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Test Report

Report Number:

F192159E1

Equipment under Test (EUT):

TN-UHF-Q300-NA Series
TN-UHF-Q180L300-NA Series

Applicant:

Werner Turck GmbH & Co. KG

Manufacturer:

Hans Turck GmbH & Co. KG

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] **ANSI C63.10: 2013** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

[2] **FCC CFR 47 Part 15** Radio Frequency Devices

[3] **RSS-247 Issue 2 (February 2017)** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[4] **RSS-Gen Issue 5 (March 2019) Amendment 1** General Requirements for Compliance of Radio Apparatus

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.

Test engineer:	Thomas KÜHN		06.11.2020
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		06.11.2020
	Name	Signature	Date

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

This test report is valid in hardcopy form as well as in electronic form.

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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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Manufacturer represented during the test by the following person:	-

1.3 Test laboratory

The tests were carried out at:

PHOENIX TESTLAB GmbH
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Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment Under Test)

Test object: *	UHF-RFID read / write device
Modelname (PMN): *	TN-UHF-Q300-NA Series, TN-,UHF-Q180L300-NA Series
HVIN: *	V2
FCC ID: *	YQ7-TN-UHF-Q300
IC: *	8821A-TNUHFQ300
Serial number: *	None
PCB identifier: * TN-UHF-Q300-NA-CDS	07677104 A (digital board), 6140/6 (RF board), 6864/1A (antenna coupler) and 7082/0 (antenna director),)
PCB identifier: * UHF-Q180L300-NA-CDS	07677104 A (digital board), 6140/6 (RF board), 7711/0 B (shield, TN-UHF-Q180L300-NA-CDS only)
Software version / FVIN: *	V1.0.2.0
Lowest internal frequency: *	750 kHz

* declared by the applicant.

Note: PHOENIX TESTLAB GmbH does not take samples. The sample used for tests is 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 (TN-UHF-Q300-NA-CDS), external (TN-UHF-Q180L300-NA-CDS)					
Antenna gain: *	8.1 dBic or 5.1 dBi					
Antenna connector: *	Reverse TNC					
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 / adapted to N	-
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 (TN-UHF-Q300-NA-CDS) and 05.10.2020 (TN-UHF-Q180L300-NA-CDS)
Start of test:	06.08.2020 (TN-UHF-Q300-NA-CDS) and 04.11.2020 (TN-UHF-Q180L300-NA-CDS)
End of test:	13.08.2020 (TN-UHF-Q300-NA-CDS) and 05.11.2020 (TN-UHF-Q180L300-NA-CDS)

2 Operational states

As declared by the applicant, the TN-UHF-Q300-NA Series is available in two variants: TN-UHF-Q300-NA-CDS and TN-UHF-Q180L300-NA-CDS. Because the TN-UHF-Q180L300-NA-CDS has no internal antenna, its housing is smaller. Full tests were carried out with the TN-UHF-Q300-NA-CDS, limited tests with the TN-UHF-Q180L300-NA-CDS. For details refer the table below. As operation channel for the limited tests of the TN-UHF-Q180L300-NA-CDS the channel was used, were the lowest margin to the limit of the similar measurement of the TN-UHF-Q300-NA-CDS was found.

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

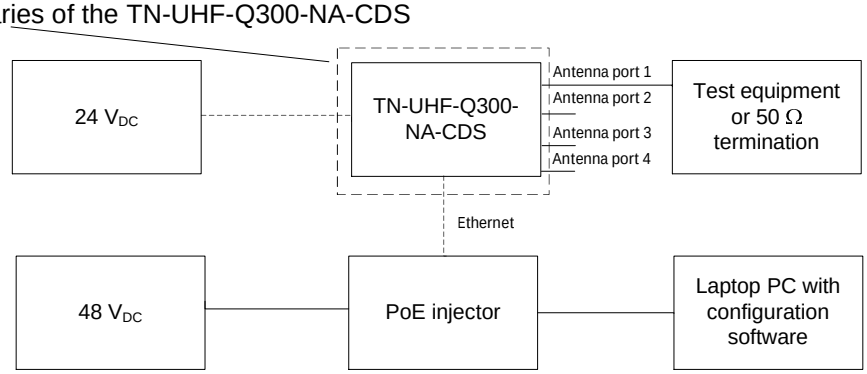
All radiated measurements were carried out with a connection to an external 24 V_{DC} power supply.

The TN-UHF-Q300-NA-CDS uses either the internal antenna or one of the external antenna ports; The TN-UHF-Q180L300-NA-CDS uses one of the external antenna ports. No simultaneous transmission on more than one RF output port of the EUTs RF circuit is possible. The used antenna port was selected with the help of the configuration software.

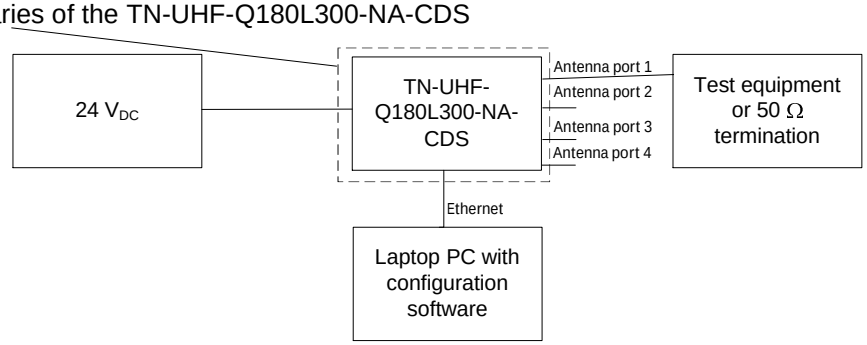
Conducted measurements were carried out at the external antenna port, which causes the highest RF output level (port 1); this port number was investigated during a preliminary measurement with both samples. With the TN-UHF-Q300-NA-CDS, the spurious emission measurements were carried out with the EUT configured operating either with its internal antenna or radiated with the external antenna port used for conducted emissions but terminated with 50 Ω. For the TN-UHF-Q180L300-NA-CDS the spurious emission measurement was carried out with the external antenna port terminated with 50 Ω.

For all measurements the output power of the EUTs was set to 30 dBm with the configuration software.

Physical boundaries of the TN-UHF-Q300-NA-CDS



Physical boundaries of the TN-UHF-Q180L300-NA-CDS



The following test modes were used during the tests:

Operation	Test items	EUT	Operation channel	Operation mode
Transmit with normal modulation on fixed channel	20 dB bandwidth	TN-UHF-Q300-NA-CDS	0, 24 or 49	1, 2, 3
	Carrier frequency separation	TN-UHF-Q300-NA-CDS	0, 24 or 49	1, 2, 3
	Dwell time	TN-UHF-Q300-NA-CDS	0, 24 or 49	1, 2, 3
	Maximum peak output power	TN-UHF-Q300-NA-CDS	0, 24 or 49	1, 2, 3
		TN-UHF-Q180L300-NA-CDS	0, 24 or 49	3
	Radiated emissions (transmitter)	TN-UHF-Q300-NA-CDS	0, 24 or 49	1, 2, 3
		TN-UHF-Q180L300-NA-CDS	49	3
Transmit with normal modulation, hopping on all channels	Number of hopping channels	TN-UHF-Q300-NA-CDS	0 to 49	4
	Conducted emissions on supply line	TN-UHF-Q300-NA-CDS	0 to 49	4

3 Additional information

During the tests the TN-UHF-Q300-NA-CDS was not labelled.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 247 [3] or RSS-Gen [4]	Status	Refer page
20 dB bandwidth	General	15.247 (a) (1) (i)	5.1 (a) [3]	Passed	9 et seq.
99 % bandwidth	General	-	6.7 [4]	Passed	9 et seq.
Carrier frequency separation	General	15.247 (a) (1) (i)	5.1 (c) [3]	Passed	10 et seq.
Number of hopping channels	902.0 – 928.0	15.247 (a) (1) (i)	5.1 (c) [3]	Passed	13 et seq.
Dwell time	902.0 – 928.0	15.247 (a) (1) (i)	5.1 (c) [3]	Passed	15 et seq.
Maximum peak output power	902.0 – 928.0	15.247 (b) (2)	5.4 (a) [3]	Passed	17 et seq.
Radiated emissions (transmitter)	0.150 - 10,000	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4]	Passed	18 et seq.
Conducted emissons at antennaport	0.150 - 10,000	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4]	Passed	39 et seq
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	44 et seq.
Antenna requirement	-	15.203 [2]	6.8 [4]	Passed *	-

*: The TN-UHF-Q300-NA-CDS has an internal antenna and reverse TNC antenna connectors, the TN-UHF-Q180L300-NA-CDS has reverse TNC antenna connectors. As declared by the applicant both devices are intended for professional installation. Furthermore, the antenna specifications for the external antenna are defined in the user manual, so the requirement is regarded as fulfilled.

