

Test report

451747-1R2TRFWL

Date of issue: February 16, 2022

Applicant:

Fujitsu Network Communications

Product:

Tri Band RU for North America

Model:

TB RU

Model variant:

N/A

FCC ID:

CFD5GRUTB

Specifications:

◆ **FCC 47 CFR Part 27**

Miscellaneous Wireless Communications Services

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
Province	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com

Tested by	Martha Espinoza, Wireless Test Engineer
Reviewed by	James Cunningham, EMC/MIL/WL Supervisor
Review date	February 16, 2022
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 contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Copyright notification

Nemko USA Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Nemko USA Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

© Nemko USA Inc.

Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Statement of compliance	4
1.4 Exclusions	4
1.5 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Part 27 test results	5
Section 3. Equipment under test (EUT) details	6
3.1 Sample information	6
3.2 EUT information	6
3.3 Technical information	6
3.4 Product description and theory of operation	6
3.5 EUT exercise details	6
3.6 EUT setup diagram	7
Section 4. Engineering considerations	8
4.1 Modifications incorporated in the EUT	8
4.2 Technical judgment	8
4.3 Deviations from laboratory tests procedures	8
Section 5. Test conditions	9
5.1 Atmospheric conditions	9
5.2 Power supply range	9
Section 6. Measurement uncertainty	10
6.1 Uncertainty of measurement	10
Section 7. Test equipment	11
7.1 Test equipment list	11
Section 8. Testing data	12
8.1 FCC §2.1033(c)(4) Modulation type	12
8.2 FCC §2.1049(h) 99% Occupied Bandwidth and frequency ranges	13
8.3 FCC §27.53 (h)(3) 26 dB Occupied Bandwidth	16
8.4 FCC 27.50(c)(3)(ii) Output power	19
8.5 FCC 27.50(B) Peak to Average Power Ratio	21
8.6 FCC 27.53(g) Emission Limits	24
Section 9. Block diagrams of test setups	37
9.1 Radiated emissions set-up	37

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Fujitsu Networks Communications, Inc.
Address	2801 Telecom Parkway
City	Richardson
Province/State	TX
Postal/Zip code	75082
Country	United States of America

1.2 Test specifications

FCC 47 CFR Part 27	Miscellaneous Wireless Communications Services
--------------------	--

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed 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 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
451747-1TRFWL	Original report issued
451747-1R1TRFWL	Note added in section 8.2.3, 8.3.3, 8.5.3, 8.6.4; Note corrected section 8.6.3; Typo corrected, section 8.3
451747-1R2TRFWL	Serial number was corrected, and part number was added, both in section 3.2.

Section 2. Summary of test results

2.1 FCC Part 27 test results

Part	Test description	Verdict
§2.1033(c)(4)	Modulation type	Pass
§2.1049(h)	99% Occupied bandwidth	Pass
§27.50(h)(j)	Frequency ranges	Pass
§27.50(d)(2)(ii)	Output power at RF antenna connector	Pass
§27.50(d)(5)	Peak to average power ratio	Pass
§27.53(h)(1)	Conducted spurious emissions	Pass
§27.53(h)(1)	Radiated spurious emissions	Pass
§27.53(h)(3)	26 dB Occupied bandwidth	Pass
§27.54	Frequency stability	Not tested ¹

¹Note: Methodology and test result for frequency stability test are described in the report 104509072LEX-003 Section 11, Page 21.

This testing covers the addition of a 15 MHz bandwidth option for the 617 – 652 MHz band (Band n71).

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	January 24, 2022
Nemko sample ID number	NEx: 451747

3.2 EUT information

Product name	Tri Band RU for North America
Model	TB RU
Part Number	TA08025-B605/03
Serial number	3LFJC09752U

3.3 Technical information

Frequency band	617 - 652 MHz (Band n71) Towers to transmit to mobile devices.
Frequency Min (MHz)	624.5 MHz
Frequency Max (MHz)	644.5 MHz
RF power Min (W), Conducted	36.643 Watts or 45.64 dBm (Port A); 146.554 Watts or 51.66 dBm (Total power across all ports)
RF power Max (W), Conducted	39.994 Watts or 46.02 dBm (Port A); 159.955 Watts or 52.04 dBm (Total power across all ports)
Field strength, Units @ distance	51.35 dBμV/m @ 3m (50.694167 MHz)
Measured BW (kHz) (26 dB)	15.29202 MHz (15 MHz OBW Declared)
Type of modulation	QPSK; 16QAM; 64QAM; 256QAM
Transmitter spurious, Units @ distance	3 Meters
Power requirements	-48 VDC
Antenna information	The EUT is professionally installed.

3.4 Product description and theory of operation

The radio unit (RU) is one of the components to configure the 5G RAN mobile communication system. The RU has three band frequencies: band n29, band n71 and band n26. Four antenna ports are shared across the frequency bands. Only the band with 15 MHz bandwidth was tested (band n71).

3.5 EUT exercise details

A laptop computer was used to send test commands to EUT to force it to transmit the appropriate signal. Unit transmit the selected signal at full power. The unit was tested using a conducted port. The antenna installation shall be done by professionals, and they are not within the scope of the tests evaluated on this document.

3.6 EUT setup diagram

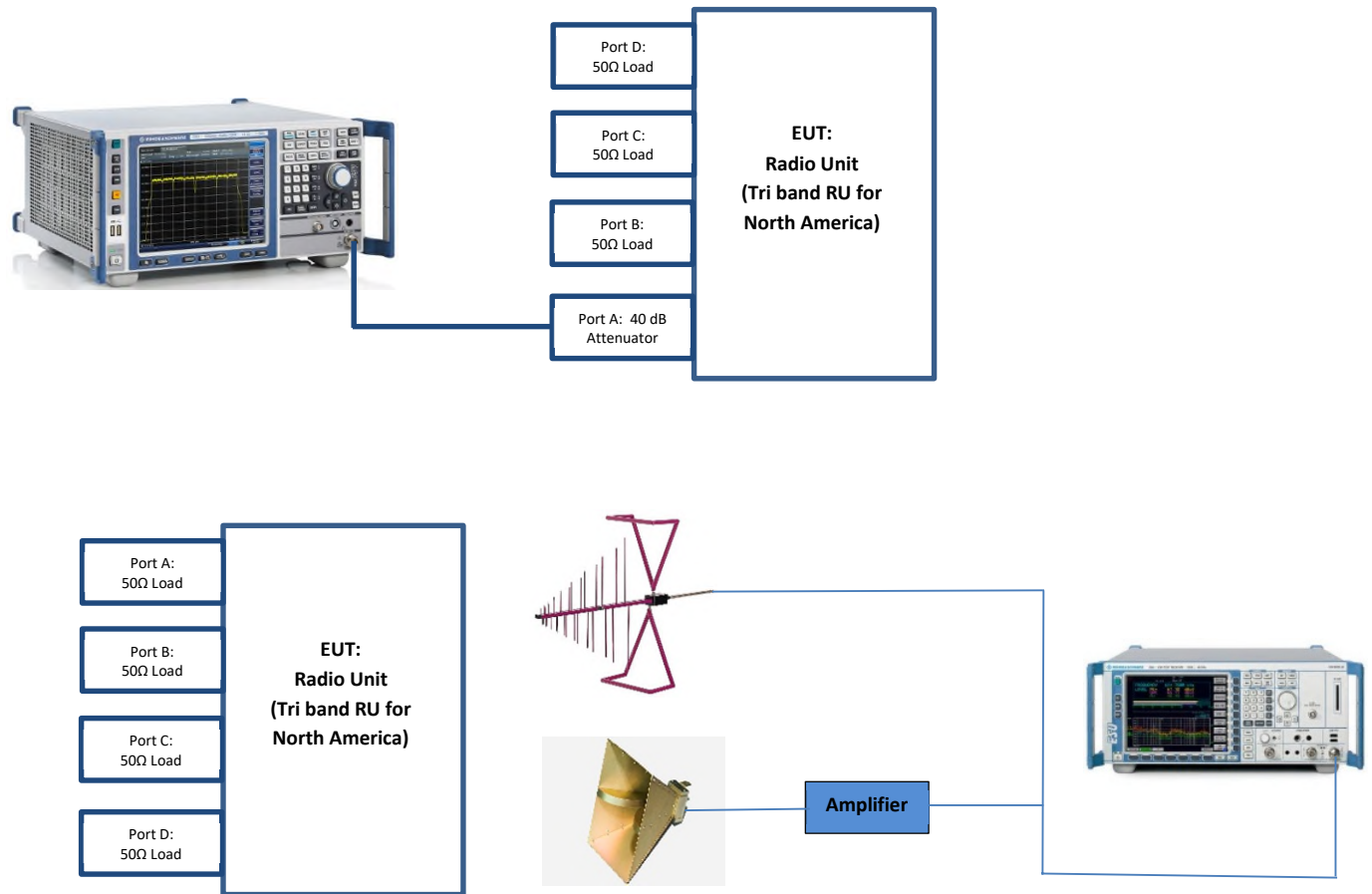


Figure 3.6-1: Setup diagram

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	860–1060 mbar

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%

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 year	05-19-2022
Signal Analyzer	Rohde & Schwarz	FSV 40	E1120	2 years	11-19-2023
Antenna, Bilog	Schaffner-Chase	CBL6111C	1763	2 years	02-18-2022
Antenna, Horn	ETS	3117-PA	E1139	2 years	04-20-2022
Power sensor	ETS-Lindgren	7002-006	E1062	1 year	05-20-2022

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC §2.1033(c)(4) Modulation type

8.1.1 Definitions and limits

(c) Applications for equipment other than that operating under parts 15, 11 and 18 of this chapter shall be accompanied by a technical report containing the following information:

(4) Type or types of emission

8.1.2 Test summary

Test date	January 26, 2022	Temperature	19 °C
Test engineer	Martha Espinoza	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	55 %

8.1.3 Observations, settings and special notes

None

8.1.4 Test data

Band	Channel (MHz)	Bandwidth (MHz)	Emission type
n71	624.5	15	QPSK; 16QAM; 64QAM; 256QAM
n71	634.5	15	QPSK; 16QAM; 64QAM; 256QAM
n71	644.5	15	QPSK; 16QAM; 64QAM; 256QAM

Table 8.1-1: Types of emission

8.2 FCC §2.1049(h) 99% Occupied Bandwidth and frequency ranges

8.2.1 Definitions and limits

§2.1049 (h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the use.

8.2.2 Test summary

Test date	January 28, 2022	Temperature	21 °C
Test engineer	Martha Espinoza	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	51%

8.2.3 Observations, settings and special notes

Selection of port A was according to section 8.4 of this document.

Spectrum analyser settings:

Resolution bandwidth	1% - 5% OBW
Video bandwidth	3*RBW
Frequency span	2*OBW
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Band	OBW Declared	Port	Channel (MHz)	99% OBW
n71	15 MHz	A	624.5	14.233 MHz
n71	15 MHz	A	634.5	14.235 MHz
n71	15 MHz	A	644.5	14.231 MHz

Table 8.2-1: 99% Occupied bandwidth, QPSK Modulation.

Band	OBW Declared	Port	Channel (MHz)	99% OBW
n71	15 MHz	A	624.5	14.302 MHz
n71	15 MHz	A	634.5	14.303 MHz
n71	15 MHz	A	644.5	14.303 MHz

Table 8.2-2: 99% Occupied bandwidth, 16QAM Modulation.

Band	OBW Declared	Port	Channel (MHz)	99% OBW
n71	15 MHz	A	624.5	14.231 MHz
n71	15 MHz	A	634.5	14.234 MHz
n71	15 MHz	A	644.5	14.227 MHz

Table 8.2-3: 99% Occupied bandwidth, 64QAM Modulation.

Band	OBW Declared	Port	Channel (MHz)	99% OBW
n71	15 MHz	A	624.5	14.215 MHz
n71	15 MHz	A	634.5	14.221 MHz
n71	15 MHz	A	644.5	14.214 MHz

Table 8.2-4: 99% Occupied bandwidth, 256QAM Modulation.

Section 8
Test name
Specification

Testing data
 FCC §2.1049(h) 99% Occupied Bandwidth
 FCC Part 2

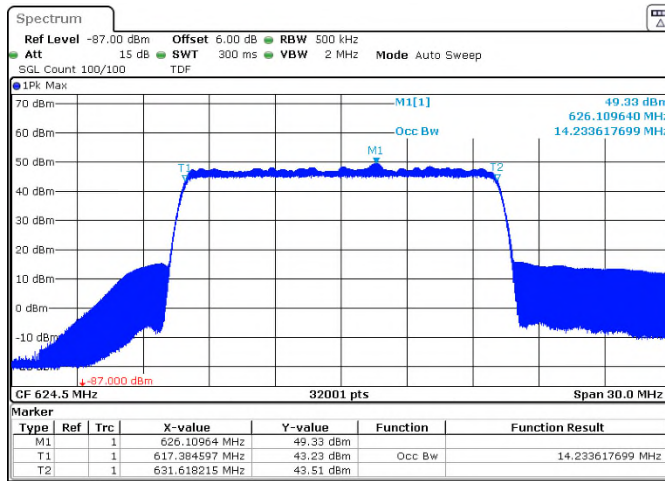


Figure 8.2-1: 99% Occupied bandwidth, QPSK Modulation, low and middle channel (15 MHz), respectively.

