

Test Report

Report Number:

F170756E4

Equipment under Test (EUT):

Control panel for welding inverters

Einschub TT/MW Smart 210mm

Applicant:

Fronius International GmbH

Manufacturer:

Fronius International GmbH





Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

- [1] **ANSI C63.4:2014** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- [2] **FCC 47 CFR Part 2:** General Rules and Regulations
- [3] **FCC 47 CFR Part 15:** Radio Frequency Devices (Subpart B)
- [4] **ICES-003 Issue 6: (January 2016)** Spectrum Management and Telecommunications. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) —Limits and Methods of Measurement

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

Tested and written by:	Bernward ROHDE		04.09.2018
	Name	Signature	Date
Reviewed and approved by:	Bernd STEINER		04.09.2018
	Name	Signature	Date

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1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	Mr. Jan HERNDLER, Mr. Franz NIEDEREDER

1.2 Manufacturer

Name:	Fronius International GmbH
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Name for contact purposes:	Mr. Jan HERNDLER
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Fax:	+43 72 42 241 - 0
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Manufacturer represented during the test by the following person:	Mr. Jan HERNDLER, Mr. Franz NIEDEREDER

1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02, FCC Test Firm Accreditation with the registration number 469623, designation number DE0004 and Industry Canada Test site registration SITE# IC3469A-1.

1.4 EUT (Equipment under Test)

EUT	
Test object: *	Control panel for welding inverters
Type / PMN	Einschub TT/MW Smart 210mm
FCC ID: *	QKWSPBBCU1
ISED Certification number: * IC: *	12270A-SPBBCU1
HVIN (Hardware Version Identification Number): *	Einschub TT/MW Smart 210mm
FVIN (Firmware Version Identification Number): *	V1.4B
HMN (Host model name): *	N/A
Order number:*	43,0001,3533
Serial number: *	N/A
PCB identifier: *	1654600

* As declared by the applicant

1.5 Technical Data of Equipment

Power Supply	DC					
Supply voltage	$U_{nom} =$	24 V DC	$U_{min} =$	21.6 V DC	$U_{max} =$	26.4 V DC

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Power connection cable	Customized	DC plug 4mm	2 m	No
Ethernet	HSD	RJ 45	3 m	Yes

Ancillary equipment used for all tests	
Laptop PC:*	Fujitsu Lifebook S751 (PM No. 201036)
AC-Adaptor**	ITE Power supply Model number: UE36LCP1-240150SPA, 24 V DC / 1.5 A
Ancillary BLE device**	RC panel pro

* provided by the laboratory

** provided by the applicant

1.6 Dates

Date of receipt of test sample:	07.09.2017
Start of test:	24.11.2017
End of test:	27.04.2018

2 Operational States

Description of function of the EUT:

- The EUT is a control panel for welding units:



During normal operation the EUT can be paired with an ancillary Smartphone/Laptop to configure the welding parameters via remote control.

As declared by the applicant, only the 13.56.MHz RFID, Bluetooth low energy and WLAN (2.4 GHz) is to be used in the final application.

The following states were defined as the operating conditions:

- Reading a NFC tag
- Wireless 2.4 GHz communication established
- Ethernet Link established

For the tests the fping was used to establish a constant data stream via LAN to a laptop, an ancillary remote control was used to establish a wireless communication.

3 Additional Information

None

4 Overview

Conducted emissions FCC 47 CFR Part 15 section 15.107 (b) [3] / ICES-003 Issue 6 section 6.1 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
AC supply line	0.15 to 0.5 MHz 0.5 to 30 MHz	79 dB μ V (QP) 66 dB μ V (AV) 73 dB μ V (QP) 60 dB μ V (AV)	ANSI C63.4	Class A	-
AC supply line	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dB μ V (QP)* 56 to 46 dB μ V (AV)* 56 dB μ V (QP) 46 dB μ V (AV) 60 dB μ V (QP) 50 dB μ V (AV)	ANSI C63.4	Class B	Passed
*: Decreases with the logarithm of the frequency					
Radiated emissions FCC 47 CFR Part 15 section 15.109 (b) [3] / ICES-003 Issue 6 section 6.2 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	39.0 dB μ V /m QP at 10 m 43.5 dB μ V /m QP at 10 m 46.5 dB μ V /m QP at 10 m 49.5 dB μ V /m QP at 10 m 49.5 dB μ V /m AV at 10 m and 69.5 dB μ V /m PK at 10 m	ANSI C63.4	Class A	-
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dB μ V/m QP at 3 m 43.5 dB μ V/m QP at 3 m 46.0 dB μ V/m QP at 3 m 54.0 dB μ V/m QP at 3 m 54.0 dB μ V/m AV at 3 m and 74.0 dB μ V/m PK at 3 m	ANSI C63.4	Class B	Passed