5 Test results

5.1 Bandwidth

5.1.1 Method of measurement (bandwidth)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be disenabled, the transmitter shall work with its maximum data rate.

The following spectrum analyser settings according to [1] shall be used:

- Span: App. 2 to 5 times the 20 dB bandwidth, centred on the actual hopping channel.
- Resolution bandwidth: 1 % to 5 % of the 20 dB bandwidth.
- Video bandwidth: three times the resolution bandwidth.
- Set the reference level of the instrument either above the measured peak conducted output power level or as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

20 dB bandwidth: After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve. Alternatively, the 20 dB down function of the spectrum analyser could be used.

99% bandwidth: Use the 99% power bandwidth function of the instrument

The measurement will be performed at the upper, the lower end and the middle of the assigned frequency band.

Test set-up:

5.1.2 Test results (20 dB bandwidth)

Ambient temperature	20 °C	Relative humidity	26 %

Measured conducted at antenna port 1 of TN-UHF-Q300-NA-CDS, hopping disabled.

Remark: The plots of this measurements are presented in annex A of this test report.

Channel number	Channel frequency [MHz]	20 dB bandwidth [kHz]
0	902.750	43.760
24	914.750	43.770
49	927.250	43.830
Measurement uncertainty		+0.66 dB / -0.72 dB

Test equipment used (see chapter 6):

19, 33, 34

5.1.3 Test results (99 % bandwidth)

Ambient temperature	20 °C	Relative humidity	26 %

Measured conducted at antenna port 1 of TN-UHF-Q300-NA-CDS, hopping disabled.

Remark: The plots of this measurements are presented in annex A of this test report.

Channel number	Channel frequency [MHz]	99 % bandwidth [kHz]
0	902.750	49.790
24	914.750	49.437
49	927.250	49.834
Measurement uncertainty		+0.66 dB / -0.72 dB

Test equipment used (see chapter 6):

19, 33, 34

5.2 Carrier frequency separation

5.2.1 Method of measurement (carrier frequency separation)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be enabled.

The following spectrum analyser settings according to [1] shall be used:

- Span: Wide enough to capture the peaks of two adjacent channels.
- Resolution bandwidth: Start with the Resolution bandwidth set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- Video bandwidth ≥ Resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the marker and the delta marker function will be used to determine the separation between the peaks of two adjacent channel signals.

The measurement will be performed at the upper, the lower end and the middle of the assigned frequency band.

Test set-up:

5.2.2 Test results (carrier frequency separation)

Ambient temperature	20 °C	Relative humidity	26 %

Measured conducted at antenna port 1 of TN-UHF-Q300-NA-CDS.

Remark: The plots of this measurements are presented in annex A of this test report.

Channel number	Channel frequency [MHz]	Channel separation [kHz]	Minimum limit [kHz]
0	902.750	500.500	43.760
24	914.750	500.500	43.770
49	927.250	500.500	43.830
Measurement uncertainty			$<10^{-7}$

Test: Passed

Test equipment used (see chapter 6):

19, 33, 34

5.3 Number of hopping frequencies

5.3.1 Method of measurement (number of hopping frequencies)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be enabled.

The following spectrum analyser settings according to [1] shall be used:

- Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- Resolution bandwidth: To identify clearly the individual channels, set the Resolution bandwidth to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the number of hopping channels could be counted. It might be possible to divide the span into some sub ranges in order to clearly show all hopping frequencies.

Test set-up:

5.3.2 Test results (number of hopping frequencies)

Ambient temperature	20 °C	Relative humidity	26 %

Measured conducted at antenna port 1 of TN-UHF-Q300-NA-CDS.

Remark: The plot of this measurement is presented in annex A of this test report.

Number of hopping channels	Limit
50	At least 50

Test: Passed

Test equipment used (see chapter 6):

19, 33, 34

5.4 Dwell time

5.4.1 Method of measurement (dwell time)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be enabled.

The following spectrum analyser settings according to [1] shall be used:

- Span: Zero, centred on a hopping channel.
- Resolution bandwidth shall be ≤ channel spacing and where possible Resolution bandwidth should be set >> 1 / *T*, where *T* is the expected dwell time per channel.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- Detector function: peak.
- Trace mode: Max hold.

The marker and delta marker function of the spectrum analyser will be used to determine the dwell time.

The measurement will be performed at the middle of the assigned frequency band.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

Test set-up:

5.4.2 Test results (dwell time)

Ambient temperature	20 °C		Relative humidity	26 %

Measured conducted at antenna port 1 of TN-UHF-Q300-NA-CDS.

Remark: The plots of this measurements are presented in annex A of this test report.

Channel number	Channel frequency [MHz]	t_{pulse} [ms]	Number of pulses	Dwell time [ms]	Limit [ms]
24	914.750	391.097	1	391.097	400.000
Measurement uncertainty				$<10^{-7}$	

Test: Passed

Test equipment used (see chapter 6):

19, 33, 34

5.5 Maximum peak output power

5.5.1 Method of measurement (maximum peak output power)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be disenabled.

The following spectrum analyser settings according to [1] shall be used:

- Span: Approx. 5 times the 20 dB bandwidth, centred on a hopping channel.
- Resolution bandwidth: > the 20 dB bandwidth of the emission being measured.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The indicated level is the peak output power, which has to be corrected with the value of the cable loss and an external attenuation (if necessary).

The measurement will be performed at the upper and lower end and the middle of the assigned frequency band.

Test set-up:

5.5.2 Test results (maximum peak output power of TN-UHF-Q300-NA-CDS)

Ambient temperature	20 °C	Relative humidity	26 %

Measured conducted at antenna port 1

Remark: The plots of this measurements are presented in annex A of this test report.

Operation mode	Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
1	0	902.750	29.2	5.1	30.0
2	24	914.750	29.2	5.1	30.0
3	49	927.205	29.8	5.1	30.0
Measurement uncertainty				+0.66 dB / -0.72 dB	

Test: Passed

Test equipment used (see chapter 6):

19, 33, 34

5.5.3 Test results (maximum peak output power of TN-UHF-Q180L300-NA-CDS)

Ambient temperature	22 °C	Relative humidity	31 %

Measured conducted at antenna port 1

Remark: The plots of this measurements are presented in annex A of this test report.

Operation mode	Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
1	0	902.750	29.4	5.1	30.0
2	24	914.750	29.4	5.1	30.0
3	49	927.205	29.2	5.1	30.0
Measurement uncertainty				+0.66 dB / -0.72 dB	

Test: Passed

Test equipment used (see chapter 6):

20, 33, 34

5.6 Radiated emissions

5.6.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into different stages.

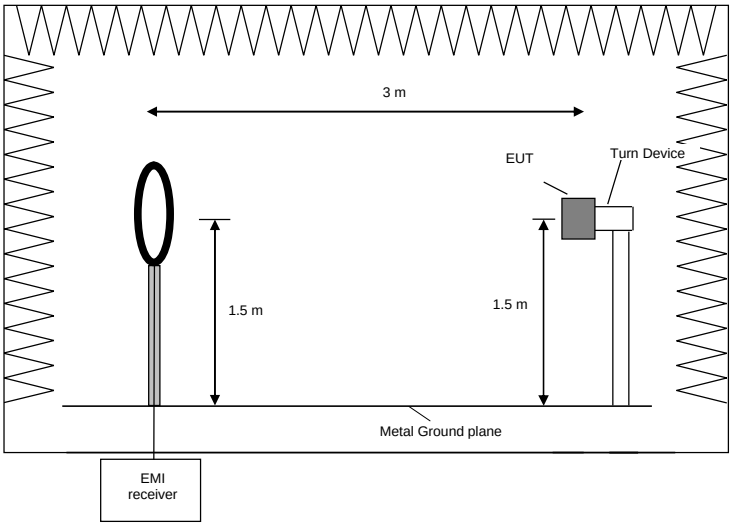
- A preliminary measurement carried out inside a semi anechoic chamber with reflecting ground plane with a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A preliminary and a final measurement carried out inside a semi anechoic chamber with reflecting ground 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 variable antenna distance and a fixed height in the frequency range 1 GHz to 25 / 40 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 40 GHz.