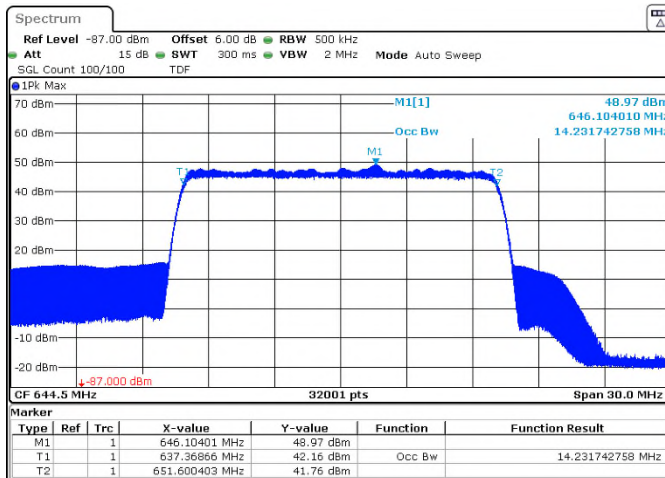
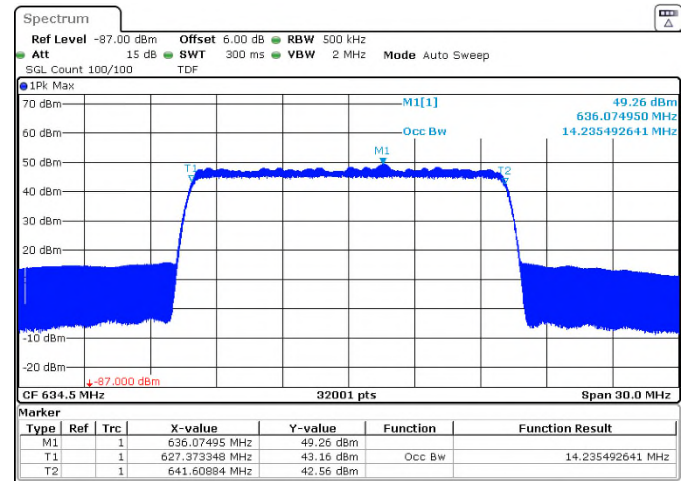


Figure 8.2-2: 99% Occupied bandwidth, QPSK Modulation, high channel (15 MHz) and 16QAM Modulation, low channel (15 MHz), respectively.

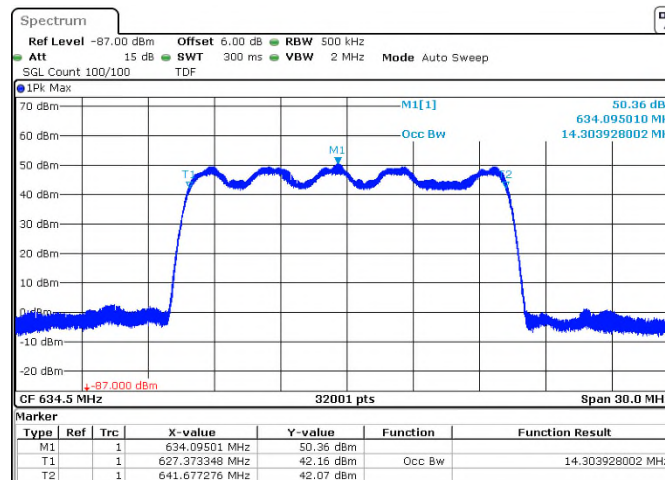
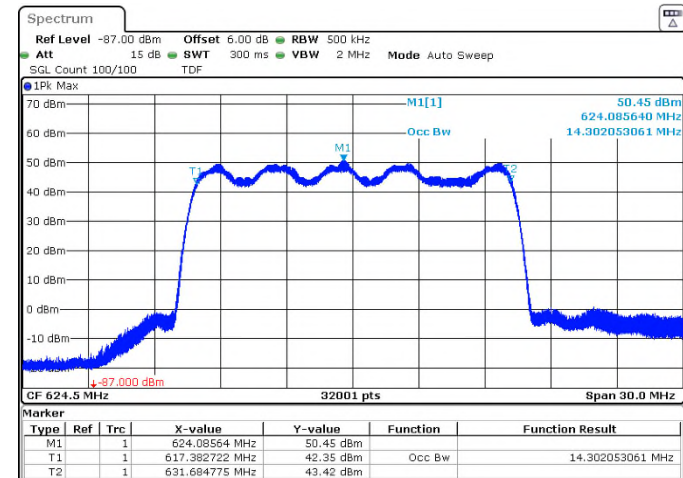
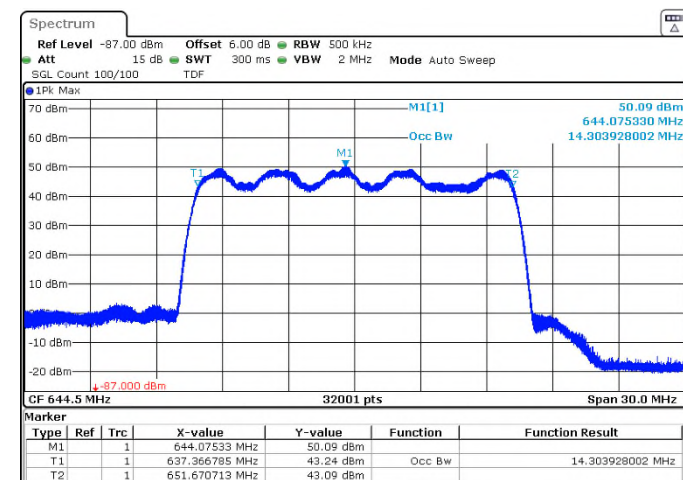


Figure 8.2-3: 99% Occupied bandwidth, 16QAM Modulation, middle and high channel (15 MHz), respectively.



Section 8
Test name
Specification

Testing data
FCC §2.1049(h) 99% Occupied Bandwidth
FCC Part 2

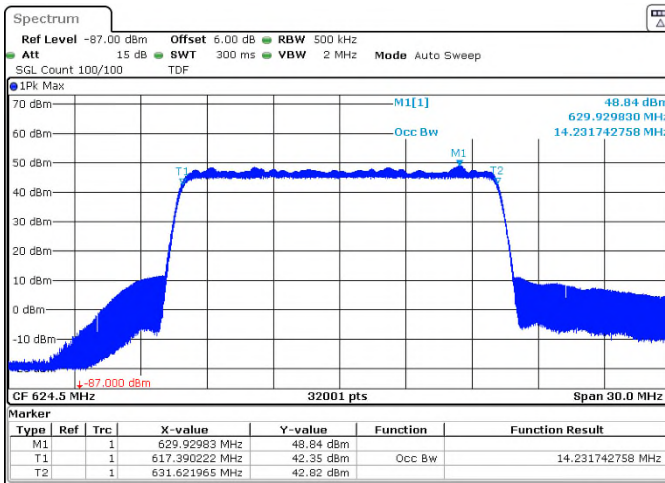


Figure 8.2-4: 99% Occupied bandwidth, 64QAM Modulation, low and middle channel (15 MHz), respectively.

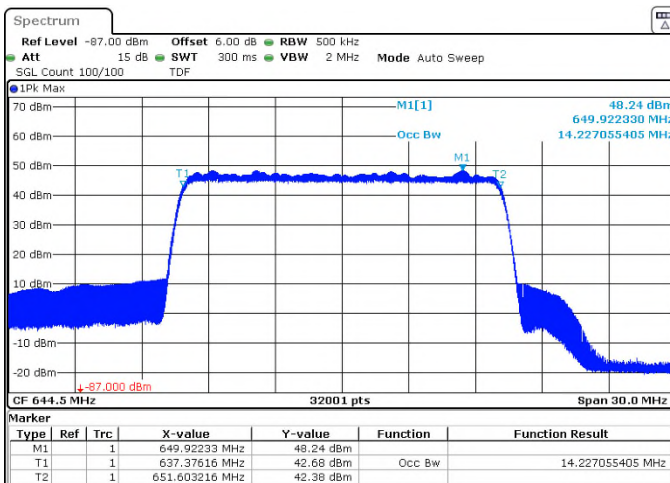
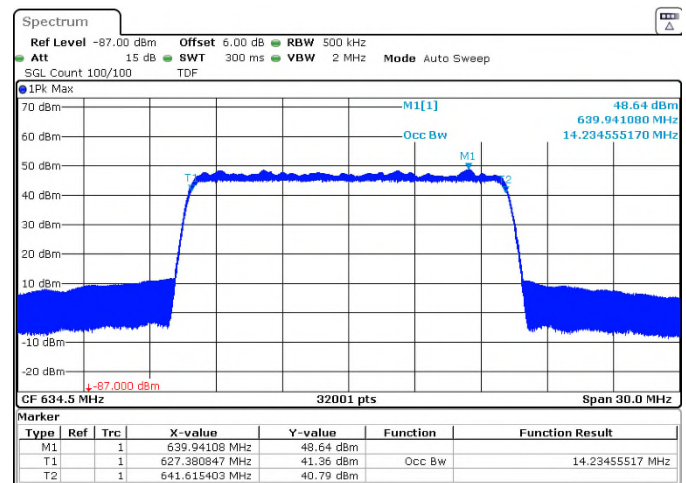


Figure 8.2-5: 99% Occupied bandwidth, 64QAM Modulation, high channel (15 MHz) and 256QAM Modulation, low channel (15 MHz), respectively.

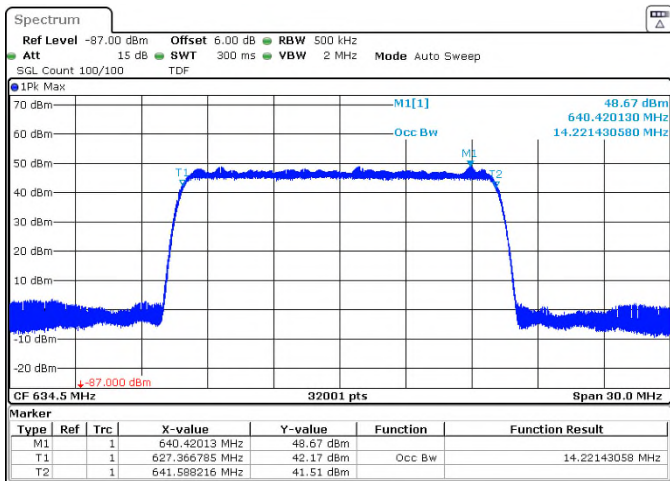
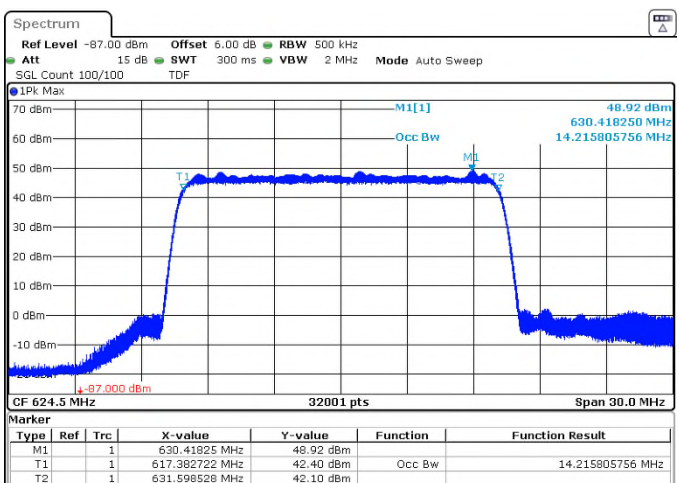
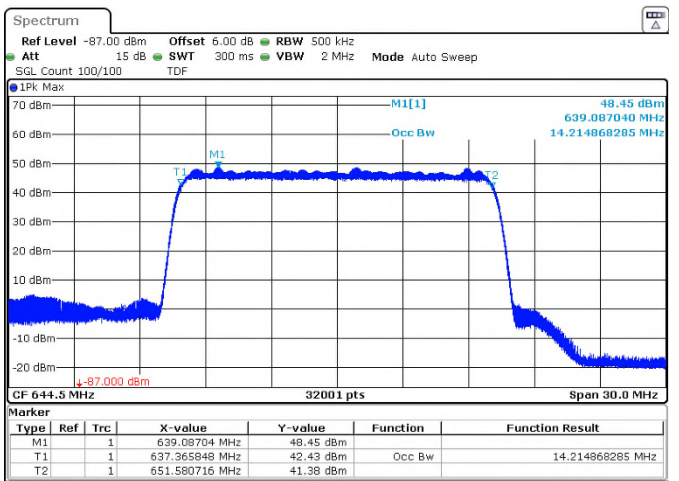


Figure 8.2-6: 99% Occupied bandwidth, 256QAM Modulation, middle and high channel (15 MHz), respectively.



8.3 FCC §27.53 (h)(3) 26 dB Occupied Bandwidth

8.3.1 Definitions and limits

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

8.3.2 Test summary

Test date	January 28, 2022	Temperature	21 °C
Test engineer	Martha Espinoza	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	51%

8.3.3 Observations, settings and special notes

Selection of port A was according to section 8.4 of this document.

Spectrum analyser settings:

Resolution bandwidth	1% - 5% OBW
Video bandwidth	3*RBW
Frequency span	2*OBW
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test data

Band	OBW Declared	Port	Channel (MHz)	26 dB OBW
n71	15 MHz	A	624.5	15.258 MHz
n71	15 MHz	A	634.5	15.257 MHz
n71	15 MHz	A	644.5	15.260 MHz

Table 8.3-1: 26 dB Occupied bandwidth, QPSK Modulation, low and middle channel (15 MHz), respectively.

Band	OBW Declared	Port	Channel (MHz)	26 dB OBW
n71	15 MHz	A	624.5	15.262 MHz
n71	15 MHz	A	634.5	15.254 MHz
n71	15 MHz	A	644.5	15.252 MHz

Table 8.3-2: 26 dB Occupied bandwidth, 16QAM Modulation.

Band	OBW Declared	Port	Channel (MHz)	26 dB OBW
n71	15 MHz	A	624.5	15.270 MHz
n71	15 MHz	A	634.5	15.292 MHz
n71	15 MHz	A	644.5	15.289 MHz

Table 8.3-3: 26 dB Occupied bandwidth, 64QAM Modulation.

Band	OBW Declared	Port	Channel (MHz)	26 dB OBW
n71	15 MHz	A	624.5	15.263 MHz
n71	15 MHz	A	634.5	15.259 MHz
n71	15 MHz	A	644.5	15.276 MHz

Table 8.3-4: 26 dB Occupied bandwidth, 256QAM Modulation.

Section 8
Test name
Specification

Testing data
FCC §27.53 (h)(3) 26 dB Occupied Bandwidth
FCC Part 27

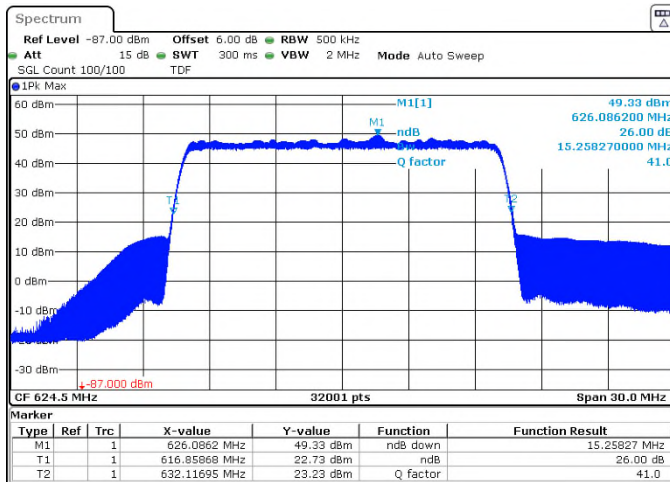


Figure 8.3-1: 26 dB Occupied bandwidth, QPSK Modulation, low and middle channel (5 MHz), respectively.

