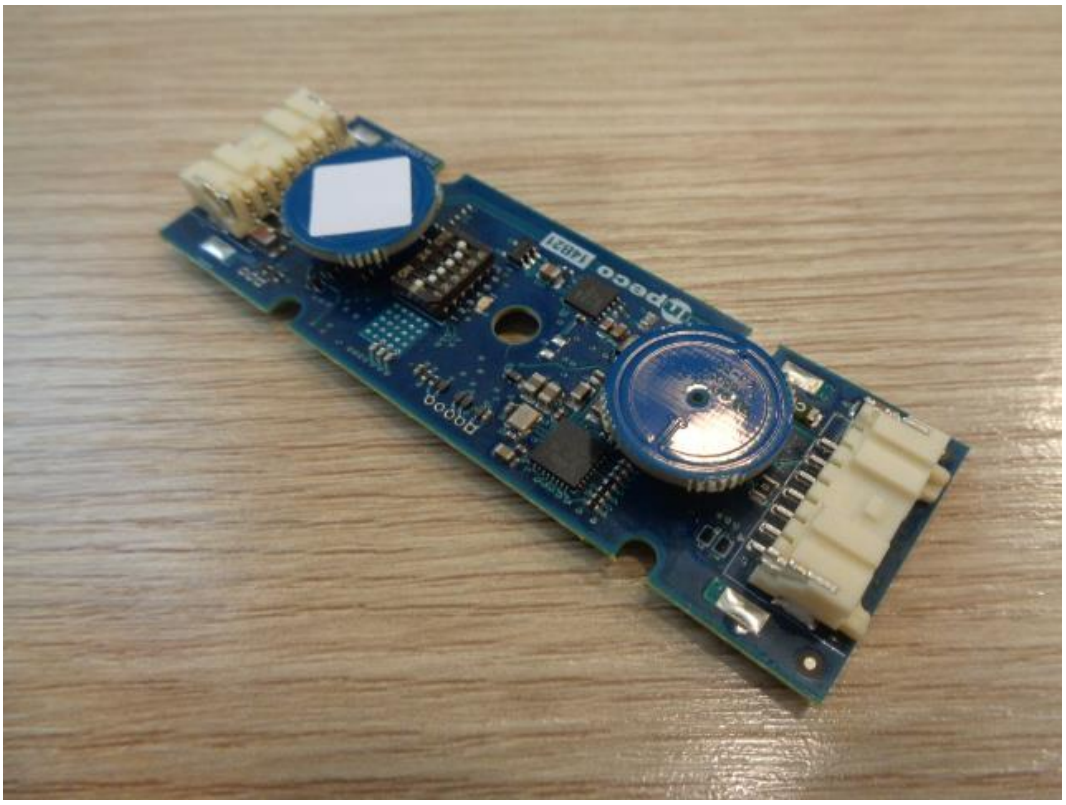
Notes:
[1] See clause 4.6 EUT Input/Output Ports
[2] See clause 4.2 EUT Power Supply
[3] See clause 4.4 EUT Operation Modes
[4] See clause 4.5 EUT Configuration Modes

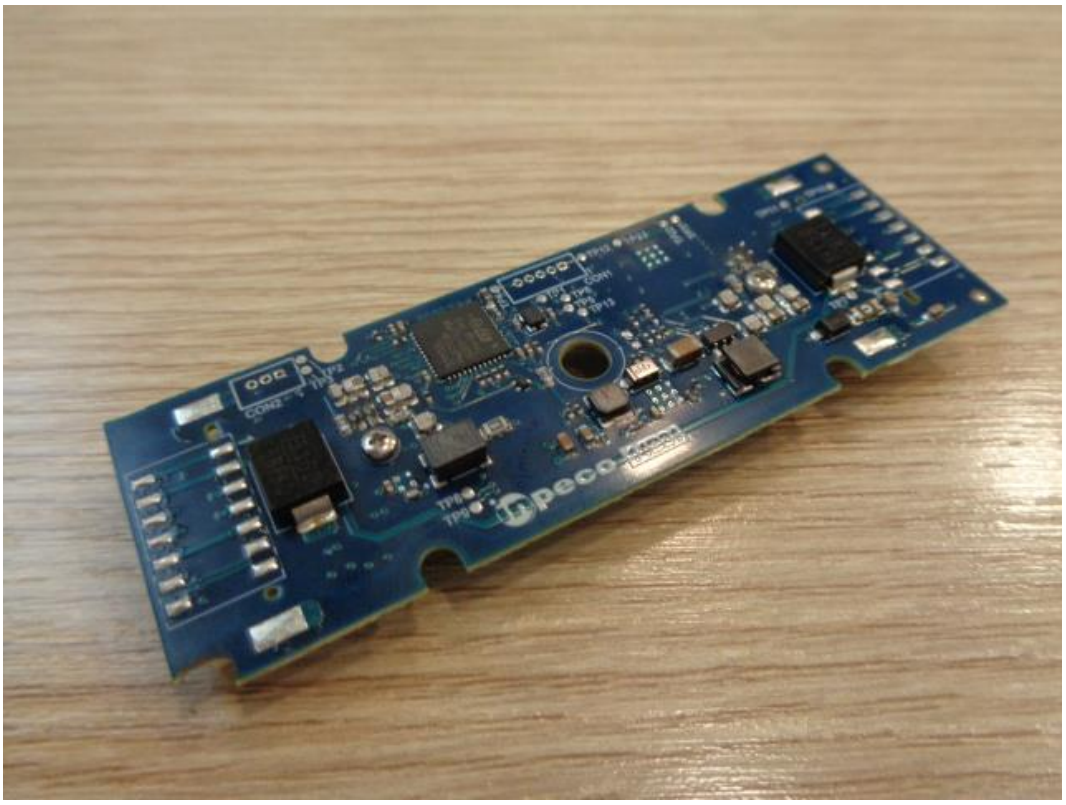


Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Detector
13.5620	48.1	50.0	-1.9	Av

6 EUT PHOTOS







End of report