Preliminary measurement (9 kHz to 30 MHz):

The frequency range 10 MHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to find the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 10 MHz to 30 MHz.

The following procedure will be used:

1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6. Repeat steps 1) to 5) with the other orthogonal axes of the EUT.
7. Rotate the measuring antenna and repeat steps 1) to 5).

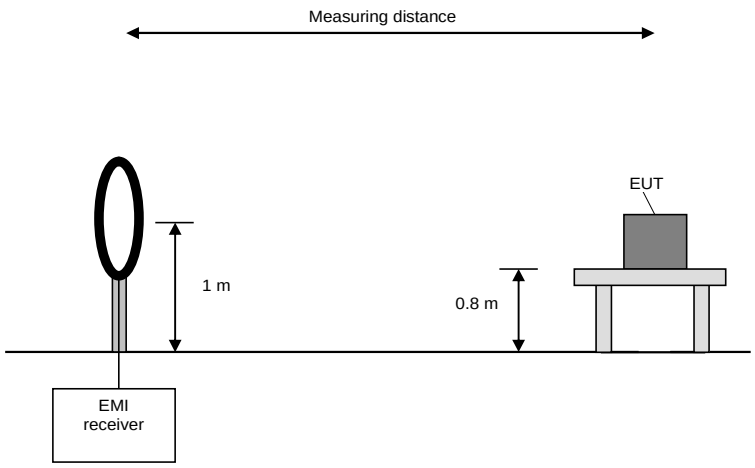
Final measurement (10 MHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m whichever is appropriate. In the case where larger measuring distances were required the results will be extrapolated based on the values measured on the closer distances according to [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak.

On the during the preliminary measurement detected frequencies the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

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

Frequency range	Resolution bandwidth
10 MHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:

8. Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
9. Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
10. Rotate the measuring antenna to find the maximum and note the value.
11. Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
12. Repeat steps 1) to 4) with the other orthogonal axes of the EUT (only if the EUT is a module or is used in a handheld application).

Preliminary and final measurement (30 MHz to 1 GHz)

The EUT is measured in the frequency range from 30 MHz to 1 GHz inside a semi anechoic chamber with a metal ground plane, which has been validated to the requirements of [1]. It is placed on a 3D-positioner to allow different positions at a distance of 3 meters from the receiving antenna. Both polarizations (vertical and horizontal) have been evaluated and the turn table has been turned to 360° to maximize the emissions. The receiving antenna is raised from 1 to 4 m.

Procedure preliminary measurement:

The following procedure is used:

13. Set the measurement antenna to 1 m height.
14. Monitor the frequency range at vertical polarization and a EUT azimuth of 0 °.
15. Rotate the EUT by 360° to maximize the detected signals in two axes.
16. Repeat 1) to 2) with the horizontal polarization of the measuring antenna.
17. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached (30 MHz to 1 GHz only).
18. 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.

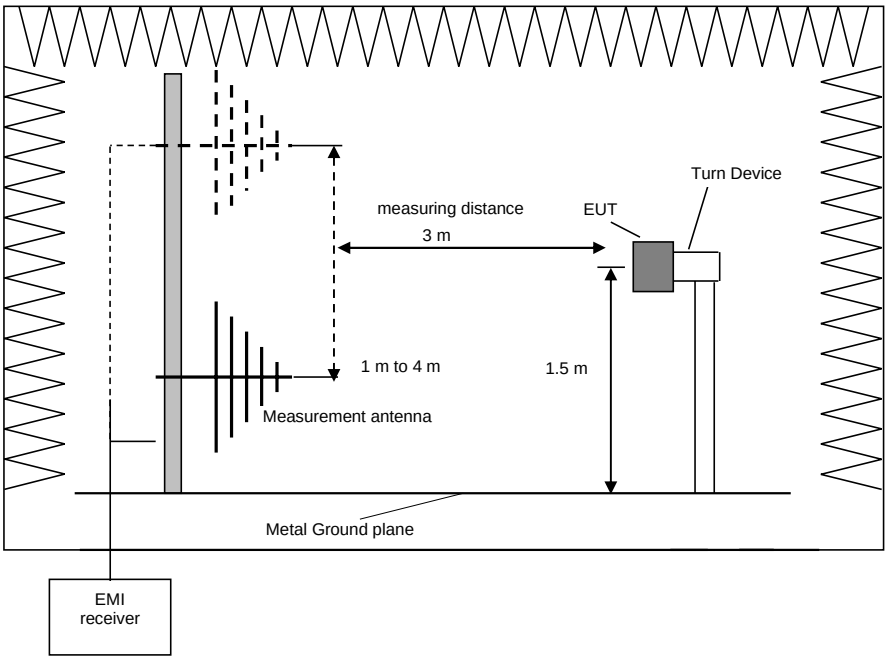
Procedure final measurement:

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 +/- 25° 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.
8. For frequencies above 960 MHz the measured field strength is converted to an EIRP value

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



Test setup for measurements below 1 GHz

Preliminary and final measurement (1 GHz to 40 GHz)

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

Procedure preliminary measurement:

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The measurement will be performed in horizontal and vertical polarisation 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 6.6.5.4 in [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

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

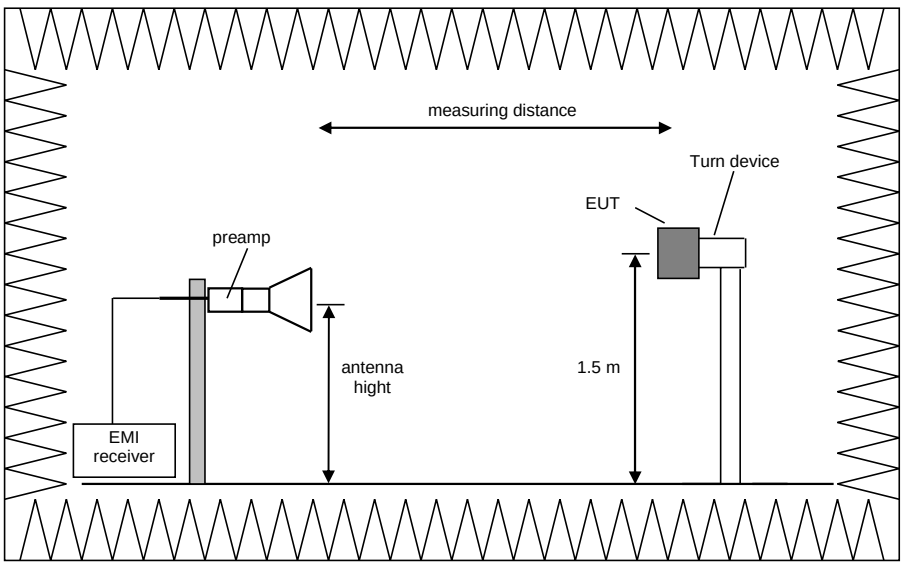
The following procedure will be used:

1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 ° with peak or RMS detector of the spectrum analyser (depending of the noise floor and the applicable limit).
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation 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°) according to 6.6.5.4 in [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 polarisation, 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.

Procedure final measurement:

The measurements were performed in the frequency range 1 GHz to 40 GHz.
The following procedure will be used:

8. Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
9. Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
10. Set the spectrum analyser to EMI mode with peak and RMS average detector activated.
11. Rotate the turntable from 0° to 360° to find the EUT angle that produces the highest emissions.
12. Note the highest displayed peak and average values
13. Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.
14. Replace the EUT by a substitution antenna, which is fed by a signal generator.
15. Carry out a substitution for each frequency detected during the steps 5) to 6).
16. Calculate the EIRP values with the help of the final measurement and the substitution results.



Test setup for measurements from 1 GHz to 40 GHz

5.6.2 Test results (radiated emissions of TN-UHF-Q300-NA-CDS)

5.6.2.1 Preliminary radiated emission measurement with internal antenna

Ambient temperature	21 °C	Relative humidity	50 %

Position of EUT: The EUT was set-up on the positioner at a height of 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied 24 V_{DC} by an external power supply.

Frequency range: The preliminary measurement was carried out in the frequency range 150 kHz to 10 GHz according to [2].

Remark: As pre-tests have shown, the emissions in the frequency range 150 kHz to 30 MHz are not depending on the transmitter operation mode. Therefore, the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

The following frequencies were found inside the restricted bands during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 240.860 MHz, 280.190 MHz, 2708.100 MHz, 3610.890 MHz and 8124.660 MHz.