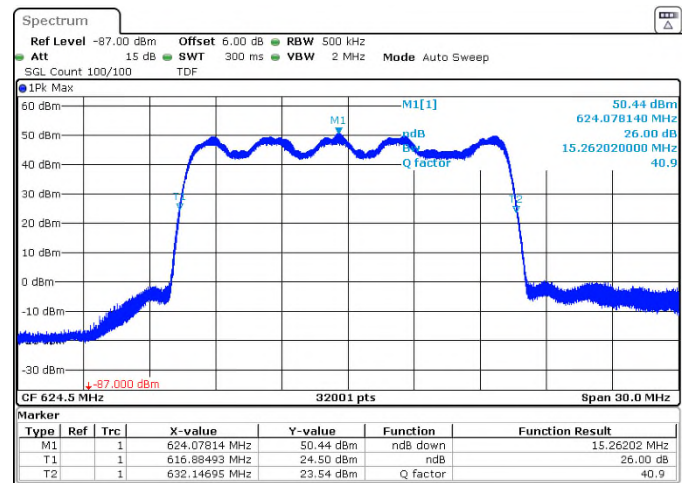
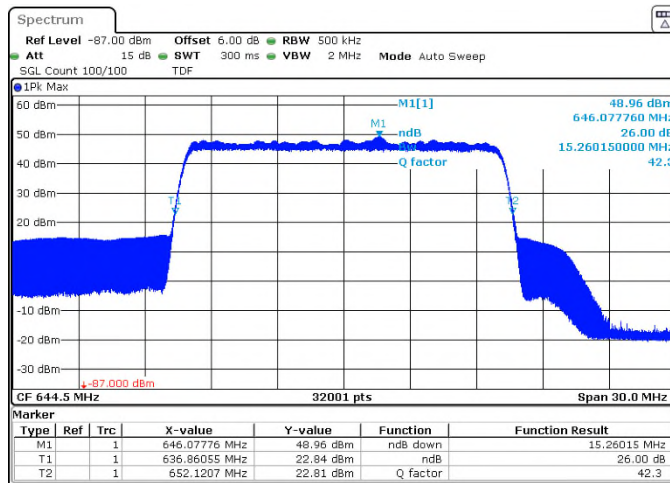
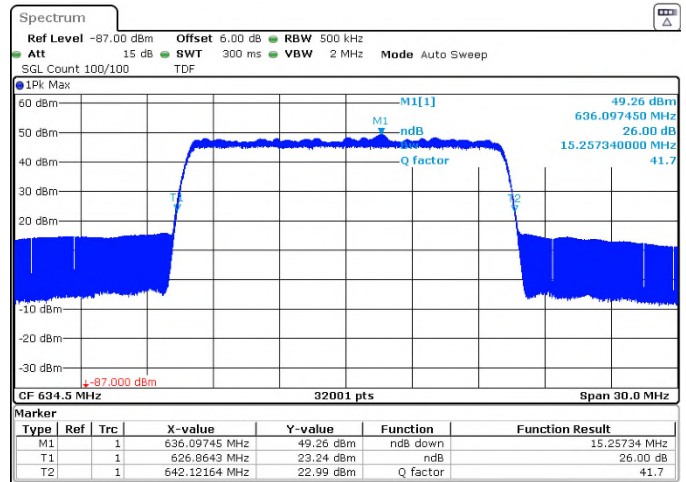


Figure 8.3-2: 26 dB Occupied bandwidth, QPSK Modulation, high channel (15 MHz) and 16QAM Modulation, low channel (15 MHz), respectively.

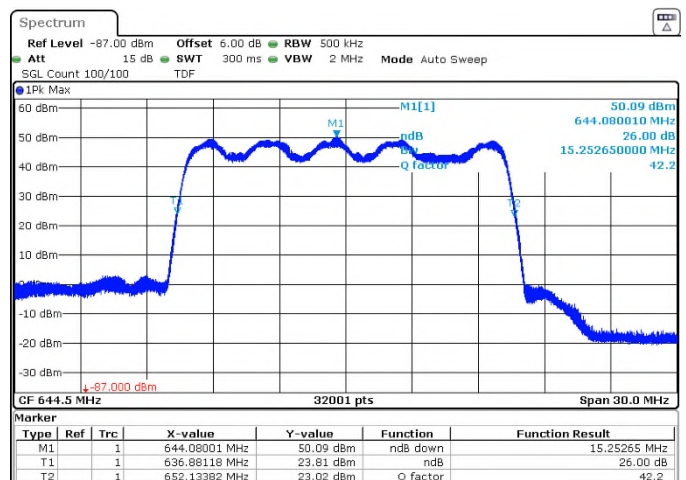
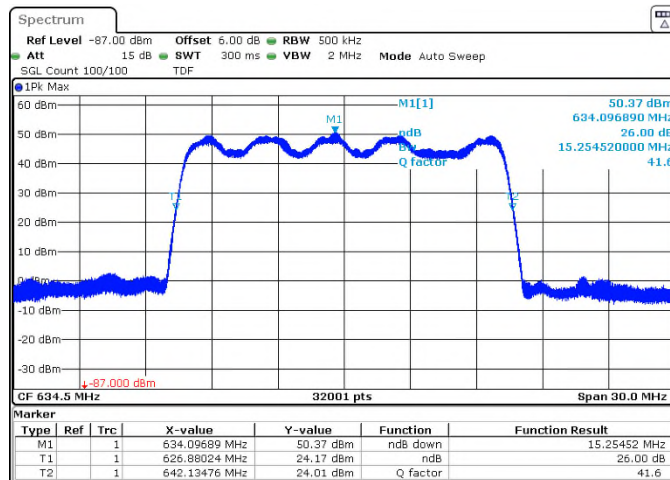


Figure 8.3-3: 26 dB Occupied bandwidth, 16QAM Modulation, middle channel (15 MHz) and high channel (15 MHz), respectively.

Section 8
Test name
Specification

Testing data
FCC §27.53 (h)(3) 26 dB Occupied Bandwidth
FCC Part 27

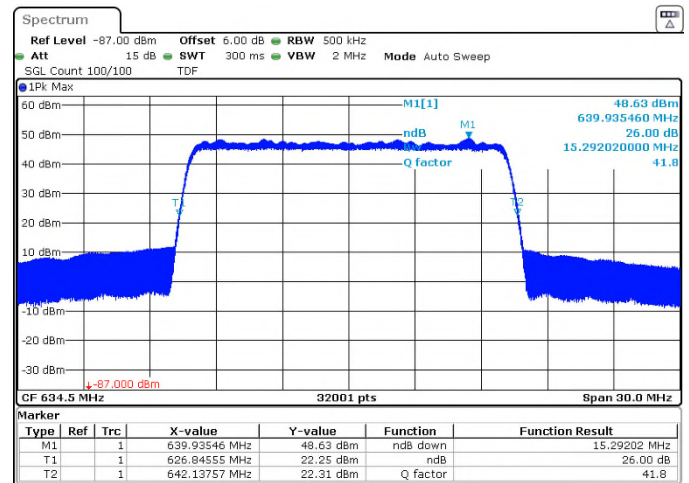
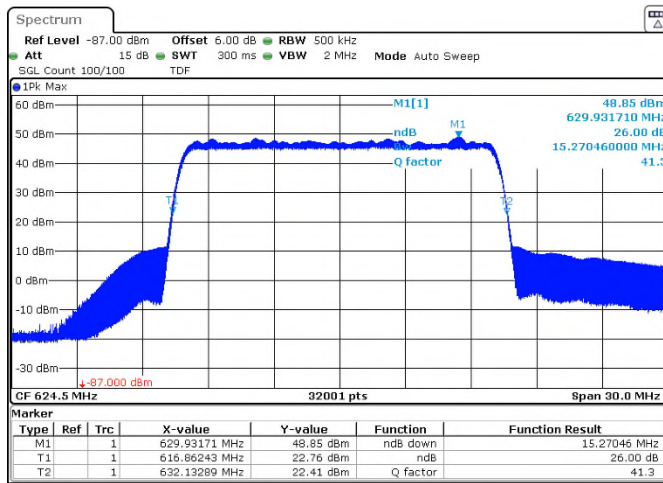


Figure 8.3-4: 26 dB Occupied bandwidth, 64QAM Modulation, low channel (15 MHz) and middle channel (15 MHz), respectively.

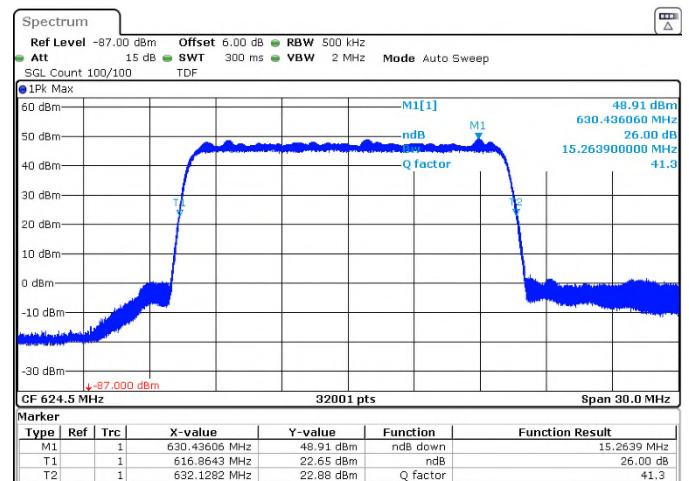
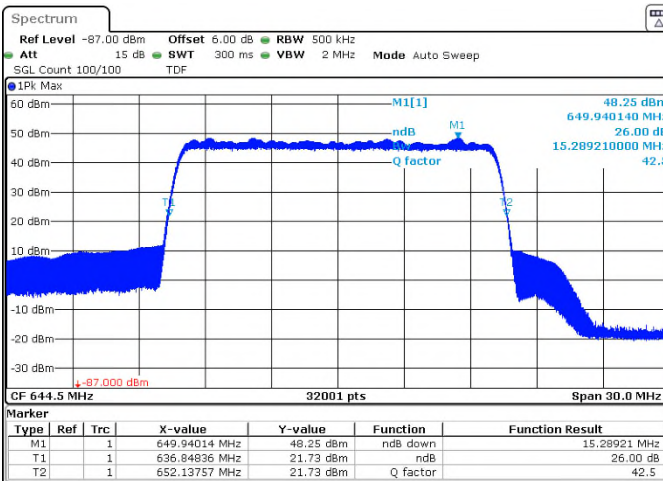


Figure 8.3-5: 26 dB Occupied bandwidth, 64QAM Modulation, high channel (15 MHz) and 256QAM Modulation, low channel (15 MHz), respectively.

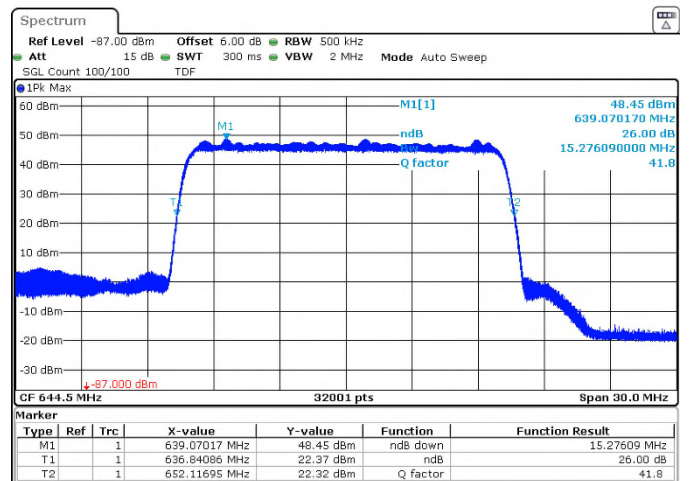
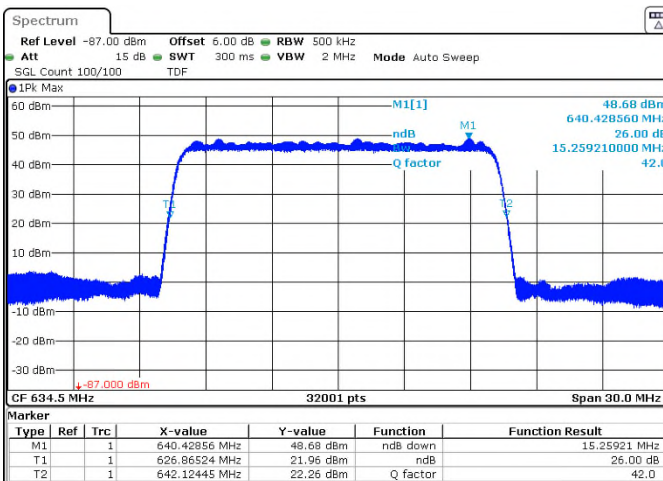


Figure 8.3-6: 26 dB Occupied bandwidth, 256QAM Modulation, middle channel (15 MHz) and high channel (15 MHz), respectively.

8.4 FCC 27.50(c)(3)(ii) Output power

8.4.1 Definitions and limits

(c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(3) Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section;

8.4.2 Test summary

Test date	January 26, 2022 January 28, 2022	Temperature	19°C 21°C
Test engineer	Martha Espinoza	Air pressure	1005 mbar; 1003 mbar
Verdict	Pass	Relative humidity	55 %; 51 %

8.4.3 Observations, settings and special notes

Power sensor settings were:

Sample rate	5MS/s
Gap time	1000 ms
Detector mode	RMS
Trigger level	-40 dBm

This test was made across the conducted port and using a sensor power. An offset of 41.5 dB was added to the measurement to compensate the losses from the cable and attenuator (40 dB) used. The signal transmitted continuously and with a 100% of duty cycle.

