

Test report

396135-1R1TRFWL

Date of issue: July 15, 2021

Applicant:

Texas Instruments Incorporated

Product:

Intelligent mmWave sensor antenna-on-package (AoP) Evaluation

Model:

IWR6843AOPEVM

Specifications:

- ◆ FCC 47 CFR Part 15.255 Subpart C
- Operation within the band 57 – 71 GHz.

Lab and test locations

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Reviewed by	James Cunningham, EMC/MIL/WL Supervisor
Review date	July 15, 2021
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko USA's ISO/IEC 17025 accreditation.

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Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15.255, Subpart C
ANSI C63.10-2013

Title 47: Telecommunication; Part 15C— Operation within the band 57 – 71 GHz
American National Standard of procedures for compliance testing of unlicensed wireless devices

1.2 Exclusions

None

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Test report revision history

Table 1.4-1: Test report revision history

Revision #	Details of changes made to test report
396135-1TRFWL	Original report issued
396135-1R1TRFWL	Section 7.1.3 was corrected from 7 dBi declared by manufacturer to 5 dBi.

Notes: None

Section 2 Summary of test results

2.1 Emissions Test results

Table 2.1-1: FCC 47 CFR Part 15.203 results.

Test description	Verdict
Antenna requirement	Pass
Notes: None	

Table 2.1-2 FCC 47 CFR Part 15.255C results.

Test description	Verdict
Equivalent Isotropically Radiated Power (E.I.R.P.)	Pass
Occupied Bandwidth	Pass
Peak conducted output power	Pass
Transmitter spurious emissions	Pass
Frequency stability	Pass
Notes: None	

Table 2.1-3 FCC 47 CFR Part 15.207 results.

Test description	Verdict
AC Line conducted emissions	Pass
Notes: None	

Section 3 Equipment under test (EUT) details

3.1 Applicant

Company name	Texas Instruments Incorporated
Address	12500 TI Boulevard MS K1-20
City	Dallas
State	TX
Postal/Zip code	75243
Country	USA

3.2 Manufacturer

Company name	Texas Instruments Incorporated
Address	12500 TI Boulevard MS K1-20
City	Dallas
State	TX
Postal/Zip code	75243
Country	USA

3.3 Sample information

Receipt date	February 13, 2020
Nemko sample ID number	NEx: 396135

3.4 EUT information

Product name	Intelligent mmWave sensor antenna-on-package (AoP) Evaluation Board
Model	IWR6843AOPEVM
Model variant	N/A
Serial number	5119910017
Power requirements	5 VDC
Description/theory of operation	The IWR6843 antenna-on-package (AoP) evaluation module (EVM) is an easy-to-use mmWave sensor EVM with integrated, short-range, wide field-of-view (FoV) AoP technology, which enables direct connectivity to the mmWave sensors carrier card platform (MMWAVEICBOOST) and allows for stand-alone use. IWR6843AOPEVM enables access to point-cloud data through a USB interface and raw analog-to-digital converter (ADC) data through a 60-pin high-speed connector. This kit is supported by standard mmWave tools and software, including mmWave studio (MMWAVE-STUDIO) and the mmWave software development kit (MMWAVE-SDK). IWR6843AOPEVM with MMWAVEICBOOST can interface with the TI MCU LaunchPad™ ecosystem.
Operational frequencies	Channel 1: 61-61.5 GHz (300 MHz BW) Channel 2: 57-64 GHz (1.3 GHz BW) Channel 3: 57-64 GHz (4 GHz BW)
Software details	N/A

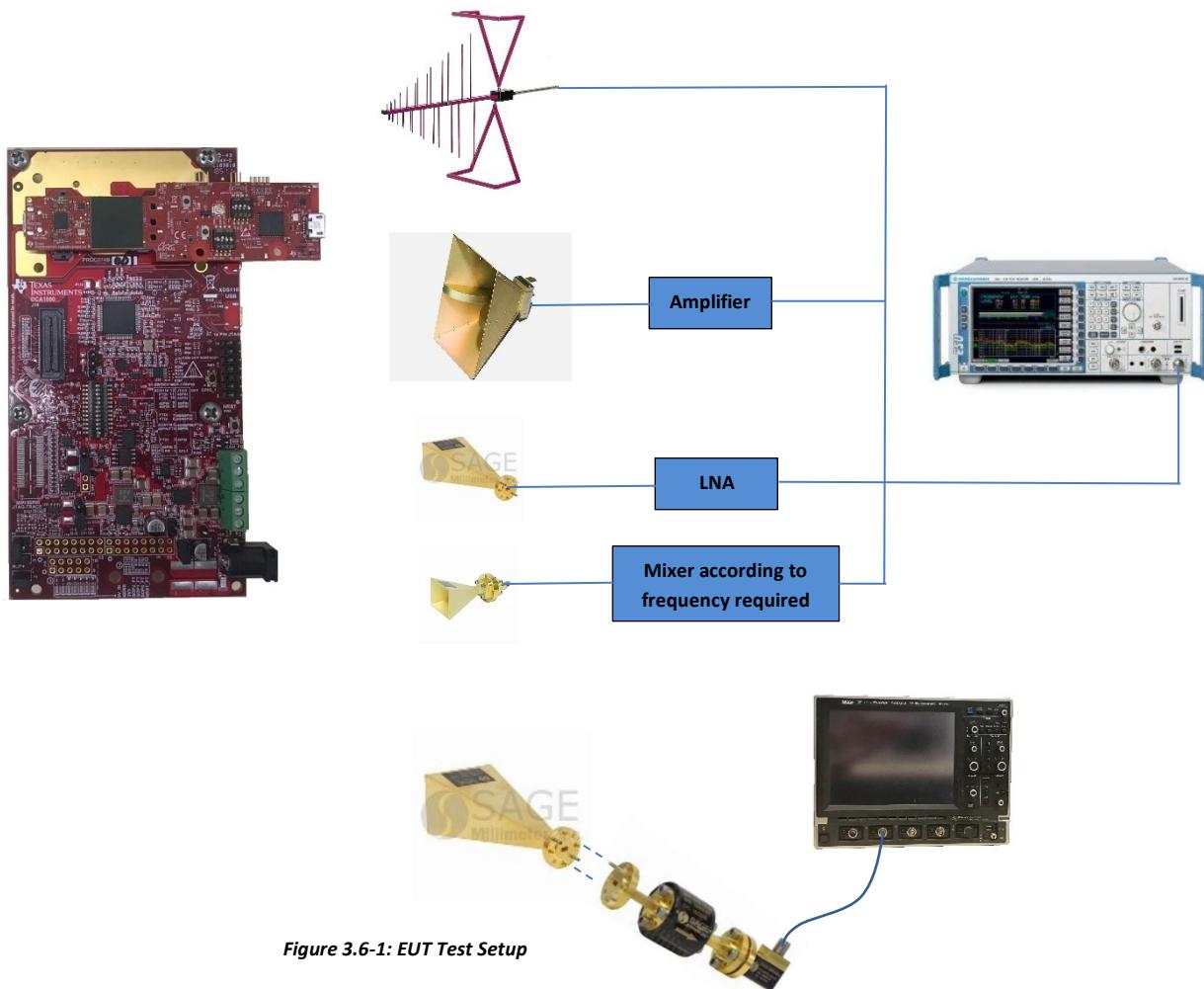
3.5 EUT exercise and monitoring details

For this test, each channel was established through software provided by client (mmWave) using two USB cables connected between the EUT and a laptop. The signal was monitored with a spectrum analyzer using the adequate settings for each channel. Once the chosen channel is activated, the unit runs in a continuous mode.

3.6 EUT setup details

Table 3.6-1: Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
Laptop	Dell	Latitude	N/A	N/A
AC Adapter	Cui Inc.	SWI18-5-N	N/A	N/A



Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Table 6.1-1: Measurement uncertainty.

Test name	Measurement uncertainty, dB
All antenna port measurements/ including OBW	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	1.38
Supply Voltages	0.05%
Time	2.09%

Important note: All testing in this document were done using the maximum radiation side of the antenna for covering the worst case in all the measurements.

Section 7 Testing data

7.1 Equivalent Isotropically Radiated Power (E.I.R.P.)

7.1.1 References

- (2) For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.
- (3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (c)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed -10 dBm and the peak EIRP level shall not exceed 10 dBm.
- (4) The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

7.1.2 Test summary

Verdict	Pass		
Test date	June 9, 2021	Temperature	21 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1003 mbar
Test location	3m semi anechoic chamber	Relative humidity	48 %

7.1.3 Notes

This test performed using the procedure described in ANSI C63.10-2013, section 9.11. The procedure indicates several steps using a measurement from EUT through a test antenna, a RF detector, and a digital oscilloscope. A substitution method is used replacing the EUT by a mmWave source to match the delivered power by mmWave source to the EUT. From this data, some calculations were performed to determine the EIRP (peak and average for signals with bandwidth equal or less than 500 MHz and within 61 – 61.5 GHz band. Peak for other bandwidths.) and the conducted power from equation (19), (22), (24) and (27) from ANSI C63.10-2013. Antenna gain from EUT declared by manufacturer: 5 dBi; Gain of the test antenna: 24 dBi

Three different scripts were provided by manufacturer corresponding to each occupied bandwidth tested: 300 MHz, 1300 MHz, and 4000 MHz.

7.1.4 Setup details

EUT setup configuration	Tabletop
Test facility	3M Semi anechoic chamber
Measuring distance	0.5 m (300 MHz); 0.055 m (1300 MHz); 0.038 m (4000 MHz)
Antenna height variation	1.62 m
Turn table position	0°
Measurement details	The EUT was measured in the maximum field strength emission.

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak and CAverage
Trace mode	Max Hold

Table 7.1-1: Radiated EIRP equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Signal analyzer	Rohde & Schwarz	FSV40	E1120	11-19-2019	11-19-2021
Mixer	Rohde & Schwarz	FS-Z75	E1149	NCR	NCR
Signal generator	Rohde & Schwarz	SMB100A	E1128	12-14-2020	12-14-2021
Digital oscilloscope	LeCroy	WS64MXS-B	E1041	12-18-2020	12-18-2021
V-Band X2, Passive Frequency Multiplier	Sage	SFP-152KF-S2	N/A	NCR	NCR
RF Detector	Eravant	STD-15SF-PI	E1310	NCR	NCR

Notes: NCR - no calibration required

7.1.5 Test data

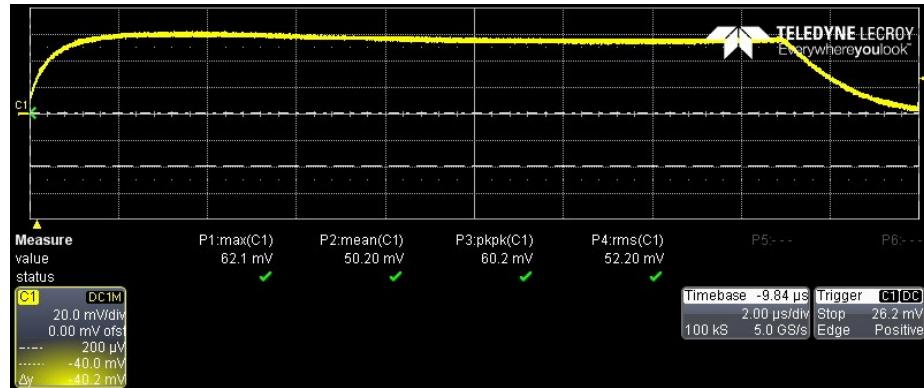


Figure 7.1-1: 300 MHz occupied bandwidth signal, view on oscilloscope.

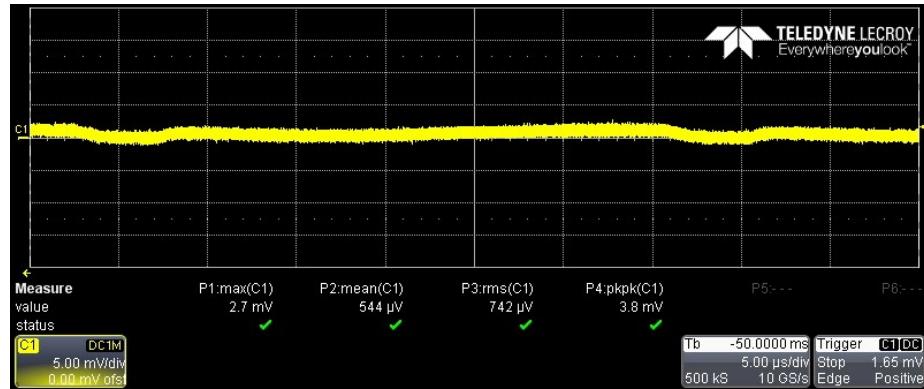


Figure 7.1-2: 1300 MHz occupied bandwidth signal, view on oscilloscope.

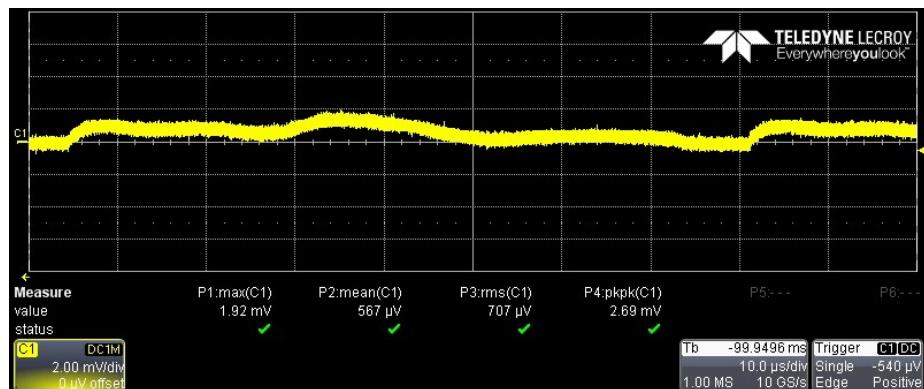


Figure 7.1-3: 4000 MHz occupied bandwidth signal, view on oscilloscope.

7.1.5 Test data, continued

Center Frequency (GHz)	Bandwidth (MHz)	Power (dBm)	Radiated Power (dBμV/m) (Calculated – see example below)	EIRP (dBm) (Calculated – see example below)	Limit (dBm)	Margin (dB)
61.25785 (Peak)	300	-18.42	130.581	19.861	+43	23.139
61.25785 (Av)		-19.19	129.811	19.091	+40	20.909
60.9212431 (Peak)	1300	-37.93	111.023	-18.870	+10	28.870
62.8373485 (Peak)	4000	-34.52	114.702	-18.403	+10	28.403

Table 7.1-2: EIRP Results: 300 MHz, 1300 MHz, and 4000 MHz.

Using equation (19):

$$E = 126.8 - 20 \log(\lambda) + P - G \quad (19)$$

Where:

$$\lambda = \frac{c}{f}$$

c=3X10⁸ m/s

E = Field strength of the emission at the measurement distance, in dBμV/m

P = Power measured at the output of the test antenna, in dBm

λ = Wavelength of the emission under investigation, in m.

G = Gain of the antenna test, in dBi

$$E = 126.8 - (20 * \log(3e8 / 61.257858e9)) + (-18.42) - (24) = 130.581 \text{ dBμV/m}$$

Using equation (22):

$$\text{EIRP} = E_{\text{Meas}} + 20 \log(d_{\text{Meas}}) - 104.7 \quad (22)$$

EIRP = Equivalent Isotropically Radiated Power, in dBm

E_{meas} = Field strength of the emission at the measurement distance, in dBμV/m

d_{meas} = Measurement distance, in m (0.5 m in this case)

$$\text{EIRP} = 130.581 + (20 * \log(0.5)) - 104.7$$

$$\text{EIRP} = 19.861 \text{ dBm}$$

7.2 Occupied bandwidth

7.2.1 References

§15.255 Operation within the band 57-71 GHz.

(e)(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

ANSI C63.4-2014

7.2.2 Test summary

Verdict	Pass		
Test date	May 18, 2020	Temperature	22 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1004 mbar
Test location	3m semi anechoic chamber	Relative humidity	64 %

7.2.3 Notes

7.2.4 Setup details

7.2.5 Setup details

EUT setup configuration	Tabletop
Test facility	3M Semi anechoic chamber
Measuring distance	3 m
Antenna height variation	1.62 m
Turn table position	0°

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	100 kHz (6 dB OBW) and 3 MHz - 10 MHz ¹ (99% OBW)
Video bandwidth	300 kHz (6 dB OBW) and 10 MHz - 40 MHz ¹ (99% OBW)
Detector mode	Peak (Preview measurement)
Trace mode	Max Hold

Note: ¹This value is the maximum RBW supported by used equipment.

