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Wireless Test Report-384990-1TRFWL

Applicant:

Tait International Limited

Product:

Licensed High UHF Portable Radio

Model:

TPGK5A

FCC ID:

CASTPGK5A

ISED Register Number

737A-TPGK5A

Specifications:

FCC 47 CFR Part 27

Miscellaneous wireless communications services

RSS-130 Issue 2, Feb 2019

Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz

Date of issue: December 12, 2019

Fahar Abdul Sukkoor, EMC Specialist

Tested by

Signature

Andrey Adelberg, Senior Wireless/EMC Specialist

Reviewed by

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Test location

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Test site registration	Organization FCC/ISED	Recognition numbers and location CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

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 Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Tait International Limited
Address	245 Wooldridge Road, Harewood,
City	Christchurch
Province/State	–
Postal/Zip code	8051
Country	New Zealand

1.2 Test specifications

FCC 47 CFR Part 27	Miscellaneous wireless communications services
RSS-130 Issue 2, February 2019	Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz
SRSP-518 Issue 2, February 2019	Technical Requirements in the Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz

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
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 27 test results

Part	Test description	Verdict
§27.50(b)(10)	RF Power output	Pass
§27.53 (c)(e)	Spurious emissions at antenna terminals	Pass
§27.53 (c)(e)	Field strength of spurious radiation	Pass
§27.53(f)	Spurious emissions within 1559–1610 MHz band	Pass
§27.54	Frequency stability	Pass
§2.1047 (a)	Audio Frequency response	Pass
§2.1047 (b)	Modulation limiting	Pass
§2.1049	Occupied bandwidth	Pass

Notes: None

2.2 RSS-130 test results

Part	Test description	Verdict
4.6.3	Transmitter output power and Effective Radiated Power (e.r.p.)	Pass
4.7.1	General unwanted emission limits	Pass
4.7.2	Additional unwanted emission limits	Pass
4.7.2	Radiated spurious emissions within 1559–1610 MHz band	Pass
4.5	Transmitter frequency stability	Pass
RSS-Gen, 6.7	Occupied bandwidth	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	October 15, 2019
Nemko sample ID number	3

3.2 EUT information

Product name	Licensed High UHF Portable Radio
Model	TPGK5A
Serial number	26214953

3.3 Technical information

Operating band	776–788 MHz, 805–806 MHz (FCC) and 777–787 MHz (ISED)
Operating frequency	776.0125–787.9875 MHz, 805.0125–805.9875 MHz
Modulation type	Analogue FM, FFSK, DMR
Occupied bandwidth (99 %)	9.92 kHz (analogue voice), 6.07 kHz (FFSK), 7.64 kHz (DMR)
Power requirements	Battery: 7.4 V _{dc} 2400 mAh
Emission designator	F3E- Analogue FM F2D- FFSK FXW- DMR Voice/data FXD- DMR data
Antenna information	TPN-AN-022 762-870 MHz ½ wave whip antenna Max. antenna gain: 1 dBi EUT is designed so that the end user may replace a broken antenna. (The EUT has a non-standard antenna jack or electrical connector.)

3.4 Product description and theory of operation

EUT is handheld radio transceiver unit operating in high UHF band.

Modulation Types: Analog FM, FFSK 1200 bps, FFSK2400, DMR. Narrowband 12.5 kHz channel spacing is used for all modulation.

Emission designator	Modulation	Symbol rate, Bd	Bit rate, bps
F3E	FM Analogue Voice	-	-
F2D	Fast Frequency Shift Keying	1200 symbols/sec	1200 bps
FXD	Digital Data	4800 symbols/sec	9600 bps
FXW	Digital Voice / Data	4800 symbols/sec	9600 bps

3.5 EUT exercise details

EUT was controlled from Tera term vis programming cable

3.6 EUT setup diagram

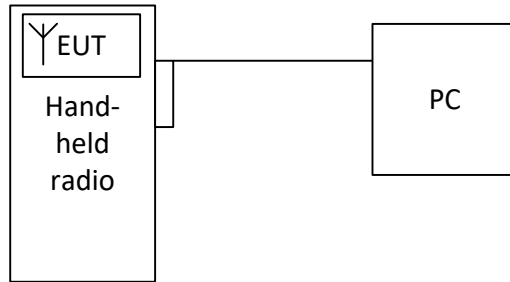


Figure 3.6-1: Setup diagram (programming)

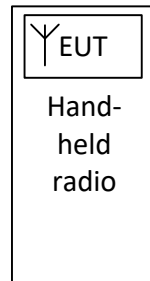


Figure 3.6-2: Setup diagram (operation)

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

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of $k=2$ with 95% certainty.

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.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	December 12, 2019
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	June 4, 2020
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	June 21, 2020
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	September 11, 2020
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	September 26, 2020
Bilog antenna (20–2000 MHz)	Sun AR	JB1	FA003009	1 year	December 6, 2019
Temperature chamber	Thermotron	SM-16C	FA001030	—	NCR
Waveform generator	HP	33120A	—	—	VOU

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 27.50(b) and RSS-130, 4.6.3 RF Power Output

8.1.1 Definitions and limits

FCC:

§27.50 Power limits and duty cycle.

(b) The following power and antenna height limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

RSS 130:

§4.6 Transmitter output power and effective radiated power (e.r.p.)

