

Test Report

Report Number:

F192159E2

Equipment under Test (EUT):

TN-UHF-Q300-NA Series

Applicant:

Werner Turck GmbH & Co. KG

Manufacturer:

Hans Turck GmbH & Co. KG



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:	<u>Thomas KÜHN</u> Name	<u></u> Signature	<u>17.08.2020</u> Date
Reviewed and approved by:	<u>Manuel BASTERT</u> Name	<u></u> Signature	<u>17.08.2020</u> Date

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1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	-

1.2 Manufacturer

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Fax:	+49 2353 709-6174
eMail address:	dr.matthias.linde@turck.com
Manufacturer represented during the test by the following person:	-

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-17186-01-06 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISSED# 3469A.

1.4 EUT (Equipment under Test)

Test object: *	UHF-RFID read / write device
Modelname (PMN): *	TN-UHF-Q300-NA Series
HVIN: *	V2
FCC ID:*	YQ7-TN-UHF-Q300
IC: *	8821A-TNUHFQ300
Serial number: *	None
PCB identifier: *	07677104 A (digital board), 6140/6 (RF board), 6864/1A (antenna coupler) and 7082/0 (antenna director)
Software version / FVIN: *	V1.0.2.0
Lowest / highest internal frequency: *	750 kHz / 927.250 MHz

* declared by the applicant.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical data of equipment

Channel 0	RX:	902.750 MHz	TX:	902.750 MHz
Channel 24	RX:	914.750 MHz	TX:	914.750 MHz
Channel 49	RX:	927.250 MHz	TX:	927.250 MHz

Rated RF output power: *	30 dBm					
Antenna type: *	Integral or external					
Antenna gain: *	8.1 dBic or 5.1 dBi					
Antenna connector: *	Yes					
Adaptive frequency agility: *	No					
Modulation: *	FHSS (GFSK)					
Supply voltage: *	U _{nom} =	24.0 V DC	U _{min} =	18.0 V DC	U _{max} =	30.0 V DC
Temperature range: *	-25 °C to +50 °C					
Ancillary used for test:	Laptop PC type Siemens Fujitsu Lifebook (supplied by the laboratory)... PoE injector type DeLOCK 802.3at (supplied by the applicant), AC/DC adaptors type PHOENIX CONTACT UNO-PS/1AC/48DC/60W and PHOENIX CONTACT MINI-PS-100-240AC/24/DC/1.3 (both supplied by the laboratory)					

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length *
	EUT	Ancillary	
DC power	5 pole M12 plug	-	3 m
Ethernet	4 pole M12 plug	RJ45	3 m
External antenna 1	RP-TNC male	Left open	-
External antenna 2	RP-TNC male	Left open	-
External antenna 3	RP-TNC male	Left open	-
External antenna 4	RP-TNC male	Left open	-
DXP0	4 pole M12 plug	Left open	-
DXP1	4 pole M12 plug	Left open	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	10.07.2020
Start of test:	13.08.2020
End of test:	14.08.2020

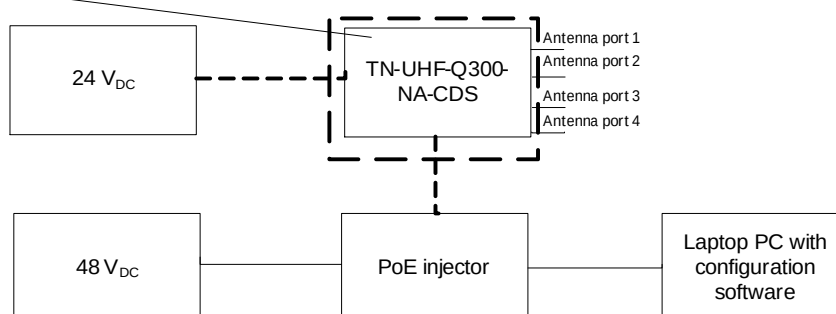
2 Operational States

The tested sample was unmodified and could be configured via the Ethernet line with the help of a laptop PC with configuration software (UHF TOOLBOX, supplied by the applicant).

