Report on the FCC Testing of the APTIV Services Deutschland GmbH Vehicle Radar Model: A3TRN In accordance with FCC 47 CFR Part 95, Subpart M

Product Service

Add value.
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Prepared for: APTIV Services Deutschland GmbH
Am Technologiepark 1
42119 Wuppertal, Germany

FCC ID: LTQA3TRN

COMMERCIAL-IN-CONFIDENCE

Date: 2023-08-25
Document Number: TR-713297342-00 | Revision 1

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Martin Steindl	2023-08-25	Steindl Martin SIGN-ID 826104
Authorised Signatory	Matthias Stumpe	2023-08-25	SIGN-ID 826254

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

Engineering Statement:
This measurement shown in this report were made in accordance with the procedures described on test pages.
All reporded testing was carried out on a sample equipment to demonstrate limited compilance with with FCC 47 CFR Part 95, Subpart M.
The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Martin Steindl	2023-08-25	Steindl Martin SIGN-ID 826105

Laboratory Accreditation
DAkkS Reg. No. D-PL-11321-11-02
DAkkS Reg. No. D-PL-11321-11-03

Laboratory recognition
Registration No. BNetzA-CAB-16/21-15

Executive Statement:
A sample of this product was tested and found to be compilant with FCC 47 CFR Part 95, Subpart M : 2021

Bundesnetzagentur
BNetzA-CAB-16/21-15

Trade Register Munich
HRB 85742
VAT ID No. DE129484267
Information pursuant to Section 2(1) DL-InfoV (Germany) at www.tuvsud.com/imprint

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Product Service

Content

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1 Report Summary

1.1 Modification Report

Alternations and additions of this report will be issued to the holders of each copy in the form of a complete document.

Revision	*Description of changes*	*Date of Issue*
0	First Issue	2023-07-12
1	Correction of cal-data	2023-08-25

Table 1: Report of Modifications

1.2 Introduction

Applicant	APTIV Services Deutschland GmbH Am Technologiepark 1 42119 Wuppertal, Germany
Manufacturer	APTIV Services Deutschland GmbH
Model Number(s)	A3TRN
FCC ID:	LTQA3TRN
Serial Number(s)	SN0006
Hardware Version(s)	B2
Software Version(s)	3.0.1
Number of Samples Tested	1
Test Specification(s) / Issue / Date	FCC 47 CFR Part 95 M : 2022
Test Plan/Issue/Date	N/A
Order Number	454234216
Date	2023-03-21
Date of Receipt of EUT	2023-06-02
Start of Test	2023-06-30
Finish of Test	2023-07-04
Name of Engineer(s)	M. Steindl, A. Deese
Related Document(s)	ANSI C63.10:2013

Product Service

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 95, Subpart M is shown below.

Section	*Specification Clause*	*Test Description*	*Result*
2.1	§ 95.3367 (a)	Radiated Average Power	Passed
2.2	§ 95.3367 (b)	Radiated Peak Power	Passed
2.3	§ 95.3379	Radiated Emissions	Passed
2.4	§ 95.3385	Bandwidth of Signal	Passed

Table 2: Results according to FCC 47 CFR Part 95, Subpart M

1.4 Product Information

1.4.1 Technical Description

The Device Under Test (DUT) is a 76 to 77 GHz vehicular radar. The device employs a dynamic chirp modulated transmit array. Multiple receive antennas are used to determine target angular resolution through digital beam forming. When installed on a vehicle, the device will operate when the vehicle is running.

Frequency Band	76 – 81 GHz
Emission designator:	425MFXN
Supply Voltage:	12 V
Supply Frequency:	DC (0 Hz)

1.4.2 EUT Ports / Cables identification

Port	*Max Cable Length specified*	*Usage*	*Screened*
Wiring harness	2 m	DC supply and Data I/O	No

Table 3

1.5 Test Configuration

The applicant provided a test sample for stand alone operation.

1.6 Modes of Operation

The DUT transmitted continuously in the 76 to 77 GHz frequency band. Tests were performed for nominal bandwidths of 175 MHz and 425 MHz.

1.7 EUT Modifications Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing test laboratory:

Test Name	Name of Engineer(s)
Radiated Average Power	M. Steindl
Radiated Peak Power	M. Steindl
Radiated Emissions	M. Steindl; A. Deese
Bandwidth of Signal	M. Steindl

Office Address:
Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

2 Test Details

2.1 Radiated Average Power

2.1.1 Specification Reference

FCC 47 CFR Part 95, Subpart M, Clause 95.3367 (a)

2.1.2 Equipment under Test and Modification State

SRR6PB2; S/N 0002; Modification State 0

2.1.3 Date of Test

2023-06-30

2.1.4 Environmental Conditions

Ambient Temperature	25 °C
Relative Humidity	41 %

2.1.5 Specification Limits

The maximum power (EIRP) within the 76 – 81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW)