7.2.5 Setup details, continued

Table 7.2-1: Occupied bandwidth equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Signal analyzer	Rohde & Schwarz	FSV40	E1120	11-19-2019	11-19-2020
Mixer	Rohde & Schwarz	FS-Z75	E1149	03-07-2019	03-07-2021

Notes: NCR - no calibration required

7.2.6 Test data

Center Frequency (GHz)	Bandwidth (MHz)	6 dB BW (MHz)	99% BW (MHz)
61.258	300	282.272	282.572
60.924	1300	1259.661	1264.454
62.124	4000	3649.640	3636.886

Table 7.2-2: Occupied Bandwidth Results: 300 MHz, 1300 MHz and 4000 MHz.

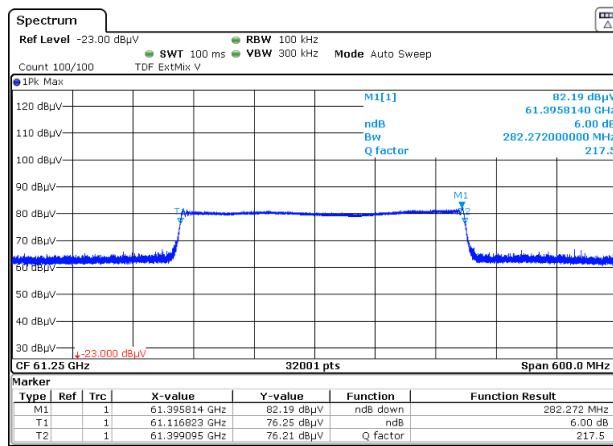


Figure 7.2-1: 6 dB OBW: 300 MHz bandwidth

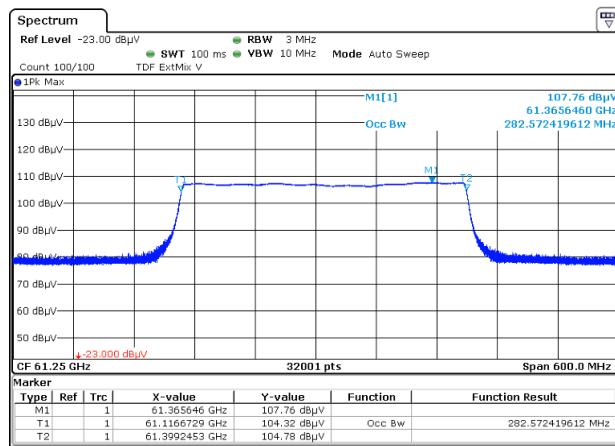


Figure 7.2-2: 99% OBW: 300 MHz bandwidth

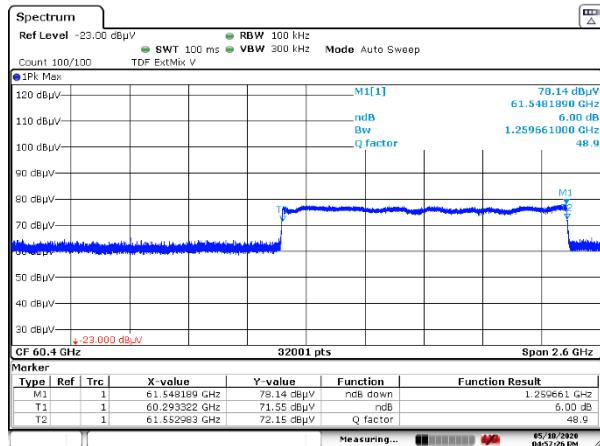


Figure 7.2-3: 6 dB OBW: 1300 MHz bandwidth

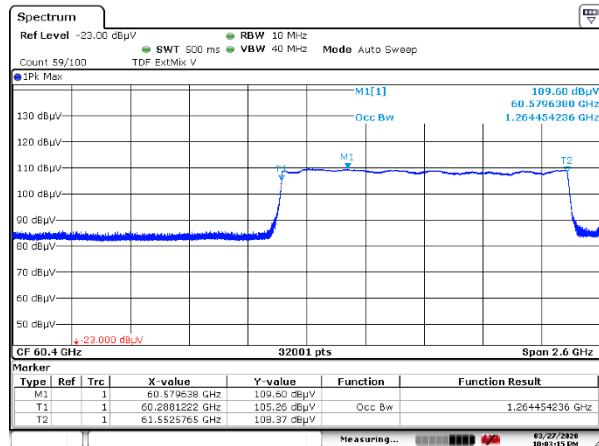


Figure 7.2-4: 99% OBW: 1300 MHz bandwidth

7.2.6 Test data, continued

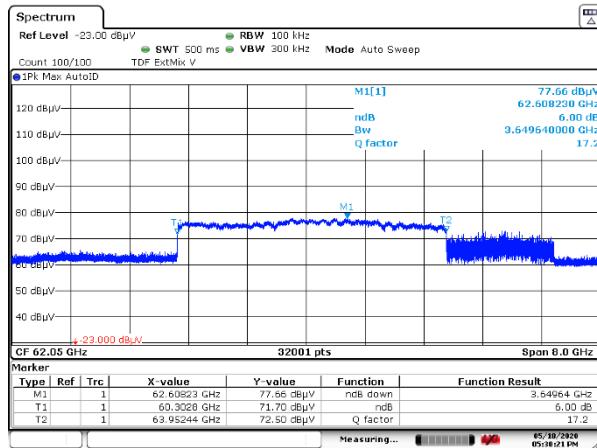


Figure 7.2-5: 6 dB OBW: 4000 MHz bandwidth

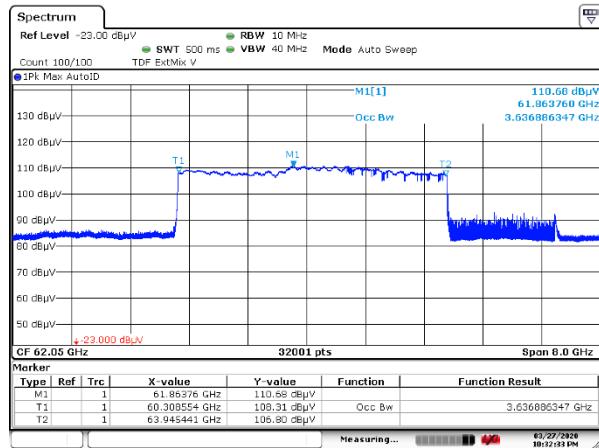


Figure 7.2-6: 99% OBW: 4000 MHz bandwidth

7.3 Peak conducted output power

7.3.1 References

§15.255 Operation within the band 57-71 GHz.

(3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (c)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed -10 dBm and the peak EIRP level shall not exceed 10 dBm ANSI C63.4-2014

7.3.2 Test summary

Verdict	Pass		
Test date	June 9, 2021	Temperature	21 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1003 mbar
Test location	3m semi anechoic chamber	Relative humidity	48 %

7.3.3 Notes

None

7.3.4 Setup details

EUT setup configuration	Tabletop
Test facility	3M Semi anechoic chamber
Measuring distance	0.5 m (300 MHz); 0.055 m (1300 MHz); 0.038 m (4000 MHz)
Antenna height variation	1.62 m
Turn table position	0°
Measurement details	The EUT was measured in the maximum field strength emission.

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak and CAverage
Trace mode	Max Hold

7.3.4 Setup details, continued

Table 7.3-1: Peak conducted output power equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Signal analyzer	Rohde & Schwarz	FSV40	E1120	11-19-2019	11-19-2021
Mixer	Rohde & Schwarz	FS-Z75	E1149	NCR	NCR
Signal generator	Rohde & Schwarz	SMB100A	E1128	12-14-2020	12-14-2021
Digital oscilloscope	LeCroy	WS64MXS-B	E1041	12-18-2020	12-18-2021
V-Band X2, Passive Frequency Multiplier	Sage	SFP-152KF-S2	N/A	NCR	NCR
RF Detector	Eravant	STD-15SF-PI	E1310	NCR	NCR

Notes: NCR - no calibration required

7.3.5 Test data

These results were calculated by subtracting the maximum antenna gain declared by manufacturer from the EIRP

Center Frequency (GHz)	Bandwidth (MHz)	EIRP (dBm)	Antenna Gain (dBi)	PK Conducted power (dBm)	PK Conducted power (mW)	Limit (dBm)	Margin (dBm)
61.257	300	19.861	5	14.861	30.627	No limit	
60.921	1300	-18.870	5	-23.870	0.00410	-10	13.870
62.837	4000	-18.403	5	-23.403	0.00456	-10	13.403

Table 7.3-2: Peak conducted output power results: 300 MHz, 1300 MHz and 4000 MHz.

7.4 Transmitter spurious emissions

7.4.1 References

§15.255 Operation within the band 57-71 GHz.

(d) Limits on spurious emissions:

- (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

ANSI C63.4-2014

Spurious radiated emissions below 40 GHz must comply with the general field strength limits of Section 15.209. Below 1000 MHz, measurements are made with a CISPR quasi-peak detector and above 1000 MHz measurements are made with an average detector with a 1 MHz RBW at 3 meters. From 40 GHz to 200 GHz the emissions must not exceed 90 pW/cm² (18,000 μV/m) at 3 meters. Measurements are to be performed at the specified limit distance. If it is impractical to make measurements at the limit distance because of the distance or low signal levels, measurements may be performed at a closer distance but a low noise amplifier and/or a higher gain test antenna should be used to make measurements at the greatest distance from the EUT which provides an adequate signal to noise ratio to permit accurate amplitude measurements and extrapolated to the limit distance as specified in Section 15.31.

200443 D02 RF Detector Method v01

7.4.2 Test summary

Verdict	Pass		
Test date	March 25, 2020; March 26, 2020; March 27, 2020;	Temperature	25;24;23 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1001;1005;1006 mbar
Test location	3m semi anechoic chamber	Relative humidity	45;34; 50 %

7.4.3 Notes

This test was done at a 3m measurement distance using the maximum radiated energy from the EUT. The spectrum was explored from 30 MHz to 200 GHz. Calculation from limit line for this test:

$$PD = \frac{EIRP_{Linear}}{4\pi d^2}$$

Where:

PD = Power density at the distance specified by the limit, in w/cm²

EIRP_{Linear} = Equivalent Isotropically Radiated Power, in watts.

d = Distance at which the power density limit is specified, in cm

$$EIRP_{Linear} = (PD)(4\pi)(d^2)$$

$$EIRP_{Linear} = (90 \times 10^{-12})(4\pi)(300^2)$$

$$EIRP_{Linear} = 0.10178 \text{ mw} \approx 85.31 \text{ dB}\mu\text{V/m} @ 3m$$

This limit was used from 40 GHz to 140 GHz. From 140 GHz to 200 GHz, the noise floor is less than 6 dB below the limit calculated at 3m. To compensate this problem, an extrapolation to a shorter distance was done. The new distance is 1 m and the new limit line is:

$$E_{SpecLimit} = E_{Meas} + 20 \log \left(\frac{d_{Meas}}{d_{SpecLimit}} \right)$$

$$E_{SpecLimit} = 85.31 + 20 \log \left(\frac{3}{1} \right) \approx 94.85 \text{ dB}\mu\text{V/m} @ 1m$$

7.4.4 Setup details

EUT setup configuration	Table top
Test facility	3m Semi anechoic chamber
Measuring distance	3m
Antenna height variation	1–4 m
Turn table position	0–360°
Measurement details	A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver/spectrum analyzer settings for frequencies below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	<ul style="list-style-type: none"> – Peak (Preview measurement) – Quasi-peak (Final measurement)
Trace mode	Max Hold
Measurement time	<ul style="list-style-type: none"> – 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak final measurement)

Receiver/spectrum analyzer settings for frequencies from 1 GHz to 40 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	<ul style="list-style-type: none"> Peak (Preview measurement) Peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	<ul style="list-style-type: none"> – 100 ms (Peak preview measurement) – 5000 ms (Peak and CAverage final measurement)

Receiver/spectrum analyzer settings for frequencies above 40 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Average
Trace mode	Max Hold
Measuring distance	1m
Antenna height	1.62 m
Turn table position	0°

Table 7.4-1: Radiated disturbance equipment list

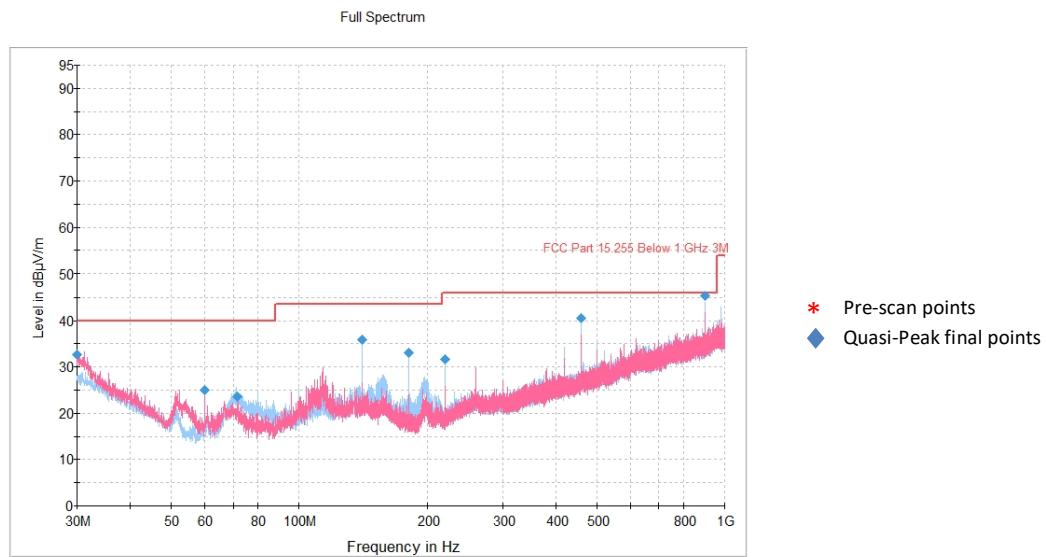
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	05-25-2018	05-25-2020
Signal Analyzer	Rohde & Schwarz	FSV 40	E1120	11-19-2019	11-19-2020
Signal Generator	Rohde & Schwarz	SMB 100A	E1128	12-23-2019	12-23-2020
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	04-18-2019	10-18-2020
Antenna, Horn	ETS	3117-PA	E1139	03-21-2019	03-21-2021
Antenna, Horn	Sage Millimeter	SAR-2309-42-S2	E1143	03-05-2018	06-05-2020
Antenna, Horn	Sage Millimeter	SAR-2309-28-S2	E1148	03-13-2018	06-13-2020
Low Noise Amplifier	Sage Millimeter	SBL-1834034030-KFKF-SI	E1228	NCR	NCR
Antenna, Horn	Sage Millimeter	SAR-2309-19-S2	E1144	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z60	E1138	03-07-2019	03-07-2021
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z75	E1149	03-07-2019	03-07-2021
Antenna, Horn	Sage Millimeter	SAR-2507-10-S2	E1146	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z110	E1154	02-06-2019	02-06-2021
Antenna, Horn	Sage Millimeter	SAR-2507-06-S2	E1182	NCR	NCR
Mixer	Radiometer Physics	HM110-170	E1178	09-27-2018	09-27-2020
Antenna, Horn	Sage Millimeter	SAR-2309-05-S2	E1184	NCR	NCR
Mixer	Radiometer Physics	HM140-220	E1177	09-25-2018	09-25-2020

Table 7.4-2: Radiated disturbance test software details

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.00.00

Notes: None

7.4.5 Test data



The spectral plot shows a vertical and horizontal scan with different colors. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-1: Radiated disturbance spectral plot (30 to 1000 MHz): 300 MHz OBW