The following frequencies were found outside the restricted bands during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 72.155 MHz, 350.000 MHz, 449.990 MHz, 749.990 MHz, 899.980MHz, 902.750 MHz, 912.000 MHz, 929.985MHz, 1805.355 MHz, 2049.840 MHz and 7222.270 MHz.

These frequencies have to be measured in a final measurement. The results are presented in the following.

Transmitter operates on the middle of the assigned frequency band (operation mode 2)

No significant frequencies above the noise floor of the system (max. 36 dBµV/m / -15.5 dBµA/m (measured with peak detector) at 3 m distance) were found during the preliminary radiated emission test in the frequency range 150 kHz to 30 MHz, so no final measurements were carried out on the outdoor test site.

The following frequencies were found inside the restricted bands during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 240.005 MHz, 280.745 MHz, 2744.145 MHz, 3658.860 MHz, 7317.900 MHz and 8232.615 MHz.

The following frequencies were found outside the restricted bands during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 72.185 MHz, 350.000 MHz, 449.990 MHz, 749.985MHz, 899.985 MHz, 912.000 MHz, 914.750 MHz, 929.985 MHz, 1829.340 MHz, 2049.840 MHz, 5488.380 MHz and 6403.140 MHz.

These frequencies have to be measured in a final measurement. The result is presented in the following.

Transmitter operates on the upper end of the assigned frequency (operation mode 3)

The following frequencies were found inside the restricted bands during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 280.625 MHz, 2781.630 MHz, 3708.855 MHz, 7417.890 MHz and 8345.160 MHz.

The following frequencies were found outside the restricted bands during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 72.200 MHz, 239.990 MHz, 350.000 MHz, 449.990 MHz, 749.985 MHz, 899.985 MHz, 912.000 MHz, 924.000 MHz, 927.250 MHz, 929.985 MHz, 936.000 MHz, 1854.401 MHz, 2049.840 MHz and 6490.620 MHz.

These frequencies have to be measured in a final measurement. The result is presented in the following.

Test equipment used (refer chapter 6):

6 – 31, 33, 34

5.6.2.2 Final radiated emission measurement (150 kHz to 30 MHz) with internal antenna

No significant frequencies above the noise floor of the system (max. 36 dBµV/m / -15.5 dBµA/m (measured with peak detector) at 3 m distance) were found during the preliminary radiated emission test. So, no final measurements were carried out on the outdoor test site.

5.6.2.3 Final radiated emission measurement (30 MHz to 1 GHz) with internal antenna

Ambient temperature	22 °C	Relative humidity	44 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied 24.0 V_{DC} by an external power supply.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] + 6 dB

The measured points and the limit line in the following diagrams refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final 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.

The measurement time with the quasi-peak measuring detector is 1 second.

Result measured with the quasi-peak detector:
(These values were marked in the diagrams in annex A by an ◆)

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)											
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Elevat. (deg)	Corr. (dB)	Restr. Band
72.155	28.6	107.3	78.7	1000	120	242	Hor.	206	90	13.7	No
240.860	38.1	46.0	7.9	1000	120	166	Vert.	30	0	18.7	Yes
280.190	39.7	46.0	6.3	1000	120	175	Hor.	21	0	20.4	Yes
350.000	36.3	107.3	71.0	1000	120	145	Hor.	188	90	22.3	No
449.990	33.3	107.3	74.0	1000	120	110	Hor.	309	0	25.0	No
749.990	37.2	107.3	70.1	1000	120	105	Hor.	325	0	30.8	No
899.980	55.4	107.3	51.9	1000	120	113	Vert.	20	0	32.0	No
902.750	127.3	Carrier	-	1000	120	112	Vert.	13	0	32.2	No
912.000	56.7	107.3	50.6	1000	120	157	Vert.	10	0	32.5	No
929.985	62.6	107.3	44.7	1000	120	106	Vert.	4	0	33.3	No
Transmitter operates at the middle of the assigned frequency band (operation mode 2)											
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Elevat. (deg)	Corr. (dB)	Restr. Band
72.185	27.8	106.7	78.9	1000	120	215.0	Hor.	200.0	90.0	13.7	No
240.005	39.1	46.0	6.9	1000	120	150.0	Vert.	36.0	0.0	18.6	Yes
280.745	40.6	46.0	5.4	1000	120	197.0	Hor.	25.0	0.0	20.4	Yes
350.000	37.4	106.7	69.3	1000	120	100.0	Vert.	205.0	0.0	22.3	No
449.990	34.6	106.7	72.1	1000	120	110.0	Hor.	316.0	0.0	25.0	No
749.985	39.0	106.7	67.7	1000	120	106.0	Hor.	320.0	0.0	30.8	No
899.985	55.3	106.7	51.4	1000	120	154.0	Vert.	4.0	0.0	32.0	No
912.000	56.8	106.7	49.9	1000	120	150.0	Vert.	3.0	0.0	32.5	No
914.750	126.7	Carrier	-	1000	120	194.0	Vert.	7.0	0.0	32.6	No
929.985	62.5	106.7	44.2	1000	120	105.0	Vert.	7.0	0.0	33.3	No
Transmitter operates at the upper end of the assigned frequency band (operation mode 3)											
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Elevat. (deg)	Corr. (dB)	Restr. Band
72.200	29.1	106.8	77.7	1000	120	250	Hor.	336	0	13.7	No
239.990	39.1	106.8	67.7	1000	120	150	Vert.	29	0	18.6	No
280.625	41.0	46.02	5.0	1000	120	193	Hor.	14	0	20.4	Yes
350.000	33.2	106.8	73.6	1000	120	113	Vert.	187	0	22.3	No
449.990	33.3	106.8	73.5	1000	120	106	Hor.	305	0	25.0	No
749.985	37.0	106.8	69.8	1000	120	107	Hor.	323	0	30.8	No
899.985	55.2	106.8	51.6	1000	120	183	Vert.	2	0	32.0	No
912.000	57.0	106.8	49.8	1000	120	106	Vert.	0	0	32.5	No
924.000	53.4	106.8	53.4	1000	120	108	Vert.	2	0	33.0	No
927.250	126.8	Carrier	-	1000	120	150	Vert.	8	0	33.2	No
929.985	62.5	106.8	44.3	1000	120	107	Vert.	8	0	33.3	No
936.000	47.7	106.8	59.1	1000	120	150	Vert.	7	0	33.6	No
Measurement uncertainty				±4.8 dB							

Test: Passed

Test equipment used (see chapter 6):

6 – 13, 15 – 17, 33, 34

5.6.2.4 Final radiated emission measurement (1 GHz to 10 GHz) with internal antenna

Ambient temperature	21 °C	Relative humidity	50 %

Position of EUT: The EUT was set-up on the positioner at a height of 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied 24.0 V_{DC} by an external power supply.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Results measured with the peak detector:

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)								
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1805.355	44.1	107.3	63.2	Hor.	306	30	-13.1	No
2049.840	40.0	107.3	67.3	Hor.	7	0	-11.8	No
2708.100	39.3	74.0	34.7	Hor.	359	0	-8.4	Yes
3610.890	47.5	74.0	26.5	Vert.	303	90	-6.5	Yes
7222.270	44.7	107.3	62.6	Hor.	194	0	4.0	No
8124.660	46.7	74.0	27.3	Vert.	332	30	6.0	Yes
Transmitter operates at the middle of the assigned frequency band (operation mode 2)								
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1829.340	43.5	106.7	63.2	Hor.	195	150	-12.9	No
2049.840	40.2	106.7	66.5	Hor.	6	30	-11.8	No
2744.145	42.7	74.0	31.3	Hor.	19	30	-8.4	Yes
3658.860	44.6	74.0	29.4	Hor.	195	150	-6.4	Yes
5488.380	42.2	106.7	64.5	Hor.	94	60	-0.1	No
6403.140	44.8	106.7	61.9	Vert.	0	0	1.6	No
7317.900	47.1	74.0	26.9	Hor.	123	30	4.6	Yes
8232.615	45.7	74.0	28.3	Vert.	165	150	6.0	Yes
Transmitter operates at the upper end of the assigned frequency band (operation mode 2)								
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1854.401	43.8	106.8	63.0	Vert.	136	150	-13.0	No
2049.840	40.4	106.8	66.4	Hor.	50	30	-11.8	No
2781.630	45.7	74.0	28.3	Hor.	12	30	-8.6	Yes
3708.855	44.5	74.0	29.5	Hor.	213	150	-6.3	Yes
6490.620	47.6	106.8	59.2	Vert.	175	150	1.9	No
7417.890	48.2	74.0	25.8	Hor.	136	0	4.6	Yes
8345.160	47.8	74.0	26.2	Hor.	182	0	6.5	Yes
Measurement uncertainty				±5.1 dB				