4.6.1 General

The transmitter output power shall be measured in terms of average power. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

4.6.3 Frequency bands 698-756 MHz and 777-787 MHz

The e.r.p. shall not exceed 30 watts for mobile equipment and outdoor fixed subscriber equipment. The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

8.1.2 Test summary

Test date	October 29, 2019	Temperature	23 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	29 %

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

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.

CCDF measurement shows PAPR values at 0.1% is 0.1 dB is well below limit of 13 dB.

Test receiver settings:

Detector mode	Peak
Resolution bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto

8.1.4 Test data

Table 8.1-1: Peak output power and ERP calculations results for frequency range 776–788 MHz

Modulation	Frequency, MHz	RF output power, dBm	EIRP, dBm	ERP, dBm	ERP, Watts	Limit, Watts	Margin, Watts
F3E	776.0125	35.04	36.04	33.89	2.45	3.00	0.55
F3E	782	35.03	36.03	33.88	2.44	3.00	0.56
F3E	787.9875	34.99	35.99	33.84	2.42	3.00	0.58
F2D	776.0125	34.89	35.89	33.74	2.37	3.00	0.63
F2D	782	34.83	35.83	33.68	2.33	3.00	0.67
F2D	787.9875	34.83	35.83	33.68	2.33	3.00	0.67
FXW	776.0125	34.92	35.92	33.77	2.38	3.00	0.62
FXW	782	34.87	35.87	33.72	2.36	3.00	0.64
FXW	787.9875	34.83	35.83	33.68	2.33	3.00	0.67

Note: EIRP = peak power + antenna gain, ERP = EIRP – 2.15 dB max. antenna gain is 1 dBi

Table 8.1-2: Peak output power and ERP calculations for frequency range 805–806 MHz

Modulation	Frequency, MHz	RF output power, dBm	EIRP, dBm	ERP, dBm	ERP, Watts	Limit, Watts	Margin, Watts
F3E	805.5	34.75	35.75	33.60	2.29	3.00	0.71
F2D	805.5	34.73	35.73	33.58	2.28	3.00	0.72
FXW	805.5	34.74	35.74	33.59	2.29	3.00	0.71

Note: EIRP = peak power + antenna gain, ERP = EIRP – 2.15 dB max. antenna gain is 1 dBi

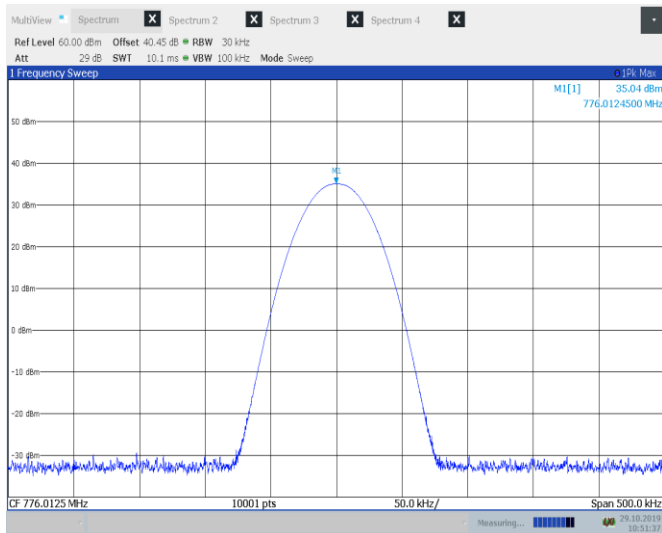


Figure 8.1-1: Output power sample plot

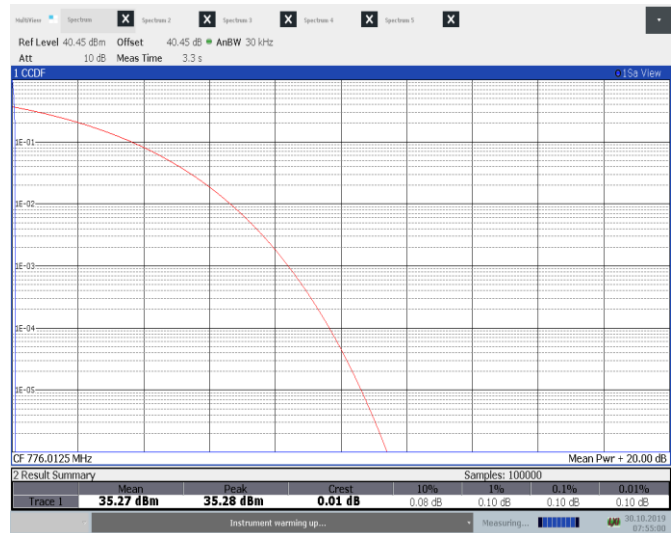


Figure 8.1-2: CCDF sample plot for PAPR values

8.2 FCC 27.53 and RSS-130, 4.7 Spurious emissions at antenna terminals

8.2.1 Definitions and limits

FCC:

§27.53 Emission limits.

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the 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, in accordance with the following:

- 1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- 2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- 3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- 4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- 5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
- 6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(e) For operations in the 775-776 MHz and 805-806 MHz bands, transmitters must comply with either paragraphs (1) through (5) of this section or the ACP emission limitations set forth in paragraphs (6) to (9) of this section.

- 1) On all frequencies between 758-775 MHz and 788-805 MHz, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- 2) On all frequencies between 758-775 MHz and 788-805 MHz, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- 3) On any frequency outside the 775-776 MHz and 805-806 MHz bands, the power of any emission shall be attenuated outside the band below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB;
- 4) Compliance with the provisions of paragraphs (e)(1) and (e)(2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment;
- 5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed.