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.000000	32.63	40.00	7.37	1000.0	120.000	130.0	V	194.0	26.5
60.013000	25.01	40.00	14.99	1000.0	120.000	104.0	V	178.0	12.5
71.569667	23.63	40.00	16.37	1000.0	120.000	250.0	H	33.0	13.7
139.990333	35.98	43.50	7.52	1000.0	120.000	133.0	H	270.0	19.4
179.994333	32.98	43.50	10.52	1000.0	120.000	103.0	H	217.0	16.8
219.990667	31.58	46.00	14.42	1000.0	120.000	98.0	H	220.0	17.8
460.001000	40.54	46.00	5.46	1000.0	120.000	105.0	H	322.0	25.8
900.025333	45.39	46.00	0.61	1000.0	120.000	155.0	H	129.0	32.7

Table 7.4-3: Radiated disturbance (Quasi-Peak) results: 300 MHz OBW

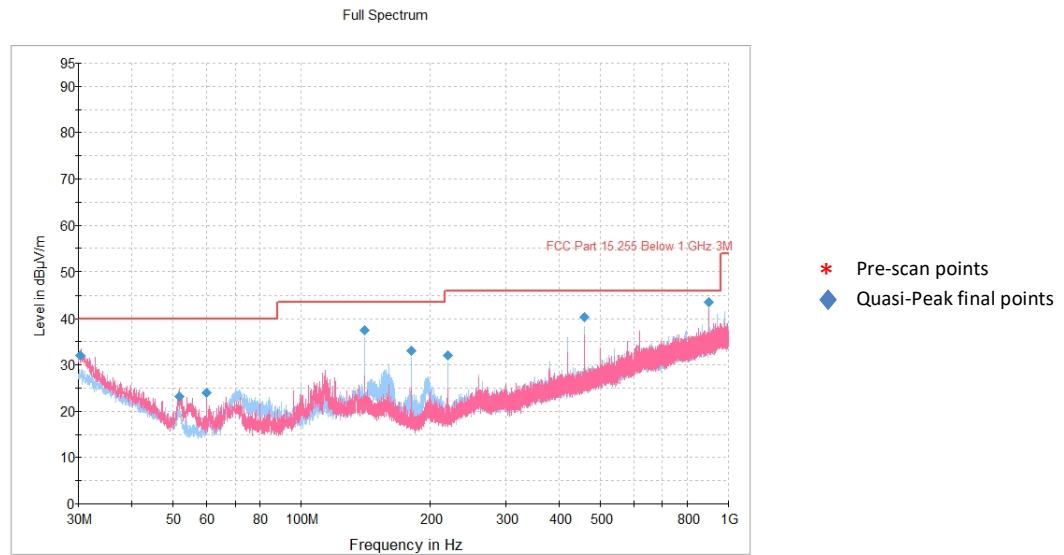
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot shows a vertical and horizontal scan with different colors. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-2: Radiated disturbance spectral plot (30 to 1000 MHz): 1300 MHz OBW

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.240000	32.03	40.00	7.97	1000.0	120.000	102.0	V	12.0	26.3
51.849667	23.11	40.00	16.89	1000.0	120.000	109.0	V	1.0	15.0
59.973000	24.08	40.00	15.92	1000.0	120.000	116.0	V	140.0	12.5
140.005667	37.42	43.50	6.08	1000.0	120.000	123.0	H	259.0	19.4
180.002000	33.03	43.50	10.47	1000.0	120.000	106.0	H	218.0	16.8
219.990667	32.12	46.00	13.88	1000.0	120.000	98.0	H	207.0	17.8
459.993333	40.27	46.00	5.73	1000.0	120.000	98.0	H	114.0	25.8
899.985333	43.58	46.00	2.42	1000.0	120.000	163.0	H	128.0	32.7

Table 7.4-4: Radiated disturbance (Quasi-Peak) results: 1300 MHz OBW

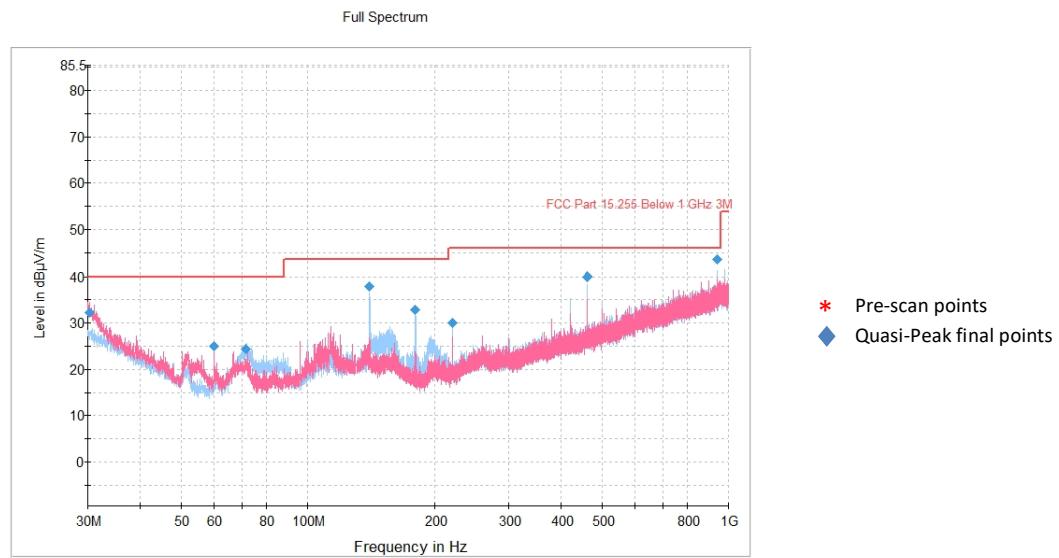
Notes:

¹ Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

² Correction factor = antenna factor ACF (dB) + cable loss (dB)

³ The maximum measured value observed over a period of 1 second was recorded.

7.4.5 Test data, continued



The spectral plot shows a vertical and horizontal scan with different colors. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-3: Radiated disturbance spectral plot (30 to 1000 MHz): 4000 MHz OBW

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.320000	32.27	40.00	7.73	1000.0	120.000	122.0	V	1.0	26.3
60.005333	24.96	40.00	15.04	1000.0	120.000	123.0	V	93.0	12.5
71.260667	24.49	40.00	15.51	1000.0	120.000	250.0	H	204.0	13.6
139.998000	37.83	43.50	5.67	1000.0	120.000	125.0	H	259.0	19.4
179.994333	32.84	43.50	10.66	1000.0	120.000	112.0	H	225.0	16.8
219.990667	30.07	46.00	15.93	1000.0	120.000	112.0	H	119.0	17.8
460.001000	39.93	46.00	6.07	1000.0	120.000	103.0	H	124.0	25.8
940.014000	43.63	46.00	2.37	1000.0	120.000	250.0	H	144.0	33.4

Table 7.4-5: Radiated disturbance (Quasi-Peak) results: 4000 MHz OBW

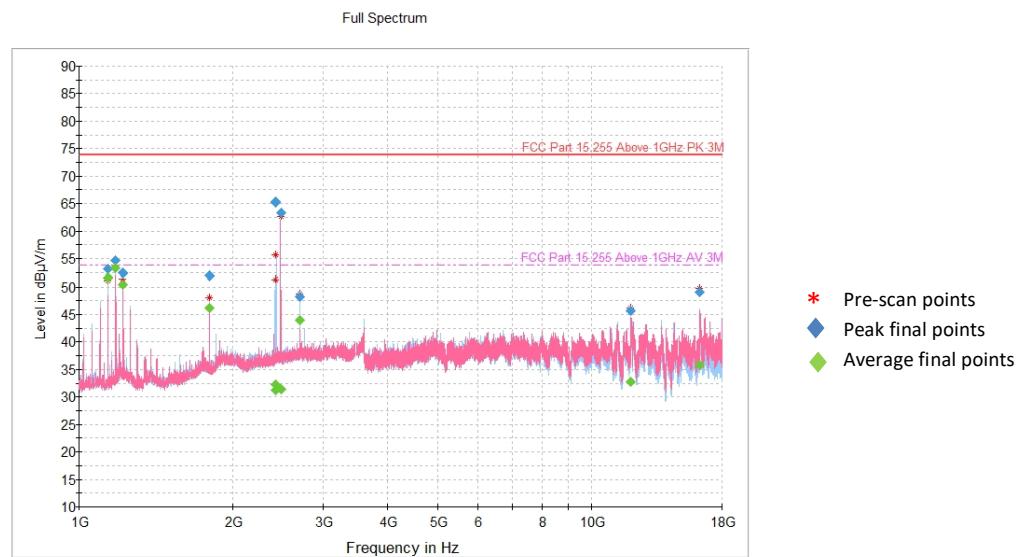
Notes:

¹ Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

² Correction factor = antenna factor ACF (dB) + cable loss (dB)

³ The maximum measured value observed over a period of 1 second was recorded.

7.4.5 Test data, continued



The spectral plot shows a vertical and horizontal scan with different colors. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-4: Radiated disturbance spectral plot (1 to 18 GHz): 300 MHz OBW

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1139.966667	53.21	---	73.90	20.69	5000.0	1000.000	127.0	H	333.0	-15.2
1139.966667	---	51.63	53.90	2.27	5000.0	1000.000	127.0	H	333.0	-15.2
1180.033333	---	53.34	53.90	0.56	5000.0	1000.000	129.0	H	344.0	-14.7
1180.033333	54.75	---	73.90	19.15	5000.0	1000.000	129.0	H	344.0	-14.7
1219.866667	---	50.37	53.90	3.53	5000.0	1000.000	115.0	H	12.0	-14.5
1219.866667	52.41	---	73.90	21.49	5000.0	1000.000	115.0	H	12.0	-14.5
1799.966667	51.99	---	73.90	21.91	5000.0	1000.000	301.0	H	199.0	-12.9
1799.966667	---	46.10	53.90	7.80	5000.0	1000.000	301.0	H	199.0	-12.9
2426.133333	65.14	---	73.90	8.76	5000.0	1000.000	243.0	H	327.0	-10.8
2426.133333	---	32.28	53.90	21.62	5000.0	1000.000	243.0	H	327.0	-10.8
2426.366667	---	31.29	53.90	22.61	5000.0	1000.000	243.0	H	324.0	-10.8
2426.366667	65.37	---	73.90	8.54	5000.0	1000.000	243.0	H	324.0	-10.8
2479.966667	63.38	---	73.90	10.52	5000.0	1000.000	105.0	V	50.0	-10.5
2479.966667	---	31.38	53.90	22.52	5000.0	1000.000	105.0	V	50.0	-10.5
2699.833333	48.26	---	73.90	25.64	5000.0	1000.000	208.0	H	213.0	-9.7
2699.833333	---	44.05	53.90	9.85	5000.0	1000.000	208.0	H	213.0	-9.7
11937.600000	---	32.73	53.90	21.17	5000.0	1000.000	325.0	V	146.0	3.4
11937.600000	45.73	---	73.90	28.17	5000.0	1000.000	325.0	V	146.0	3.4
16303.700000	49.15	---	73.90	24.75	5000.0	1000.000	162.0	H	109.0	10.3
16303.700000	---	35.79	53.90	18.11	5000.0	1000.000	162.0	H	109.0	10.3

Table 7.4-6: Radiated disturbance (Peak and CAverage) results: 300 MHz OBW

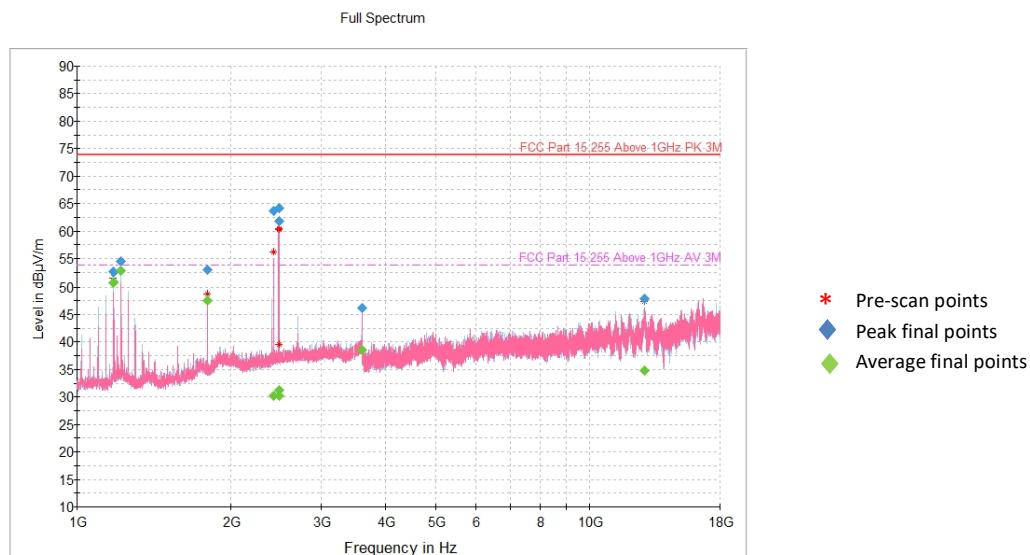
Notes:

¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

² Correction factor = antenna factor ACF (dB) + cable loss (dB) – amplifier gain (dB)

³ The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot shows a vertical and horizontal scan with different colors. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-5: Radiated disturbance spectral plot (1 to 18 GHz): 1300 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1180.033333	52.58	---	73.90	21.32	5000.0	1000.000	98.0	H	0.0	-14.7
1180.033333	---	50.79	73.90	3.11	5000.0	1000.000	98.0	H	0.0	-14.7
1219.866667	54.53	---	73.90	19.37	5000.0	1000.000	98.0	H	0.0	-14.5
1219.866667	---	52.82	73.90	1.08	5000.0	1000.000	98.0	H	0.0	-14.5
1799.966667	53.05	---	73.90	20.85	5000.0	1000.000	276.0	H	199.0	-12.9
1799.966667	---	47.48	53.90	6.42	5000.0	1000.000	276.0	H	199.0	-12.9
2425.733333	---	30.13	53.90	23.77	5000.0	1000.000	125.0	V	73.0	-10.8
2425.733333	63.69	---	73.90	10.21	5000.0	1000.000	125.0	V	73.0	-10.8
2480.133333	64.11	---	73.90	9.79	5000.0	1000.000	124.0	V	60.0	-10.5
2480.133333	---	31.26	53.90	22.64	5000.0	1000.000	124.0	V	60.0	-10.5
2480.300000	---	30.15	53.90	23.75	5000.0	1000.000	259.0	H	140.0	-10.5
2480.300000	61.75	---	73.90	12.15	5000.0	1000.000	259.0	H	140.0	-10.5
3600.100000	46.20	---	73.90	27.70	5000.0	1000.000	231.0	V	20.0	-6.3
3600.100000	---	38.58	53.90	15.32	5000.0	1000.000	231.0	V	20.0	-6.3
12830.466667	47.82	---	73.90	26.08	5000.0	1000.000	394.0	V	0.0	6.5
12830.466667	---	34.80	53.90	19.10	5000.0	1000.000	394.0	V	0.0	6.5

Table 7.4-7: Radiated disturbance (Peak and CAverage) results: 1300 MHz OBW

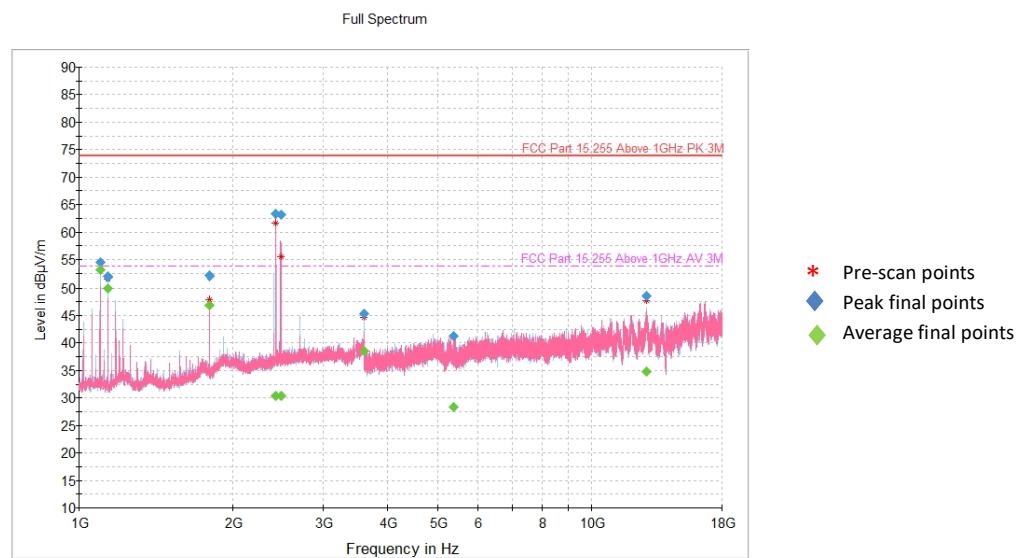
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot shows a vertical and horizontal scan with different colors. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-6: Radiated disturbance spectral plot (1 to 18 GHz): 4000 MHz OBW