EUT has four ports which can transmit at the same time in a correlated way. This correlation permit to make the measurement in one port getting as a result the total power from the four ports adding a factor calculated from the next equation:

$$\text{Correlation factor} = 10\text{Log}(N)$$

Where N is the number of ports. In this specific case, $N = 4$,

$$\text{Correlation factor} = 10\text{Log}(4) = 6.02 \text{ dB}$$

To select the measurement port, a quick power test was done. The four ports are similar, however, the port with maximum power was chosen to make all the remaining tests. This pre-test was applied only to band n71 (unique with 15 MHz bandwidth):

Band	Modulation	OBW	Channel	Power Port A	Power Port B	Power Port C	Power Port D
n71	QPSK	15 MHz	634.5MHz	45.92 dBm	45.88 dBm	45.91 dBm	45.88 dBm

Port A was selected in the band, and it will be used to evaluate all the tests of this document.

EUT can transmit three bands: band n29, band n71 and band n26. The scope of this document is only band n71 with a declared bandwidth of 15 MH, four modulations, three channels. Unit transmitted the selected signal at full power.

8.4.4 Test data

Band	Modulation	OBW (MHz)	Port	Channel (MHz)	Power (RMS) (dBm)	Correlation factor (dB)	Total power across all ports (dBm)
n71	QPSK	15	A	624.5	45.96	6	51.98
n71	QPSK	15	A	634.5	45.92	6	51.94
n71	QPSK	15	A	644.5	45.64	6	51.66
n71	16QAM	15	A	624.5	46.00	6	52.02
n71	16QAM	15	A	634.5	45.92	6	51.94
n71	16QAM	15	A	644.5	45.68	6	51.70
n71	64QAM	15	A	624.5	46.00	6	52.02
n71	64QAM	15	A	634.5	45.93	6	51.95
n71	64QAM	15	A	644.5	45.68	6	51.70
n71	256QAM	15	A	624.5	46.02	6	52.04
n71	256QAM	15	A	634.5	45.95	6	51.97
n71	256QAM	15	A	644.5	45.69	6	51.71

Table 8.4-1: Conducted output power, band n71, 15 MHz OBW

8.5 FCC 27.50(B) Peak to Average Power Ratio

8.5.1 Definitions and limits

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

8.5.2 Test summary

Test date	January 28, 2022	Temperature	21 °C
Test engineer	Martha Espinoza	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	51%

8.5.3 Observations, settings and special notes

Selection of port A was according to section 8.4 of this document.

Spectrum analyser settings:

Resolution bandwidth	≥ OBW
Number of counts	The necessary number up to stabilizes the measured
Trace mode	Clear/Write

8.5.4 Test data

Band	OBW Declared	Port	Channel (MHz)	0.1%	0.1% Limit	Margin
n71	15 MHz	A	624.5	7.83 dB	13 dB	5.17 dB
n71	15 MHz	A	634.5	7.83 dB	13 dB	5.17 dB
n71	15 MHz	A	644.5	7.94 dB	13 dB	5.06 dB

Table 8.5-1: Peak to average power ratio, QPSK Modulation.

Band	OBW Declared	Port	Channel (MHz)	0.1%	0.1% Limit	Margin
n71	15 MHz	A	624.5	7.88 dB	13 dB	5.12 dB
n71	15 MHz	A	634.5	7.86 dB	13 dB	5.14 dB
n71	15 MHz	A	644.5	7.94 dB	13 dB	5.06 dB

Table 8.5-2: Peak to average power ratio, 16QAM Modulation.

Band	OBW Declared	Port	Channel (MHz)	0.1%	0.1% Limit	Margin
n71	15 MHz	A	624.5	7.86 dB	13 dB	5.14 dB
n71	15 MHz	A	634.5	7.83 dB	13 dB	5.17 dB
n71	15 MHz	A	644.5	7.91 dB	13 dB	5.09 dB

Table 8.5-3: Peak to average power ratio, 64QAM Modulation.

Band	OBW Declared	Port	Channel (MHz)	0.1%	0.1% Limit	Margin
n71	15 MHz	A	624.5	7.86 dB	13 dB	5.14 dB
n71	15 MHz	A	634.5	7.83 dB	13 dB	5.17 dB
n71	15 MHz	A	644.5	7.91 dB	13 dB	5.09 dB

Table 8.5-4: Peak to average power ratio, 256QAM Modulation.

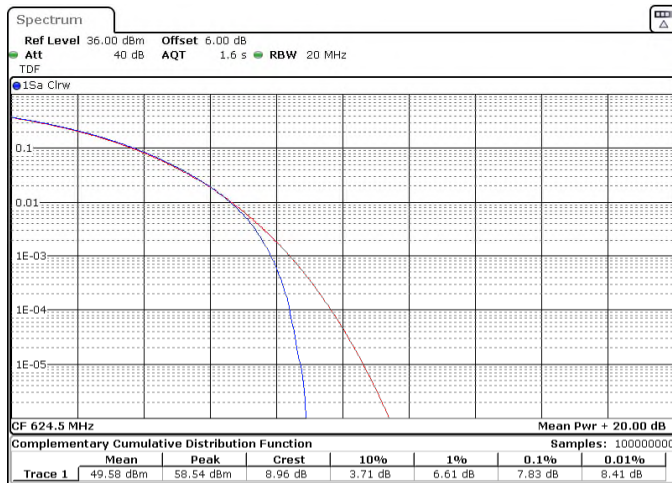


Figure 8.5-1: Peak to average power ratio, QPSK Modulation, low channel (15 MHz) and middle channel (15 MHz), respectively.

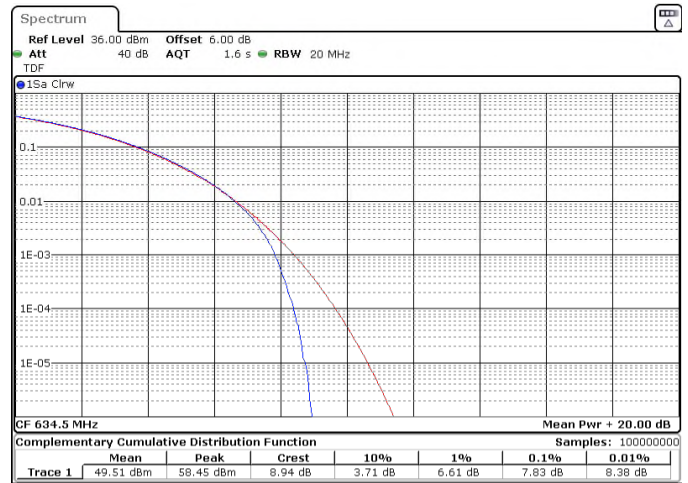
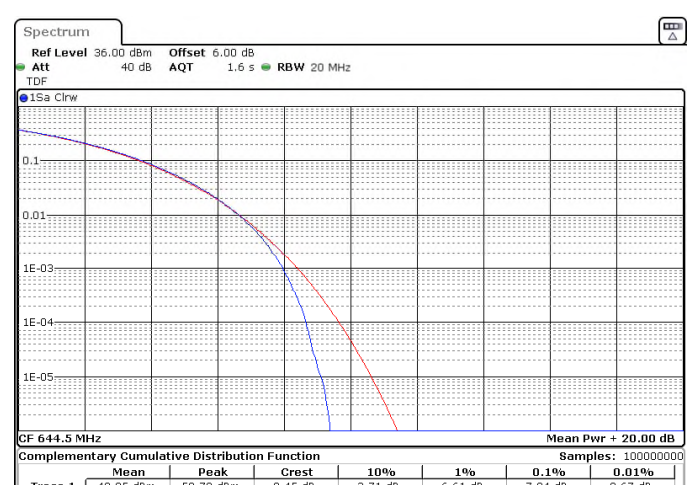


Figure 8.5-2: Peak to average power ratio, QPSK Modulation, high channel (15 MHz) and 16QAM Modulation, low channel (15 MHz), respectively.



Figure 8.5-3: Peak to average power ratio, 16QAM, Modulation, middle channel (15 MHz) and high channel (15 MHz), respectively.



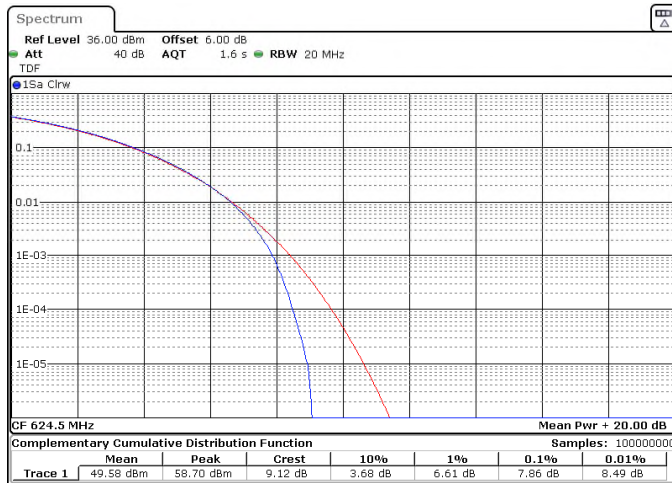


Figure 8.5-4: Peak to average power ratio, 64QAM, Modulation, low channel (15 MHz) and middle channel (15 MHz), respectively.

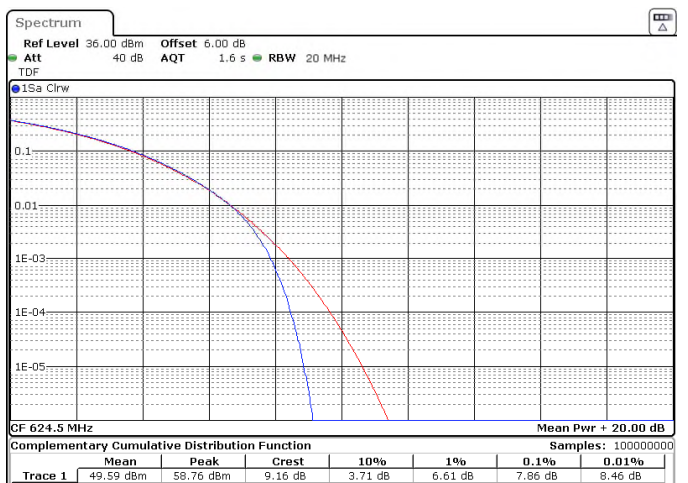


Figure 8.5-5: Peak to average power ratio, 64QAM, Modulation, high channel (15 MHz) and 256QAM, low channel (15 MHz), respectively.

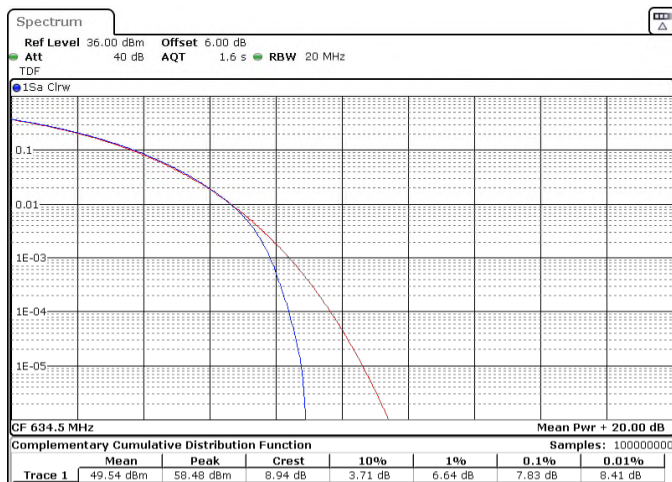


Figure 8.5-6: Peak to average power ratio, 256QAM, Modulation, middle channel (15 MHz) and high channel (15 MHz), respectively.

8.6 FCC 27.53(g) Emission Limits

8.6.1 Definitions and limits

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

8.6.2 Test summary

Test date	January 27, 2022 January 28, 2022	Temperature	19 °C 21 °C
Test engineer	Martha Espinoza	Air pressure	1002; 1003 mbar
Verdict	Pass	Relative humidity	57%; 51%

8.6.3 Observations, settings and special notes

EUT setup configuration	Table top
Test facility	3 m 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	– Peak (Preview measurement) – Quasi-peak (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak final measurement)

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (Preview measurement) Peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Peak and CAverage final measurement)

Spectrum analyzer settings (conducted test):

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Frequency span	Sufficient for making an accurate measurement
Detector mode	RMS
Trace mode	Max Hold

8.6.4 Observations, settings and special notes, continued

This test was realized in two parts: one with a conducted setup and another one with a radiated setup.

The conducted test was made on port A (this port was selected based on test showed on section 8.4), transmitting at max power and with the other three ports loaded with 50 Ω loads. For capturing the signal with the equipment, it was divided in two ranges, using a transducer factor to compensate the losses caused by a cable and attenuator used to protect the test equipment. Additional to this number, a 6 dB correlation factor was added to evaluate the complete power across the four ports, considering the ranges where harmonic can be observed. The first range was measured from 30 MHz to 3 GHz where the fundamental signal is visible. The second range was selected from 3 GHz to 7 GHz, where the internal attenuator was reduced significantly to get a good noise floor level. Both ranges used the 6 dB offset and a transducer factor (include the cable losses and attenuator). The evaluation was made using the three channels and all the modulations.

The radiated test was made transmitting to max power too with the four ports terminated with 50 Ω loads. The scans were made from 30 MHz to 7 GHz considering all the channels but only the modulation with the highest power as was showed at section 8.4. For band n71, the modulation selected was 256QAM as the worst case.

Based on equation $43 + 10 \log_{10}(P)$ dB, the general emission limit is -13 dBm (conducted and radiated test) or the equivalent at 3m is 82.23 dBuV/m above 1 GHz and 84.38 dBuV/m below 1 GHz.

Selection of port A was according to section 8.4 of this document.