Remark: As declared by the applicant the highest internal clock frequency is 2.48 GHz.
Therefore the radiated emission measurement must be carried out up to 5th of the highest internal clock frequency in this case 12.75 GHz.

The EUT was classified by the applicant as CLASS B equipment.

5 Results

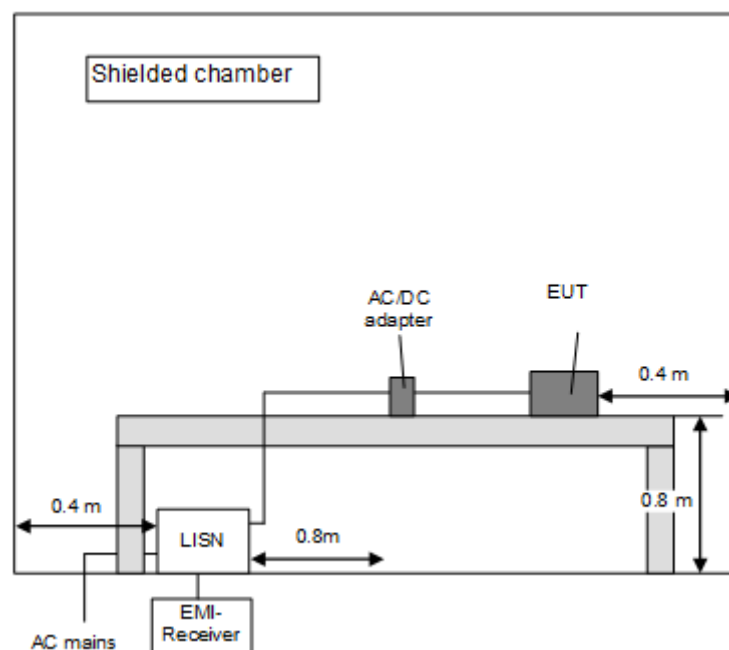
5.1 Conducted emissions on power supply lines

5.1.1 Test method

This test will be carried out in a shielded chamber. Table top devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices will be placed directly on the ground plane. The setup of the Equipment under test will be in accordance to [1].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriate limit, this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz

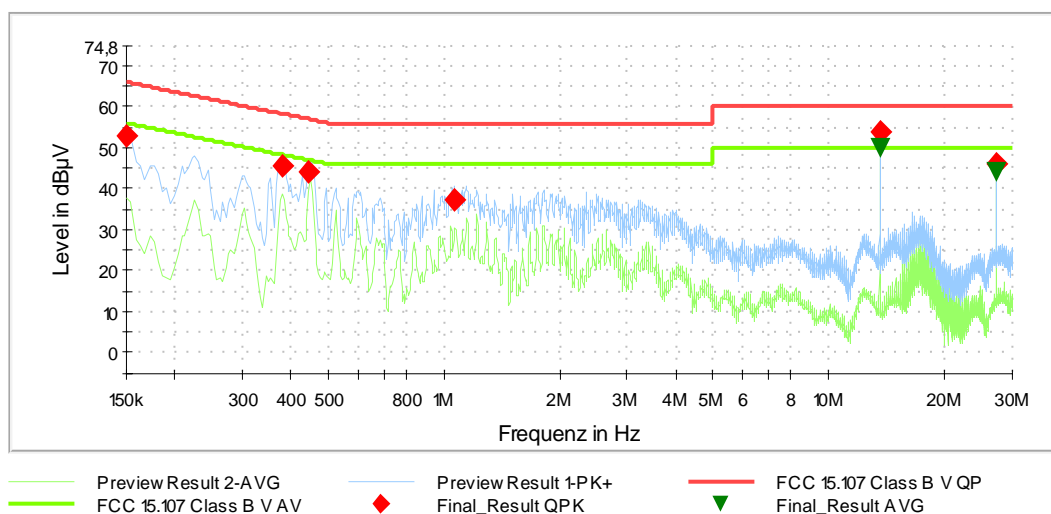


5.1.3 Test results (Conducted emissions on power supply lines)

5.1.3.1 Mode: WLAN, Ethernet and NFC active only

Test description:	Conducted emission measurement
EUT:	Einschub TT/MW Smart 210mm
Manufacturer:	Fronius International
Operating conditions:	WLAN and NFC active, Ethernet active power supply powered with 120 V AC / 60 Hz
Test site:	Shielded room M4
Operator:	B.ROHDE / M. BASTERT
Date of test	29.03.2018

The curves in the diagrams below only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by ◆ and the average ▼ measured points by ▼.



Results 150 kHz – 30 MHz									
Frequency [MHz]	QuasiPeak [dBμV]	Average [dBμV]	Limit [dBμV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	53.02	---	66.00	12.98	5000.0	9.000	N	GND	9.8
0.381300	45.34	---	58.25	12.91	5000.0	9.000	N	GND	9.9
0.445200	44.04	---	56.96	12.93	5000.0	9.000	N	GND	9.9
1.060800	37.37	---	56.00	18.63	5000.0	9.000	N	FLO	9.9
13.560000	---	49.92	50.00	0.08	5000.0	9.000	N	GND	10.8
13.560000	53.61	---	60.00	6.39	5000.0	9.000	N	FLO	10.8
27.119400	---	44.02	50.00	5.98	5000.0	9.000	N	GND	11.2
27.119400	46.19	---	60.00	13.81	5000.0	9.000	N	GND	11.2

Test: Passed

Test equipment (please refer to chapter 6 for details)
21 - 25

5.2 Radiated emissions

5.2.1 Test method

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out on an open area test site with reflecting ground plane and various antenna heights in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.
- A final measurement carried out in a fully anechoic chamber and various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.

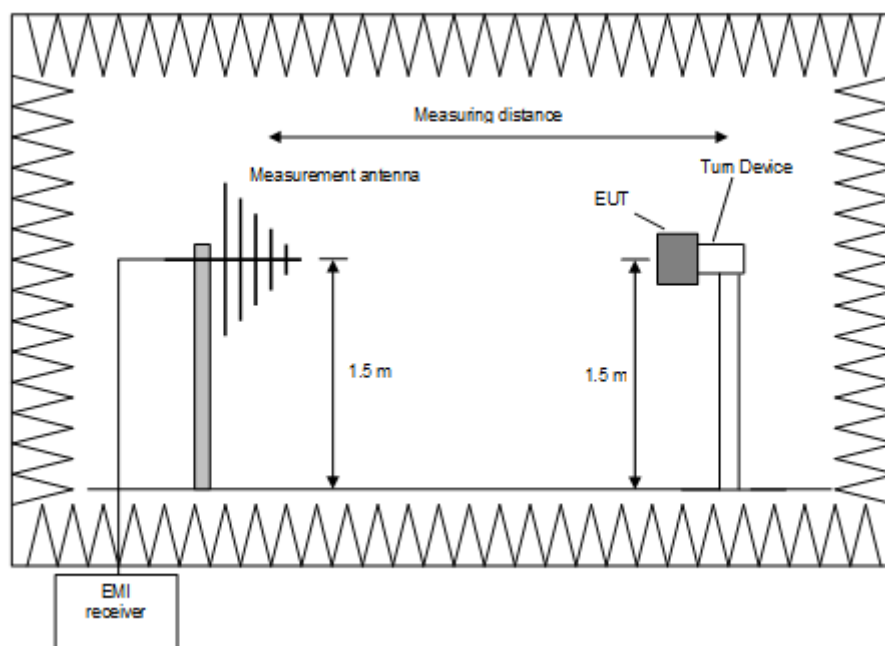
Preliminary measurement (30 MHz to 1 GHz)

This measurement will be performed in a fully anechoic chamber. Table top devices will be set up on a non-conducting turn device on the height of 1.5 m. The set-up of the Equipment under test will be in accordance to [1].

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyzer set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30 ° steps according to [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Pre-scans were performed in the frequency range 30 MHz to 1 GHz.