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1100.133333	54.47	---	73.90	19.43	5000.0	1000.000	103.0	H	315.0	-15.4
1100.133333	---	53.17	53.90	0.73	5000.0	1000.000	103.0	H	315.0	-15.4
1140.200000	---	49.95	53.90	3.95	5000.0	1000.000	101.0	H	344.0	-15.2
1140.200000	51.90	---	73.90	22.00	5000.0	1000.000	101.0	H	344.0	-15.2
1799.966667	---	46.79	53.90	7.11	5000.0	1000.000	314.0	H	194.0	-12.9
1799.966667	52.04	---	73.90	21.86	5000.0	1000.000	314.0	H	194.0	-12.9
2426.300000	---	30.34	53.90	23.56	5000.0	1000.000	117.0	V	20.0	-10.8
2426.300000	63.38	---	73.90	10.52	5000.0	1000.000	117.0	V	20.0	-10.8
2480.366667	63.22	---	73.90	10.68	5000.0	1000.000	184.0	V	16.0	-10.5
2480.366667	---	30.36	53.90	23.54	5000.0	1000.000	184.0	V	16.0	-10.5
3600.100000	---	38.56	53.90	15.34	5000.0	1000.000	236.0	H	12.0	-6.3
3600.100000	45.41	---	73.90	28.49	5000.0	1000.000	236.0	H	12.0	-6.3
5383.900000	---	28.31	53.90	25.59	5000.0	1000.000	402.0	V	32.0	-3.3
5383.900000	41.25	---	73.90	32.65	5000.0	1000.000	402.0	V	32.0	-3.3
12805.100000	---	34.74	53.90	19.16	5000.0	1000.000	293.0	H	178.0	6.5
12805.100000	48.59	---	73.90	25.31	5000.0	1000.000	293.0	H	178.0	6.5

Table 7.4-8: Radiated disturbance (Peak and CAverage) results: 4000 MHz OBW

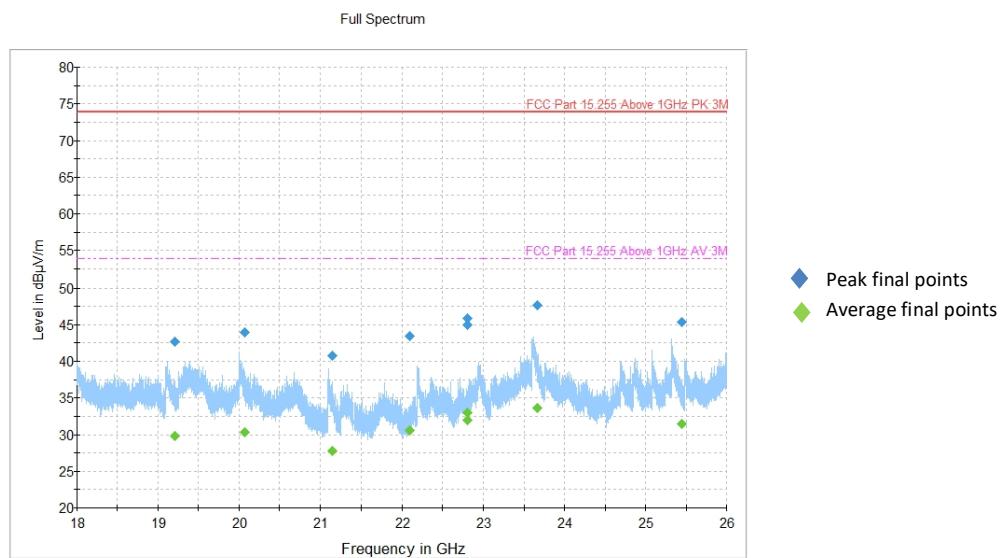
Notes:

¹Field strength (dBμV/m) = receiver/spectrum analyzer value (dBμV) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-7: Radiated disturbance spectral plot (18 to 26 GHz): 300 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19211.334333	42.69	---	73.90	31.21	5000.0	1000.000	386.0	V	0.0	14.1
19211.334333	---	29.82	53.90	24.08	5000.0	1000.000	386.0	V	0.0	14.1
20073.990000	43.97	---	73.90	29.93	5000.0	1000.000	389.0	H	0.0	13.5
20073.990000	---	30.28	53.90	23.62	5000.0	1000.000	389.0	H	0.0	13.5
21150.873167	40.83	---	73.90	33.07	5000.0	1000.000	199.0	V	354.0	14.0
21150.873167	---	27.80	53.90	26.10	5000.0	1000.000	199.0	V	354.0	14.0
22094.640500	---	30.51	53.90	23.39	5000.0	1000.000	251.0	V	192.0	15.3
22094.640500	43.42	---	73.90	30.48	5000.0	1000.000	251.0	V	192.0	15.3
22809.101667	45.91	---	73.90	27.99	5000.0	1000.000	285.0	V	21.0	17.0
22809.101667	---	32.02	53.90	21.88	5000.0	1000.000	285.0	V	21.0	17.0
22809.101667	---	33.05	53.90	20.85	5000.0	1000.000	285.0	V	21.0	17.0
22809.101667	44.94	---	73.90	28.96	5000.0	1000.000	285.0	V	21.0	17.0
23661.864833	47.69	---	73.90	26.21	5000.0	1000.000	109.0	V	146.0	19.9
23661.864833	---	33.62	53.90	20.28	5000.0	1000.000	109.0	V	146.0	19.9
25451.269000	45.32	---	73.90	28.58	5000.0	1000.000	369.0	V	305.0	18.9
25451.269000	---	31.43	53.90	22.47	5000.0	1000.000	369.0	V	305.0	18.9

Table 7.4-9: Radiated disturbance (Peak and CAverage) results: 300 MHz OBW

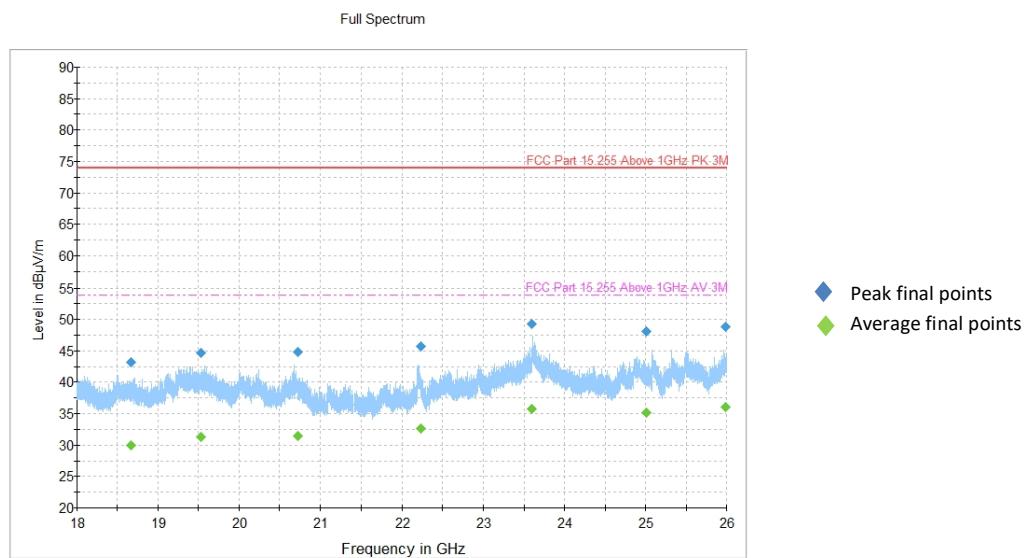
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-8: Radiated disturbance spectral plot (18 to 26 GHz): 1300 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18668.044500	---	30.00	53.90	23.90	5000.0	1000.000	343.0	H	188.0	14.3
18668.044500	43.17	---	73.90	30.73	5000.0	1000.000	343.0	H	188.0	14.3
19531.315167	44.66	---	73.90	29.24	5000.0	1000.000	248.0	V	238.0	14.0
19531.315167	---	31.36	53.90	22.54	5000.0	1000.000	248.0	V	238.0	14.0
20721.595000	---	31.45	53.90	22.45	5000.0	1000.000	219.0	H	127.0	15.9
20721.595000	44.76	---	73.90	29.14	5000.0	1000.000	219.0	H	127.0	15.9
22225.081000	---	32.67	53.90	21.23	5000.0	1000.000	364.0	V	338.0	15.8
22225.081000	45.66	---	73.90	28.24	5000.0	1000.000	364.0	V	338.0	15.8
23601.668500	49.30	---	73.90	24.60	5000.0	1000.000	402.0	H	264.0	20.4
23601.668500	---	35.73	53.90	18.17	5000.0	1000.000	402.0	H	264.0	20.4
25007.743000	48.09	---	73.90	25.81	5000.0	1000.000	281.0	V	163.0	19.0
25007.743000	---	35.09	53.90	18.81	5000.0	1000.000	281.0	V	163.0	19.0
25988.307000	---	36.11	53.90	17.79	5000.0	1000.000	112.0	V	0.0	20.5
25988.307000	48.88	---	73.90	25.02	5000.0	1000.000	112.0	V	0.0	20.5

Table 7.4-10: Radiated disturbance (Peak and CAverage) results: 1300 MHz OBW

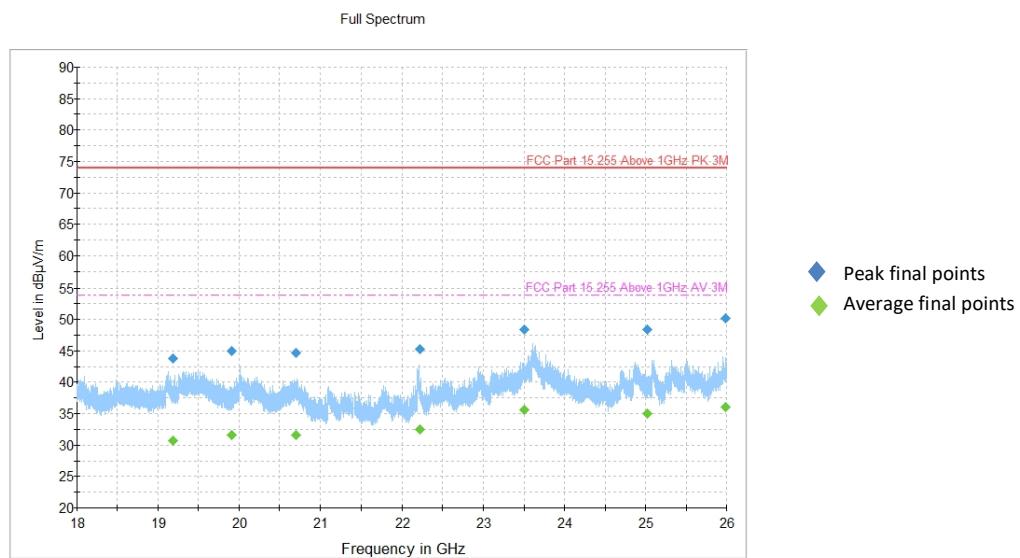
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-9: Radiated disturbance spectral plot (18 to 26 GHz): 4000 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19178.324000	---	30.63	53.90	23.27	5000.0	1000.000	274.0	V	20.0	13.8
19178.324000	43.76	---	73.90	30.14	5000.0	1000.000	274.0	V	20.0	13.8
19911.424167	---	31.66	53.90	22.24	5000.0	1000.000	376.0	V	201.0	13.5
19911.424167	44.97	---	73.90	28.93	5000.0	1000.000	376.0	V	201.0	13.5
20700.108667	44.63	---	73.90	29.27	5000.0	1000.000	152.0	H	254.0	15.9
20700.108667	---	31.59	53.90	22.31	5000.0	1000.000	152.0	H	254.0	15.9
22213.849167	---	32.55	53.90	21.35	5000.0	1000.000	209.0	H	0.0	15.9
22213.849167	45.20	---	73.90	28.70	5000.0	1000.000	209.0	H	0.0	15.9
23502.904333	48.44	---	73.90	25.46	5000.0	1000.000	260.0	V	168.0	20.3
23502.904333	---	35.56	53.90	18.34	5000.0	1000.000	260.0	V	168.0	20.3
25025.763667	48.36	---	73.90	25.54	5000.0	1000.000	169.0	V	28.0	19.1
25025.763667	---	35.06	53.90	18.84	5000.0	1000.000	169.0	V	28.0	19.1
25991.166833	---	36.09	53.90	17.81	5000.0	1000.000	328.0	V	78.0	20.5
25991.166833	50.12	---	73.90	23.78	5000.0	1000.000	328.0	V	78.0	20.5

Table 7.4-11: Radiated disturbance (Peak and CAverage) results: 4000 MHz OBW

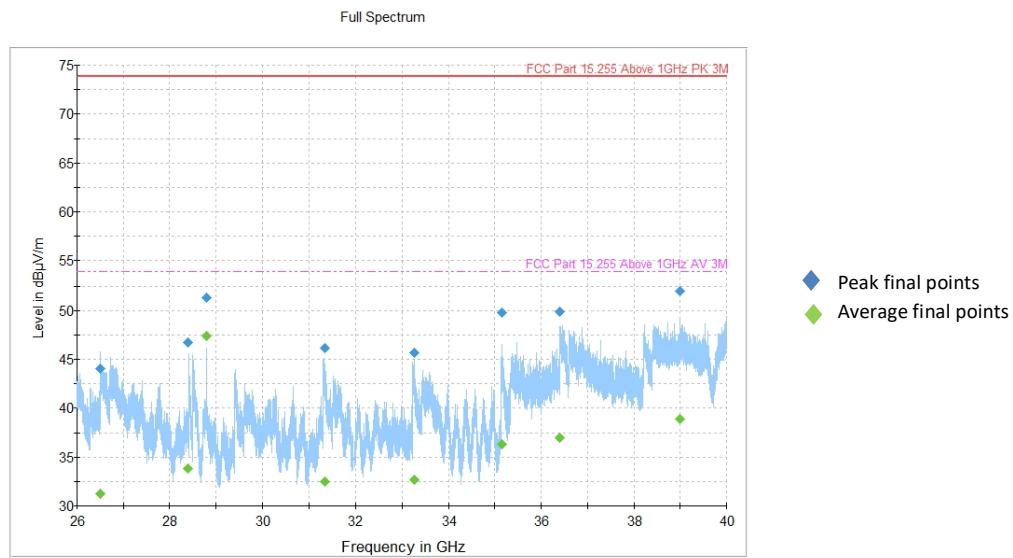
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-10: Radiated disturbance spectral plot (26 to 40 GHz): 300 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26504.666667	---	31.21	53.90	22.69	5000.0	1000.000	116.0	V	221.0	8.2
26504.666667	44.07	---	73.90	29.83	5000.0	1000.000	116.0	V	221.0	8.2
28401.933333	---	33.81	53.90	20.09	5000.0	1000.000	101.0	V	237.0	11.0
28401.933333	46.69	---	73.90	27.21	5000.0	1000.000	101.0	V	237.0	11.0
28800.200000	---	47.40	53.90	6.50	5000.0	1000.000	161.0	V	1.0	9.5
28800.200000	51.32	---	73.90	22.58	5000.0	1000.000	161.0	V	1.0	9.5
31345.066667	---	32.44	53.90	21.46	5000.0	1000.000	175.0	V	142.0	12.7
31345.066667	46.16	---	73.90	27.74	5000.0	1000.000	175.0	V	142.0	12.7
33254.266667	---	32.68	53.90	21.22	5000.0	1000.000	122.0	V	307.0	12.3
33254.266667	45.65	---	73.90	28.25	5000.0	1000.000	122.0	V	307.0	12.3
35150.933333	---	36.33	53.90	17.57	5000.0	1000.000	104.0	V	58.0	14.4
35150.933333	49.81	---	73.90	24.09	5000.0	1000.000	104.0	V	58.0	14.4
36405.066667	49.84	---	73.90	24.06	5000.0	1000.000	199.0	V	123.0	16.3
36405.066667	---	36.97	53.90	16.93	5000.0	1000.000	199.0	V	123.0	16.3
38985.866667	52.00	---	73.90	21.90	5000.0	1000.000	122.0	V	142.0	18.1
38985.866667	---	38.84	53.90	15.06	5000.0	1000.000	122.0	V	142.0	18.1