8.6.5 Test data

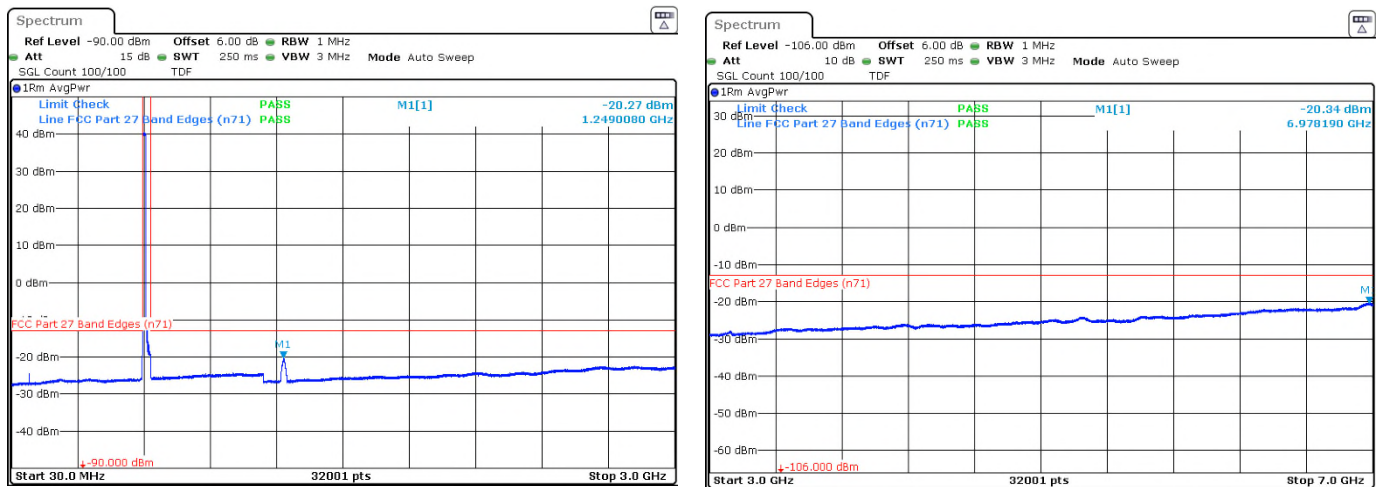


Figure 8.6-1: Conducted emission test, QPSK Modulation, low channel (15 MHz).

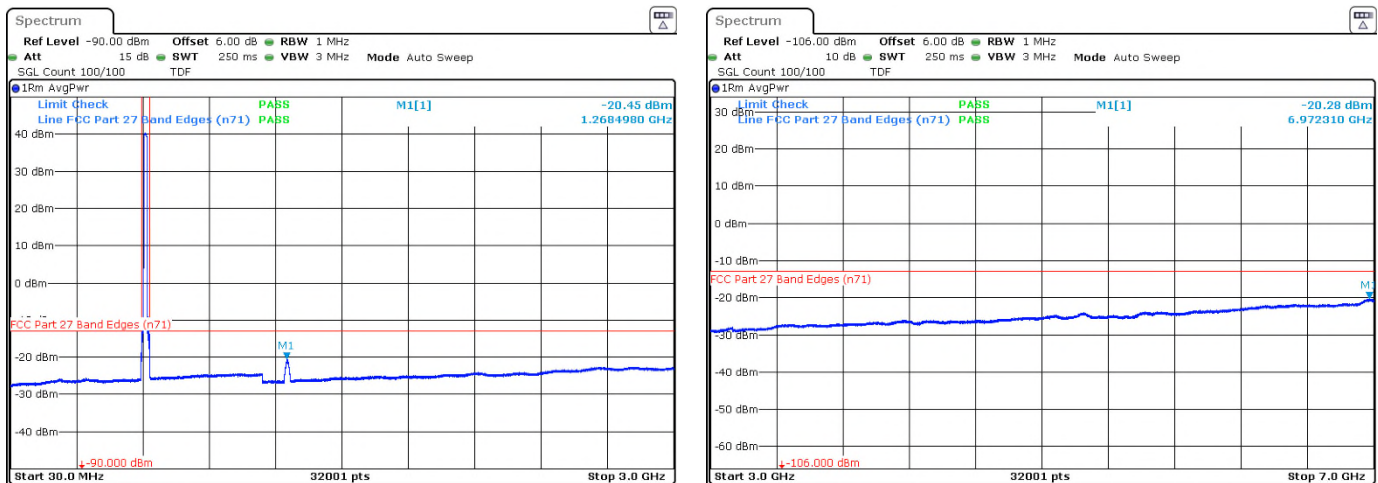


Figure 8.6-2: Conducted emission test, QPSK Modulation, middle channel (15 MHz).

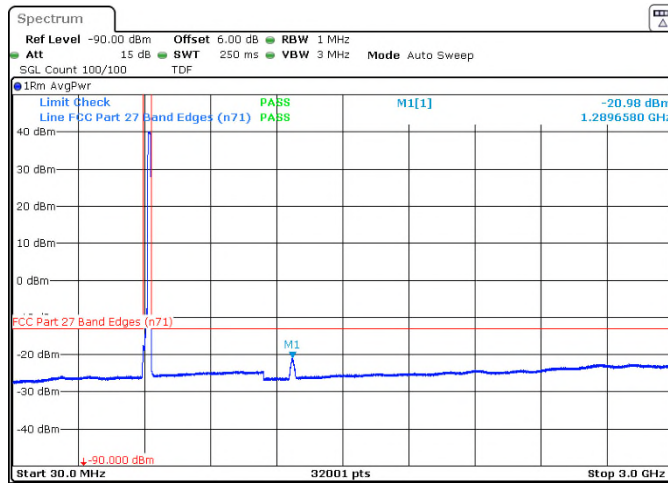


Figure 8.6-3: Conducted emission test, QPSK Modulation, high channel (15 MHz).

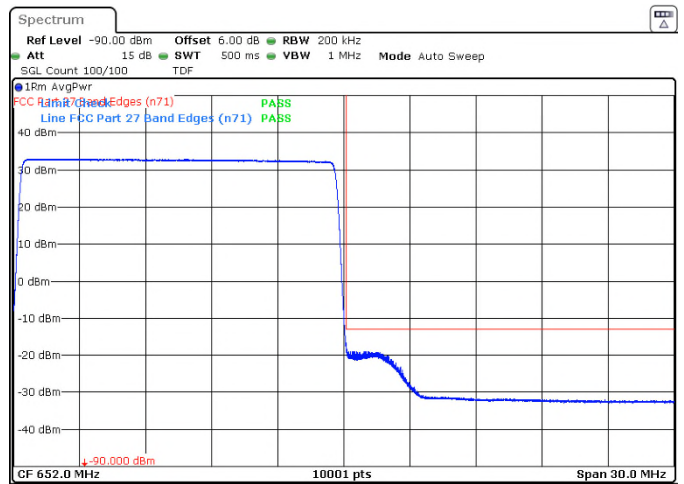
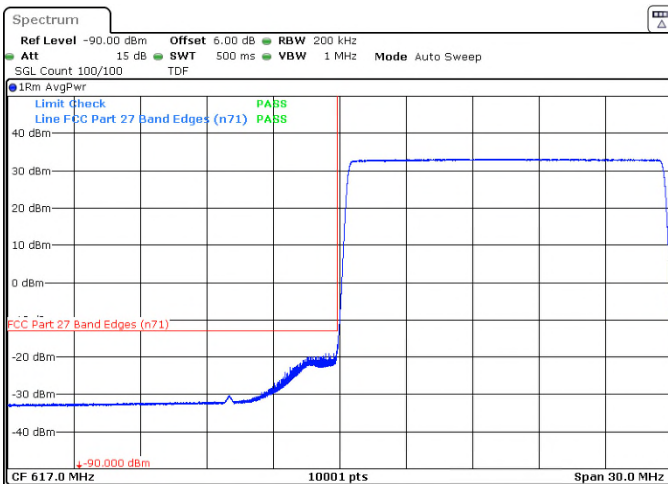
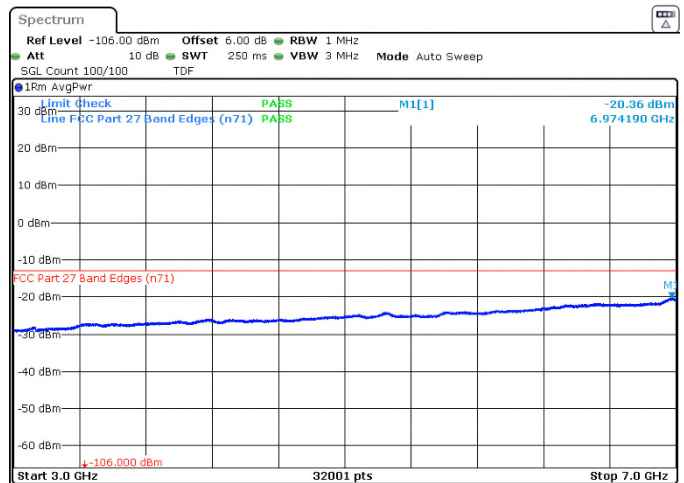


Figure 8.6-4: Conducted emission test, QPSK Modulation, band edge: low and high channels, respectively (15 MHz).

***Note: For this specific test the frequency limit has a frequency offset equivalent at $RBW/2$ (± 100 kHz from the low and high edge of the band), in order to demonstrate compliance. This offset was taken according to ANSI C63.26 Clause 5.7.2 (g) rules.**

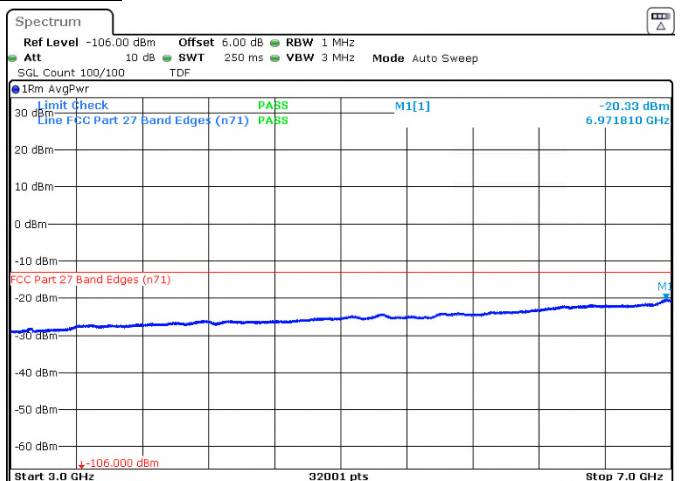
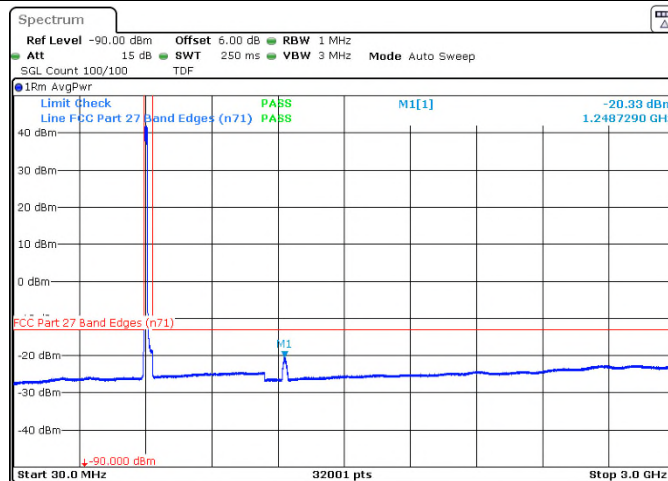


Figure 8.6-5: Conducted emission test, 16QAM Modulation, low channel (15 MHz).

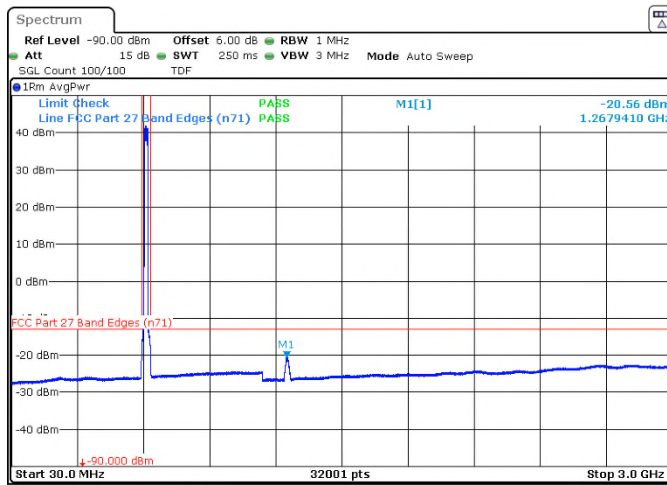


Figure 8.6-6: Conducted emission test, 16QAM Modulation, middle channel (15 MHz).

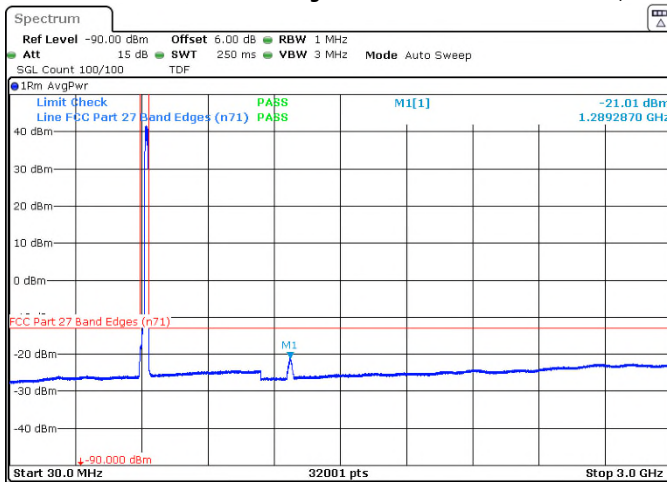
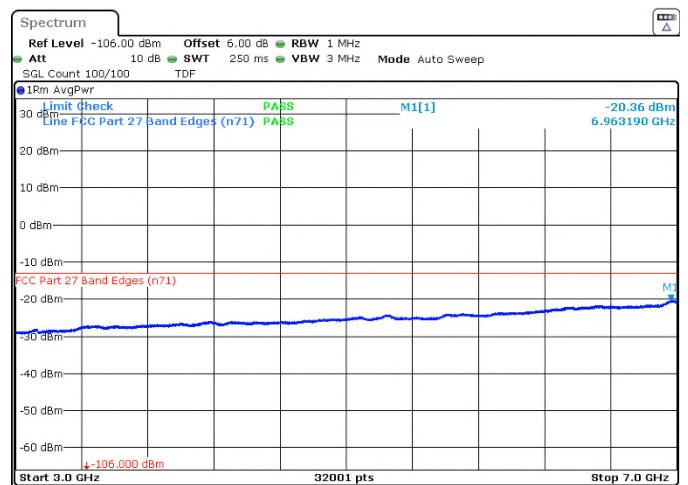


Figure 8.6-7: Conducted emission test, 16QAM Modulation, high channel (15 MHz).