All radiated measurements were carried out with a connection to an external 24 V_{DC} power supply.

During all measurements every 500 ms the status of the EUT was requested by the configuration software, the rf part of the EUT was not active. Every received status report from the EUT increased a counter of the configuration software.

Physical boundaries of the Equipment Under Test



3 Additional Information

All tests were carried out with a TN-UHF-Q300-NA-CDS.

During the tests the EUT was not labelled.

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	79 dBμV (QP) 66 dBμV (AV)	ANSI C63.4	Class A	-
	0.5 to 30 MHz	73 dBμV (QP) 60 dBμV (AV)			
AC supply line	0.15 to 0.5 MHz	66 to 56 dBμV (QP)* 56 to 46 dBμV (AV)*	ANSI C63.4	Class B	Passed
	0.5 to 5 MHz	56 dBμV (QP) 46 dBμV (AV)			
	5 to 30 MHz	60 dBμV (QP) 50 dBμV (AV)			
*: 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	39.0 dBμV /m QP at 10 m 43.5 dBμV /m QP at 10 m 46.5 dBμV /m QP at 10 m 49.5 dBμV /m QP at 10 m	ANSI C63.4	Class A	-
	above 1000 MHz	49.5 dBμV /m AV at 10 m and 69.5 dBμV /m PK at 10 m			
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz	40.0 dBμV/m QP at 3 m 43.5 dBμV/m QP at 3 m 46.0 dBμV/m QP at 3 m 54.0 dBμV/m QP at 3 m	ANSI C63.4	Class B	Passed
	above 1000 MHz	54.0 dBμV/m AV at 3 m and 74.0 dBμV/m PK at 3 m			

Remark: As declared by the applicant the highest internal frequency is 927.250 MHz (Transmitter operates on the highest channel). Therefore, the radiated emission measurement must be carried out up to 5th of the highest internal frequency in this case 5 GHz.

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

5 Results

5.1 Conducted emissions on power supply lines

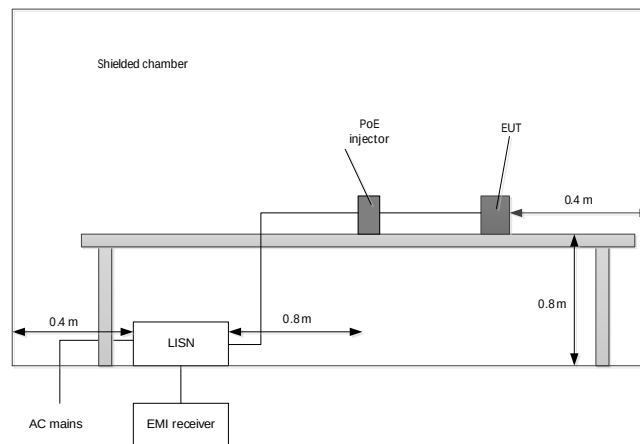
5.1.1 Test method

This test will be carried out in a shielded chamber. Tabletop 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].

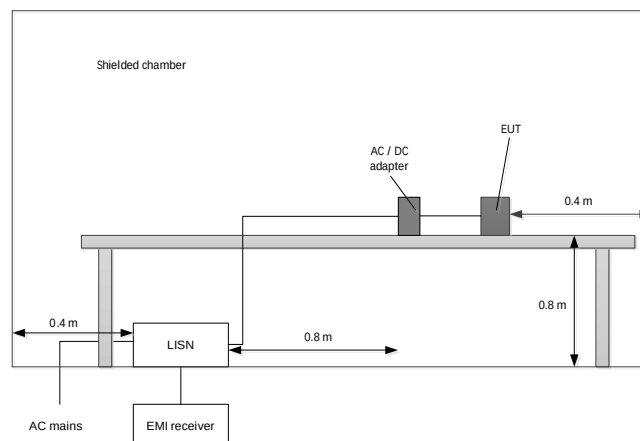
The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below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