Table 7.4-12: Radiated disturbance (Peak and CAverage) results: 300 MHz OBW

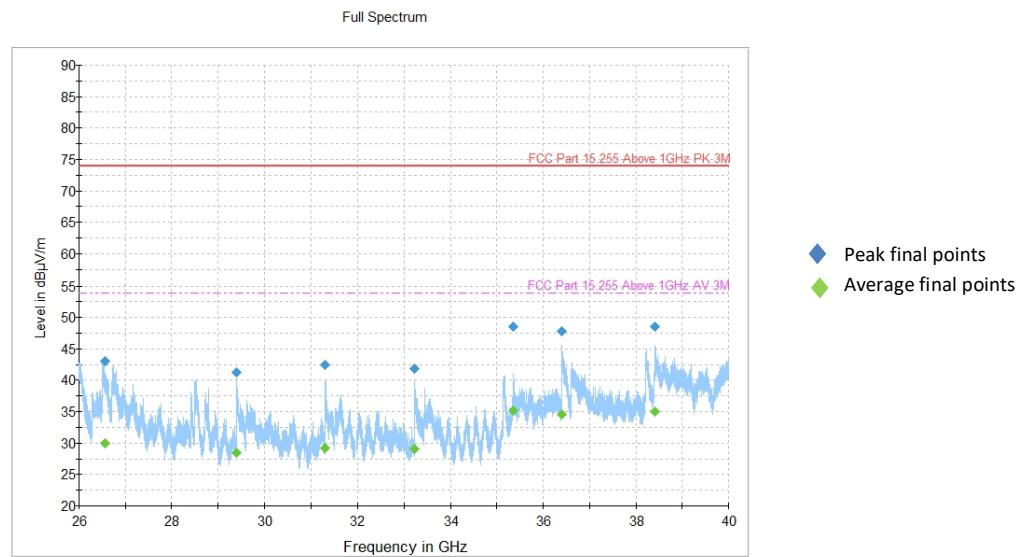
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-11: Radiated disturbance spectral plot (26 to 40 GHz): 1300 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26553.866667	43.00	---	73.90	30.90	5000.0	1000.000	107.0	V	121.0	8.3
26553.866667	---	29.89	53.90	24.01	5000.0	1000.000	107.0	V	121.0	8.3
29397.533333	---	28.52	53.90	25.38	5000.0	1000.000	103.0	V	1.0	10.1
29397.533333	41.23	---	73.90	32.67	5000.0	1000.000	103.0	V	1.0	10.1
31301.733333	---	29.17	53.90	24.73	5000.0	1000.000	225.0	V	38.0	12.5
31301.733333	42.40	---	73.90	31.50	5000.0	1000.000	225.0	V	38.0	12.5
33221.533333	41.89	---	73.90	32.01	5000.0	1000.000	99.0	V	24.0	12.4
33221.533333	---	29.08	53.90	24.82	5000.0	1000.000	99.0	V	24.0	12.4
35358.600000	48.55	---	73.90	25.35	5000.0	1000.000	218.0	H	177.0	15.7
35358.600000	---	35.15	53.90	18.75	5000.0	1000.000	218.0	H	177.0	15.7
36397.733333	47.74	---	73.90	26.16	5000.0	1000.000	106.0	V	156.0	16.3
36397.733333	---	34.50	53.90	19.40	5000.0	1000.000	106.0	V	156.0	16.3
38411.733333	48.48	---	73.90	25.42	5000.0	1000.000	106.0	V	9.0	16.7
38411.733333	---	35.01	53.90	18.89	5000.0	1000.000	106.0	V	9.0	16.7

Table 7.4-13: Radiated disturbance (Peak and CAverage) results: 1300 MHz OBW

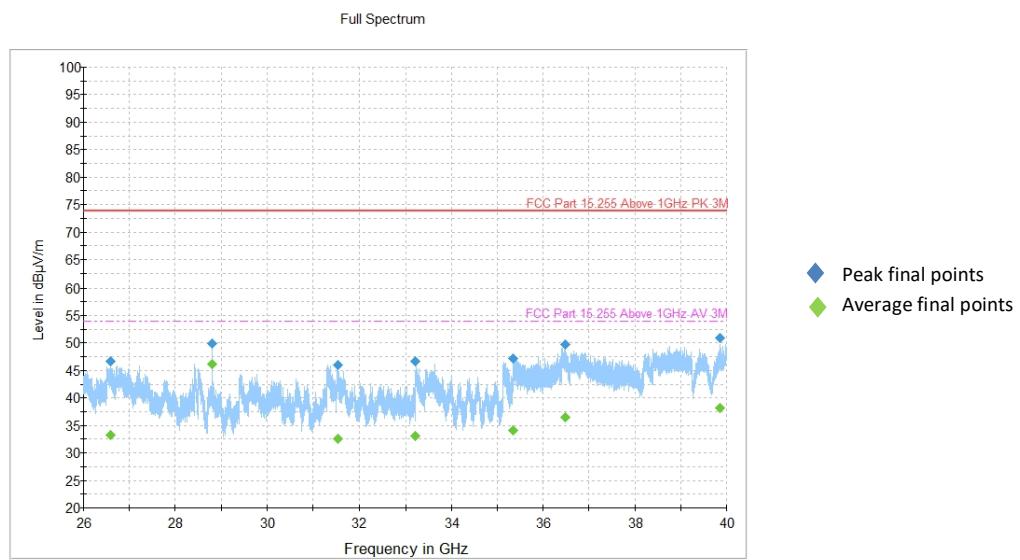
Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 7.4-12: Radiated disturbance spectral plot (26 to 40 GHz): 4000 MHz OBW

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
26599.133333	46.73	---	73.90	27.17	5000.0	1000.000	102.0	V	9.0	8.3
26599.133333	---	33.25	53.90	20.65	5000.0	1000.000	102.0	V	9.0	8.3
28800.666667	49.96	---	73.90	23.94	5000.0	1000.000	134.0	V	4.0	9.5
28800.666667	---	46.15	53.90	7.75	5000.0	1000.000	134.0	V	4.0	9.5
31546.066667	45.98	---	73.90	27.92	5000.0	1000.000	98.0	V	339.0	12.9
31546.066667	---	32.54	53.90	21.36	5000.0	1000.000	98.0	V	339.0	12.9
33211.066667	---	33.10	53.90	20.80	5000.0	1000.000	124.0	V	9.0	12.4
33211.066667	46.70	---	73.90	27.20	5000.0	1000.000	124.0	V	9.0	12.4
35349.200000	---	34.05	53.90	19.85	5000.0	1000.000	108.0	V	88.0	15.6
35349.200000	47.22	---	73.90	26.68	5000.0	1000.000	108.0	V	88.0	15.6
36484.933333	49.70	---	73.90	24.20	5000.0	1000.000	106.0	V	192.0	16.3
36484.933333	---	36.51	53.90	17.39	5000.0	1000.000	106.0	V	192.0	16.3
39849.333333	50.97	---	73.90	22.93	5000.0	1000.000	124.0	V	213.0	18.0
39849.333333	---	38.19	53.90	15.71	5000.0	1000.000	124.0	V	213.0	18.0

Table 7.4-14: Radiated disturbance (Peak and CAverage) results: 4000 MHz OBW

Notes:

¹Field strength (dB μ V/m) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor = antenna factor ACF (dB) + cable loss (dB) - amplifier gain (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.4.5 Test data, continued

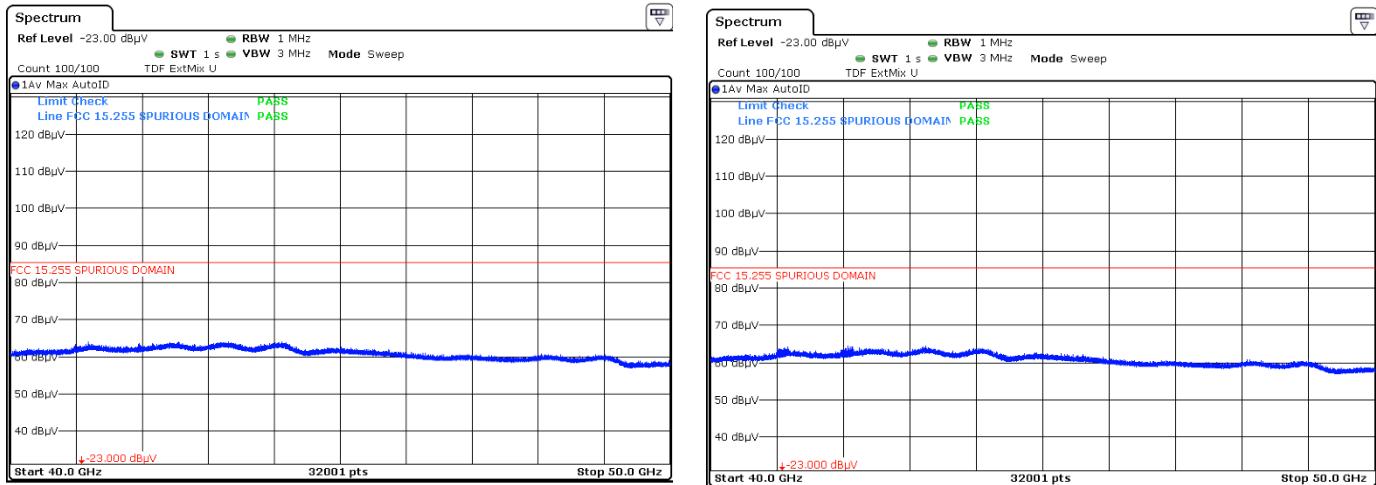


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 40 to 50 GHz, horizontal and vertical polarization respectively: (300 MHz OBW).

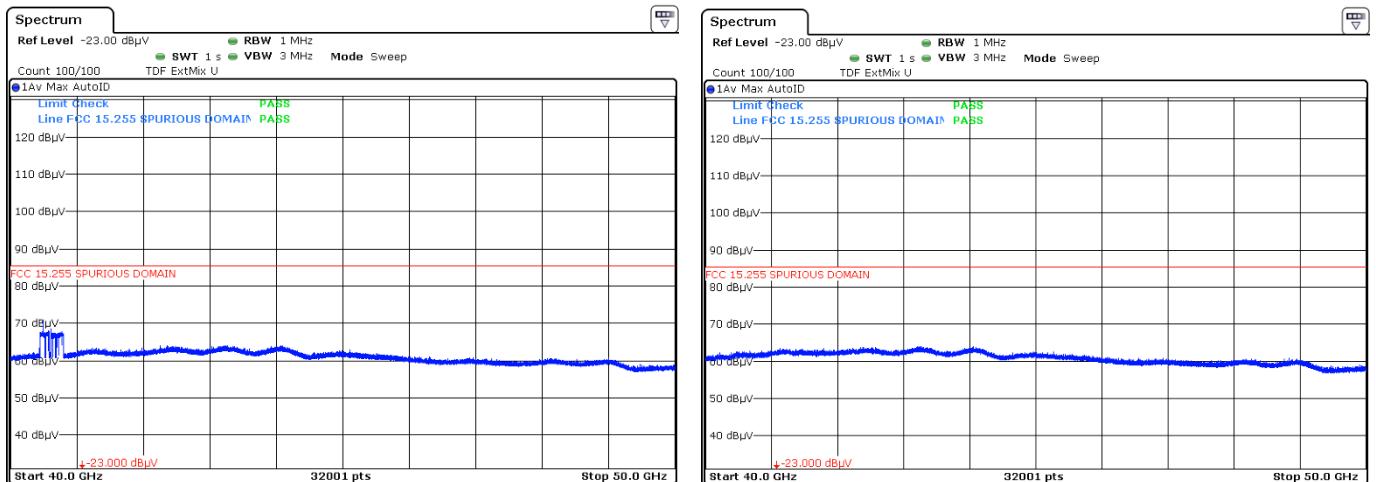


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 40 to 50 GHz, horizontal and vertical polarization respectively: (1300 MHz OBW).

Note: The auto ID function was active for avoiding the ghost signal produced by the mixer used, however, an intermodulation product is present in this range because the equipment was unable to suppress it. In any case, the intermodulation product is below the limit line, which indicates compliance with the FCC rules.

7.4.5 Test data, continued

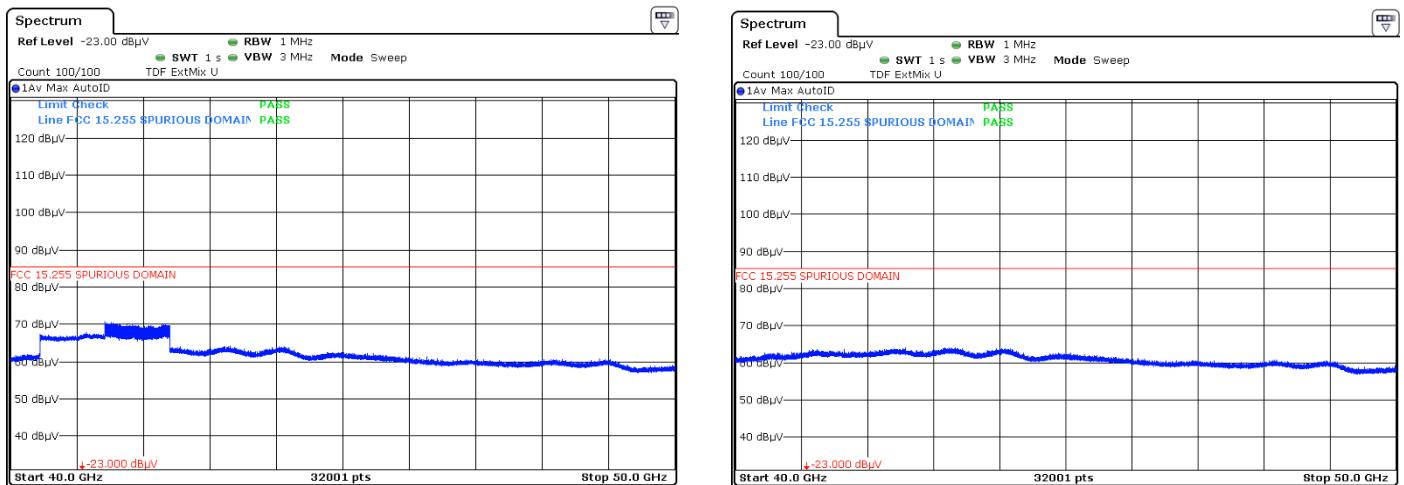


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 40 to 50 GHz, horizontal and vertical polarization respectively: (4000 MHz OBW).

Note: The auto ID function was active for avoiding the ghost signal produced by the mixer used, however, an intermodulation product is present in this range because the equipment was unable to suppress it. In any case, the intermodulation product is below the limit line, which indicates compliance with the FCC rules.