2.1.6 Test Method

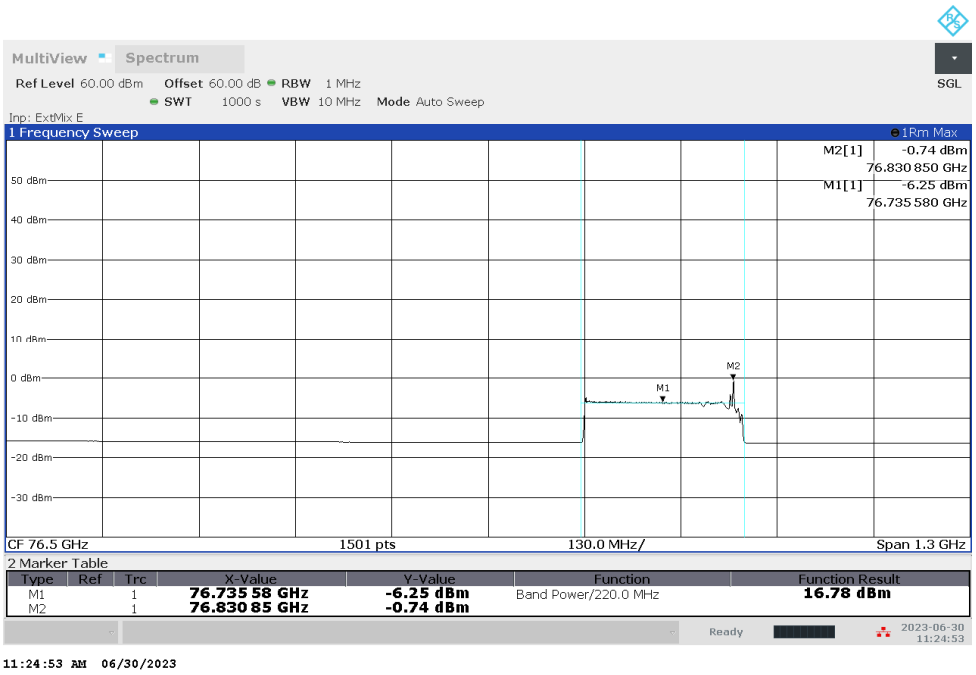
The test was performed according to ANSI C63.10, section 10.3.5
See section 2.3 of this test report for details.

Product Service

2.1.7 Test Results

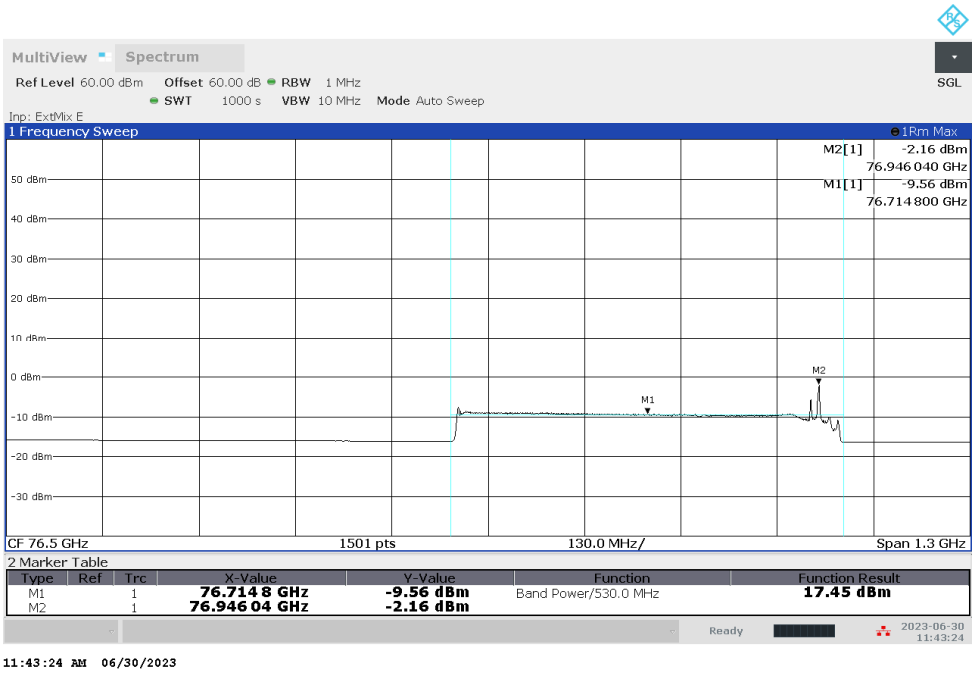
Detector	*EIRP (dBm)*	*Limit (dBm)*
Average (peak value)	-6.25	50 dBm
Average (band function)	16.78	50 dBm

Table 5: RMS Power for 175 MHz bandwidth



Detector	*EIRP (dBm)*	*Limit (dBm)*
Average (peak value)	-2.16	50 dBm
Average (band function)	17.45	50 dBm

Table 6: RMS Power for 425 MHz bandwidth



2.1.8 Test Location and Test Equipment

The test was carried out in fully anechoic room, No. 2

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal and Spectrum Analyzer	Rohde & Schwarz	FSW43	54396	12	2024-04-30
Waveguide Mixer	Rohde & Schwarz	FS-Z90	25850	36	2026-05-31
Horn Antenna	Flann	26240-20	37898		

Table 7

2.2 Radiated Peak Power

2.2.1 Specification Reference

FCC 47 CFR Part 95, Subpart M, Clause 95.3367 (b)

2.2.2 Equipment under Test and Modification State

SRR6PB2; S/N 0002; Modification State 0

2.2.3 Date of Test

2022-11-25

2.2.4 Environmental Conditions

Ambient Temperature	22 °C
Relative Humidity	38 %

2.2.5 Specification Limits

The maximum peak power (EIRP) within the 76 – 81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz Resolution Bandwidth (RBW)