Test setup for measurement with the EUT supplied via PoE:



Test setup for measurement with the EUT supplied with DC:

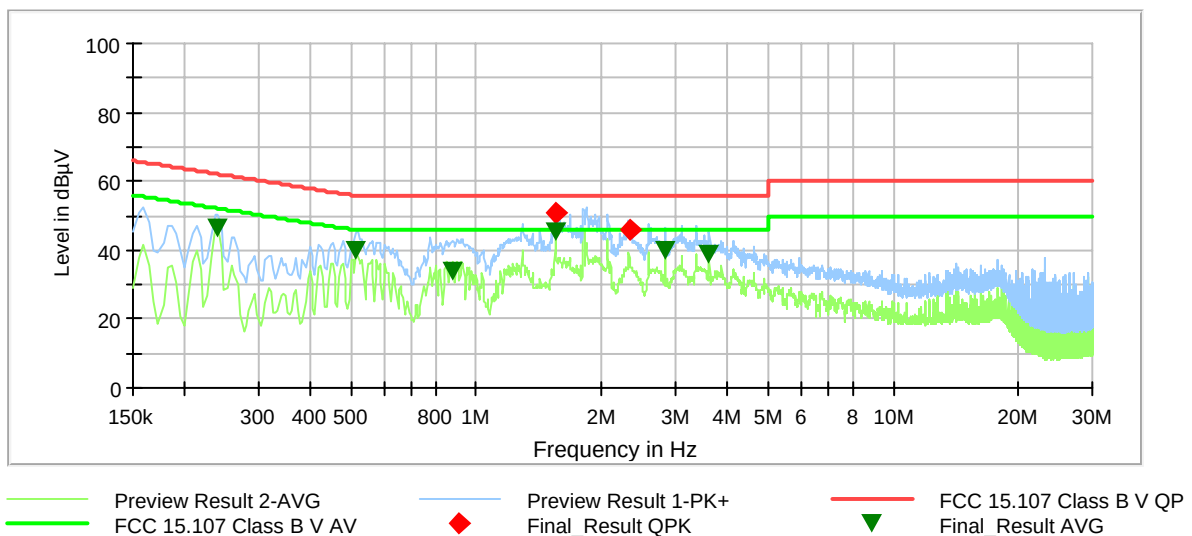


5.1.2 Results conducted emission measurement on AC mains (EUT supplied via PoE)

Ambient temperature	22 °C	Relative humidity	73 %
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Test description: Conducted emission measurement
 EUT: TN-UHF-Q300-NA-CDS
 Manufacturer: Werner Turck GmbH & Co. KG
 Operating conditions: Continuous communication
 Test site: Phoenix TESTLAB GmbH, shielded room M4
 Operator: Th. KÜHN
 Comment: Supplied via PoE injector DeLOCK 802.3at and UNO-PS/1AC/48DC/60W
 Date of test: 14.08.2020

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 ▼.



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.239100	---	46.6	52.1	5.5	5000	9	L1	GND	9.9
0.516300	---	39.7	46.0	6.3	5000	9	L1	FLO	9.9
0.876300	---	33.7	46.0	12.3	5000	9	L1	GND	9.9
1.549500	---	45.1	46.0	0.9	5000	9	L1	FLO	9.9
1.549500	50.9	---	56.0	5.1	5000	9	L1	GND	9.9
2.325300	45.9	---	56.0	10.1	5000	9	L1	FLO	10.2
2.841900	---	39.8	46.0	6.2	5000	9	L1	GND	10.2
3.617700	---	38.9	46.0	7.1	5000	9	L1	GND	10.3
Measurement uncertainty				±2.8 dB					

Test result Passed

Test equipment used (refer clause 6):