RSS-130:

§4.7 Transmitter unwanted emissions

4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

4.7.2 Additional unwanted emissions limits

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

- $76 + 10 \log_{10} p$ (watts), dB, for base and fixed equipment and
- $65 + 10 \log_{10} p$ (watts), dB, for mobile and portable equipment

8.2.2 Test summary

Test date	October 30, 2019	Temperature	24 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	29 %

8.2.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to the 10th harmonic.
 All measurements were performed using a peak detector.

Spectrum analyzer settings for conducted spurious emissions measurements:

Resolution bandwidth:	100 kHz (6.25 and 30 kHz used)
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

8.2.4 Test data

Table 8.2-1: Band edge emissions measurement results for band covering 776-788 MHz

Channel	Frequency, MHz	Peak Field strength, dBm		Margin, dB
		Measured	Limit	
Low(F3E)	776	-33.23	-13	20.23
High(F3E)	788	-27.53	-13	14.53
Low(F2D)	776	-29.26	-13	16.26
High(F2D)	788	-27.79	-13	14.79
Low(FXW)	776	-25.60	-13	12.60
High(FXW)	788	-29.82	-13	16.82

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable

Table 8.2-2: Band edge emissions measurement results for band covering 805-806 MHz

Channel	Frequency, MHz	Peak Field strength, dBm		Margin, dB
		Measured	Limit	
Low(F3E)	805	-36.54	-35	1.54
High(F3E)	806	-26.76	-13	13.76
Low(F2D)	805	-35.32	-35	0.32
High(F2D)	806	-27.71	-13	14.71
Low(FXW)	805	-36.66	-35	1.66
High(FXW)	806	-27.15	-13	14.15

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable

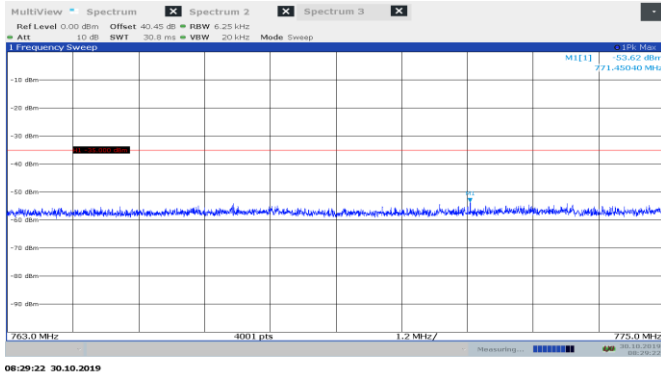


Figure 8.2-1: Spurious emissions within 763-775 MHz protection band for low channel 776.0125 MHz analogue FM

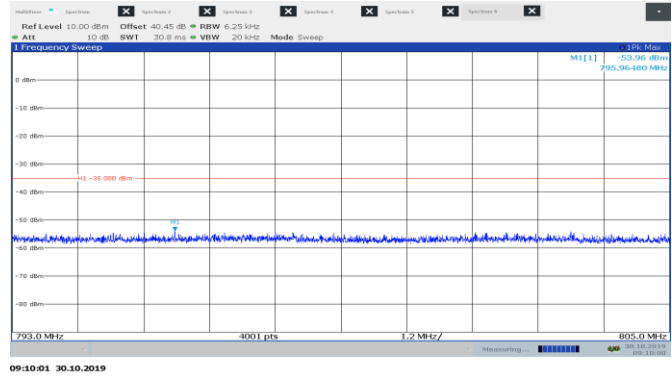


Figure 8.2-2: Spurious emissions within 793-805 MHz protection band for high channel 787.9875 MHz analogue FM

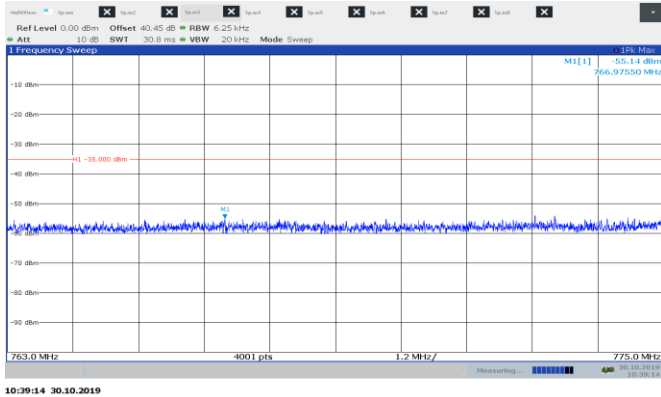


Figure 8.2-3: Spurious emissions within 763-775 MHz protection band for low channel 776.0125 MHz FFSK

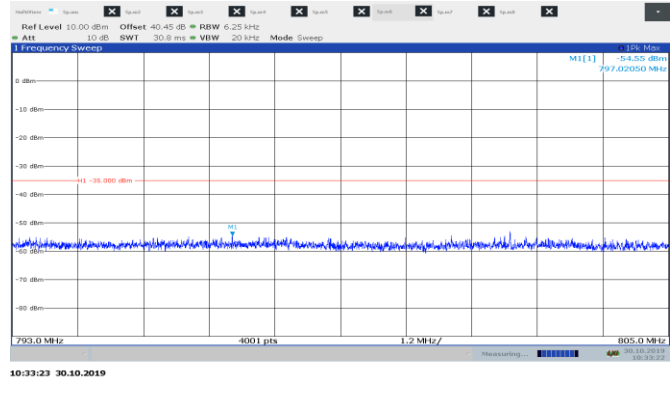


Figure 8.2-4: Spurious emissions within 793-805 MHz protection band for high channel 787.9875 MHz FFSK