2.2.6 Test Method

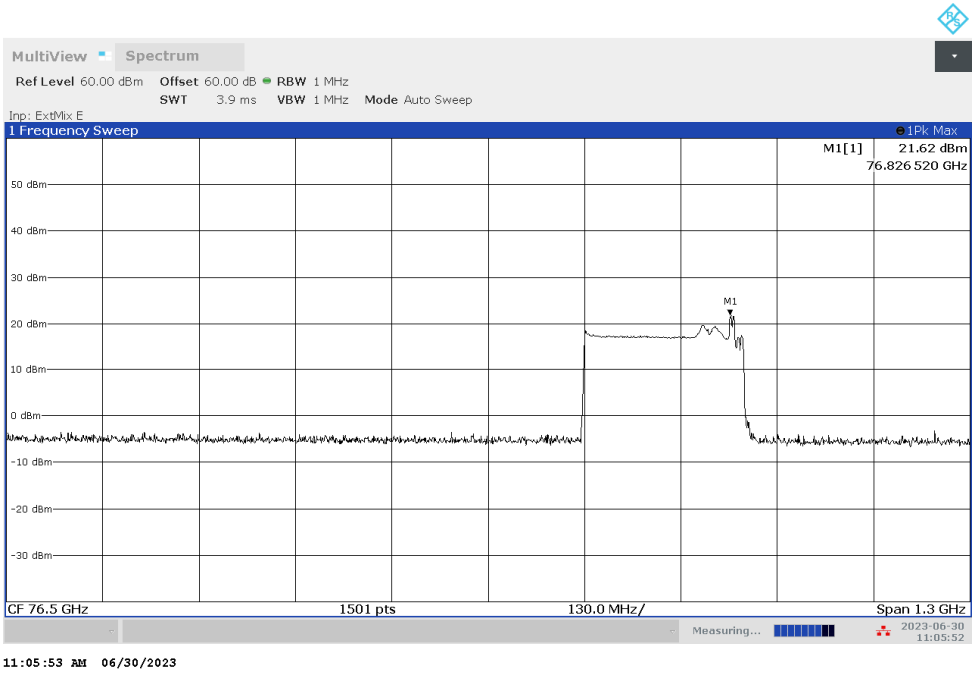
The test was performed according to ANSI C63.10, section 10.3.5
See section 2.3 of this test report for details.

Product Service

2.2.7 Test Results

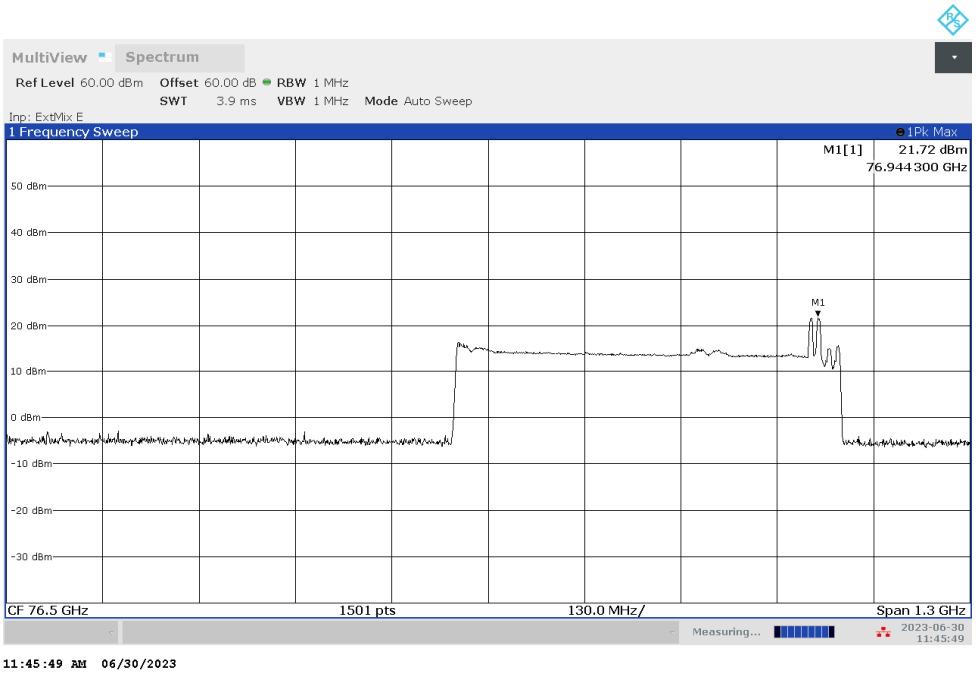
Detector	*EIRP (dBm)*	*Limit (dBm)*
Peak	21.62	55 dBm

Table 8: Peak Power for 175 MHz bandwidth



Detector	*EIRP (dBm)*	*Limit (dBm)*
Peak	21.72	55 dBm

Table 9: Peak Power for 425 MHz bandwidth



2.2.8 Test Location and Test Equipment

The test was carried out in fully anechoic room, No. 2

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal and Spectrum Analyzer	Rohde & Schwarz	FSW43	54396	12	2024-04-30
Waveguide Mixer	Rohde & Schwarz	FS-Z90	25850	36	2026-05-31
Horn Antenna	Flann	26240-20	37898		

Table 10

2.3 Radiated Emissions

2.3.1 Specification Reference

FCC 47 CFR Part 95, Subpart M, Clause 95.3379

2.3.2 Equipment under Test and Modification State

SRR6PB2; S/N 0002; Modification State 0

2.3.3 Date of Test

2023-06-05 to 2023-07-04

2.3.4 Environmental Conditions

Ambient Temperature	22 °C
Relative Humidity	38 %

Product Service

2.3.5 Specification Limits

General radiated emission limits:					
Frequency Range (MHz)	*Test distance (m)*	*Field strength*		*Field strength*	
		(µA/m)	*(dBµA/m)*	*(µV/m)*	*(dBµV/m)*
0.009 – 0.49	300	6.37 / *f*	20*lg(6.37 / *f*)	2400 / *f*	20*lg(2400 / *f*)
0.49 – 1.705	30	63.7 / *f*	20*lg(63.7 / *f*)	24000 / *f*	20*lg(24000 / *f*)
1.705 - 30	30	0.08	20*lg(0.08 / *f*)	30	20*lg(30 / *f*)
30 – 88	3	---	---	100	40
88 – 216	3	--	---	150	43.5
126 – 960	3	--	---	200	46
960 – 40000	3	---	---	500	54
Note 1: *f* in kHz					

Table 11 Radiated emission limits at or below 40 GHz

Frequency range	*Spectral Density*	*EIRP*
40 – 200 GHz	600 pW/cm² at 3 m	-7.70 dBm
200 – 231 GHz	1000 pW/cm² at 3 m	-5.49 dBm

Table 12 Radiated emission limits above 40 GHz

At frequencies at or above 30 MHz, measurements may be performed at distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 m, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements.