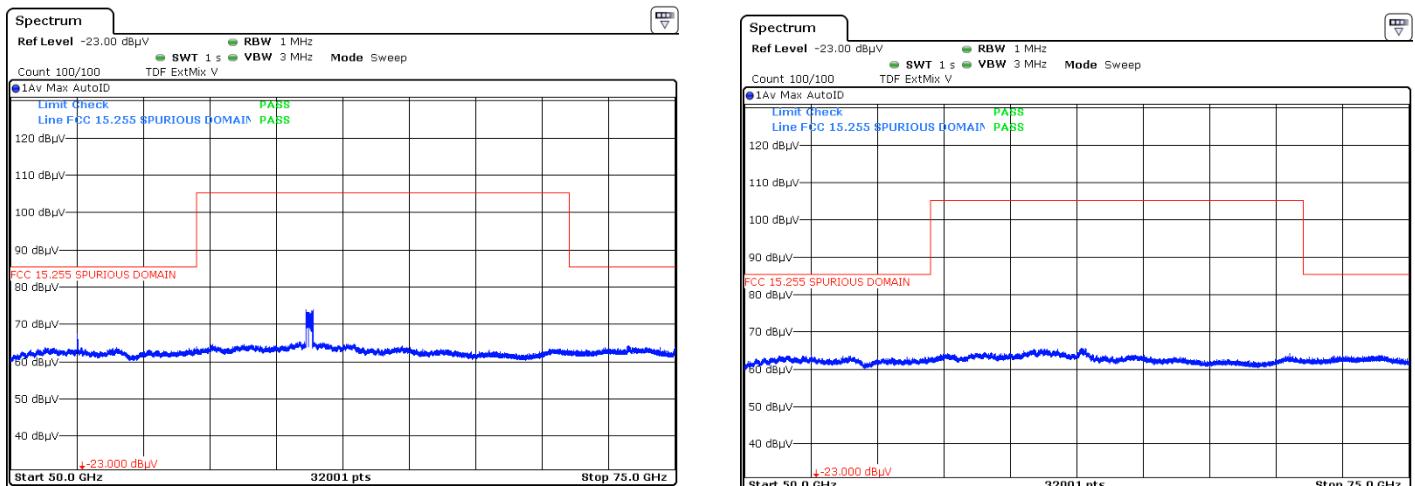


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 50 to 75 GHz, horizontal and vertical polarization respectively: (300 MHz OBW).

Note: The excluded band (non-restrictive) corresponds to the frequency band which is allowed the fundamental transmission (from 57 to 71 GHz) and it was showed on the plot as reference because it is not part of the evaluation in this test.

7.4.5 Test data, continued

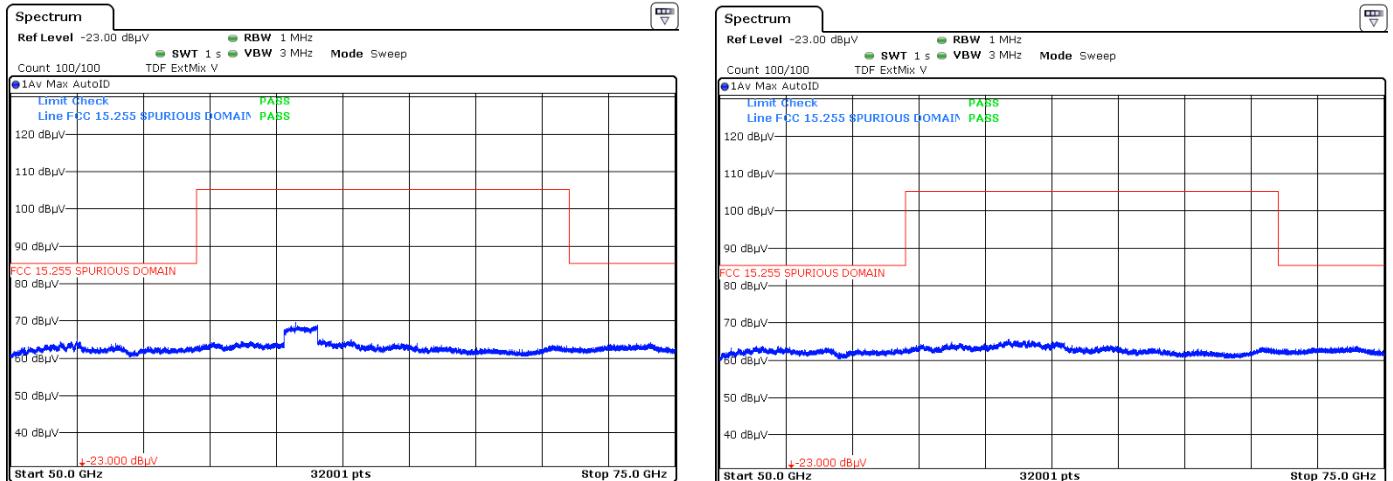


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 50 to 75 GHz, horizontal and vertical polarization respectively: (1300 MHz OBW).

Note: The excluded band (non-restrictive) corresponds to the frequency band which is allowed the fundamental transmission (from 57 to 71 GHz) and it was showed on the plot as reference because it is not part of the evaluation in this test.

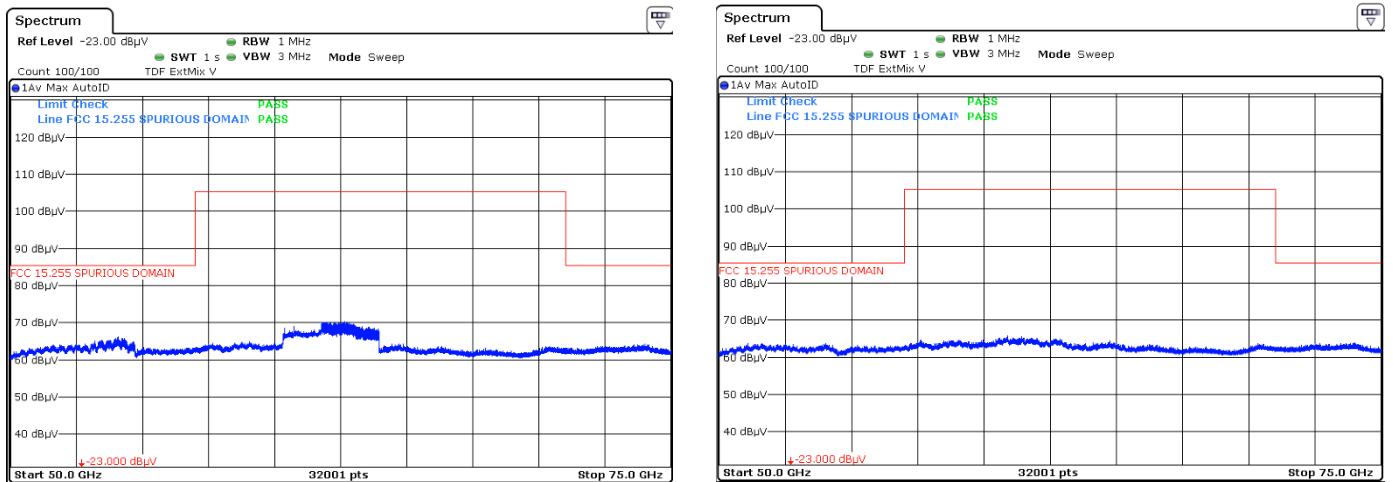


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 50 to 75 GHz, horizontal and vertical polarization respectively: (4000 MHz OBW).

Note: The excluded band (non-restrictive) corresponds to the frequency band which is allowed the fundamental transmission (from 57 to 71 GHz) and it was showed on the plot as reference because it is not part of the evaluation in this test.

7.4.5 Test data, continued

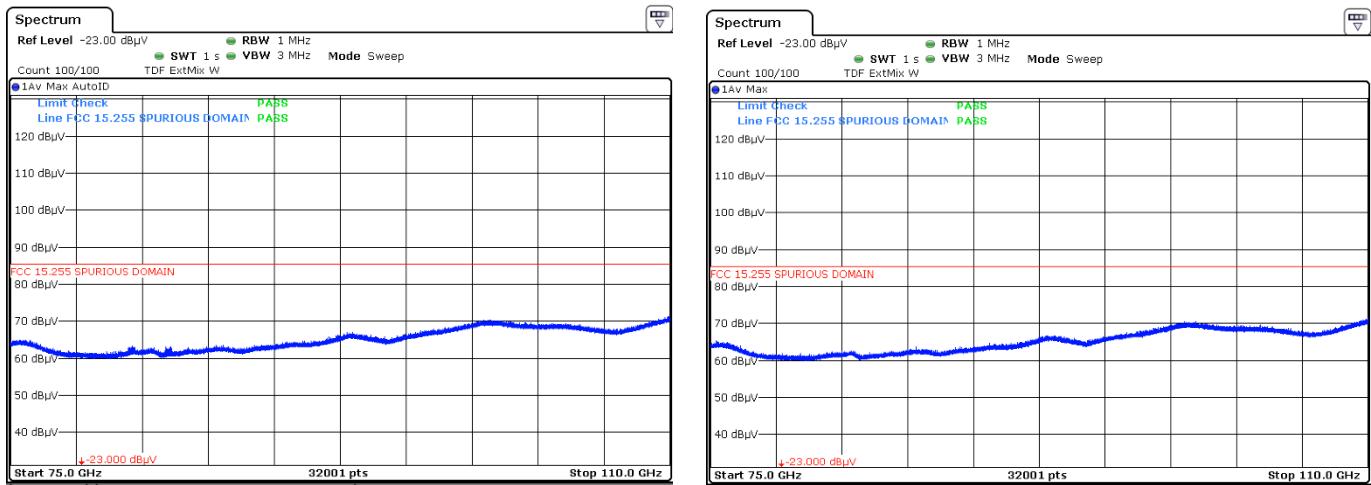


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 75 to 110 GHz, horizontal and vertical polarization respectively: (300 MHz OBW).

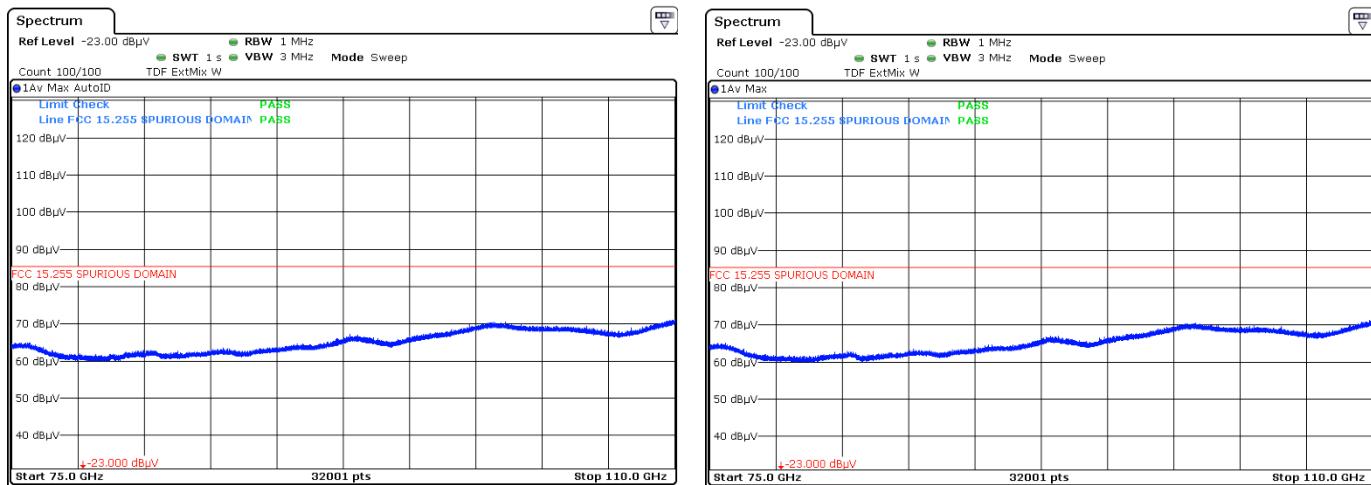


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 75 to 110 GHz, horizontal and vertical polarization respectively: (1300 MHz OBW).

7.4.5 Test data, continued

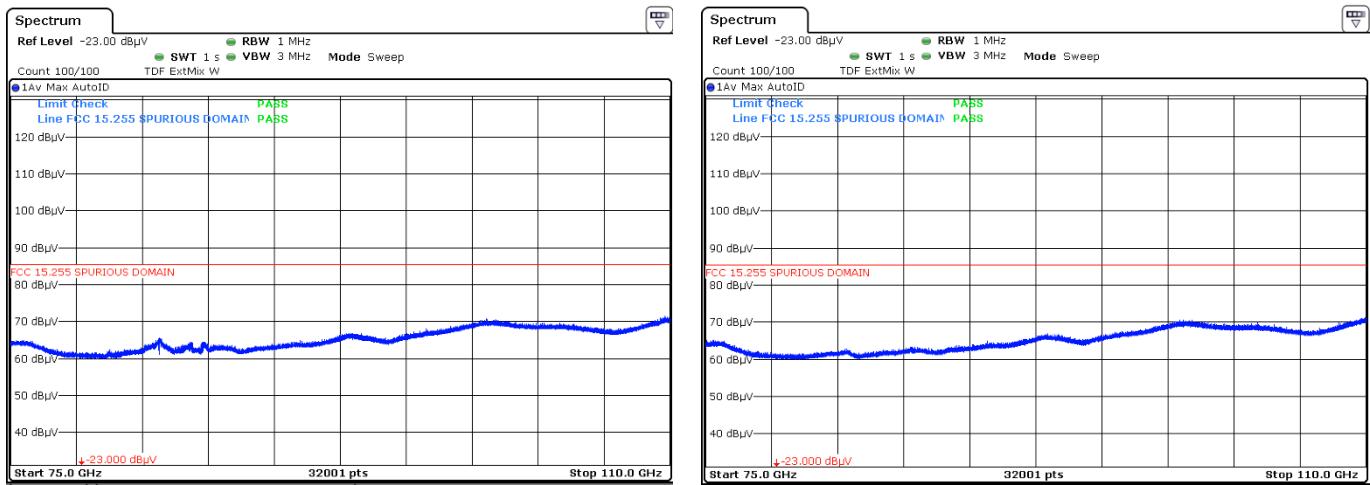


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 75 to 110 GHz, horizontal and vertical polarization respectively: (4000 MHz OBW).

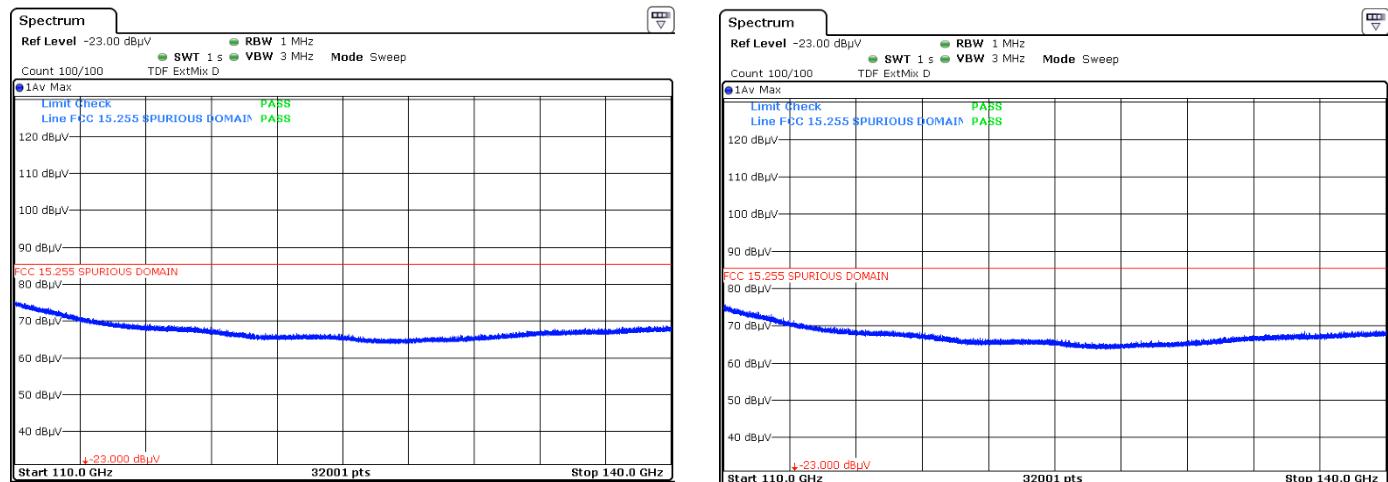


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 110 to 140 GHz, horizontal and vertical polarization respectively: (300 MHz OBW).