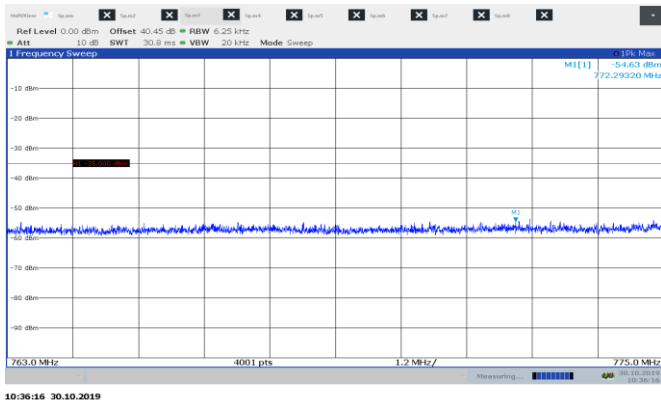


Figure 8.2-5: Spurious emissions within 763-775 MHz protection band for low channel 776.0125 MHz DMR

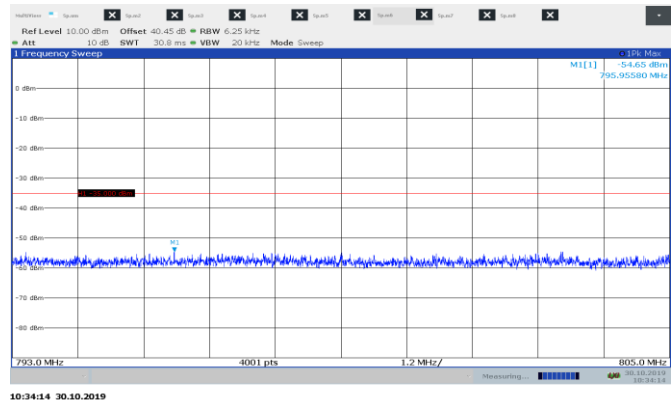


Figure 8.2-6: Spurious emissions within 793-805 MHz protection band for high channel 787.9875 MHz DMR

Section 8
Test name
Specification

Testing data
 Clause 27.53 and RSS-130, 4.7 Spurious emissions at antenna terminals
 FCC Part 27, RSS-130, Issue 2

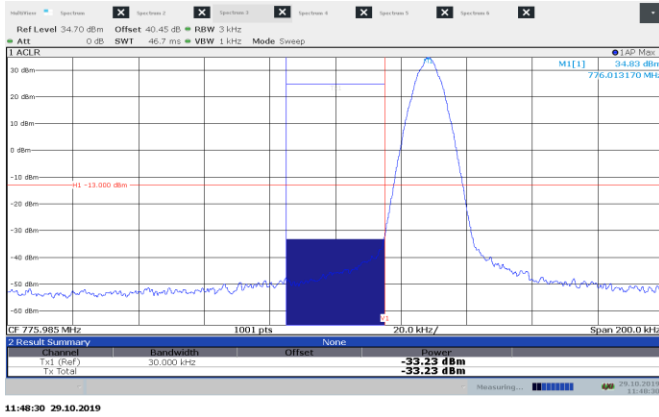


Figure 8.2-7: Low band edge emissions outside operating band in low channel 776.0125 MHz analogue FM

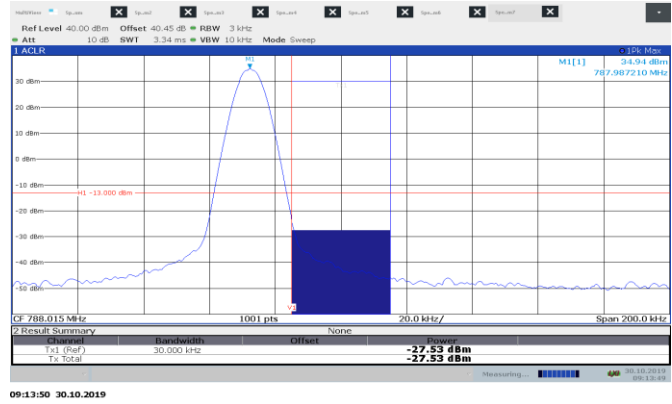


Figure 8.2-8: High band edge for emissions outside operating band in high channel 787.9875 MHz analogue FM

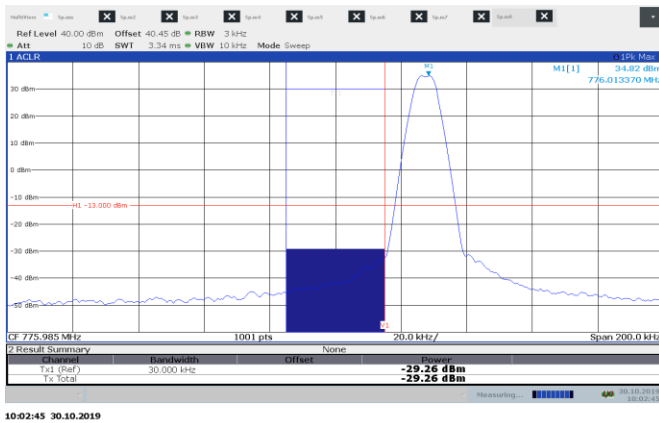


Figure 8.2-9 : Low band edge emissions outside operating band in low channel 776.0125 MHz FFSK