At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempts should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

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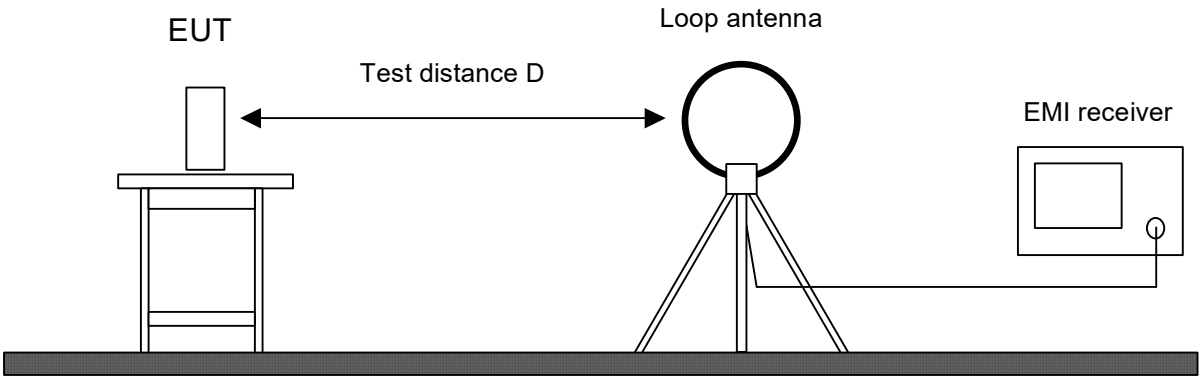
2.3.6 Test Method

The test was performed according to ANSI C63.10, sections 11.11 and 11.12

Prescans are performed in six positions of the EUT to get the full spectrum of emission caused by the EUT with the measuring antenna raised and lowered from 1 m to 4 m with vertical and horizontal polarisation to find the combination of table position, antenna height and antenna polarisation for the maximum emission levels.
Data reduction is applied to these results to select those levels having less margin than 10 dB or exceeding the limit using subranges and limited number of maximums.
Further maximisation for adjusting the maximum position is following.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

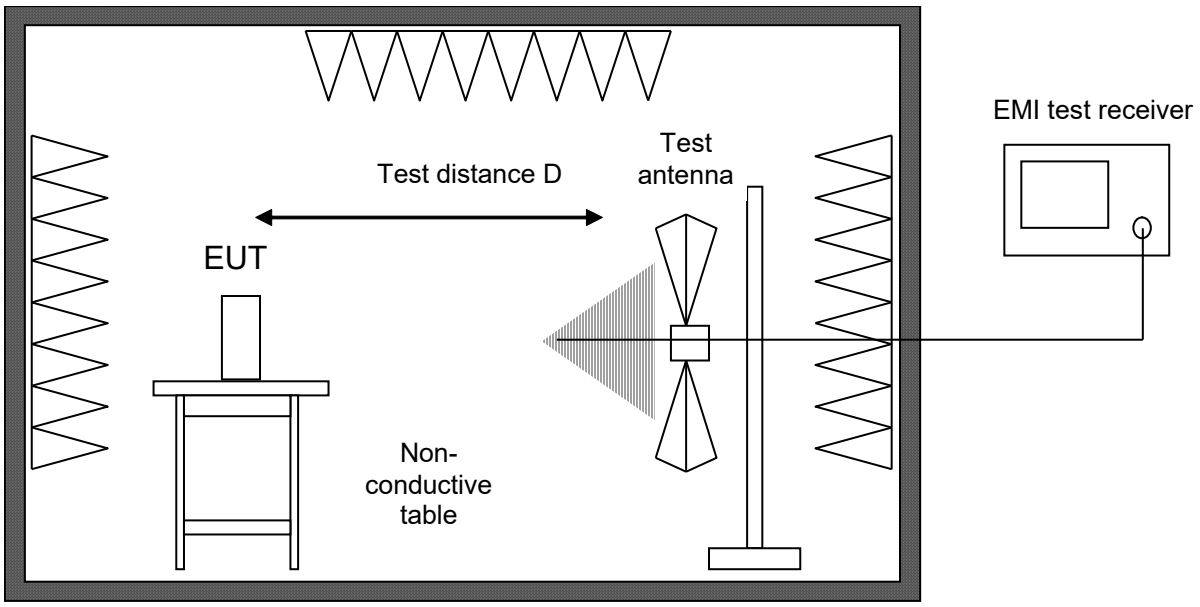
2.3.6.1 Frequency range 9 kHz – 30 MHz



The EUT was placed on a non-conductive table, 0.8 m above the ground.
Radiated emissions in the frequency 9 kHz – 30 MHz is measured within a semi-anechoic room with an active loop antenna with the measurement detector set to peak. In addition in the frequency range 9 kHz to 490 kHz also an average detector was used. The measurement bandwidth of the receiver was set to 300 Hz in the frequency range 9 kHz to 150 kHz and 10 kHz in the frequency range 150 kHz to 30 MHz. Prescans were performed in six positions of the EUT.
For final measurements the detector was set to CISPR quasi-peak and in addition to CISPR average in the frequency range 9 kHz to 490 kHz with a resolution bandwidth 200 Hz in the frequency range 9 kHz to 150 kHz and 9 kHz in the frequency range 150 kHz to 30 MHz. Final tests were performed immediately after a final frequency and zoom (for drifting disturbances) and maximum adjustment.