Results measured with the average detector:

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)								
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1805.355	40.8	107.3	66.5	Hor.	306	30	-13.1	No
2049.840	35.6	107.3	71.7	Hor.	7	0	-11.8	No
2708.100	31.8	54.0	22.2	Hor.	3.0	0	-8.4	Yes
3610.890	43.6	54.0	10.4	Vert.	303	90	-6.5	Yes
7222.270	33.8	107.3	73.5	Hor.	194	0	4.0	No
8124.660	36.9	54.0	17.1	Vert.	332	30	6.0	Yes
Transmitter operates at the middle of the assigned frequency band (operation mode 2)								
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1829.340	40.1	106.7	66.6	Hor.	195	150	-12.9	No
2049.840	35.2	106.7	71.5	Hor.	6	30	-11.8	No
2744.145	37.3	54.0	16.7	Hor.	19	30	-8.4	Yes
3658.860	39.3	54.0	14.7	Hor.	195	150	-6.4	Yes
5488.380	32.2	106.7	74.5	Hor.	94	60	-0.1	No
6403.140	35.9	106.7	70.8	Vert.	0	0	1.6	No
7317.900	38.6	54.0	15.4	Hor.	123	30	4.6	Yes
8232.615	34.8	54.0	19.2	Vert.	165	150	6.0	Yes
Transmitter operates at the upper end of the assigned frequency band (operation mode 3)								
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1854.401	40.4	106.8	66.4	Vert.	136	150	-13.0	No
2049.840	35.4	106.8	71.4	Hor.	50	30	-11.8	No
2781.630	41.2	54.0	12.8	Hor.	12	30	-8.6	Yes
3708.855	38.4	54.0	15.6	Hor.	213	150	-6.3	Yes
6490.620	41.5	106.8	65.3	Vert.	175	150	1.9	No
7417.890	39.5	54.0	14.5	Hor.	136	0	4.6	Yes
8345.160	37.0	54.0	17.0	Hor.	182	0	6.5	Yes
Measurement uncertainty				±5.1 dB				

Test: Passed

Test equipment used (see chapter 6):

18 – 30, 33, 34

5.6.2.5 Preliminary radiated emission measurement with external antenna port terminated

Ambient temperature	21 °C		Relative humidity	50 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m and 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied 24.0 V_{DC} by an external power supply.

Frequency range: The preliminary measurement was carried out in the frequency range 150 kHz to 10 GHz according to [2].

Remark: As pre-tests have shown, the emissions in the frequency range 150 kHz to 30 MHz are not depending on the transmitter operation mode. Therefore, the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

The following frequencies were found during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 72.375 MHz, 239.990 MHz, 279.235 MHz, 350.000 MHz, 450.000 MHz, 749.990 MHz and 902.750 MHz.

The following frequencies were found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1805.755 MHz, 2049.840 MHz, 2708.100 MHz, 3610.845 MHz, 5416.380 MHz, 6319.125 MHz, 7221.870 MHz, 8124.615 MHz and 9027.405 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the middle of the assigned frequency band (operation mode 2)

No significant frequencies above the noise floor of the system (max. 38 dBµV/m / -13.5 dBµV/m (measured with peak detector) at 3 m distance) were found during the preliminary radiated emission test in the frequency range 150 kHz to 30 MHz, so no measurements were carried out on the outdoor test site.

The following frequencies were found during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 72.445 MHz, 240.000 MHz, 279.480 MHz, 350.000 MHz, 450.000 MHz, 749.990 MHz, 914.750 MHz.

The following frequencies were found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1829.385 MHz, 2049.840 MHz, 2744.100 MHz, 3658.860 MHz, 5488.380 MHz, 6403.140 MHz, 7317.900 MHz and 8232.660 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the upper end of the assigned frequency (operation mode 3)

The following frequencies were found during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 72.440 MHz, 239.995 MHz, 279.815 MHz, 350.000 MHz, 450.000 MHz, 749.990 MHz and 927.250 MHz.

The following frequencies were found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1854.360 MHz, 2781.630 MHz, 3708.855 MHz, 4636.125 MHz, 5563.395 MHz, 6490.620 MHz 7417.890 MHz and 8345.160 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

Test equipment used (see chapter 6):

6 – 31, 33, 34

5.6.2.6 Final radiated emission measurement (150 kHz to 30 MHz) with external antenna port terminated

No significant frequencies above the noise floor of the system (max. 38 dBµV/m / -13.5 dBµA/m (measured with peak detector) at 3 m distance) were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

5.6.2.7 Final radiated emission measurement (30 MHz to 1 GHz) with external antenna port terminated

Ambient temperature	22 °C	Relative humidity	64 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied 24.0 V_{DC} by an external power supply.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] + 6 dB

The measured points and the limit line in the following diagrams refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final 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.

The measurement time with the quasi-peak measuring detector is 1 second.

Result measured with the quasi-peak detector:
(These values were marked in the diagrams in annex A by an ◆)

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)										
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Elevat. (deg)	Corr. (dB)
72.375	27.1	40.0	12.9	1000	120	197	H	202	90.0	13.7
239.990	38.5	46.0	7.5	1000	120	157	V	25	0.0	18.6
279.235	42.4	46.0	3.6	1000	120	201	H	17	0.0	20.3
350.000	35.7	46.0	10.3	1000	120	302	H	152	90.0	22.3
450.000	38.0	46.0	8.0	1000	120	227	H	148	90.0	25.0
749.990	34.6	46.0	11.4	1000	120	150	H	313	0.0	30.8
902.750	78.4	Wanted signal		1000	120	127	V	7	0.0	32.2
Transmitter operates on the middle of the assigned frequency band (operation mode 2)										
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Elevat. (deg)	Corr. (dB)
72.445	29.6	40.0	10.4	1000	120	213	H	205	90	13.7
240.000	40.2	46.0	5.8	1000	120	160	V	25	0	18.6
279.480	41.7	46.0	4.3	1000	120	214	H	25	0	20.3
350.000	34.1	46.0	11.9	1000	120	105	V	201	0	22.3
450.000	38.3	46.0	7.7	1000	120	220	H	149	90	25.0
749.990	33.8	46.0	12.2	1000	120	150	H	318	0	30.8
914.750	81.6	Wanted signal		1000	120	145	V	4	0	32.6
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)										
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Elevat. (deg)	Corr. (dB)
72.440	29.3	40.0	10.7	1000	120	223	Hor.	192	0	13.7
239.995	39.4	46.0	6.6	1000	120	172	Vert.	40	0	18.6
279.815	41.6	46.0	4.4	1000	120	190	Hor.	25	0	20.3
350.000	35.5	46.0	10.5	1000	120	300	Hor.	158	90	22.3
450.000	37.9	46.0	8.1	1000	120	219	Hor.	145	90	25.0
749.990	34.0	46.0	12.0	1000	120	150	Hor.	310	0	30.8
927.250	82.3	Wanted signal		1000	120	105	Vert.	-1	0	33.2
Measurement uncertainty				±4.8 dB						

Test: Passed

Test equipment used (see chapter 6):

6 – 13, 15 – 17, 33, 34

5.6.2.8 Final radiated emission measurement (1 GHz to 10 GHz) with external antenna port terminated

Ambient temperature	22 °C	Relative humidity	44 %

Position of EUT: The EUT was set-up on the positioner at a height of 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied 24 V_{DC} by an external power supply.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Results measured with the peak detector:

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)							
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1805.755	41.1	74.0	32.9	Vert.	276	60	-13.1
2049.840	40.5	74.0	33.5	Hor.	50	30	-11.8
2708.100	46.3	74.0	27.7	Hor.	22	30	-8.4
3610.845	52.0	74.0	22.0	Vert.	303	90	-6.5
5416.380	44.1	74.0	29.9	Hor.	50	0	-0.3
6319.125	44.9	74.0	29.1	Vert.	340	0	1.1
7221.870	47.6	74.0	26.4	Hor.	184	0	4.0
8124.615	52.6	74.0	21.4	Vert.	340	0	6.0
9027.405	49.3	74.0	24.7	Hor.	0	0	8.8
Transmitter operates at the middle of the assigned frequency band (operation mode 2)							
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1829.385	42.1	74.0	31.9	Hor.	272	0	-12.9
2049.840	40.0	74.0	34.0	Hor.	324	30	-11.8
2744.100	48.2	74.0	25.8	Hor.	350	30	-8.4
3658.860	49.6	74.0	24.4	Vert.	179	120	-6.4
5488.380	45.4	74.0	28.6	Hor.	32	30	-0.1
6403.140	48.9	74.0	25.1	Vert.	174	150	1.6
7317.900	50.4	74.0	23.6	Hor.	134	0	4.6
8232.660	52.2	74.0	21.8	Hor.	12	30	6.0
Transmitter operates at the upper end of the assigned frequency band (operation mode 3)							
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1854.360	52.4	74.0	21.6	Vert.	272	90	-13.0
2781.630	51.8	74.0	22.2	Hor.	0	0	-8.6
3708.855	46.4	74.0	27.6	Hor.	240	150	-6.3
4636.125	45.2	74.0	28.8	Vert.	312	60	-2.7
5563.395	44.4	74.0	29.6	Hor.	65	30	0.1
6490.620	55.5	74.0	18.5	Hor.	57	30	1.9
7417.890	54.6	74.0	19.4	Hor.	49	150	4.6
8345.160	57.0	74.0	17.0	Hor.	41	0	6.5
Measurement uncertainty			±5.1 dB				

Result measured with the average detector:

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)							
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1805.755	32.8	54.0	21.2	Vert.	276	60	-13.1
2049.840	36.3	54.0	17.7	Hor.	50	30	-11.8
2708.100	42.6	54.0	11.4	Hor.	22	30	-8.4
3610.845	46.5	54.0	7.5	Vert.	303	90	-6.5
5416.380	37.0	54.0	17.0	Hor.	50	0	-0.3
6319.125	37.5	54.0	16.5	Vert.	340	0	1.1
7221.870	39.5	54.0	14.5	Hor.	184	0	4.0
8124.615	47.2	54.0	6.8	Vert.	340	0	6.0
9027.405	39.8	54.0	14.2	Hor.	0	0	8.8
Transmitter operates at the middle of the assigned frequency band (operation mode 2)							
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1829.385	38.4	54.0	15.6	Hor.	272.0	0.0	-12.9
2049.840	35.4	54.0	18.6	Hor.	324.0	30.0	-11.8
2744.100	44.7	54.0	9.3	Hor.	350.0	30.0	-8.4
3658.860	46.2	54.0	7.8	Vert.	179.0	120.0	-6.4
5488.380	38.4	54.0	15.6	Hor.	32.0	30.0	-0.1
6403.140	42.2	54.0	11.8	Vert.	174.0	150.0	1.6
7317.900	44.7	54.0	9.3	Hor.	134.0	0.0	4.6
8232.660	46.6	54.0	7.4	Hor.	12.0	30.0	6.0
Transmitter operates at the upper end of the assigned frequency band (operation mode 3)							
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1854.360	50.5	54.0	3.5	Vert.	272	90	-13.0
2781.630	48.9	54.0	5.1	Hor.	0	0	-8.6
3708.855	41.3	54.0	12.7	Hor.	240	150	-6.3
4636.125	39.4	54.0	14.6	Vert.	312	60	-2.7
5563.395	37.0	54.0	17.0	Hor.	65	30	0.1
6490.620	52.3	54.0	1.7	Hor.	57	30	1.9
7417.890	50.4	54.0	3.6	Hor.	49	150	4.6
8345.160	53.4	54.0	0.6	Hor.	41	0	6.5
Measurement uncertainty			±5.1 dB				

Test: Passed

Test equipment used (see chapter 6):

18 – 30, 32, 33, 34

5.6.3 Test results (radiated emissions of TN-UHF-Q180L300-NA-CDS)

5.6.3.1 Preliminary radiated emission measurement with external antenna port terminated

Ambient temperature	22 °C	Relative humidity	33 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m and 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied 24.0 V_{DC} by an external power supply.

Frequency range: The preliminary measurement was carried out in the frequency range 150 kHz to 10 GHz according to [2].

Transmitter operates on the upper end of the assigned frequency (operation mode 3)

The following frequencies were found during the preliminary radiated emission test in the frequency range 30 MHz to 1 GHz:

- 927.250 MHz (wanted signal) and 980.100 MHz (highest level of the noise floor).

The following frequencies were found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1854.360 MHz, 2781.630 MHz, 3708.855 MHz, 4636.125 MHz, 5563.395 MHz, 6490.620 MHz 7417.890 MHz, 8345.160 MHz and 9272.385 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

Test equipment used (see chapter 6):

6 – 18, 20 – 23, 25 – 30, 33, 34, 36

5.6.3.2 Final radiated emission measurement (150 kHz to 30 MHz) with external antenna port terminated

No significant frequencies above the noise floor of the system (max. 40 dBµV/m / -11.5 dBµA/m (measured with peak detector) at 3 m distance) were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

5.6.3.3 Final radiated emission measurement (30 MHz to 1 GHz) with external antenna port terminated

Ambient temperature	22 °C	Relative humidity	20 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied 24.0 V_{DC} by an external power supply.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] + 6 dB

Resolution bandwidth: For all measurements a resolution bandwidth of 120 kHz was used.

The measured points and the limit line in the following diagrams refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final 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.

The measurement time with the quasi-peak measuring detector is 1 second.

Result measured with the quasi-peak detector:
(These values were marked in the diagrams in annex A by an ◆)

Transmitter operates on the upper end of the assigned frequency band (operation mode 3)								
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
927.250	55.1	Wanted signal		154	Hor.	269.0	90	32.9
980.100	24.4	54.0	29.6	358	Vert.	289.0	0	33.8
Measurement uncertainty				±4.8 dB				

Test: Passed

Test equipment used (see chapter 6):

6 – 13, 15 – 17, 33, 34

5.6.3.4 Final radiated emission measurement (1 GHz to 10 GHz) with external antenna port terminated

Ambient temperature	22 °C	Relative humidity	33 %

Position of EUT: The EUT was set-up on the positioner at a height of 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex B of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied 24 V_{DC} by an external power supply.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Results measured with the peak detector:

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)							
Frequency (MHz)	Peak result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1854.360	46.8	74.0	27.2	Hor.	226	150	-13.1
2781.630	51.8	74.0	22.2	Hor.	27	0	-8.7
3708.855	48.2	74.0	25.8	Hor.	318	30	-6.7
4636.125	52.2	74.0	21.8	Hor.	34	0	-3.3
5563.395	49.4	74.0	24.6	Hor.	208	150	-0.4
6490.620	47.3	74.0	26.7	Hor.	69	0	1.6
7417.890	51.8	74.0	22.2	Vert.	179	150	4.0
8345.160	52.3	74.0	21.7	Vert.	1	150	6.0
9272.385	49.2	74.0	24.8	Hor.	153	150	5.7
Measurement uncertainty			±5.1 dB				

Result measured with the average detector:

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)							
Frequency (MHz)	Average result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)
1854.360	43.8	54.0	10.2	Hor.	226	150	-13.1
2781.646	49.2	54.0	4.8	Hor.	27	0	-8.7
3708.895	44.7	54.0	9.3	Hor.	318	30	-6.7
4636.157	48.9	54.0	5.1	Hor.	34	0	-3.3
5563.395	44.6	54.0	9.4	Hor.	208	150	-0.4
6490.656	41.3	54.0	12.7	Hor.	69	0	1.6
7417.891	47.3	54.0	6.7	Vert.	179	150	4.0
8345.160	47.4	54.0	6.6	Vert.	1	150	6.0
9272.385	41.3	54.0	12.7	Hor.	153	150	5.7
Measurement uncertainty			±5.1 dB				

Test: Passed

Test equipment used (see chapter 6):

18, 20 – 23, 25 – 30, 33, 34, 36

5.7 Conducted emissions on antenna port

5.7.1 Method of measurement (conducted emissions in the restricted bands)

The relating measurements were carried out in a conducting manner. Therefore, the antenna port was connected via a suitable external attenuator to a spectrum analyser. The measurement procedure refers to part 11.12.2.2 in document [1].