The following procedure will be used:

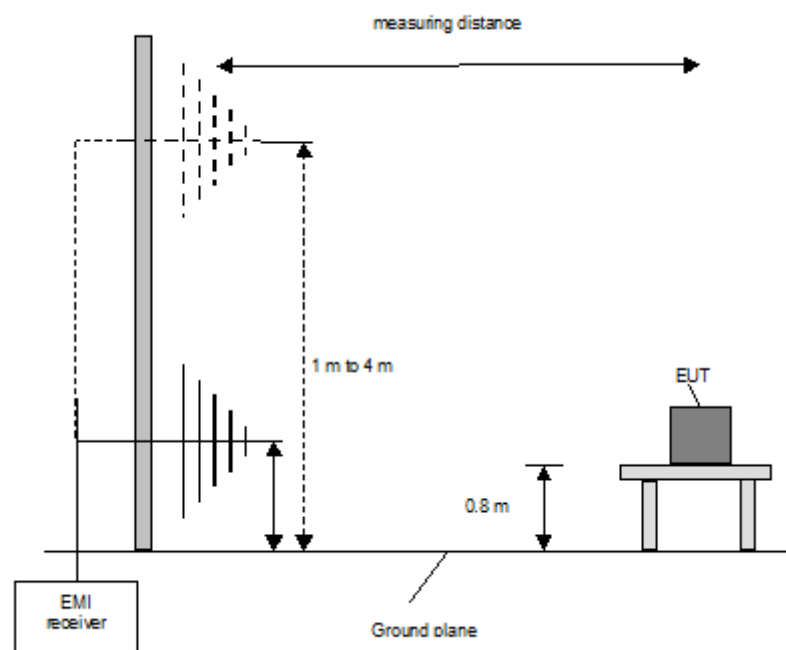
1. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0°.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarization, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0° to 360°, the measuring antenna will be set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
Repeat 1) to 3) for the other orthogonal antenna polarization.
Move the antenna and the turntable to the position where the maximum value is detected.
Measure while moving the antenna slowly +/- 1 m.
Set the antenna to the position where the maximum value is found.
Measure while moving the turntable +/- 45 °.
Set the turntable to the azimuth where the maximum value is found.
Measure with Final detector (QP and AV) and note the value.
Repeat 5) to 10) for each frequency.
Repeat 1) to 11) for each orthogonal axes of the EUT if handheld equipment.

Preliminary and final measurement (1 GHz to 40 GHz)

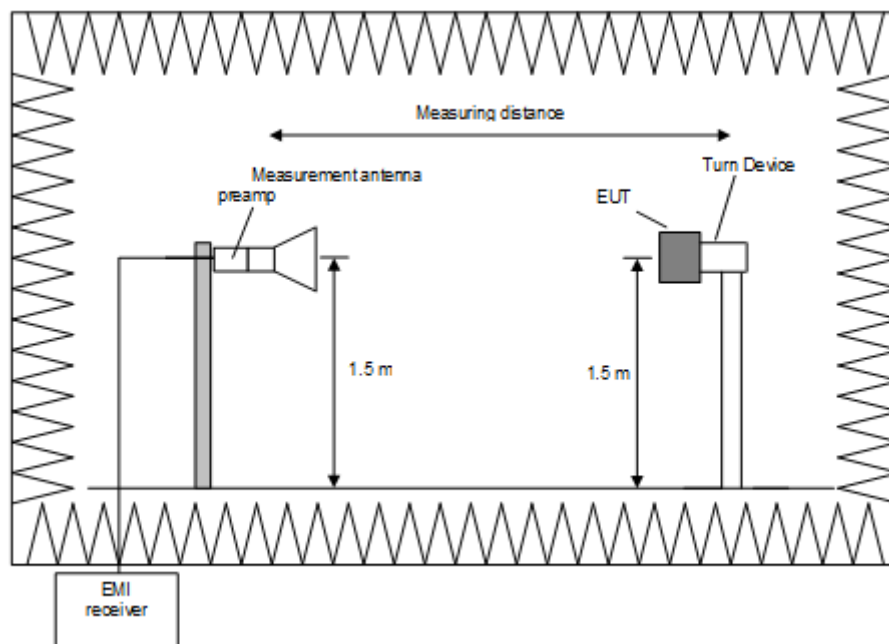
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5 m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyzer set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30 ° steps according to [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.