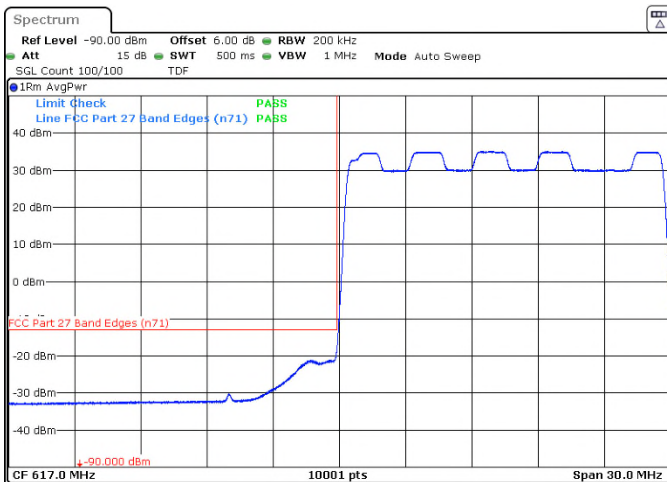
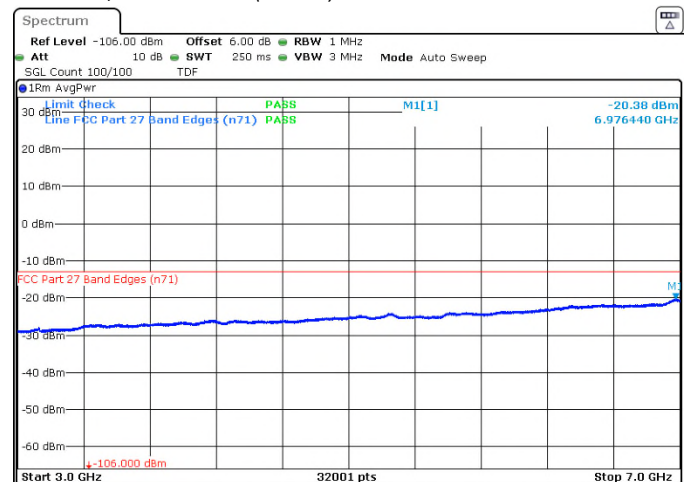
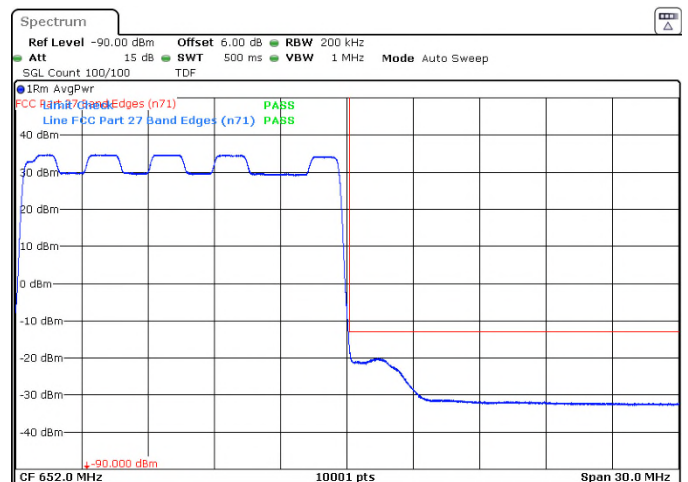


Figure 8.6-8: Conducted emission test, 16QAM Modulation, band edge: low and high channels, respectively (15 MHz).



***Note:** For this specific test the frequency limit has a frequency offset equivalent at $RBW/2 (\pm 100 \text{ kHz})$ from the low and high edge of the band, in order to demonstrate compliance. This offset was taken according to ANSI C63.26 Clause 5.7.2 (g) rules.

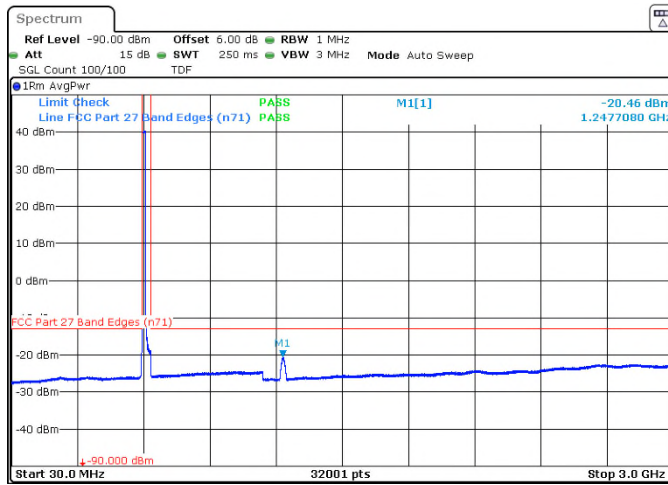


Figure 8.6-9: Conducted emission test, 64QAM Modulation, low channel (15 MHz).

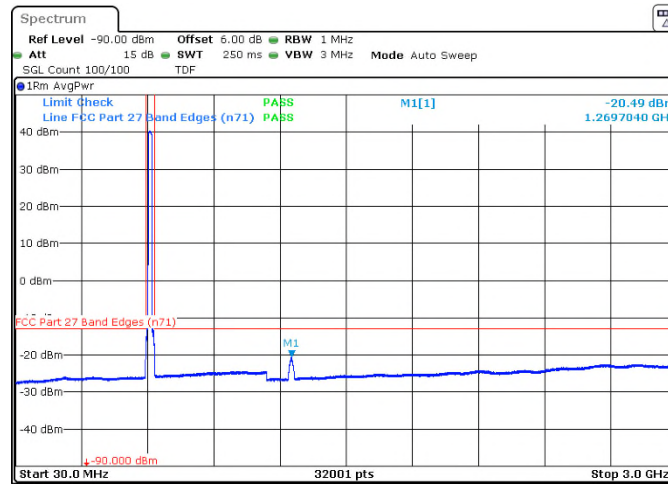
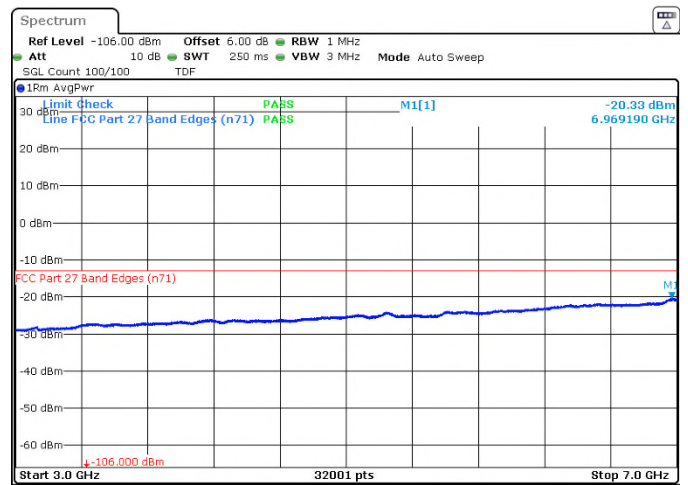


Figure 8.6-10: Conducted emission test, 64QAM Modulation, middle channel (15 MHz).

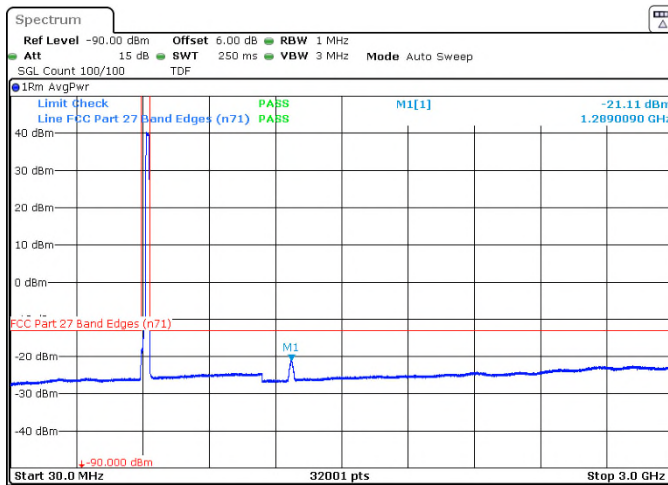
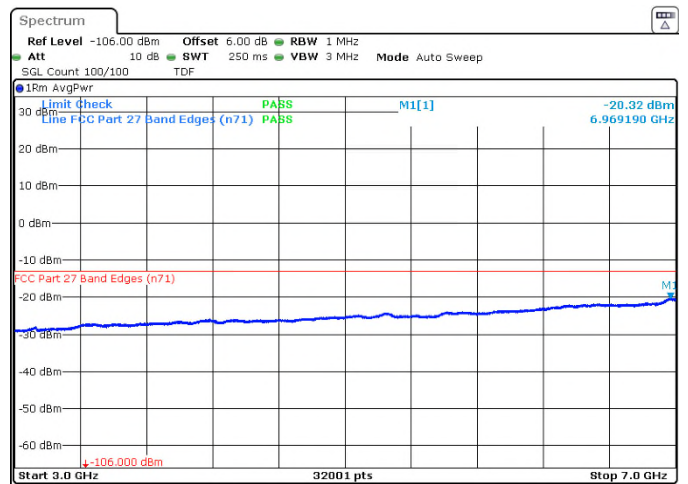


Figure 8.6-11: Conducted emission test, 64QAM Modulation, high channel (15 MHz).

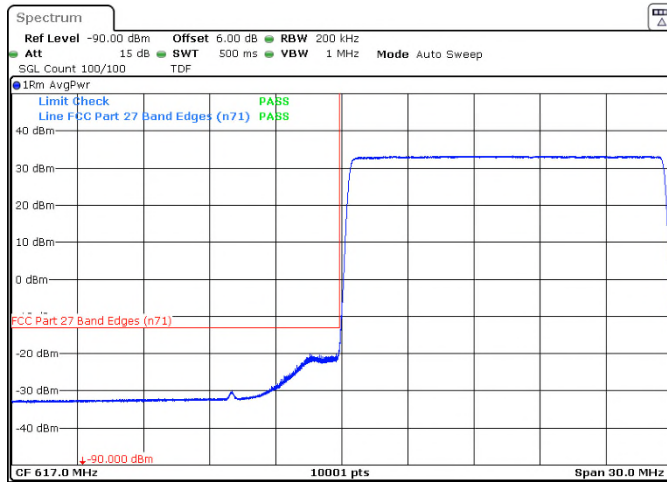


Figure 8.6-12: Conducted emission test, 64QAM Modulation, band edge: low and high channels, respectively (15 MHz).

***Note: For this specific test the frequency limit has a frequency offset equivalent at RBW/2 (± 100 kHz from the low and high edge of the band), in order to demonstrate compliance. This offset was taken according to ANSI C63.26 Clause 5.7.2 (q) rules.**

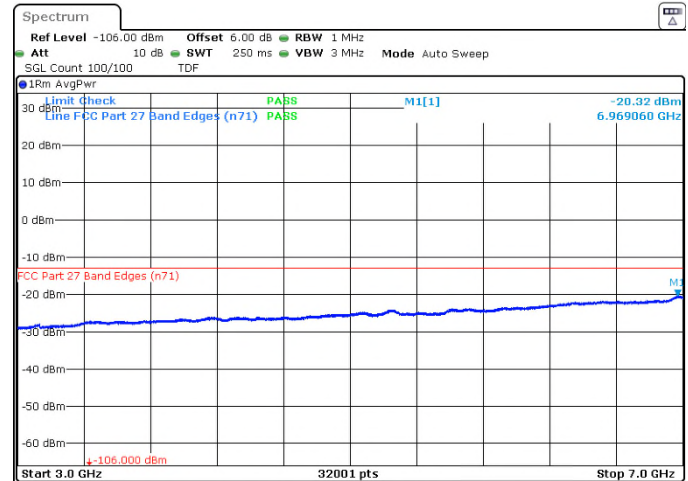
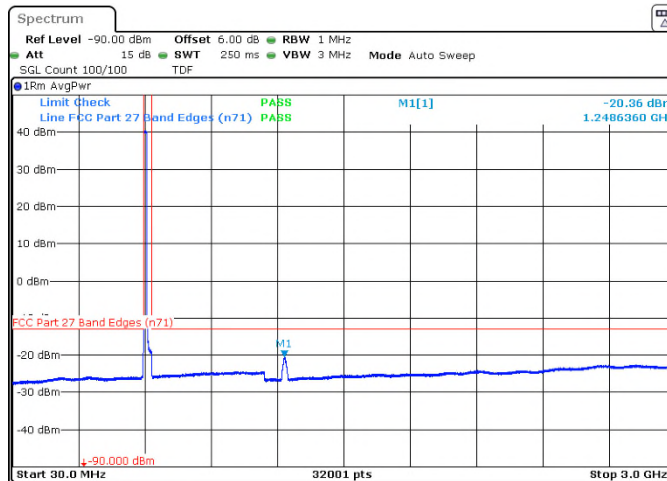


Figure 8.6-13: Conducted emission test, 256QAM Modulation, low channel (15 MHz).