If emissions were detected during the preliminary measurements, they were measured using the following measurement procedures:

Procedure for average measurement: 11.12.2.5.2 – Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction:

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:

- The EUT shall be configured to operate at the maximum achievable duty cycle.
- Measure the duty cycle D of the transmitter output signal as described in 11.6 in [1].
- Set the RBW = 1 MHz (unless otherwise specified).
- Set the VBW ≥ 3 x RBW.
- Detector = power average (RMS).
- Ensure that the number of measurement points in the sweep to ≥ 2 x (span/RBW).
- Averaging type = power
- Sweep time = auto
- Perform a trace average of at least 100 traces
- Correct the resulting measurement value by adding the duty cycle correction value (only applicable if not transmit continuously).

Peak measurement procedure: 11.12.2.4 in [1]

- Set the analyzer span to encompass the entire unwanted emission bandwidth.
- Set the RBW = specified in Table 1.
- Set the VBW ≥ RBW.
- Set sweep time = auto.
- Detector = peak.
- Trace mode = max hold.
- Allow the trace to stabilize.
- Use the peak marker function to determine the peak power over the emission bandwidth.

Table 1 RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

5.7.1.1 Limit calculations

The following general procedure is described in chapter 11.12.2.2 in [1].

1. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 11.12.2.3 through 11.12.2.5 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
2. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP (see 11.12.2.6 for guidance on determining the applicable antenna gain).
3. Add the appropriate maximum ground reflection factor to the EIRP (6 dB for frequencies ≤ 30 MHz; 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and 0 dB for frequencies > 1000 MHz).
4. For MIMO devices, measure the power of each chain and sum the EIRP of all chains in linear terms (i.e., watts and mW).
5. Convert the resultant EIRP to an equivalent electric field strength using the following relationship:

$$E = EIRP - 20\log(d) + 104.8 \qquad (1)$$

where

E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m

1. Compare the resultant electric field strength level with the applicable regulatory limit.
2. C Perform the radiated spurious emission test.

Chapter 14 in [1] states, that for transmitters with multiple outputs in the same band, summing of emissions and accounting for array gain have to be considered.

For this test report the procedure of summing of emissions as described in 14.3.2.2 in [1] was used.

To account for directional gain which might occur in case of N transmit antennas, the directional has to be calculated as

$$G_{Dir} = G_{Ant} + 10\log(N) dBi,$$

whereby N is the number of antennas.

This EUT has only one antenna port, therefore no calculation for multiple ports have to be performed.

5.7.2 Method of measurement (conducted emissions in the unrestricted bands)

In any 100 kHz outside the authorized frequency band, the power shall be attenuated by 20 dB, compared to the highest in band power in any 100 kHz. This shall be demonstrated by using the peak power procedure. The reference level shall be measured using the procedure described in 5.7.2.1 and the emission level according to procedure 5.7.2.2. The procedures are based on chapter 11.11.2 and 11.11.3 in [1].

5.7.2.1 Reference level measurement

Set instrument center frequency to DTS channel center frequency.

1. Set the span to ≥ 1.5 times the DTS bandwidth.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 3 x RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum PSD level.

5.7.2.2 Emission level measurement

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 3 x RBW.
4. Detector = peak.
5. Ensure that the number of measurement points ≥ span/RBW
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

5.7.3 Test results (conducted emissions)

Ambient temperature	22 °C	Relative humidity	70 %

Measured conducted at antenna port 1 of TN-UHF-Q300-NA-CDS.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied 24.0 V DC by an external power supply.

Test record: All results are shown in the following. The plots of this measurements are presented in annex A of this test report.

Frequency range: The measurement was carried out in the frequency range 150 kHz to 10 GHz according to [2].

Remark: As pre-tests have shown, the emissions in the frequency range 150 kHz to 30 MHz are not depending on the transmitter operation mode. Therefore, the emissions in this frequency range were measured only with the transmitter operates in operation mode 1.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

No significant emissions at least 20 dB below the limit were found in the frequency range 150 kHz to 30 MHz, therefore no results are submitted.

The following frequencies were found in the frequency range 30 MHz to 1 GHz:

- 899.985 MHz, 902.750 MHz, 912.000 MHz and 929.985 MHz.

The following frequency was found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1109.981 MHz.

The results of the measurement of these frequencies were presented in the following.

Transmitter operates at the middle of the assigned frequency band (operation mode 2)

The following frequencies were found in the frequency range 30 MHz to 1 GHz:

- 899.985 MHz, 912.000 MHz 914.750 MHz and 929.985 MHz.

The following frequency was found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1109.981 MHz.

The results of the measurement of these frequencies were presented in the following.

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)

The following frequencies were found in the frequency range 30 MHz to 1 GHz:

- 899.985 MHz, 912.000 MHz 927.250 MHz and 929.985 MHz.

The following frequency was found during the preliminary radiated emission test in the frequency range 1 GHz to 10 GHz:

- 1109.981 MHz.

The results of the measurement of these frequencies were presented in the following.

Spurious emissions (operation mode 1)										
Operating channel	Frequency [MHz]	Reading [dBm]	Max. antenna gain [dBi]	Ground reflection factor [dB]	Calculated EIRP [dBm]	Calculated field strength [dBµV/m]	Min. limit [dBµV/m]	Margin [dB]	Result	Restricted Band
0 (902.750 MHz)	899.985	-40.7	5.1	4.7	-30.9	64.4	107.3 *1	42.9	Passed	No
	902.750	29.2	Wanted signal, no spurious emission							
	912.000	-39.5	5.1	4.7	-29.7	65.6	107.3 *1	41.74	Passed	No
	929.985	-36.1	5.1	4.7	-26.6	69.0	107.3 *1	38.3	Passed	No
	1109.981	-51.8	5.1	0.0	-46.7	48.6	54	5.4	Passed	Yes
Spurious emissions (operation mode 2)										
Operating channel	Frequency [MHz]	Reading [dBm]	Max. antenna gain [dBi]	Ground reflection factor [dB]	Calculated EIRP [dBm]	Calculated field strength [dBµV/m]	Min. limit [dBµV/m]	Margin [dB]	Result	Restricted Band
24 (914.750 MHz)	899.985	-40.7	5.1	4.7	-30.9	64.4 *2	106.7 *1	42.3	Passed	No
	912.000	-39.5	5.1	4.7	-29.7	65.6 *2	106.7 *1	41.1	Passed	No
	914.750	29.2	Wanted signal, no spurious emission							
	929.985	-36.1	5.1	4.7	-26.3	69.0 *2	106.7 *1	37.7	Passed	No
	1109.981	-51.8	5.1	0.0	-46.7	48.6 *2	54.0	5.4	Passed	Yes
Spurious emissions (operation mode 3)										
Operating channel	Frequency [MHz]	Reading [dBm]	Max. antenna gain [dBi]	Ground reflection factor [dB]	Calculated EIRP [dBm]	Calculated field strength [dBµV/m]	Min. limit [dBµV/m]	Margin [dB]	Result	Restricted Band
49 (927.250 MHz)	899.985	-40.7	5.1	4.7	-30.9	64.4 *2	106.8 *1	42.4	Passed	No
	912.000	-39.5	5.1	4.7	-29.7	65.5 *2	106.8 *1	41.3	Passed	No
	927.250	29.8	Wanted signal, no spurious emission							
	929.985	-36.1	5.1	4.7	-26.3	69.0 *2	106.8 *1	37.8	Passed	No
	1109.981	-51.8	5.1	0.0	-46.7	48.6 *2	54.0	5.4	Passed	Yes
Measurement uncertainty			±2.7 dB							

*1: Limit (20 dBc) calculated with minimum antenna gain (0 dBi) from radiated measurement, refer clause 5.6.2.3

*2: Measured with peak detector only, because the peak value is already below the average limit

Test: Passed

Test equipment used (see chapter 6):

19, 30, 32, 33, 34

5.8 Conducted emissions on power supply lines (150 kHz to 30 MHz)

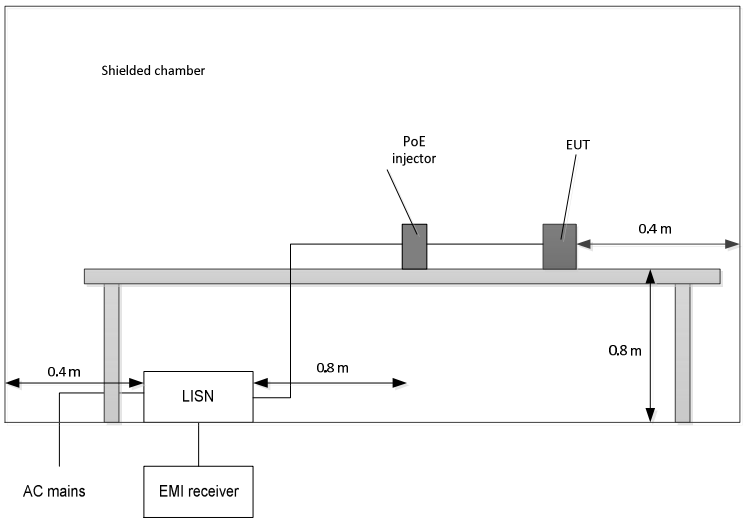
5.8.1 Method of measurement

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].