Product Service

2.3.6.2 Frequency range 30 MHz – 1 GHz

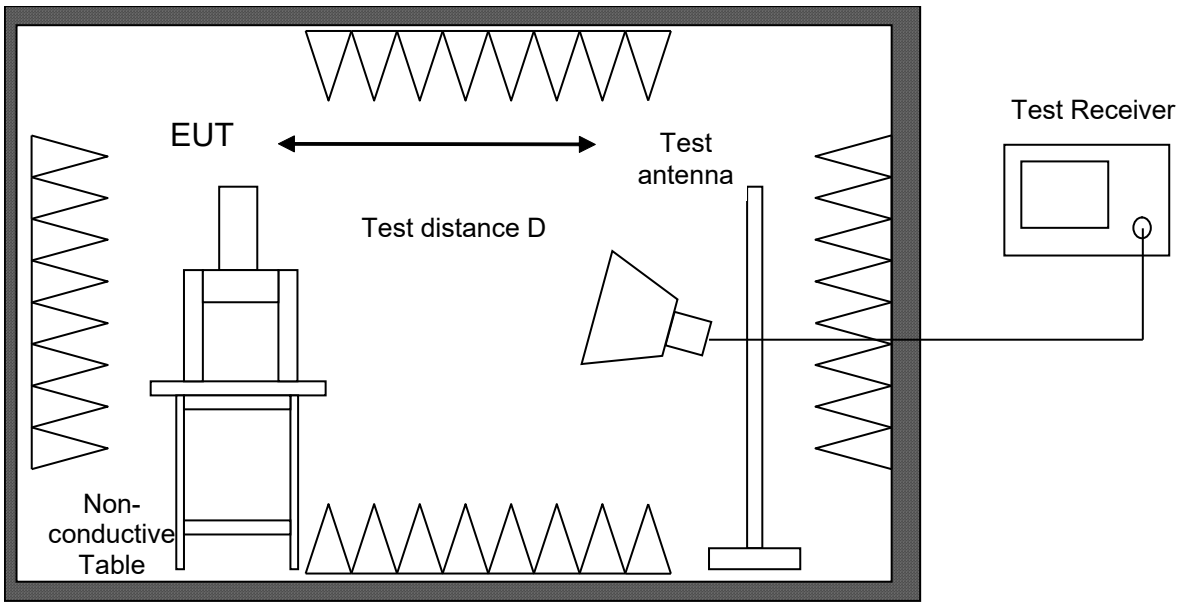


Alternate test site (semi anechoic room)

The EUT was placed on a non-conductive table, 0.8 m above the ground plane
Radiated emissions in the frequency range 30 MHz – 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4. for alternative test sites. A linear polarised logarithmic periodic antenna combined with a 4:1 broadband dipole (“Trilog broadband antenna”) is used.
For prescan tests the test receiver is set to peak-detector with a bandwidth of 120 kHz.
With the measurement bandwidth of the test receiver set to 120 kHz CISPR quasi-peak detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.

Product Service

2.3.6.3 Frequency range above 1 GHz



Fully anechoic room

The EUT was placed on a non-conductive table, 1.5 m above the ground plane
Radiated emission tests above 1 GHz are performed in a fully anechoic room with the S_{VSWR} requirements of ANSI C63.4. Measurements are performed both in the horizontal and vertical planes of polarisation using a test receiver with the detector function set to peak and average and the resolution bandwidth set to 1 MHz. Testing above 1 GHz is performed with horn antennas with the EUT in boresight of the antenna.
For prescan tests the test receiver is set to peak- and average-detector with a bandwidth of 1 MHz. With the measurement bandwidth of the test receiver set to 1 MHz and peak- and CISPR average-detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.

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2.3.7 Test Results

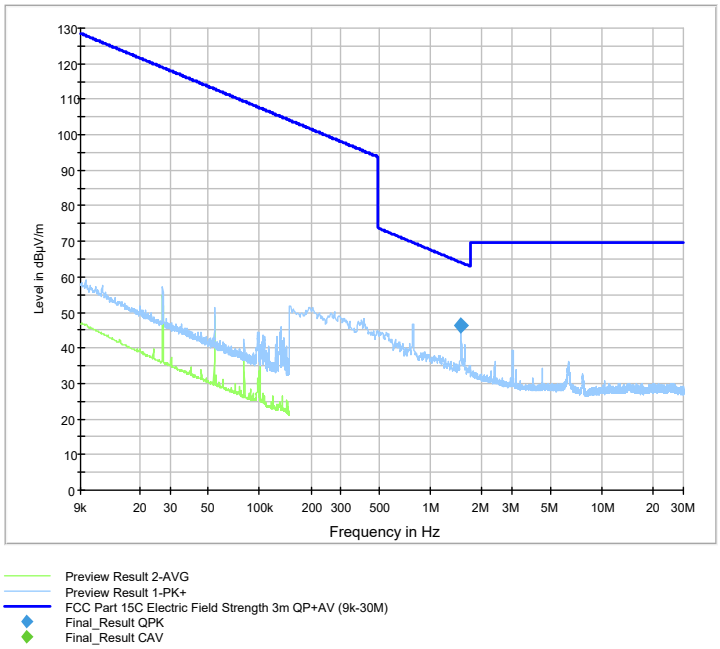
Frequency range	*Limit applied*	*Test distance*
9 kHz – 1 GHz	95.3379(a)(1)	3 m
1 – 18 GHz	95.3379(a)(1)	1 m
18 – 110 GHz	95.3379(a)(2)	3 m
110 – 220 GHz	95.3379(a)(2)	1 m
220 – 325 GHz	95.3379(a)(2)	0.5 m