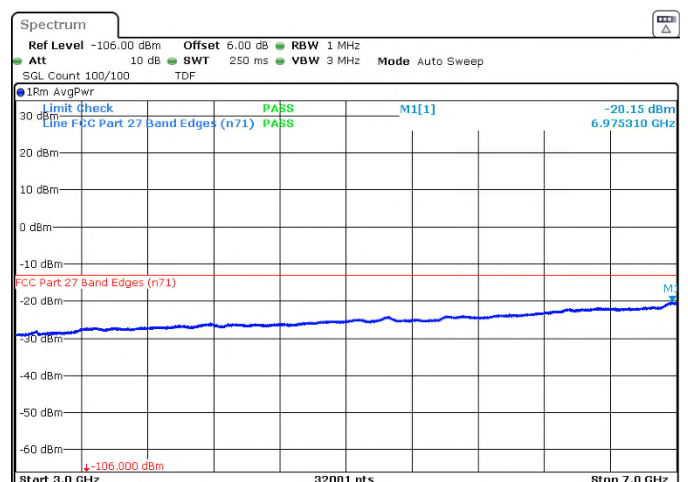
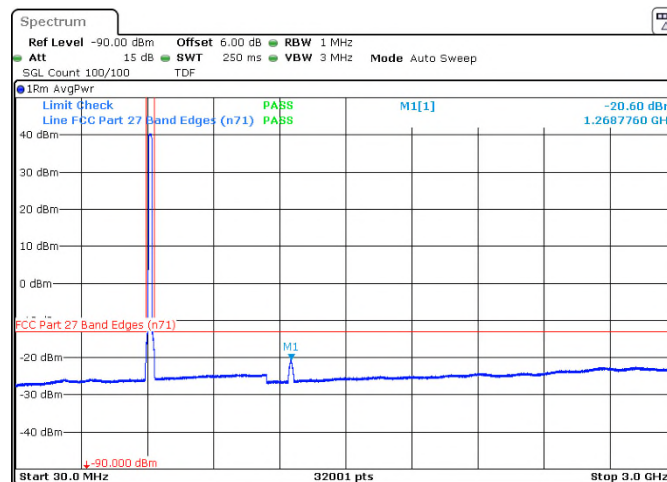


Figure 8.6-14: Conducted emission test, 256QAM Modulation, middle channel (15 MHz).

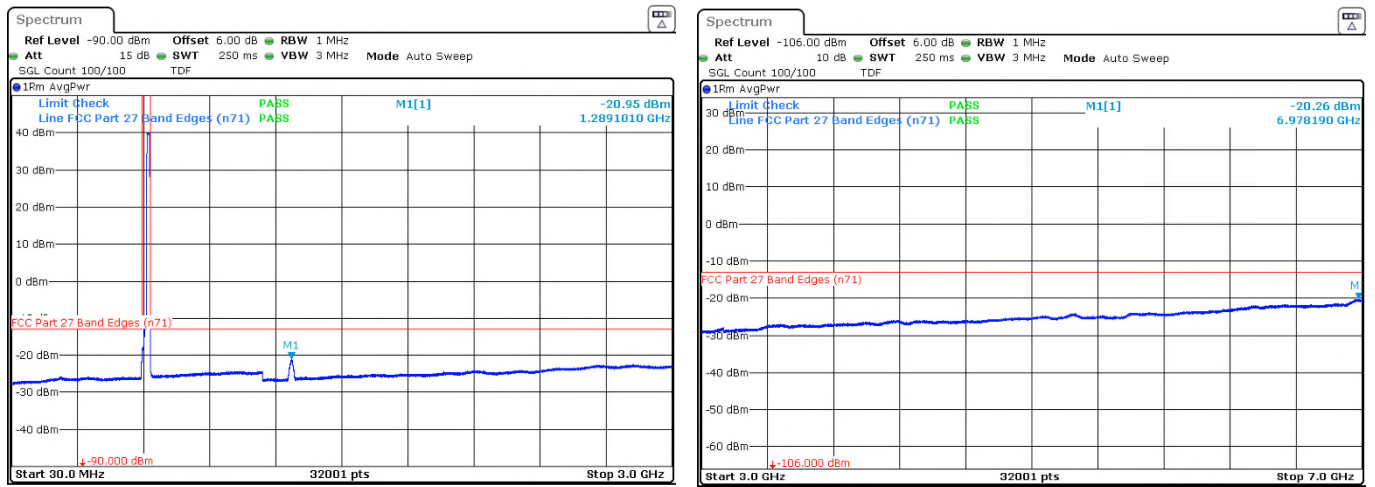


Figure 8.6-15: Conducted emission test, 256QAM Modulation, high channel (15 MHz).

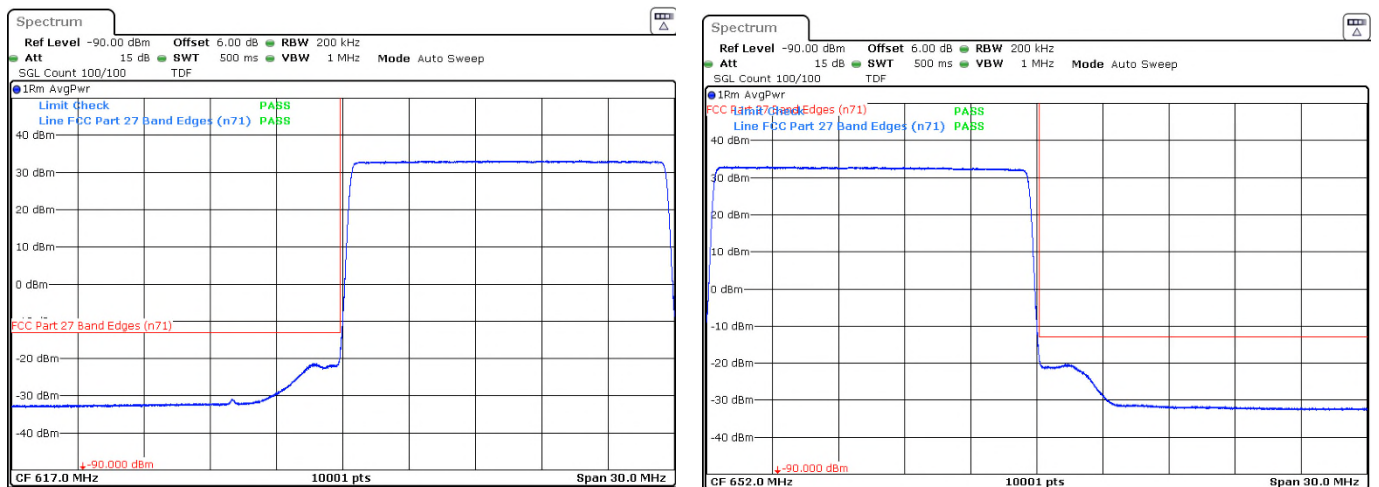
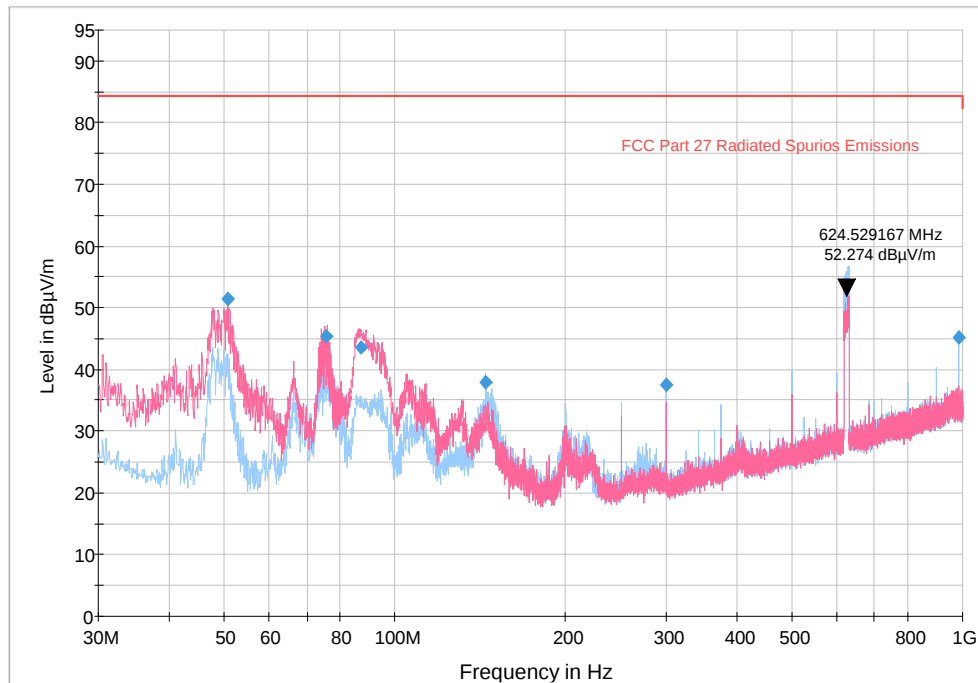


Figure 8.6-16: Conducted emission test, 256QAM Modulation, band edge: low and high channels, respectively (15 MHz).

***Note: For this specific test the frequency limit has a frequency offset equivalent at $RBW/2$ (± 100 kHz from the low and high edge of the band), in order to demonstrate compliance. This offset was taken according to ANSI C63.26 Clause 5.7.2 (g) rules.**

Full Spectrum



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

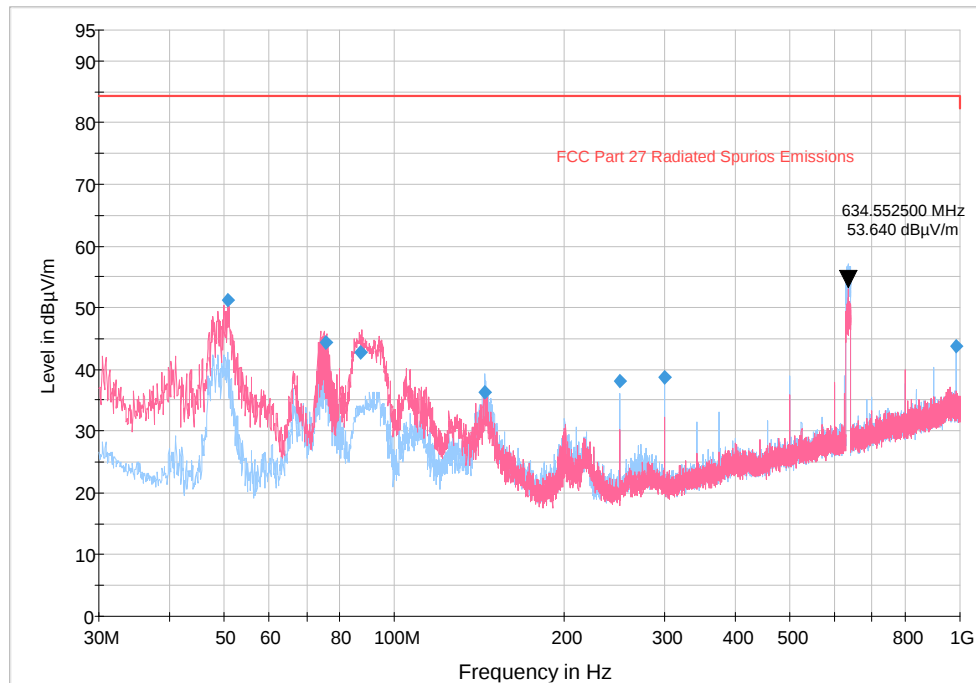
Figure 8.6-17: Emissions limit plot – Field strength measured from 0.030 to 1 GHz, 256QAM Modulation, 15 MHz OBW, Low channel.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.694167	51.35	84.38	33.03	5000.0	120.000	100.0	V	234.0	15.7
75.513333	45.45	84.38	38.93	5000.0	120.000	119.0	V	184.0	14.5
87.178333	43.52	84.38	40.86	5000.0	120.000	100.0	V	334.0	15.7
144.742500	37.99	84.38	46.39	5000.0	120.000	128.0	H	54.0	19.4
300.024167	37.54	84.38	46.84	5000.0	120.000	100.0	H	355.0	22.0
983.025833	45.26	84.38	39.12	5000.0	120.000	222.0	H	246.0	34.3

Table 8.6-1: Emissions limit results – Field strength measured from 0.030 to 1 GHz, 256QAM Modulation, 15 MHz OBW, Low channel.

- Notes:
- ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
 - ² Correction factors = antenna factor ACF (dB) + cable loss (dB)
 - ³ The maximum measured value observed over a period of 5 seconds was recorded.
 - ⁴ The spectral plot shows the vertical and horizontal scan separately.
 - ⁵ This measurement was done at 3m

Full Spectrum



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

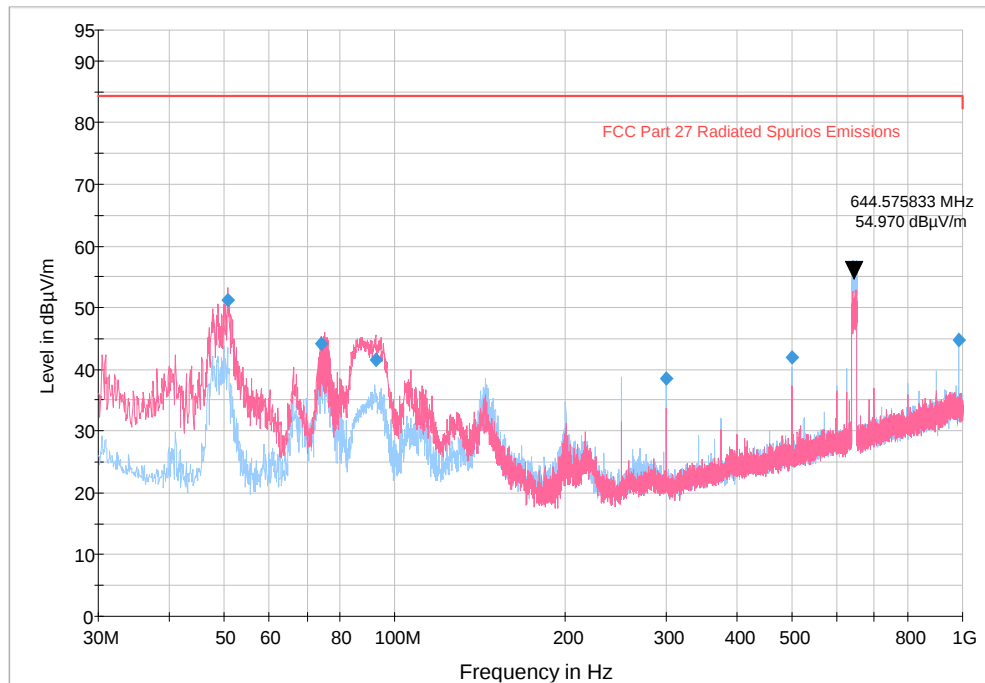
Figure 8.6-18: Emissions limit plot – Field strength measured from 0.030 to 1 GHz, 256QAM Modulation, 15 MHz OBW, Middle channel.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.652500	51.21	84.38	33.17	5000.0	120.000	118.0	V	243.0	15.7
75.505000	44.46	84.38	39.92	5000.0	120.000	125.0	V	166.0	14.4
87.112500	42.81	84.38	41.57	5000.0	120.000	100.0	V	306.0	15.7
144.702500	36.24	84.38	48.14	5000.0	120.000	146.0	H	34.0	19.4
250.028333	38.10	84.38	46.28	5000.0	120.000	100.0	H	128.0	20.9
300.024167	38.64	84.38	45.74	5000.0	120.000	100.0	H	100.0	22.0
983.025833	43.73	84.38	40.65	5000.0	120.000	155.0	H	223.0	34.3

Table 8.6-2: Emissions limit results – Field strength measured from 0.030 to 1 GHz, 256QAM Modulation, 15 MHz OBW, Middle channel.