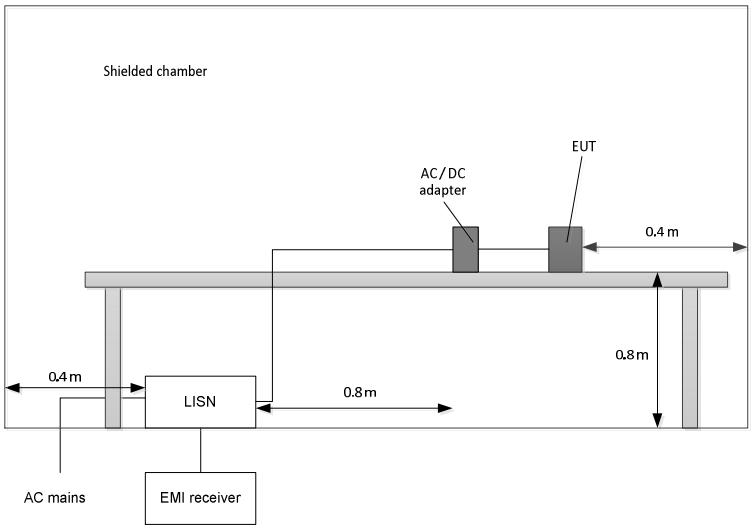
The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below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



5.8.2 Test results (conducted emissions on power supply lines)

5.8.2.1 Test results with EUT supplied via PoE

Ambient temperature	22 °C	Relative humidity	73 %

Testsample: TN-UHF-Q300-NA-CDS

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

Cable guide: The cables of the EUT were fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex B of this test report.

Test record: The test was carried out in operation mode 4 of the EUT (refer also clause 2 of this test report). All results are shown in the following. The plot of this measurements is presented in annex A of this test report.

Supply voltage: During this test the EUT was supplied 48.0 V_{DC} by an PoE injector type DeLOCK 802.3at, which was powered by an AC/DC adaptor type PHOENIX CONTACT UNO-PS/1AC/48DC/60W, which was connected to an AC mains network with 120 V_{AC} / 60 Hz.

The curves in the diagram in annex A 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 ◆, the average measured points with▼.

Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Line	PE	Corr. [dB]
0.165300	53.1	---	65.2	12.1	5000	9	L1	GND	9.8
0.166200	---	44.3	55.2	10.9	5000	9	L1	FLO	9.8
0.595500	---	35.9	46.0	10.1	5000	9	L1	FLO	9.9
1.032000	---	42.7	46.0	3.3	5000	9	L1	FLO	9.9
1.032900	46.3	---	56.0	9.7	5000	9	L1	FLO	9.9
1.547700	---	43.6	46.0	2.4	5000	9	L1	FLO	9.9
1.550400	43.8	---	56.0	12.2	5000	9	N	FLO	9.9
1.825800	43.9	---	56.0	12.1	5000	9	L1	GND	10.0
2.321700	---	37.9	46.0	8.1	5000	9	L1	FLO	10.2
2.323500	43.2	---	56.0	12.8	5000	9	L1	GND	10.2
3.610500	---	40.2	46.0	5.8	5000	9	L1	FLO	10.3
3.612300	43.7	---	56.0	12.3	5000	9	L1	GND	10.3
Measurement uncertainty			±2.8 dB						

Test: Passed

Test equipment used (refer clause 6):

1 – 5, 34, 35

5.8.2.2 Test results with EUT supplied with DC

Ambient temperature	22 °C	Relative humidity	73 %

Testsample: TN-UHF-Q300-NA-CDS

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

Cable guide: The cables of the EUT were fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex B of this test report.

Test record: The test was carried out in operation mode 4 of the EUT (refer also clause 2 of this test report). All results are shown in the following. The plot of this measurements is presented in annex A of this test report.

Supply voltage: During this test the EUT was supplied 24.0 V_{DC} by an external power supply type PHOENIX CONTACT MINI-PS-100-240AC/24/DC/1.3, which was connected to an AC mains network with 120 VAC / 60 Hz.

The curves in the diagram in annex A 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 ♦, the average measured points with▼.

Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Line	PE	Corr. [dB]
0.160800	56.8	---	65.4	8.6	5000	9	L1	GND	9.8
0.402000	---	36.5	47.8	11.3	5000	9	L1	FLO	9.9
17.502000	49.9	---	60.0	10.1	5000	9	N	FLO	10.9
17.620800	---	46.5	50.0	3.5	5000	9	L1	GND	10.9
17.864700	51.2	---	60.0	8.8	5000	9	N	GND	10.9
18.223800	---	47.1	50.0	2.9	5000	9	N	GND	10.9
Measurement uncertainty			±2.8 dB						

Test: Passed

Test equipment used (refer clause 6):

1 – 5, 33, 34

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Shielded chamber M4	-	Siemens	B83117-S1-X158-	480088	Calibration not necessary	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	100292	481182	12.02.2020	02.2022
3	LISN	NSLK8128	Schwarzbeck	8128161	480138	11.02.2020	02.2022
4	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	Calibration not necessary	
5	EMI Software	EMC 32	Rohde & Schwarz	100061	481022	Calibration not necessary	
6	Semi anechoic chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
7	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
8	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
9	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
10	Positioner	TG1.5-10kg	Maturo	110/2648.01	483042	Calibration not necessary	
11	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
12	System software EMC32 M276	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
13	Ultralog Antenna	CBL6111D	Chase	25761	480894	18.09.2017 + 09.10.2020	09.2020 + 10.2023
14	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	05.02.2020	02.2021
15	EMI Test receiver ESW	ESW44	Rohde & Schwarz	101828	482979	12.04.2019	04.2021
16	Cable C417	Sucoflex 118	Huber+Suhner	500654/118	-	Calibration not necessary	
17	6 dB attenuator	R412706000	Radiall	9833	410082	Calibration not necessary	
18	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Calibration not necessary	
19	Spectrum analyser	FSW43	Rohde & Schwarz	100586 & 100926	481720	04.03.2020	03.2022
20	Measuring receiver	ESW44	Rohde & Schwarz	101635	482467	18.02.2020	02.2022
21	Controller	MCU	Maturo	MCU/043/971107	480832	Calibration not necessary	
22	Turntable	DS420HE	Deisel	420/620/80	480315	Calibration not necessary	
23	Antenna support	AS615P	Deisel	615/310	480187	Calibration not necessary	
24	Antenna	HL50	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
25	RF-cable No. 36	Sucoflex 106B	Suhner	0587/6B	480865	Calibration not necessary	
26	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670	Calibration not necessary	
27	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330	Calibration not necessary	
28	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Calibration not necessary	
29	Turn device	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	

30	High Pass Filter	WHKX12-935-1000-15000-40ST	Wainwright	12	482908	Calibration not necessary	
31	Tuneable Notch Filter	WRCA800/900-0.2/40-6EEK	Wainwright Instruments GmbH	15	480414	Calibration not necessary	
32	20 dB attenuator	WA8 / 18-20-34	Weinschel	-	481450	Calibration not necessary	
33	DC power supply	HM8142	Hameg	142981P 03955	480719	Calibration not necessary	
34	Digital multimeter	971A	Hewlett Packard	JP39009358	480721	16.01.2020	01.2021
35	AC source	AC6803A	Keysight	JPVJ002509	482350	Calibration not necessary	
36	Antenna	HL50	Rohde & Schwarz	100908	482977	13.08.2019	08.2022

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 C63.4-2014	19.09.2019	18.09.2021
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.07.2018	12.07.2021
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
F192159E1	06.11.2020	Document created
-	-	-
-	-	-
-	-	-

9 List of annexes

Annex A	Measurement plots	26 pages
Annex B	Test set-up photos	16 pages