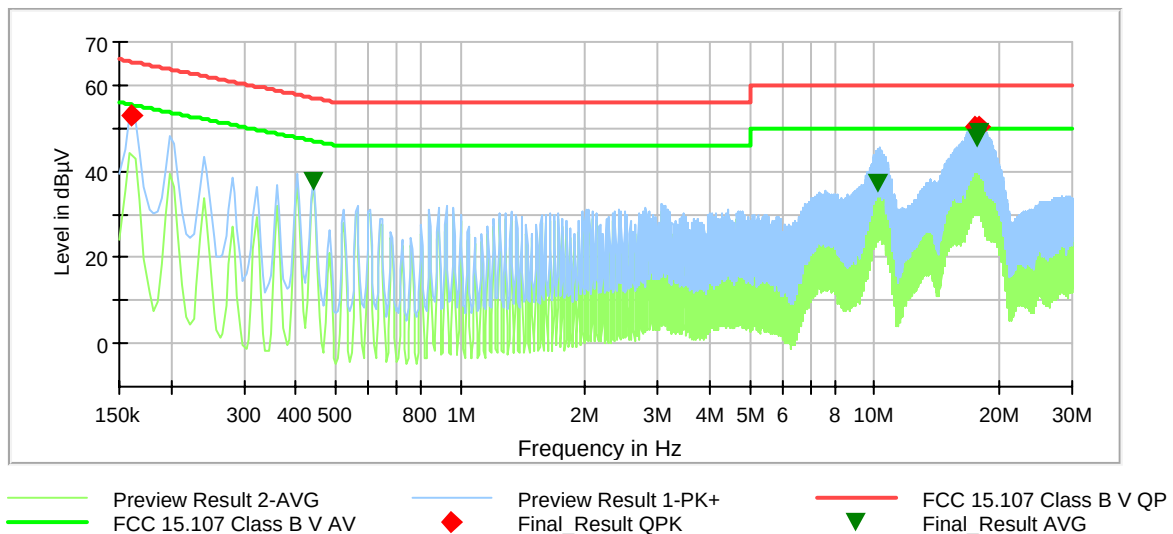
1 – 6, 18

5.1.3 Results conducted emission measurement on AC mains (EUT supplied via DC)

Ambient temperature	22 °C	Relative humidity	73 %
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Test description: Conducted emission measurement
 EUT: TN-UHF-Q300-NA-CDS
 Manufacturer: Werner Turck GmbH & Co. KG
 Operating conditions: Continuous communication
 Test site: Phoenix TESTLAB GmbH, shielded room M4
 Operator: Th. KÜHN
 Comment: Powered via MINI-PS-100-240AC/24/DC/1.3
 Date of test: 14.08.2020

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 ▼.



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.160800	53.1	---	65.4	12.3	5000	9	L1	FLO	9.8
0.442500	---	37.5	47.0	9.5	5000	9	N	FLO	9.9
10.244400	---	37.3	50.0	12.7	5000	9	N	GND	10.6
17.477700	50.3	---	60.0	9.7	5000	9	N	FLO	10.9
17.600100	---	47.8	50.0	2.2	5000	9	L1	FLO	10.9
17.923200	---	48.8	50.0	1.2	5000	9	N	GND	10.9
17.959200	50.5	---	60.0	9.5	5000	9	N	FLO	10.9
Measurement uncertainty				±2.8 dB					

Test result Passed

Test equipment used (refer clause 6):