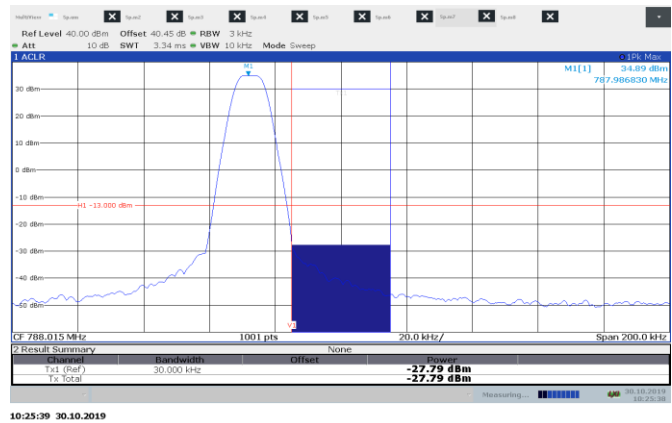


Figure 8.2-10: High band edge for emissions outside operating band in high channel 787.9875 MHz FFSK

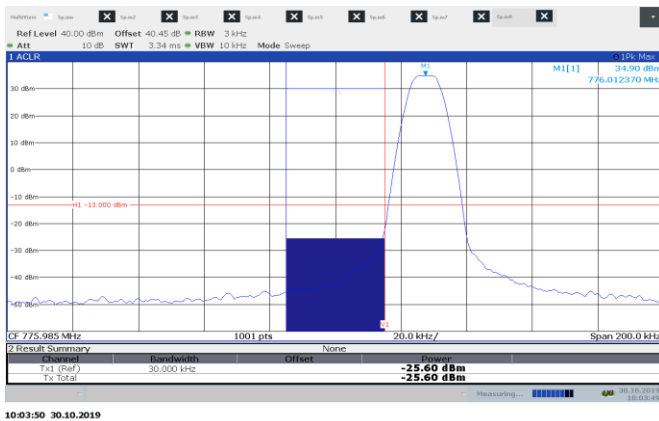


Figure 8.2-11 : Low band edge emissions outside operating band in low channel 776.0125 MHz DMR

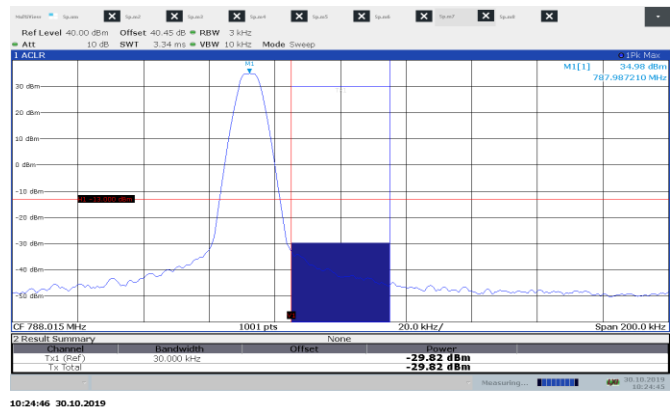
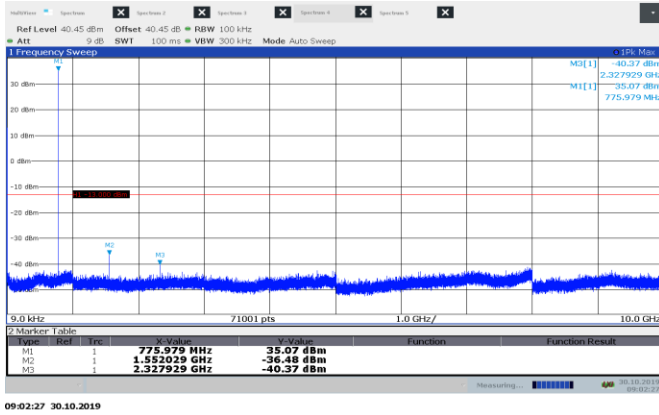


Figure 8.2-12: High band edge for emissions outside operating band in high channel 787.9875 MHz DMR

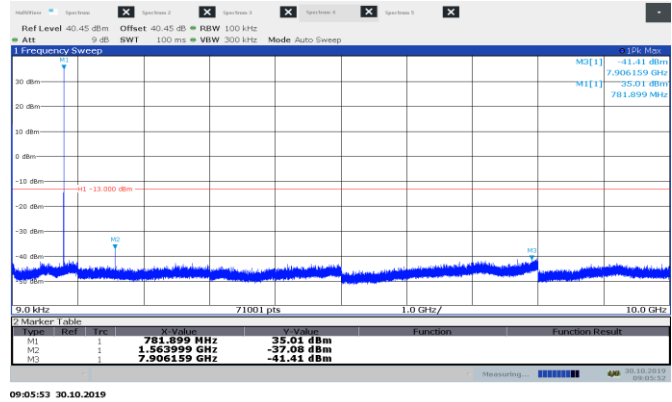
Section 8
Test name
Specification

Testing data
 Clause 27.53 and RSS-130, 4.7 Spurious emissions at antenna terminals
 FCC Part 27, RSS-130, Issue 2