Table 13

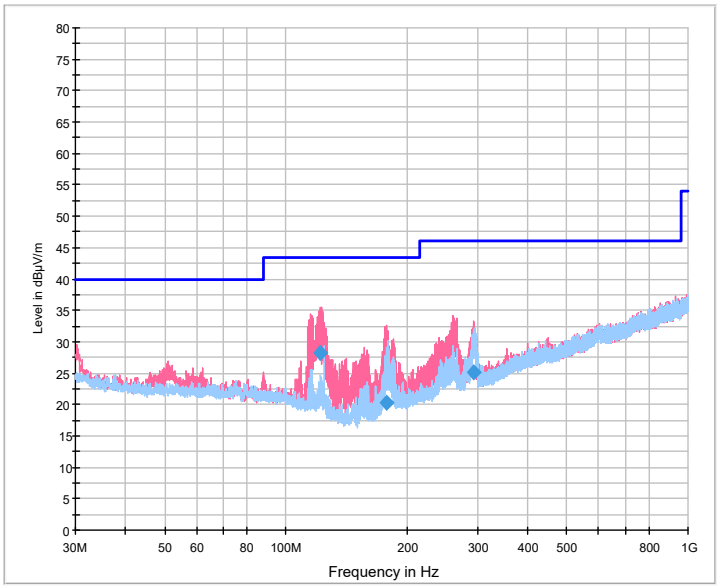
Sample calculation:
Final Value (dBµV/m) = Reading Value (dBµV) + (Cable attenuation (dB) + Antenna Transducer (dB(1/m)))

Additional correction of limit in the frequency range 9 – 490 kHz (300 m to 3 m): +80.0 dB
Additional correction of limit in the frequency range 490 kHz – 30 MHz (30 m to 3 m): +40.0 dB
Additional correction of limit in the frequency ranges 1 – 40 GHz (3 m to 1 m): +9.54 dB

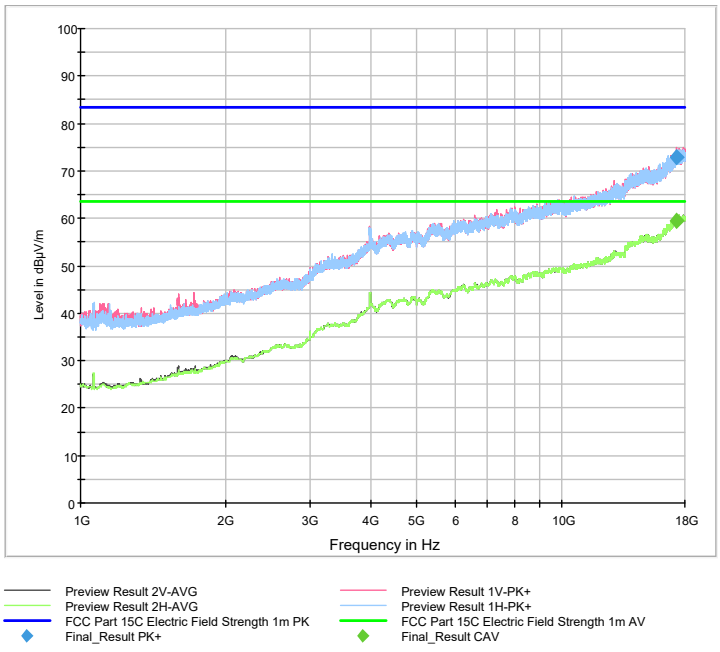
2.3.7.1 Test Results for 175 MHz bandwidth



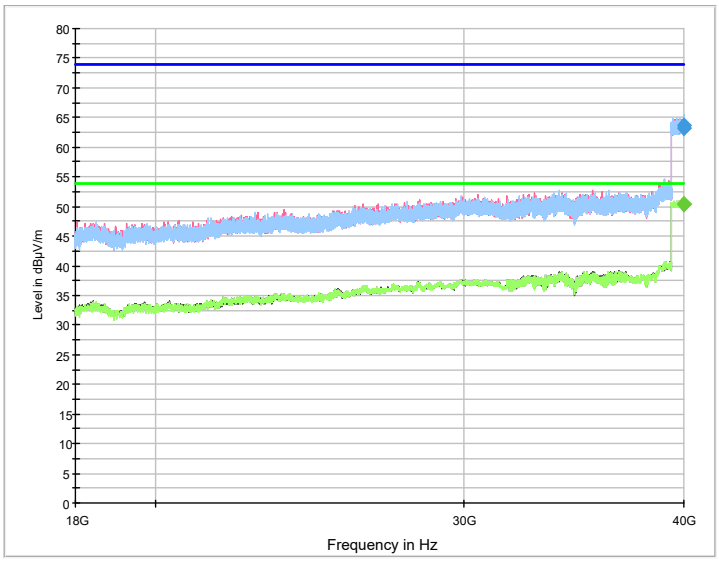
Frequency MHz	*QuasiPeak dBµV/m*	*CAverage dBµV/m*	*Limit dBµV/m*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Height cm*	*Pol*	*Azimuth deg*	*Corr. dB*
1.506750	46.26	0.00	64.04	17.78	1000	9	100.0	V	203.0	19.8