The following procedure will be used:

8. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
9. Rotate the EUT by 360° to maximize the detected signals.
10. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
11. Make a hardcopy of the spectrum.
12. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°)

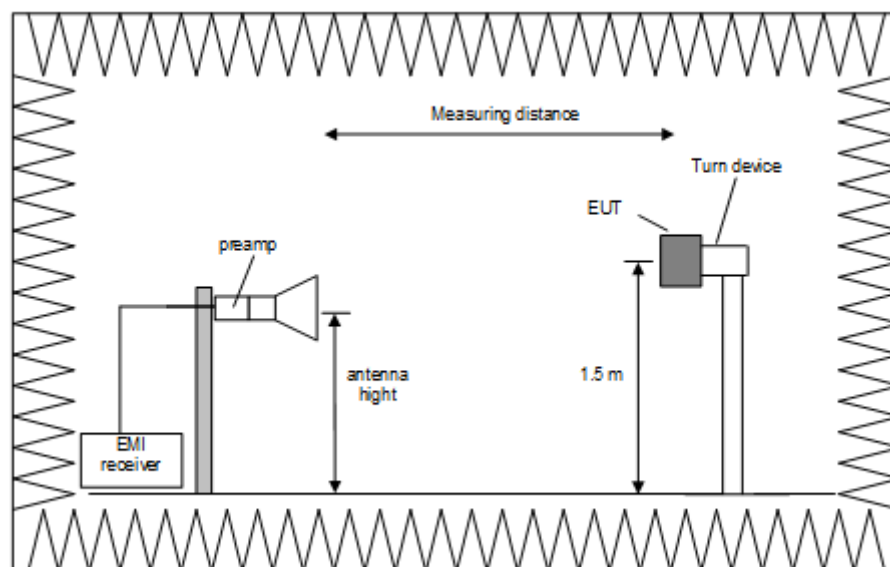
13. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
14. The measurement antenna polarization, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

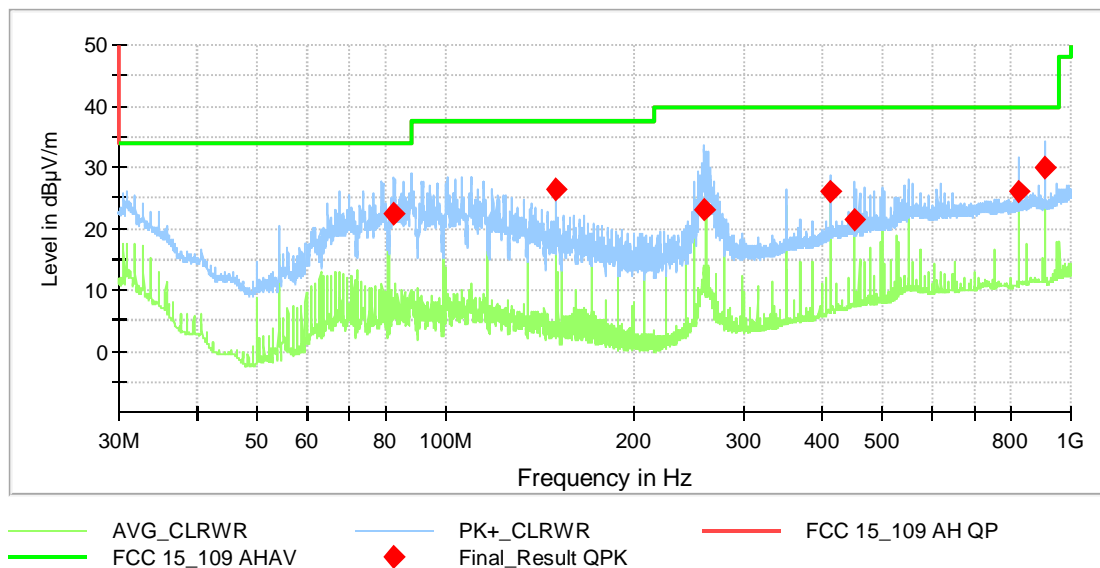
The measurements were performed in the frequency range 1 GHz to 40 GHz.