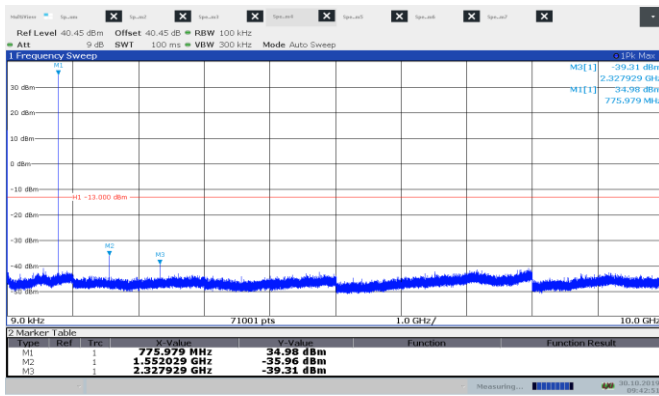
09:02:27 30.10.2019

Figure 8.2-13: Conducted spurious emissions 9 kHz – 10 GHz low channel 776.0125 MHz analogue FM



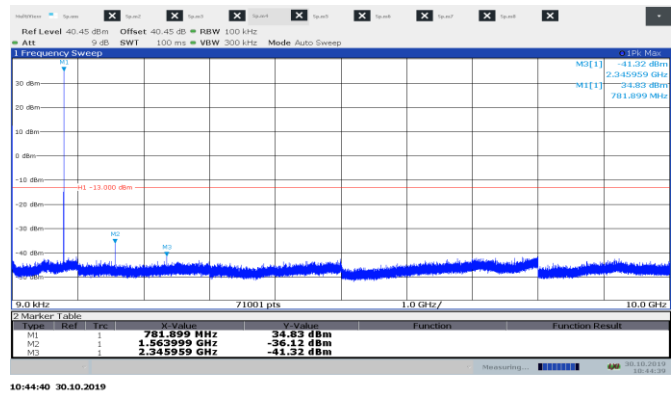
09:05:53 30.10.2019

Figure 8.2-14: Conducted spurious emissions 9 kHz – 10 GHz mid channel 782 MHz analogue FM



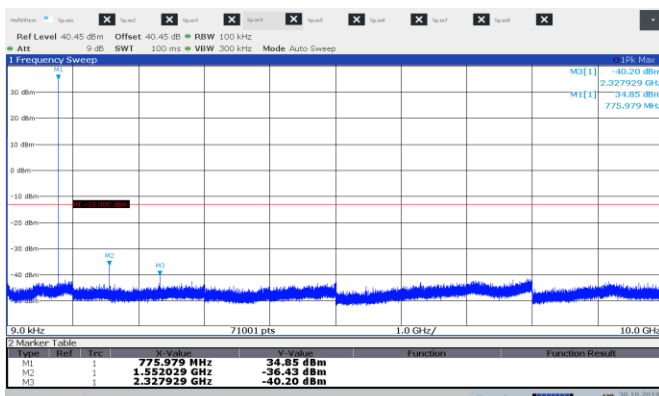
09:42:52 30.10.2019

Figure 8.2-15 : Conducted spurious emissions 9 kHz – 10 GHz low channel 776.0125 MHz FFSK



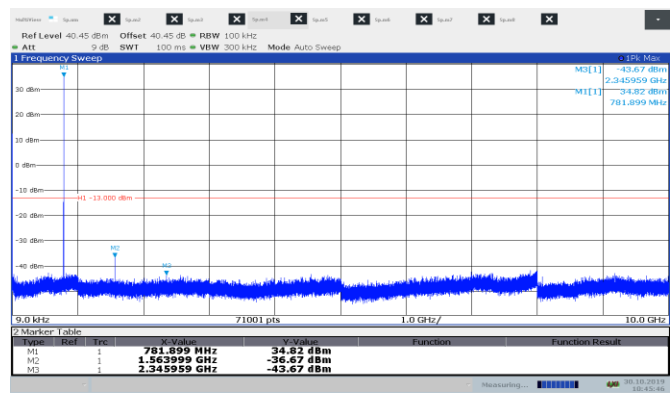
10:44:40 30.10.2019

Figure 8.2-16: Conducted spurious emissions 9 kHz – 10 GHz mid channel 782 MHz FFSK



10:42:17 30.10.2019

Figure 8.2-17: Conducted spurious emissions 9 kHz – 10 GHz low channel 776.0125 MHz DMR



10:45:46 30.10.2019

Figure 8.2-18: Conducted spurious emissions 9 kHz – 10 GHz mid channel 782 MHz DMR

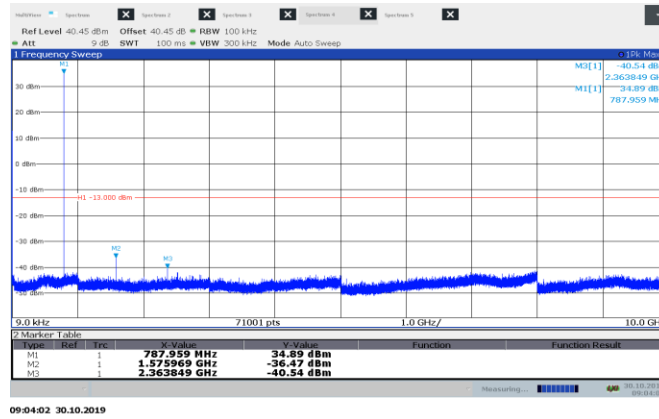


Figure 8.2-19: Conducted spurious emissions 9 kHz – 10 GHz high channel 787.9875 MHz analogue FM