1 – 6, 18

5.2 Radiated emissions

5.2.1 Test method

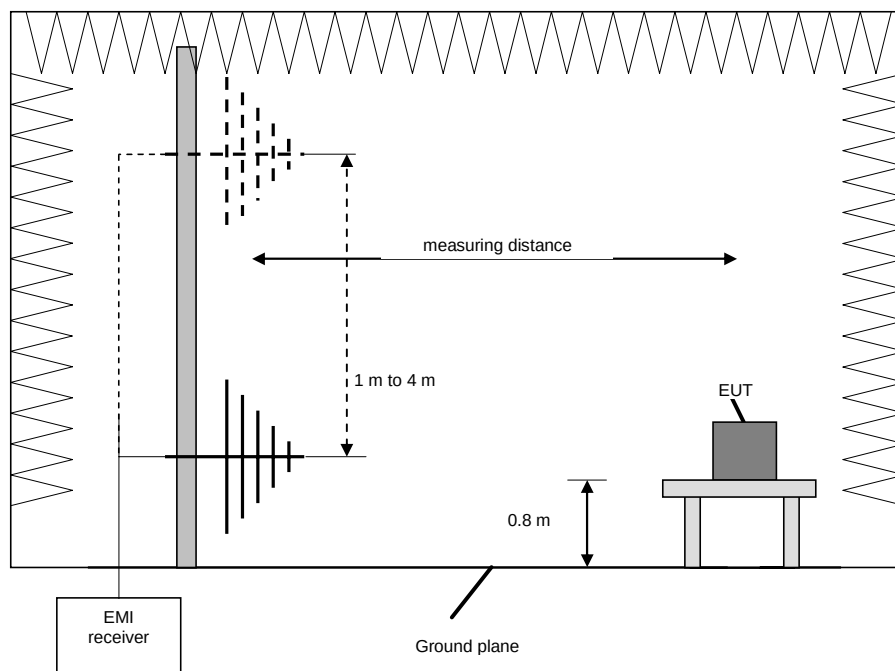
Preliminary and final measurement (30 MHz to 1 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with a metal ground plane in a 3 m distance.

During the 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:

Test	Frequency range	Resolution bandwidth
Preliminary measurement	30 MHz to 1 GHz	100 kHz
Frequency peak search	± 1 MHz	10 kHz
Final measurement	30 MHz to 1 GHz	120 kHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with ± 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT position (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by ± 0.5 m from the value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by $\pm 30^\circ$ from the value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst-case antenna height and the worst-case turntable azimuth
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

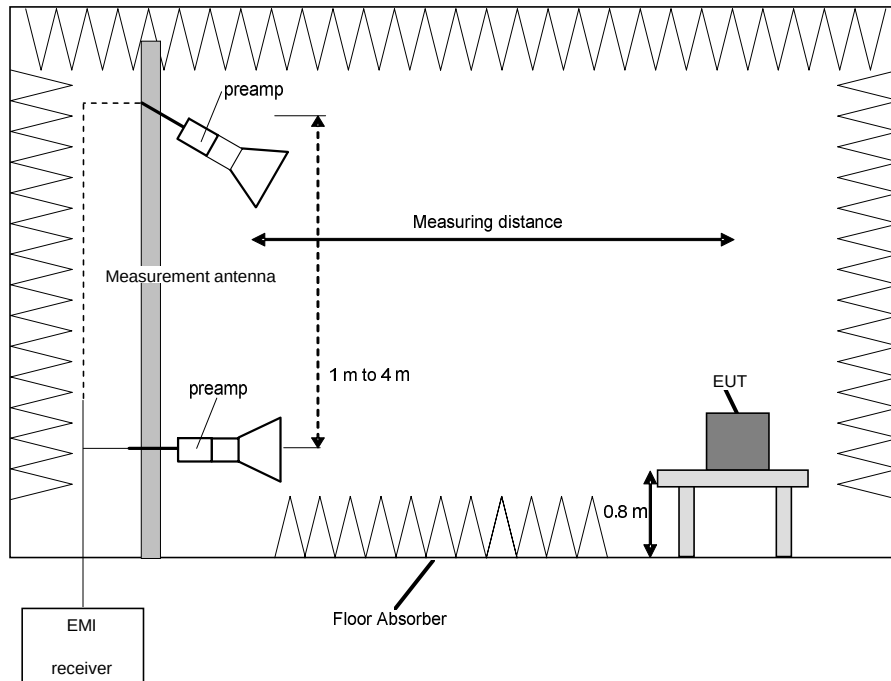
Preliminary and final measurement (1 – 40 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with floor absorbers between EUT and measurement antenna in a 3 m distance.

During the 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. For each height the angle of the antenna will be tilted so that the measurement antenna is always aiming at the EUT.