The following procedure will be used:

- 1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna polarization to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyzer to EMI mode with peak and average detector activated.
- 4) Rotate the turntable from 0° to 360° to find the EUT angle that produces the highest emissions.
- 5) Note the highest displayed peak and average values
- 6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.2.2 Results preliminary measurement 30 MHz to 1 GHz

Test description: Radiated emission measurement
 EUT: BLE and NFC active, Ethernet active
 power supply powered with 120 V AC / 60 Hz
 Manufacturer: Fronius International
 Operating conditions: BLE and NFC active, Ethernet active
 Test site: Phoenix TESTLAB GmbH, FAR M20
 Operator: B. ROHDE
 Comment: 24 V DC
 Date of test: 09.10.2017



The following frequencies were found during the preliminary radiated emission test:

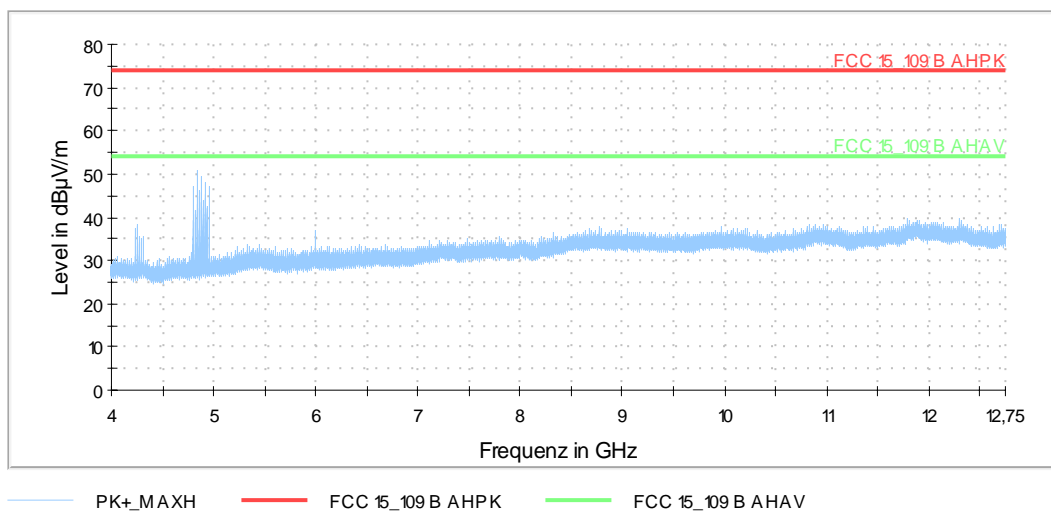
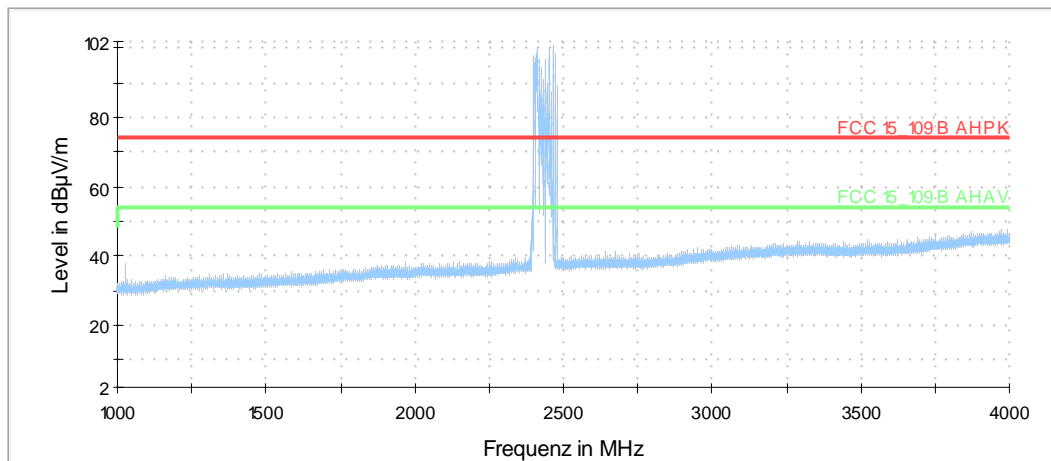
Frequency (MHz)
82.746000
150.000000
259.158000
411.444000
450.000000
822.870000
909.492000

These frequencies have to be measured with in a final measurement.