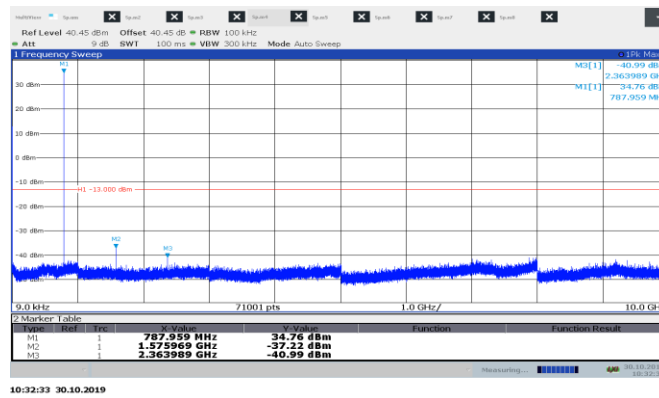


Figure 8.2-20 : Conducted spurious emissions 9 kHz – 10 GHz high channel 787.9875 MHz FFSK

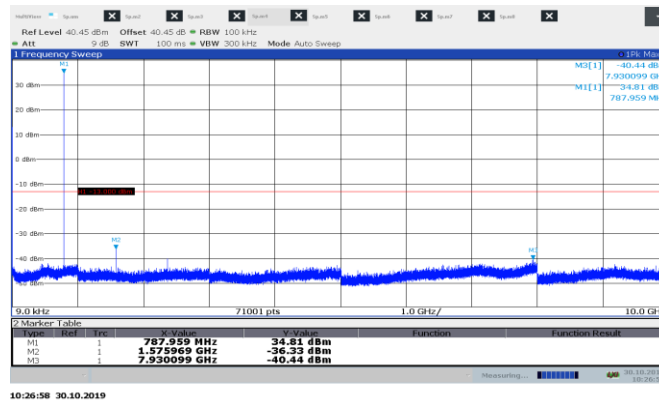


Figure 8.2-21: Conducted spurious emissions 9 kHz – 10 GHz high channel 787.9875 DMR

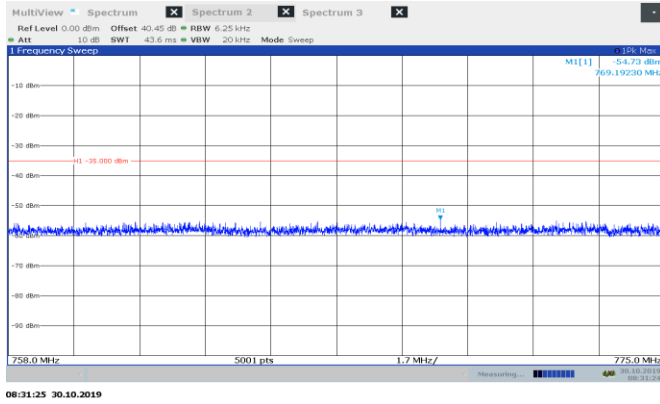


Figure 8.2-22: Spurious emissions within protection band 758-775 MHz protection band low channel 805.0125 MHz analogue FM

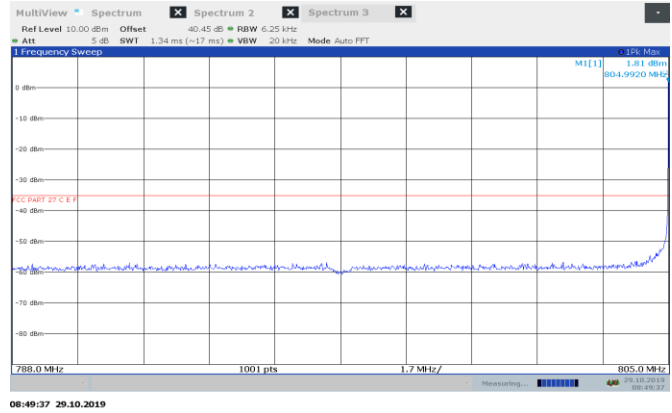


Figure 8.2-23: Spurious emissions within protection band 788-805 MHz protection band low channel 805.0125 MHz analogue FM

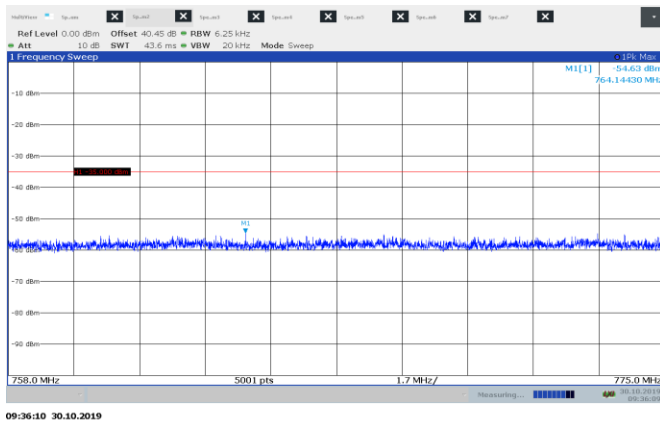


Figure 8.2-24: Spurious emissions within protection band 758-775 MHz protection band low channel 805.0125 MHz FFSK