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

Test	Frequency range	Resolution bandwidth
Preliminary measurement	1 - 40 GHz	1 MHz
Frequency peak search	± 10 MHz	100 kHz
Final measurement	1 - 40 GHz	1 MHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for the highest value.

Procedure final measurement:

The following procedure is used:

1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with ± 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT orientation (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by ± 0.5 m from the worst-case value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by $\pm 30^\circ$ from the worst-case value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst-case antenna height and the worst-case turntable azimuth.
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

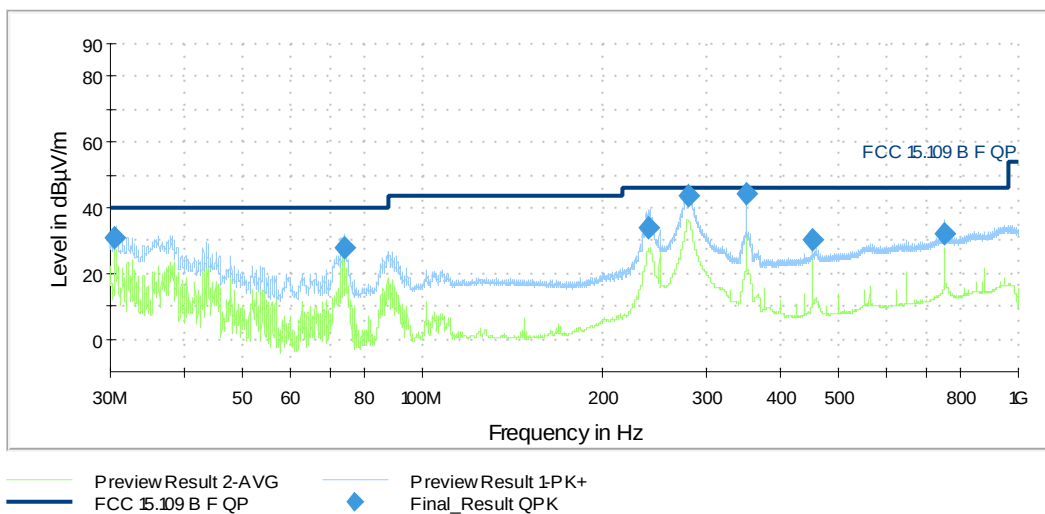
5.2.2 Result final measurement from 30 MHz to 1 GHz

Ambient temperature	23 °C	Relative humidity	63 %
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Test description: Radiated emission measurement
 EUT: TN-UHF-Q300-NA-CDS
 Manufacturer: Werner Turck GmbH & Co. KG
 Operating conditions: Continuous communication
 Test site: Phoenix TESTLAB GmbH, semi anechoic chamber M276
 Operator: Th. KÜHN
 Date of test: 13.08.2020

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 in a semi anechoic chamber.

The results of the standard subsequent measurement in a semi 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)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
51.600	20.1	40.0	19.9	1000	120	130	Vert.	-4	15.7
70.050	18.6	40.0	21.4	1000	120	195	Vert.	168	13.4
353.900	25.2	46.0	20.8	1000	120	300	Vert.	194	22.4
398.150	29.6	46.0	16.4	1000	120	133	Vert.	201	23.9
500.000	27.0	46.0	19.0	1000	120	156	Hor.	249	26.1
589.825	29.6	46.0	16.4	1000	120	125	Vert.	169	28.0
Measurement uncertainty					±4.8 dB				

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 used (refer clause 6):