Test equipment (please refer to chapter 6 for details)
1 – 8; 10

5.2.3 Results preliminary measurement above 1 GHz

Test description:	Radiated emission measurement
EUT:	BLE and NFC active, Ethernet active power supply powered with 120 V AC / 60 Hz
Manufacturer:	Fronius International
Operating conditions:	BLE, NFC and ETH enabled
Test site:	FAR M20
Operator:	B. ROHDE
Comment:	24 V DC
Date of test	24.11.2017



The following frequencies were found during the preliminary radiated emission test:

Frequency (MHz)
4254.722222
4848.944444
5999.861111

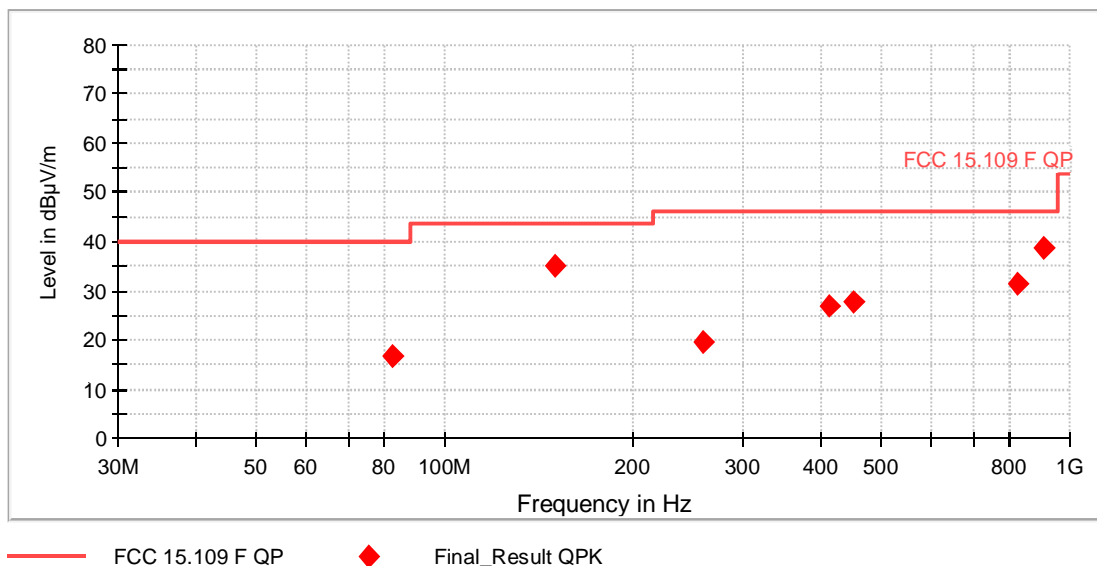
These frequencies have to be measured with in a final measurement.
The emissions @ 2.4 – 2.5 GHz is the wanted signal and is therefore not rated.

Test equipment (please refer to chapter 6 for details)
1 – 3; 5 – 6; 8 – 13

5.2.4 Result final measurement from 30 MHz to 1 GHz

Test description:	Radiated emission measurement
EUT:	BLE and NFC active, Ethernet active power supply powered with 120 V AC / 60 Hz
Manufacturer:	Fronius International
Operating conditions:	BLE and NFC active, Ethernet active
Test site:	Phoenix TESTLAB GmbH, OATS M6
Operator:	M. Bastert
Date of test	27.04.2018

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with "◆" are the measured results of the standard subsequent measurement on the open area test site.



The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

Results 30 MHz - 1 GHz									
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
82.746000	16.78	40.00	23.22	1000.0	120.000	353.0	V	0.0	16.2
150.000000	34.97	43.50	8.53	1000.0	120.000	235.0	V	90.0	19.1
259.158000	19.52	46.00	26.48	1000.0	120.000	228.0	H	22.0	21.6
411.444000	26.87	46.00	19.13	1000.0	120.000	103.0	V	110.0	25.1
450.000000	27.62	46.00	18.38	1000.0	120.000	226.0	V	115.0	25.4
822.870000	31.27	46.00	14.73	1000.0	120.000	102.0	V	7.0	29.9
909.492000	38.91	46.00	7.09	1000.0	120.000	109.0	H	13.0	30.4
Measurement uncertainty				+ / - 5.38					

Test: Passed

The correction factor was calculated as follows.