7.4.5 Test data, continued

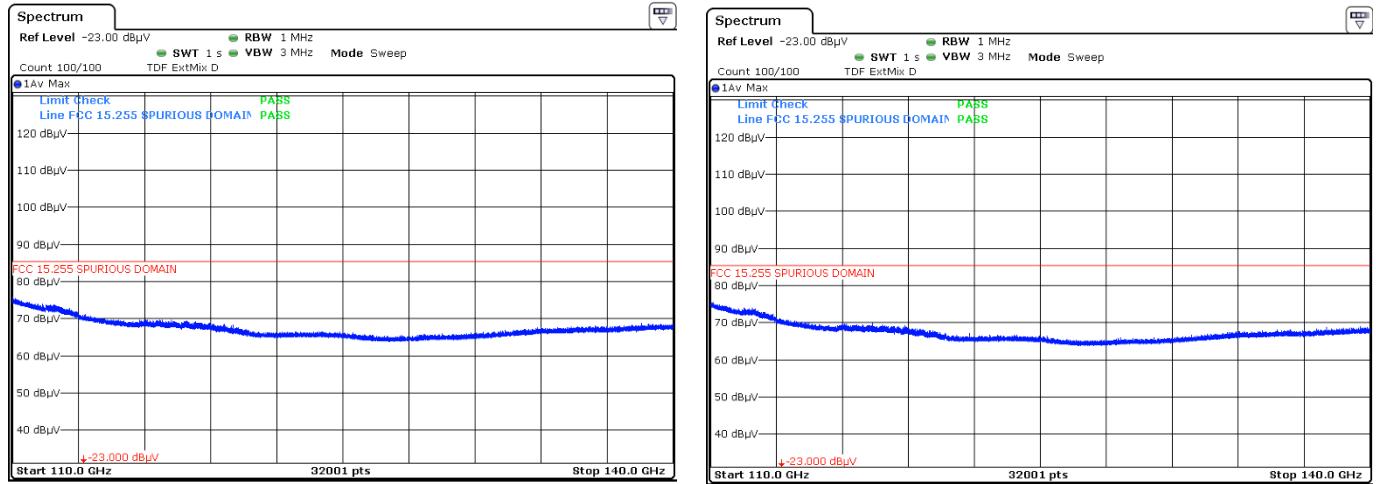


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 110 to 140 GHz, horizontal and vertical polarization respectively: (1300 MHz OBW).

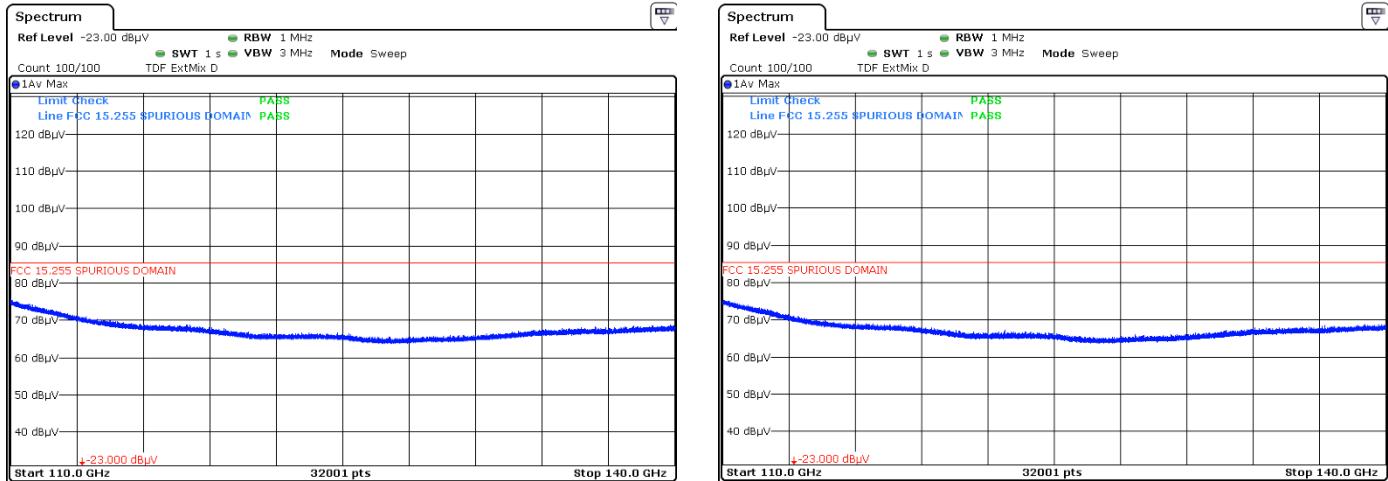


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 110 to 140 GHz, horizontal and vertical polarization respectively: (4000 MHz OBW).

7.4.5 Test data, continued

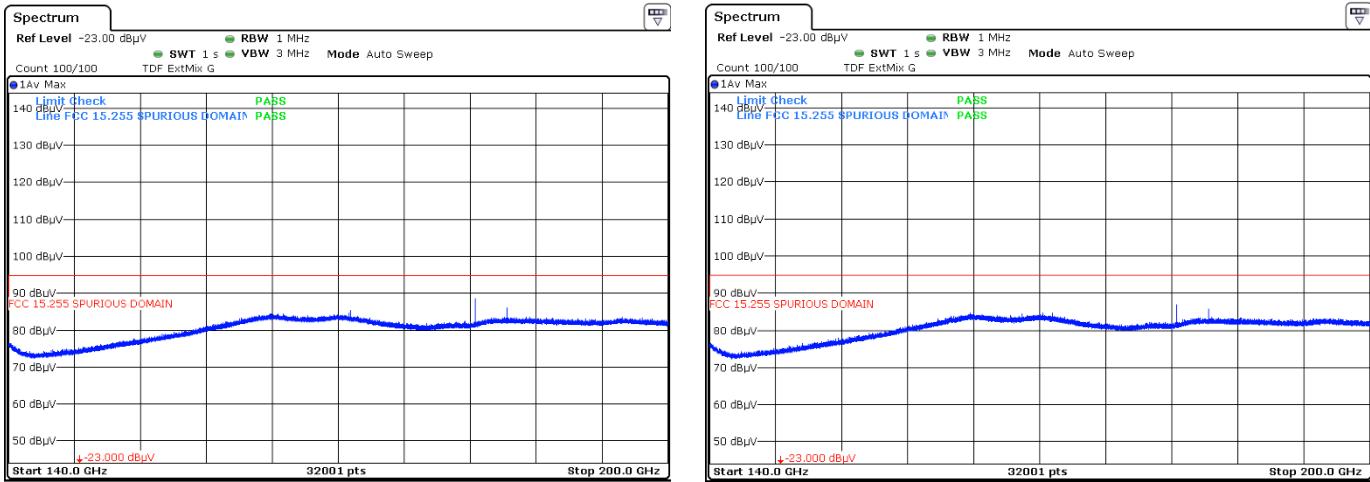


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 140 to 200 GHz, horizontal and vertical polarization respectively: (300 MHz OBW).

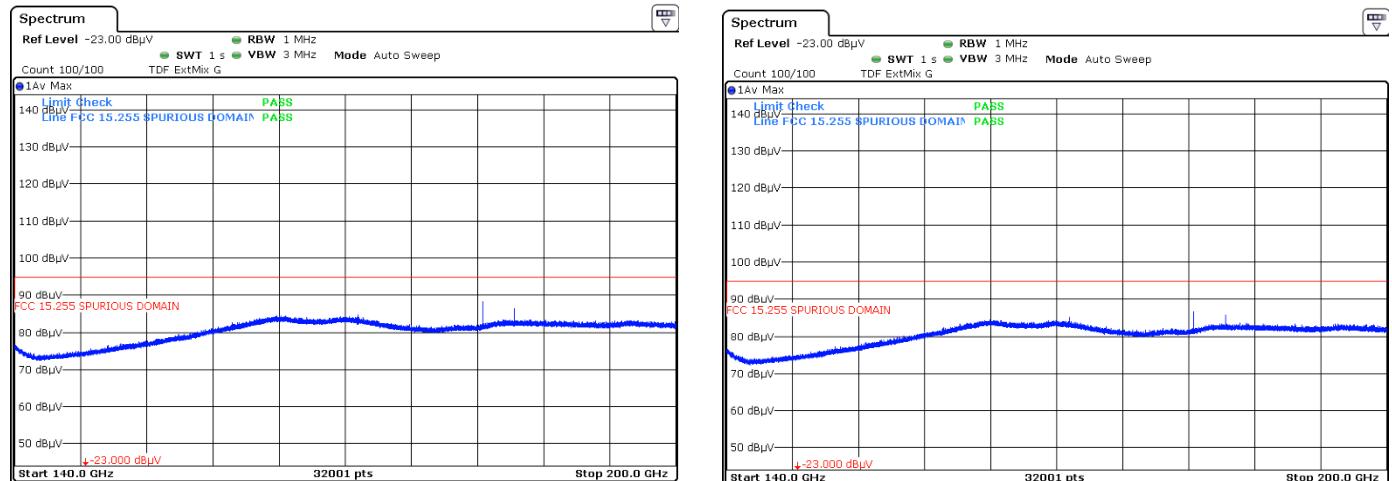


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 140 to 200 GHz, horizontal and vertical polarization respectively: (1300 MHz OBW).

7.4.5 Test data, continued

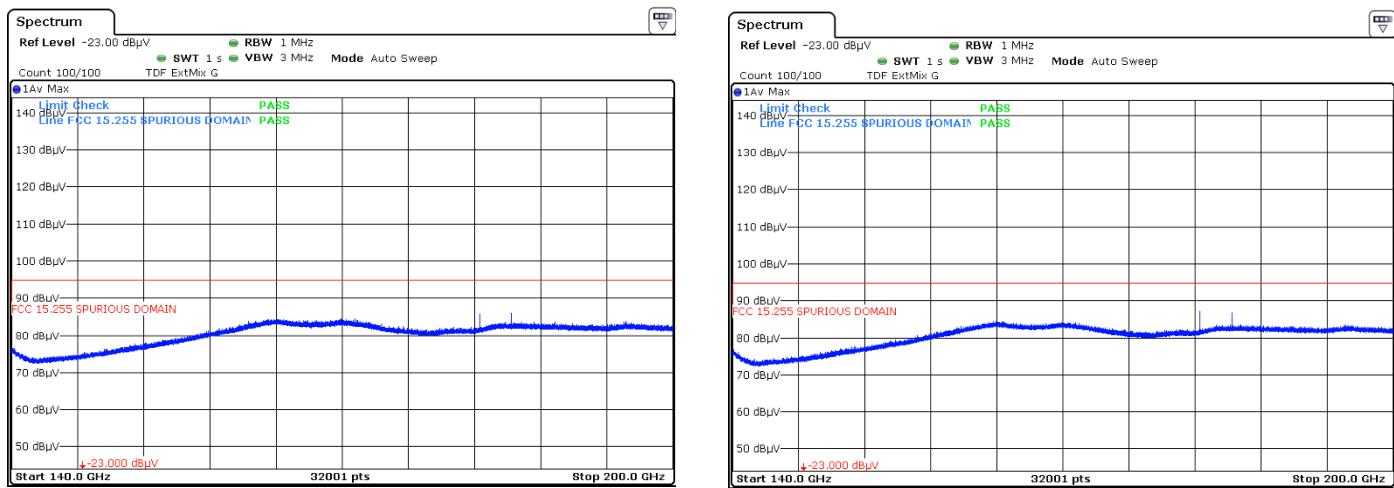


Figure 7.4: Unwanted emissions spurious band plot – Field strength measured from 140 to 200 GHz, horizontal and vertical polarization respectively: (4000 MHz OBW).

7.5 Frequency Stability

7.5.1 References

200443 D02 RF Detector Method v01

As specified in Section 15.215(c), the 20 dB bandwidth of the fundamental emission must be contained within the frequency band over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage. Frequency stability is to be measured according to Section 2.1055 at the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth.

ANSI C63.10-2013

With the EUT at ambient temperature (approximately 25 °C) and voltage source set to the EUT nominal operating voltage (100%), record the spectrum mask of the EUT emission on the spectrum analyzer.

Vary EUT power supply between 85% and 115% of nominal, and record the frequency excursion of the EUT emission mask. Set the power supply to 100% nominal setting, and raise EUT operating temperature to 50 °C.

Record the frequency excursion of the EUT emission mask. Repeat step d) at each 10 °C increment down to 20 °C

7.5.2 Test summary

Verdict	Pass		
Test date	March 30, 2020	Temperature	26 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	999 mbar
Test location	Wireless Bench	Relative humidity	53 %

7.5.3 Notes

The test can be measured using the general ANSI C63.10-2013 or the specific procedure KDB 200443 D02 RF Detector Method v01. The first one requires a reference mask when the EUT is in the optimal conditions (20°C and 100% from the power source) which was taken using the power function of 99%. The second one required a 20-dB occupied bandwidth as a reference mask. The first method per ANSI C63.10-2013 was used.

7.5.4 Setup details

EUT setup configuration	Table top
Test facility	Wireless Bench
Measuring distance	0.5 m
Antenna height variation	1 m
Turn table position	0°

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

7.5.1 Test data

Table 7.5-1: Frequency stability equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Signal analyzer	Rohde & Schwarz	FSV40	E1120	11-19-2019	11-19-2020
Mixer	Rohde & Schwarz	FS-Z75	E1149	03-07-2019	03-07-2021
Temperature Chamber	Test Equity	115A	E1162	06-18-2019	06-19-2020

Table 7.5-2: Frequency stability results, 300 MHz bandwidth operation

Voltage	Temperature	F1	F2	CF	ppm
120V	-20	61.1162980	61.397136	61.2567170	21.2
120V	-10	61.1152698	61.397886	61.2565779	23.5
120V	0	61.114973	61.3970735	61.2560233	32.5
120V	10	61.1157073	61.3963548	61.2560311	32.4
120V	20	61.1182541	61.3977766	61.25801535	Reference
120V	30	61.1171917	61.3963861	61.2567889	20.0
120V	40	61.1175510	61.3973704	61.2574607	9.1
120V	50	61.1183166	61.3980422	61.2581794	2.7

Voltage	Temperature	F1	F2	CF	ppm
120	20	61.1182541	61.3977766	61.25801535	0.0
102	20	61.1165354	61.397011	61.2567732	20.3
138	20	61.116551	61.3970579	61.25680445	19.8

Table 7.5-3: Frequency stability results, 1300 MHz bandwidth operation

Voltage	Temperature	F1	F2	CF	ppm
120V	-20	60.2978688	61.4404797	60.8691743	832.7
120V	-10	60.2979188	61.5497797	60.9238493	64.8
120V	0	60.2967189	61.4400297	60.8683743	845.8
120V	10	60.2963689	61.5488797	60.9226243	44.7
120V	20	60.2973188	61.5424799	60.9198994	Reference
120V	30	60.2963189	61.5383801	60.9173495	41.9
120V	40	60.2964689	61.5419299	60.9191994	11.5
120V	50	60.2970188	61.5472298	60.9221243	36.5

Voltage	Temperature	F1	F2	CF	ppm
120	20	60.2973188	61.5424799	60.9198994	0.0
102	20	60.2971688	61.5430299	60.9200994	3.3
138	20	60.2971688	61.5430799	60.9201244	3.7

7.5.5 Test data, continued

Table 7.5-4: Frequency stability results, 4000 MHz bandwidth operation

Voltage	Temperature	F1	F2	CF	ppm
120V	-20	60.355015	63.914751	62.1348830	53.0
120V	-10	60.372565	63.92901	62.1507875	308.9
120V	0	60.365618	63.931969	62.1487935	276.8
120V	10	60.363546	63.924623	62.1440845	201.1
120V	20	60.34295	63.920235	62.1315925	Reference
120V	30	60.344169	63.920113	62.1321410	8.8
120V	40	60.351481	63.925476	62.1384785	110.8
120V	50	60.329788	63.861615	62.0957015	577.7
Voltage	Temperature	F1	F2	CF	ppm
120	20	60.34295	63.920235	62.1315925	0.0
102	20	60.351359	63.892083	62.1217210	158.9
138	20	60.36184	63.915482	62.1386610	113.8

Note: This standard does not specify a ppm value as a limit. This table is just for reference and the only requirement by standard is the fundamental emission must to be inside to the band assigned.