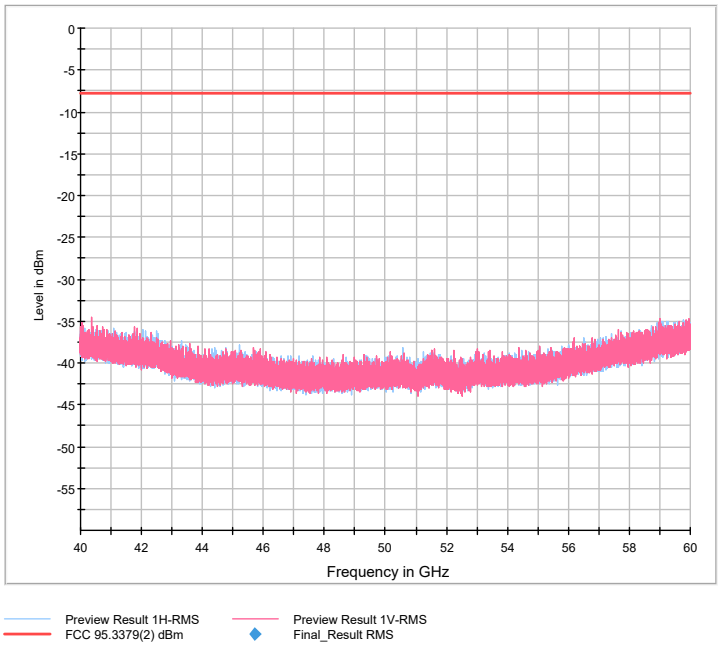
Frequency MHz	*Qua-siPeak dBµV/m*	*Limit dBµV/m*	*Mar-gin dB*	*Meas. Time ms*	*Band-width kHz*	*Height cm*	*Pol*	*Azi-muth deg*	*Corr. dB/m*
121.770000	28.14	43.50	15.36	1000	120	103.0	V	119.0	16.7
177.600000	20.29	43.50	23.21	1000	120	139.0	V	89.0	16.7
294.150000	25.17	46.02	20.85	1000	120	116.0	V	30.0	21.0

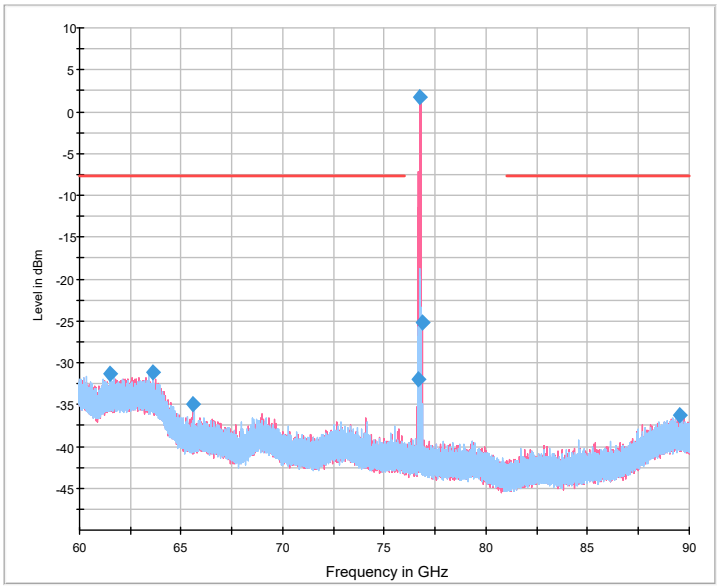


Frequency MHz	*Max-Peak dBµV/m*	*CAver-age dBµV/m*	*Limit dBµV/m*	*Mar-gin dB*	*Meas. Time ms*	*Band-width kHz*	*Height cm*	*Pol*	*Azi-muth deg*	*Corr. dB/m*
17302.750000	0.00	59.43	63.50	4.07	1000	1000	147.0	V	-113.0	58.1
17302.750000	72.78	0.00	83.50	10.72	1000	1000	147.0	V	-113.0	58.1



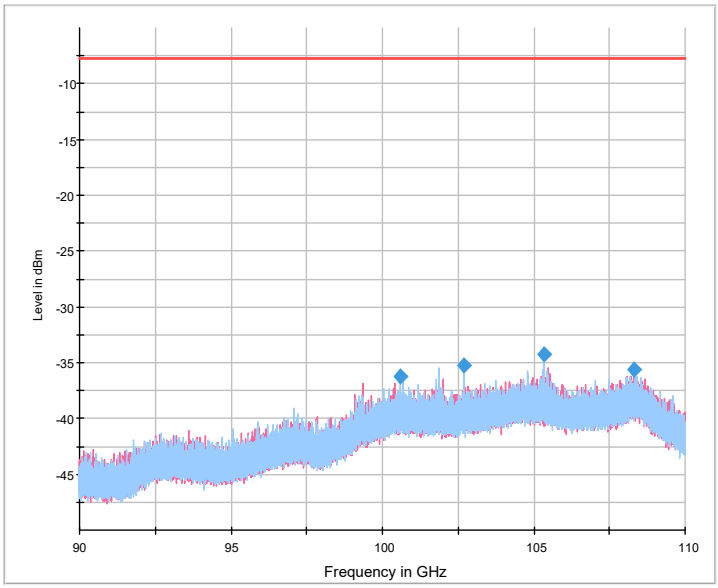
Frequency MHz	*Max-Peak dBµV/m*	*CAver-age dBµV/m*	*Limit dBµV/m*	*Mar-gin dB*	*Meas. Time ms*	*Band-width kHz*	*Height cm*	*Pol*	*Azi-muth deg*	*Corr. dB/m*
39977.750000		50.41	53.98	3.57	1000	1000	125.0	H	-60.0	36.4
39977.750000	63.23		73.98	10.75	1000	1000	125.0	H	-60.0	36.4
39993.000000		50.48	53.98	3.50	1000	1000	160.0	H	-167.0	36.5
39993.000000	63.70		73.98	10.28	1000	1000	160.0	H	-167.0	36.5