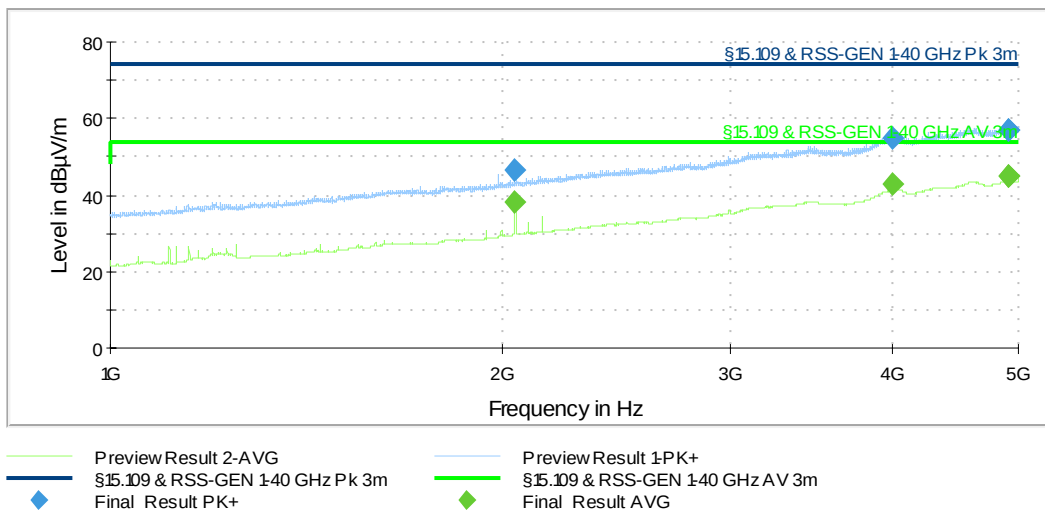
7 – 15

5.2.3 Result final measurement above 1 GHz

Ambient temperature	23 °C	Relative humidity	63 %
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Test description: Radiated emission measurement
 EUT: TN-UHF-Q300-NA-CDS
 Manufacturer: Werner Turck GmbH & Co. KG
 Operating conditions: Continuous communication
 Test site: Phoenix TESTLAB GmbH, semi anechoic chamber M276
 Operator: Th. KÜHN
 Date of test: 13.08.2020

The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna 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 a semi 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)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)
2050.000	46.4	---	74.0	27.6	100	1000	165	Hor.	54	32.5
	---	37.9	54.0	16.1	100	1000	165	Hor.	54	32.5
3995.150	---	42.7	54.0	11.3	100	1000	119	Hor.	205	40.3
	55.2	---	74.0	18.8	100	1000	119	Hor.	205	40.3
4904.900	57.2	---	74.0	16.8	100	1000	364	Vert.	137	43.0
	---	45.0	54.0	9.0	100	1000	364	Vert.	137	43.0
4906.150	---	45.0	54.0	9.0	100	1000	117	Hor.	263	43.0
	57.0	---	74.0	17.0	100	1000	117	Hor.	263	43.0
Measurement uncertainty						±5.1 dB				

Test result: Passed

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 equipment used (refer clause 6):

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6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	AC supply	AC6803A	Keysight	JPVJ002509	482350	Calibration not necessary	
2	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
3	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
4	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	12.02.2020	02.2022
5	Transient Filter Limiter	CFL 9206A	Teseq	38268	481982	12.02.2020	02.2022
6	LISN	NSLK8128	Schwarzbeck	8128161	480138	11.02.2020	02.2022
7	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
8	Antenna (Bilog)	CBL6111D	Schaffner	25761	480894	19.10.2017	10.2020
9	Systemsoftware	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
10	RF Switch Matrix	OSP220	Rohde & Schwarz	-	482976	Calibration not necessary	
11	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
12	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
13	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
14	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
15	EMI Test receiver	ESW44	Rohde & Schwarz	101828	482979	14.11.2019	11.2021
16	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	18.02.2020	02.2022
17	Log Per Antenna	HL050	Rohde & Schwarz	4062.4063.02-100908	482977	13.08.2019	08.2022
18	Coupling / Decoupling network	CDN S10 A	PHOENIX TESTLAB	-	410199	Calibration not necessary	

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4a-2017	19.09.2019	18.09.2021
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.10.2019	30.09.2021
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	06.11.2018	05.11.2020

8 Report History

Report Number	Date	Comment
F192159E2	17.08.2020	Initial Test Report
-	-	-
-	-	-

9 List of Annexes

Annex A Test Setup Photos

5 pages