7.6 AC Line conducted emissions

7.6.1 References

ANSI C63.4-2014

7.6.2 Test summary

Verdict	Pass		
Test date	April 17, 2020	Temperature	27 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1002 mbar
Test location	Ground Plane	Relative humidity	49 %

7.6.3 Notes

None

7.6.4 Setup details

Port under test	AC Main Port
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	<ul style="list-style-type: none"> – Peak and Average (Preview measurement) – Quasi-peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	<ul style="list-style-type: none"> – 100 ms (Peak and Average preview measurement) – 5000 ms (Quasi-peak final measurement) – 5000 ms (CAverage final measurement)

Table 7.6-1: Conducted disturbance at mains port equipment list

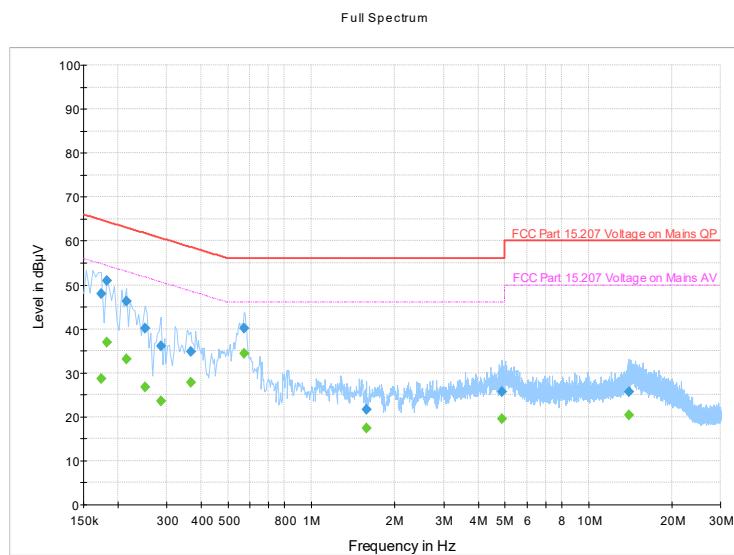
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Two Line V-Network	Rohde & Schwartz	ENV216	E1019	1 Year	12-Jul-2020
Transient Limiter	HP	11947A	684	1 Year	20-Jan-2021
EMC Test Receiver	Rohde & Schwarz	ESCI 7	E1026	2 Year	29-May-2021

Table 7.6-2: Conducted disturbance at mains port test software details

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.20.01

Notes: None

7.6.5 Test data



The spectral plot has been corrected with transducer factors (i.e. cable loss, LISN factors, and transient limiter).

Figure 7.6-1: Conducted disturbance at mains port spectral plot: 300 MHz OBW

Frequency (MHz)	QuasiPeak (dB μ V)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.174000	---	28.59	54.77	26.17	5000.0	9.000	L1	ON	19.6
0.174000	47.89	---	64.77	16.87	5000.0	9.000	L1	ON	19.6
0.182000	---	36.97	54.39	17.43	5000.0	9.000	L1	ON	19.6
0.182000	50.99	---	64.39	13.40	5000.0	9.000	L1	ON	19.6
0.214000	---	33.06	53.05	19.98	5000.0	9.000	L1	ON	19.5
0.214000	46.34	---	63.05	16.71	5000.0	9.000	L1	ON	19.5
0.250000	---	26.80	51.76	24.96	5000.0	9.000	L1	ON	19.5
0.250000	40.08	---	61.76	21.68	5000.0	9.000	L1	ON	19.5
0.286000	---	23.56	50.64	27.08	5000.0	9.000	L1	ON	19.5
0.286000	36.01	---	60.64	24.63	5000.0	9.000	L1	ON	19.5
0.366000	---	27.84	48.59	20.75	5000.0	9.000	L1	ON	19.4
0.366000	34.79	---	58.59	23.80	5000.0	9.000	L1	ON	19.4
0.570000	---	34.39	46.00	11.61	5000.0	9.000	N	ON	19.4
0.570000	40.20	---	56.00	15.80	5000.0	9.000	N	ON	19.4
1.578000	---	17.35	46.00	28.65	5000.0	9.000	N	ON	19.4
1.578000	21.63	---	56.00	34.37	5000.0	9.000	N	ON	19.4
4.866000	---	19.53	46.00	26.47	5000.0	9.000	N	ON	19.3
4.866000	25.59	---	56.00	30.41	5000.0	9.000	N	ON	19.3
13.990000	---	20.38	50.00	29.62	5000.0	9.000	N	ON	20.2
13.990000	25.77	---	60.00	34.23	5000.0	9.000	N	ON	20.2

Table 7.6-3: Conducted disturbance at mains port (Quasi-Peak and CAverage) results: 300 MHz OBW

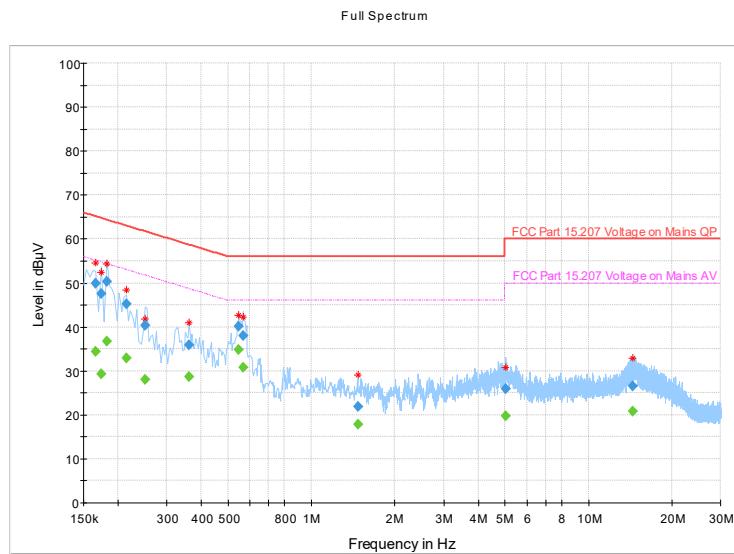
Notes:

¹Result (dB μ V) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

²Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.6.5 Test data continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. cable loss, LISN factors, and transient limiter).

Figure 7.6-2: Conducted disturbance at mains port spectral plot: 1300 MHz OBW

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166000	49.99	---	65.16	15.17	5000.0	9.000	N	ON	19.6
0.166000	---	34.33	55.16	20.83	5000.0	9.000	N	ON	19.6
0.174000	47.46	---	64.77	17.31	5000.0	9.000	L1	ON	19.6
0.174000	---	29.28	54.77	25.49	5000.0	9.000	L1	ON	19.6
0.182000	---	36.72	54.39	17.67	5000.0	9.000	N	ON	19.5
0.182000	50.34	---	64.39	14.05	5000.0	9.000	N	ON	19.5
0.214000	45.27	---	63.05	17.78	5000.0	9.000	N	ON	19.5
0.214000	---	32.94	53.05	20.11	5000.0	9.000	N	ON	19.5
0.250000	40.34	---	61.76	21.41	5000.0	9.000	N	ON	19.5
0.250000	---	28.00	51.76	23.76	5000.0	9.000	N	ON	19.5
0.362000	35.83	---	58.68	22.85	5000.0	9.000	L1	ON	19.4
0.362000	---	28.74	48.68	19.94	5000.0	9.000	L1	ON	19.4
0.546000	40.07	---	56.00	15.93	5000.0	9.000	N	ON	19.4
0.546000	---	34.89	46.00	11.11	5000.0	9.000	N	ON	19.4
0.566000	---	30.87	46.00	15.13	5000.0	9.000	L1	ON	19.4
0.566000	38.01	---	56.00	17.99	5000.0	9.000	L1	ON	19.4
1.470000	---	17.85	46.00	28.15	5000.0	9.000	L1	ON	19.4
1.470000	21.87	---	56.00	34.13	5000.0	9.000	L1	ON	19.4
5.042000	---	19.70	50.00	30.30	5000.0	9.000	N	ON	19.3
5.042000	25.90	---	60.00	34.10	5000.0	9.000	N	ON	19.3
14.502000	---	20.83	50.00	29.17	5000.0	9.000	N	ON	20.2
14.502000	26.56	---	60.00	33.44	5000.0	9.000	N	ON	20.2

Table 7.6-4: Conducted disturbance at mains port (Quasi-Peak and CAverage) results: 1300 MHz OBW

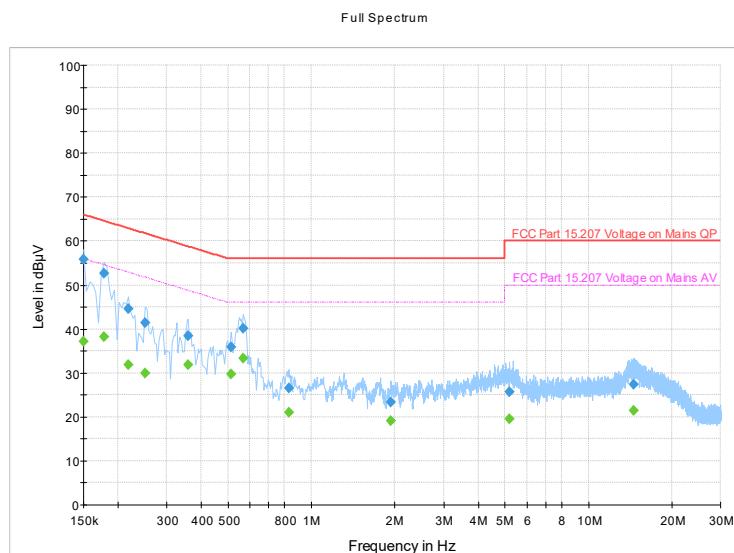
Notes:

¹Result (dBμV) = receiver/spectrum analyzer value (dBμV) + correction factor (dB)

²Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)

³The maximum measured value observed over a period of 5 seconds was recorded.

7.6.5 Test data continued



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. cable loss, LISN factors, and transient limiter).

Figure 7.6-3: Conducted disturbance at mains port spectral plot: 4000 MHz OBW

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	---	37.21	56.00	18.79	5000.0	9.000	L1	ON	19.6
0.150000	55.86	---	66.00	10.14	5000.0	9.000	L1	ON	19.6
0.178000	---	38.23	54.58	16.35	5000.0	9.000	L1	ON	19.6
0.178000	52.60	---	64.58	11.97	5000.0	9.000	L1	ON	19.6
0.218000	---	31.87	52.90	21.02	5000.0	9.000	N	ON	19.5
0.218000	44.65	---	62.90	18.24	5000.0	9.000	N	ON	19.5
0.250000	---	30.03	51.76	21.72	5000.0	9.000	N	ON	19.5
0.250000	41.30	---	61.76	20.45	5000.0	9.000	N	ON	19.5
0.358000	---	31.90	48.78	16.88	5000.0	9.000	N	ON	19.4
0.358000	38.44	---	58.78	20.34	5000.0	9.000	N	ON	19.4
0.510000	---	29.65	46.00	16.35	5000.0	9.000	N	ON	19.4
0.510000	35.86	---	56.00	20.14	5000.0	9.000	N	ON	19.4
0.566000	---	33.33	46.00	12.67	5000.0	9.000	N	ON	19.4
0.566000	40.14	---	56.00	15.86	5000.0	9.000	N	ON	19.4
0.826000	---	20.97	46.00	25.03	5000.0	9.000	N	ON	19.4
0.826000	26.46	---	56.00	29.54	5000.0	9.000	N	ON	19.4
1.938000	---	19.19	46.00	26.81	5000.0	9.000	N	ON	19.4
1.938000	23.31	---	56.00	32.69	5000.0	9.000	N	ON	19.4
5.170000	---	19.55	50.00	30.45	5000.0	9.000	N	ON	19.3
5.170000	25.78	---	60.00	34.22	5000.0	9.000	N	ON	19.3
14.554000	---	21.54	50.00	28.46	5000.0	9.000	N	ON	20.2
14.554000	27.30	---	60.00	32.70	5000.0	9.000	N	ON	20.2

Table 7.6-5: Conducted disturbance at mains port (Quasi-Peak and CAverage) results: 4000 MHz OBW

Notes:

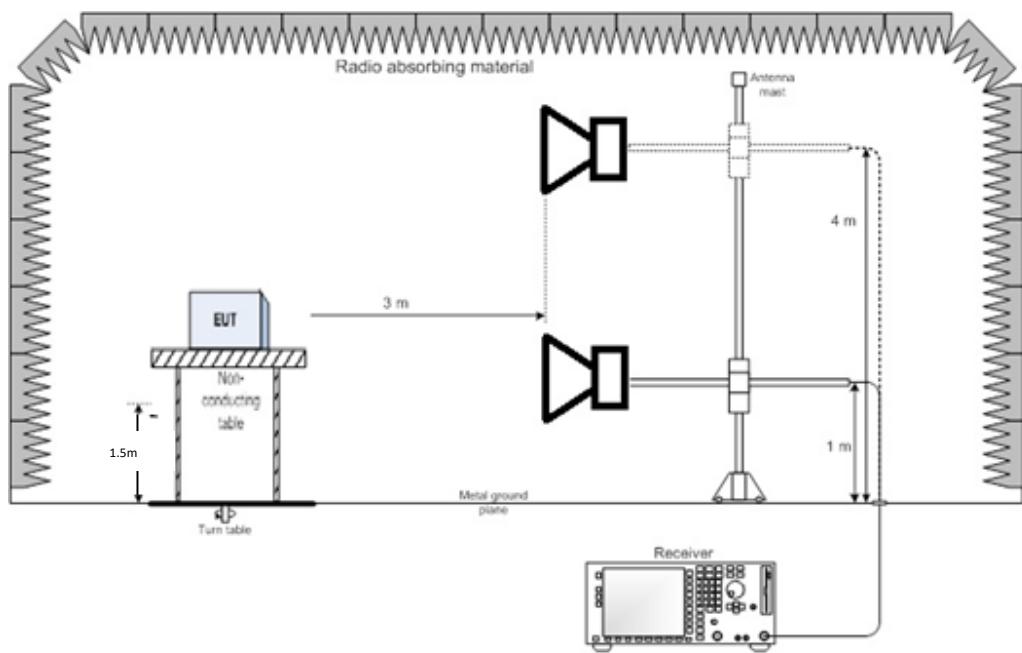
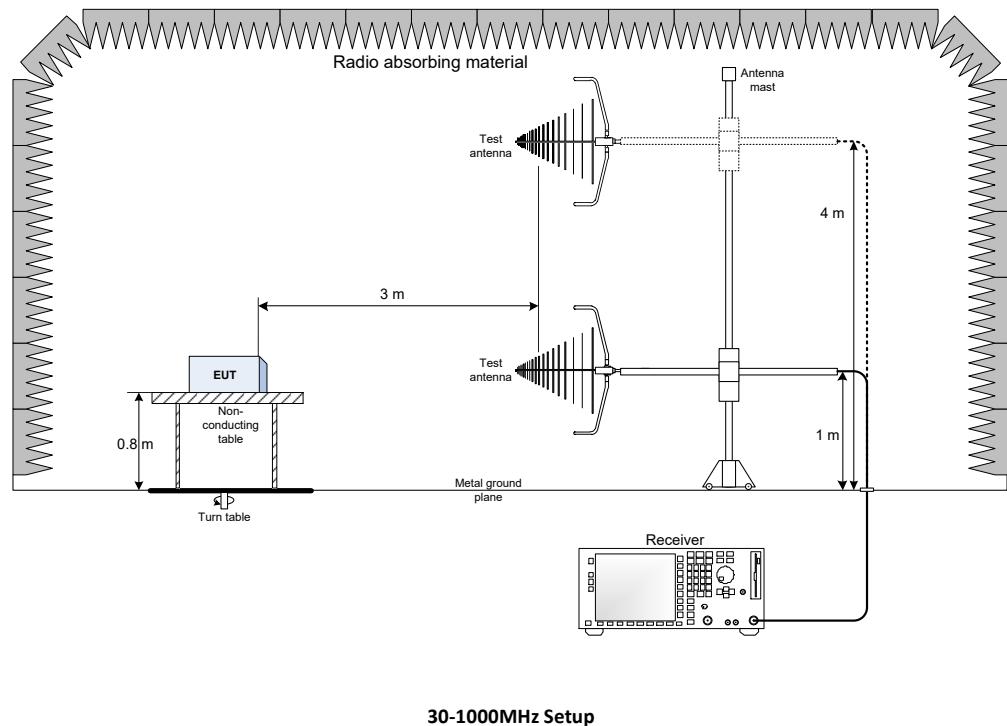
¹ Result (dBμV) = receiver/spectrum analyzer value (dBμV) + correction factor (dB)

² Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)

³ The maximum measured value observed over a period of 5 seconds was recorded.

Section 8 Block diagrams of test set-ups

8.1 Radiated emissions set-up





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