Corr. (dB) = cable attenuation (dB) + 6 dB attenuator (dB) + antenna factor (dB)

Therefore the reading can be calculated as follows:

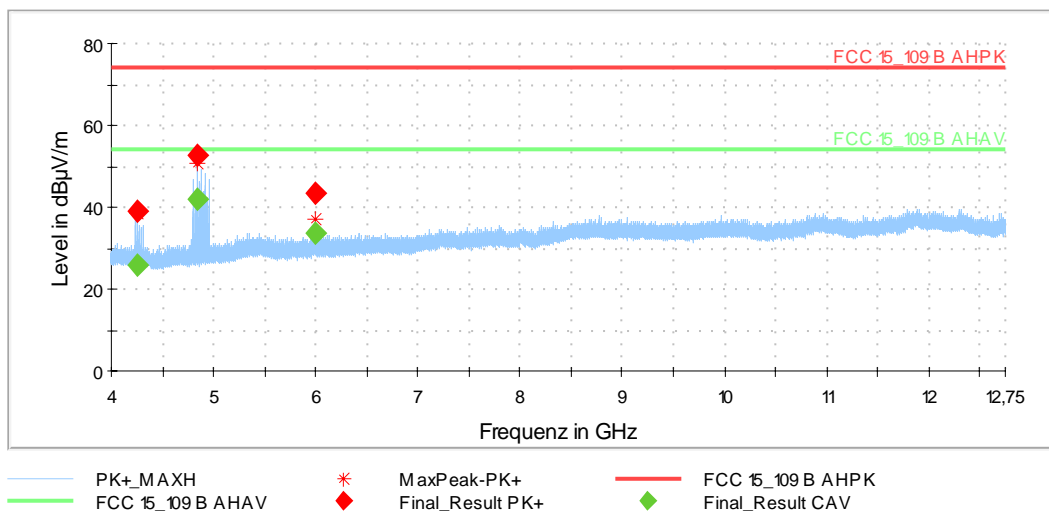
Reading (dBμV/m) = result QuasiPeak (dBμV/m) - Corr. (dB)

Test equipment (please refer to chapter 6 for details)
14 - 20

5.2.5 Result final measurement above 1 GHz

Test description:	Radiated emission measurement
EUT:	BLE and NFC active, Ethernet active
Manufacturer:	Fronius International
Operating conditions:	BLE, NFC and ETH enabled
Test site:	FAR M20
Operator:	B. ROHDE
Comment:	24 V DC
Date of test	24.11.2017

The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with the EUT in various positions. The top measured curve represents the peak measurement. The measured points marked with "♦" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◆" are frequency points for the final average detector measurement.



The results of the standard subsequent measurement above 1 GHz in an anechoic chamber are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m) PK/AV	Margin (dB)	Pol	Azimuth (deg)	Corr. (dB)
4254.722222	---	26.0	54	28.0	V	78	90
4254.722222	38.9	---	74	35.1	V	78	90
4848.944444	---	42.4	54	11.6	V	321	120
4848.944444	52.8	---	74	21.2	V	321	120
5999.861111	---	33.7	54	20.3	V	0	30
5999.861111	43.3	---	74	30.7	V	0	30

All other emissions were more than 20 dB below the limit

The correction factor was calculated as follows.

Corr. (dB) = cable attenuation (dB) + preamplifier (dB) + antenna factor (dB)

Therefore the reading can be calculated as follows:

Reading (dBμV/m) = result Peak or Average (dBμV/m) - Corr. (dB)

Test result: Passed

Test equipment (please refer to chapter 6 for details)

1 – 3; 5 – 6; 8 – 13

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
2	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
3	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
4	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
5	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
6	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
7	RF-cable No.36	Sucoflex 106B	Suhner	0587/6B / Kabel 36	480865	Calibration not necessary	
8	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
9	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
10	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	22.06.2017	06.2019
11	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
12	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
13	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
14	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
15	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
16	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
17	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
18	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
19	Antenna (Bilog)	CBL6111D	Schaffner Elektrottest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
20	Measuring receiver	ESR7	Rohde & Schwarz	101939	482558	19.09.2017	09.2019
21	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
22	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
23	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
24	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020
25	Power supply AC	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	

7 Report History

Report Number	Date	Comment
F170756E4	03.06.2019	Initial Test Report

8 List of Annexes

Annex A Test Setup Photos

4 pages