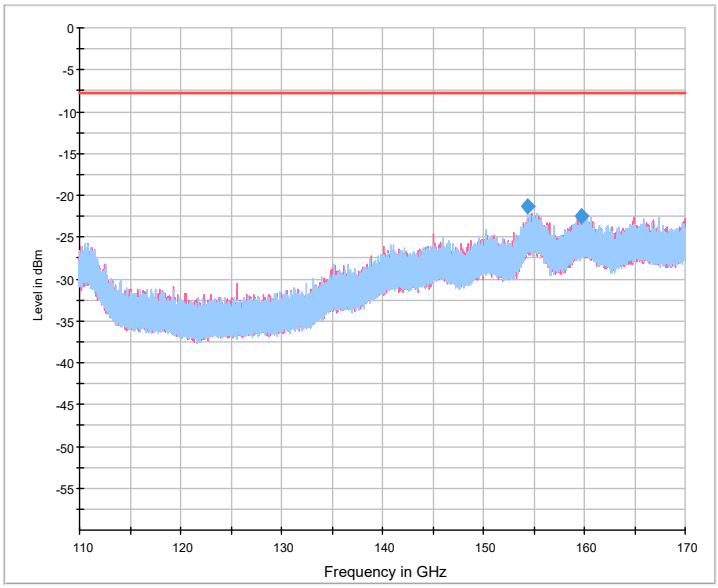


Frequency MHz	*RMS dBm*	*Limit dBm*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Height cm*	*Pol*	*Azimuth deg*	*Corr. dB*
61520.500000	-31.37	-7.70	23.67	15.0	1000	150.0	H	14.0	-63.0
63613.500000	-31.10	-7.70	23.40	15.0	1000	150.0	V	38.0	-63.0
65546.500000	-35.01	-7.70	27.31	15.0	1000	150.0	V	145.0	-63.0
76636.000000	-31.93	*		15.0	1000	150.0	V	47.0	-62.9
76727.000000	1.79	*		15.0	1000	150.0	V	0.0	-62.9
76840.500000	-25.29	*		15.0	1000	150.0	V	285.0	-62.9
89544.000000	-36.25	-7.70	28.55	15.0	1000	150.0	V	121.0	-62.7

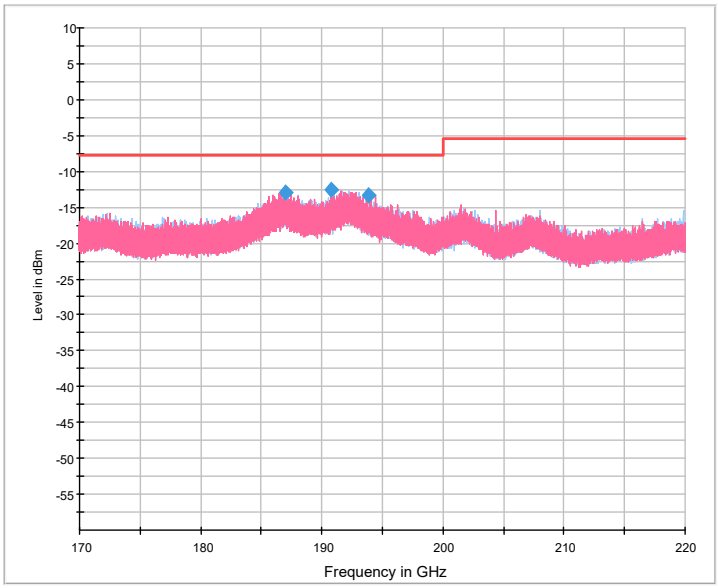
*: Carrier emission within the designated frequency band – not evaluated as spurious emission



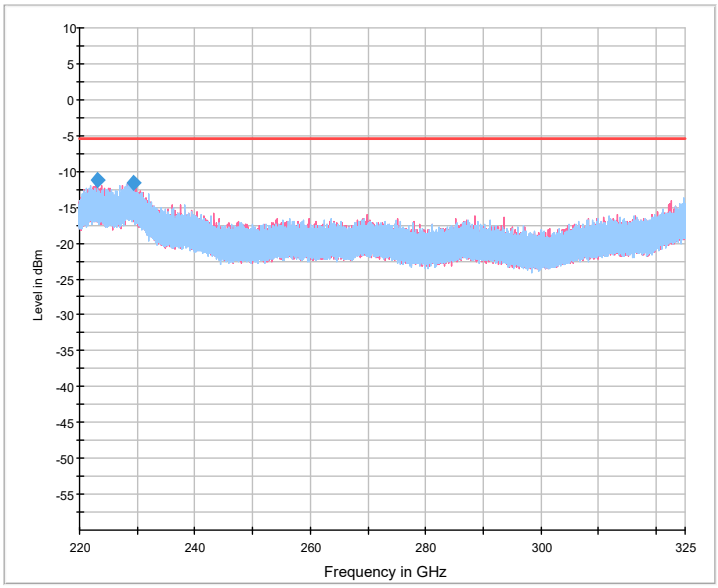
Frequency *MHz*	*RMS* *dBm*	*Limit* *dBm*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
100607.000000	-36.20	-7.70	28.50	2.5	1000	150.0	H	89.0	-67.1
102687.000000	-35.24	-7.70	27.54	2.5	1000	150.0	H	72.0	-67.1
105322.000000	-34.27	-7.70	26.57	2.5	1000	150.0	H	24.0	-67.1
108322.500000	-35.57	-7.70	27.87	2.5	1000	150.0	V	252.0	-67.0



Frequency *MHz*	*RMS* *dBm*	*Limit* *dBm*	*Mar-gin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azi-muth* *deg*	*Corr.* *dB*
154413.000000	-21.36	-7.70	13.66	2.5	1000.000	150.0	H	176.0	-54.8
159712.500000	-22.48	-7.70	14.78	2.5	1000.000	150.0	V	277.0	-54.5



Frequency *MHz*	*RMS* *dBm*	*Limit* *dBm*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
187004.500000	-12.86	-7.70	5.15	2.5	1000	150.0	H	170.0	-50
190827.000000	-12.54	-7.70	4.83	2.5	1000	150.0	V	243.0	-50
193829.500000	-13.37	-7.70	5.67	2.5	1000	150.0	H	105.0	-50



Frequency *MHz*	*RMS* *dBm*	*Limit* *dBm*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
223007.725000	-11.19	-5.49	5.70	2.5	1000	150.0	V	261.0	-51.8
229251.550000	-11.66	-5.49	6.18	2.5	1000	150.0	H	0.0	-51.8