- Notes:
- ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
 - ² Correction factors = antenna factor ACF (dB) + cable loss (dB)
 - ³ The maximum measured value observed over a period of 5 seconds was recorded.
 - ⁴ The spectral plot shows the vertical and horizontal scan separately.
 - ⁵ This measurement was done at 3m

Full Spectrum



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

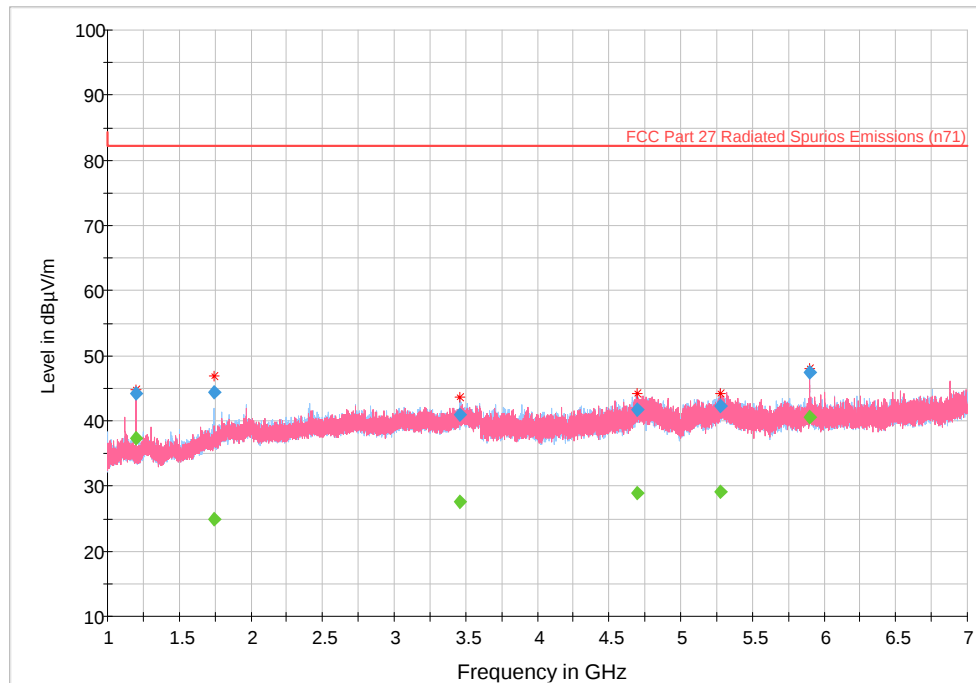
Figure 8.6-19: Emissions limit plot – Field strength measured from 0.030 to 1 GHz, 256QAM Modulation, 15 MHz OBW, High channel.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.652500	51.16	84.38	33.22	5000.0	120.000	100.0	V	223.0	15.7
74.025000	44.12	84.38	40.26	5000.0	120.000	100.0	V	270.0	14.2
92.563333	41.55	84.38	42.83	5000.0	120.000	118.0	V	325.0	16.6
300.024167	38.61	84.38	45.77	5000.0	120.000	100.0	H	100.0	22.0
500.046667	41.89	84.38	42.49	5000.0	120.000	128.0	H	132.0	27.1
983.065833	44.69	84.38	39.69	5000.0	120.000	223.0	H	248.0	34.3

Table 8.6-3: Emissions limit results – Field strength measured from 0.030 to 1 GHz, 256QAM Modulation, 15 MHz OBW, High channel.

- Notes:
- ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
 - ² Correction factors = antenna factor ACF (dB) + cable loss (dB)
 - ³ The maximum measured value observed over a period of 5 seconds was recorded.
 - ⁴ The spectral plot shows the vertical and horizontal scan separately.
 - ⁵ This measurement was done at 3m

Full Spectrum



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 8.6-20: Emissions limit plot – Field strength measured from 1 to 7 GHz, 256QAM Modulation, 15 MHz OBW, Low channel.

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)
1200.400000	44.28	---	82.23	37.95	5000.0	1000.000	107.0	V	255.0	-13.2
1200.400000	---	37.31	82.23	44.92	5000.0	1000.000	107.0	V	255.0	-13.2
1742.800000	---	24.93	82.23	57.30	5000.0	1000.000	118.0	H	309.0	-11.5
1742.800000	44.35	---	82.23	37.88	5000.0	1000.000	118.0	H	309.0	-11.5
3460.400000	---	27.56	82.23	54.67	5000.0	1000.000	276.0	H	42.0	-5.5
3460.400000	40.95	---	82.23	41.28	5000.0	1000.000	276.0	H	42.0	-5.5
4694.800000	---	28.93	82.23	53.30	5000.0	1000.000	266.0	V	32.0	-0.7
4694.800000	41.81	---	82.23	40.42	5000.0	1000.000	266.0	V	32.0	-0.7
5278.000000	42.22	---	82.23	40.01	5000.0	1000.000	218.0	H	260.0	-0.8
5278.000000	---	29.17	82.23	53.06	5000.0	1000.000	218.0	H	260.0	-0.8
5898.200000	---	40.53	82.23	41.70	5000.0	1000.000	133.0	V	160.0	0.3
5898.200000	47.47	---	82.23	34.76	5000.0	1000.000	133.0	V	160.0	0.3

Table 8.6-4: Emissions limit results – Field strength measured from 1 to 7 GHz, 256QAM Modulation, 15 MHz OBW, Low channel.

Notes:

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

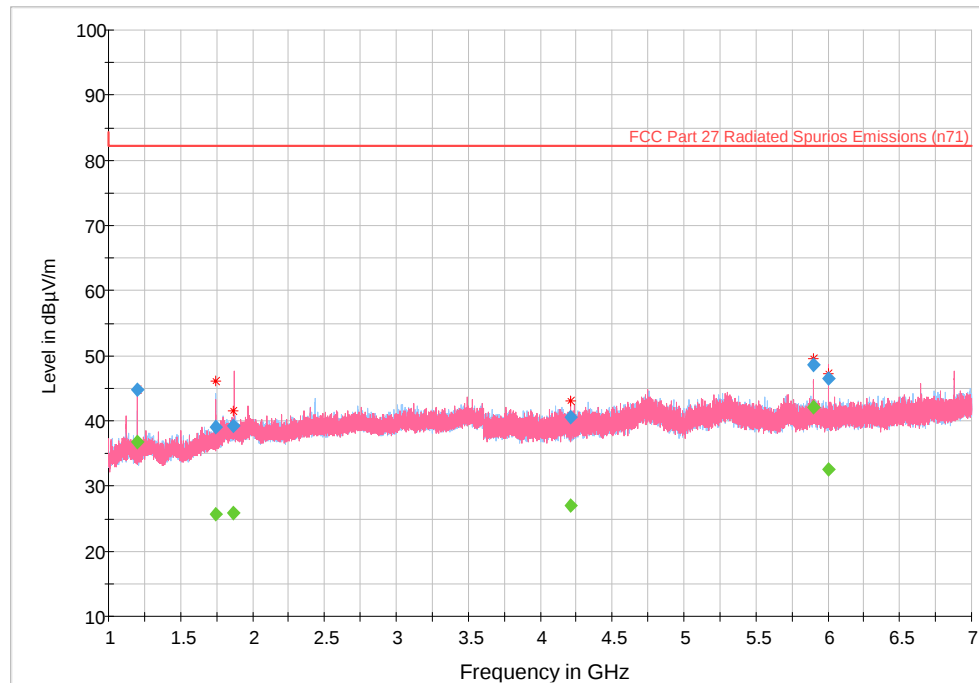
² Correction factors = antenna factor ACF (dB) + cable loss (dB)+20 dB attenuator to protect the test equipment

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

⁴ The spectral plot is a summation of a vertical and horizontal scan.

⁵ This measurement was done at 3m

Full Spectrum



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 8.6-21: Emissions limit plot – Field strength measured from 1 to 7 GHz, 256QAM Modulation, 15 MHz OBW, Middle channel.

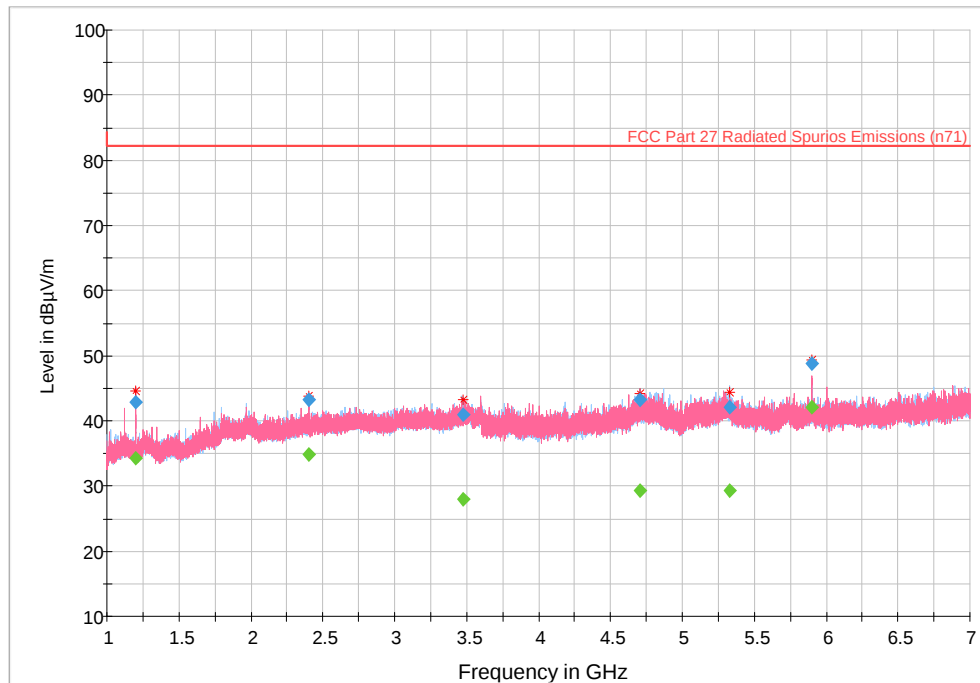
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1200.200000	---	36.83	82.23	45.40	5000.0	1000.000	104.0	V	255.0	-13.2
1200.200000	44.80	---	82.23	37.43	5000.0	1000.000	104.0	V	255.0	-13.2
1746.600000	38.99	---	82.23	43.24	5000.0	1000.000	142.0	H	156.0	-11.4
1746.600000	---	25.71	82.23	56.52	5000.0	1000.000	142.0	H	156.0	-11.4
1866.600000	39.33	---	82.23	42.90	5000.0	1000.000	402.0	V	66.0	-10.3
1866.600000	---	25.77	82.23	56.46	5000.0	1000.000	402.0	V	66.0	-10.3
4214.200000	---	27.06	82.23	55.17	5000.0	1000.000	233.0	V	247.0	-2.7
4214.200000	40.53	---	82.23	41.70	5000.0	1000.000	233.0	V	247.0	-2.7
5898.400000	48.57	---	82.23	33.66	5000.0	1000.000	131.0	V	172.0	0.3
5898.400000	---	42.06	82.23	40.17	5000.0	1000.000	131.0	V	172.0	0.3
6000.400000	46.42	---	82.23	35.81	5000.0	1000.000	100.0	V	31.0	0.4
6000.400000	---	32.64	82.23	49.59	5000.0	1000.000	100.0	V	31.0	0.4

Table 8.6-5: Emissions limit results – Field strength measured from 1 to 18 GHz, QPSK Modulation, 5 MHz OBW, Middle channel.

Notes:

- ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
- ² Correction factors = antenna factor ACF (dB) + cable loss (dB)+20 dB attenuator to protect the test equipment
- ³ The maximum measured value observed over a period of 5 seconds was recorded.
- ⁴ The spectral plot is a summation of a vertical and horizontal scan.
- ⁵ This measurement was done at 3m

Full Spectrum



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 8.6-22: Emissions limit plot – Field strength measured from 1 to 7 GHz, 256QAM Modulation, 15 MHz OBW, High channel.

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)
1200.000000	---	34.19	82.23	48.04	5000.0	1000.000	157.0	V	250.0	-13.2
1200.000000	42.94	---	82.23	39.29	5000.0	1000.000	157.0	V	250.0	-13.2
2400.800000	---	34.88	82.23	47.35	5000.0	1000.000	111.0	V	350.0	-9.0
2400.800000	43.29	---	82.23	38.94	5000.0	1000.000	111.0	V	350.0	-9.0
3472.200000	---	27.95	82.23	54.28	5000.0	1000.000	225.0	H	149.0	-5.4
3472.200000	40.93	---	82.23	41.30	5000.0	1000.000	225.0	H	149.0	-5.4
4705.800000	43.24	---	82.23	38.99	5000.0	1000.000	182.0	H	184.0	-0.6
4705.800000	---	29.24	82.23	52.99	5000.0	1000.000	182.0	H	184.0	-0.6
5331.600000	---	29.34	82.23	52.89	5000.0	1000.000	183.0	H	0.0	-0.8
5331.600000	42.15	---	82.23	40.08	5000.0	1000.000	183.0	H	0.0	-0.8
5898.200000	48.74	---	82.23	33.49	5000.0	1000.000	160.0	V	168.0	0.3
5898.200000	---	42.13	82.23	40.10	5000.0	1000.000	160.0	V	168.0	0.3

Table 8.6-6: Emissions limit results – Field strength measured from 1 to 7 GHz, 256QAM Modulation, 15 MHz OBW, High channel.

Notes:

- ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
- ² Correction factors = antenna factor ACF (dB) + cable loss (dB)+20 dB attenuator to protect the test equipment
- ³ The maximum measured value observed over a period of 5 seconds was recorded.
- ⁴ The spectral plot is a summation of a vertical and horizontal scan.
- ⁵ This measurement was done at 3m

Section 9. Block diagrams of test setups

9.1 Radiated emissions set-up