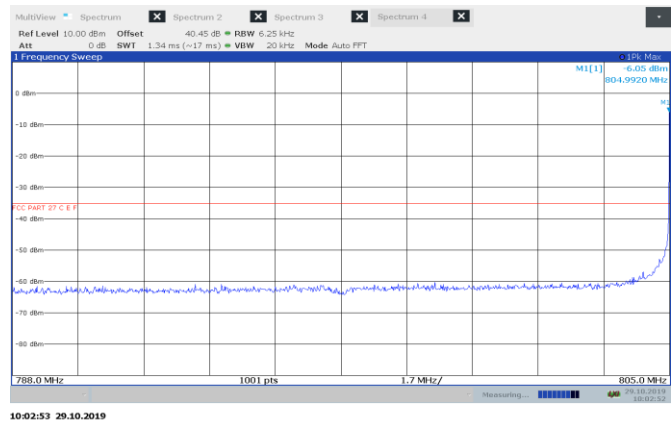


Figure 8.2-25: Spurious emissions within protection band 788-805 MHz protection band low channel 805.0125 MHz FFSK

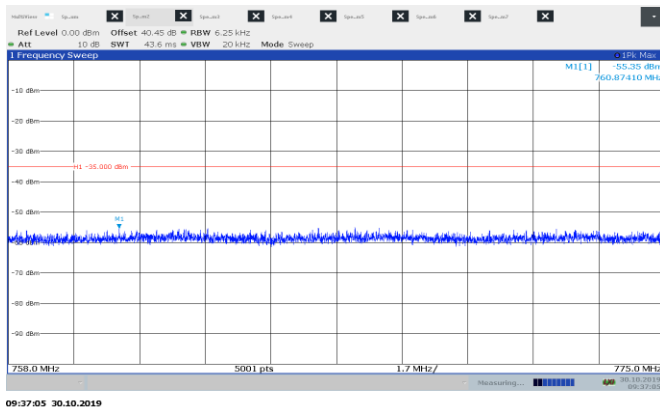


Figure 8.2-26: Spurious emissions within protection band 758-775 MHz protection band low channel 805.0125 MHz DMR

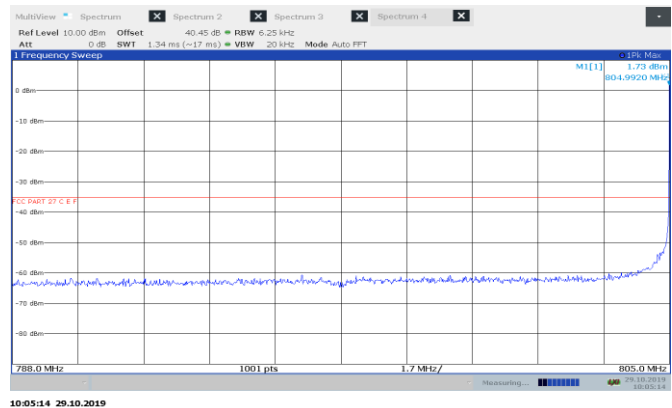
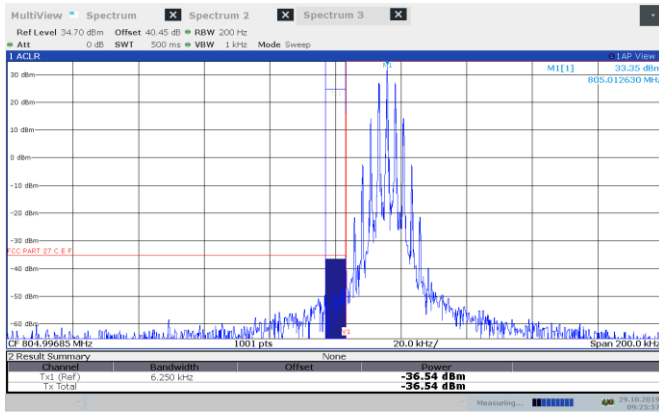


Figure 8.2-27: Spurious emissions within protection band 788-805 MHz protection band low channel 805.0125 MHz DMR

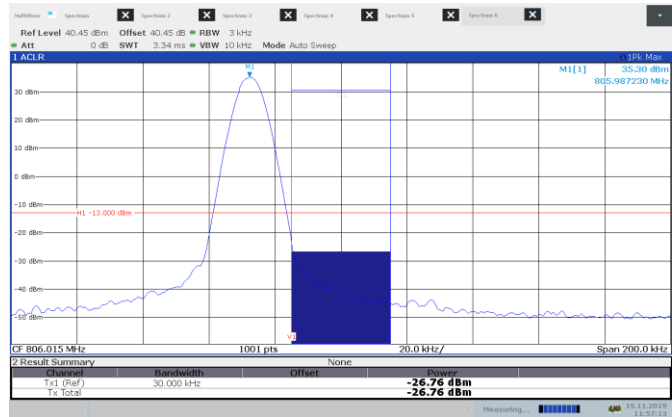
Section 8
Test name
Specification

Testing data
 Clause 27.53 and RSS-130, 4.7 Spurious emissions at antenna terminals
 FCC Part 27, RSS-130, Issue 2



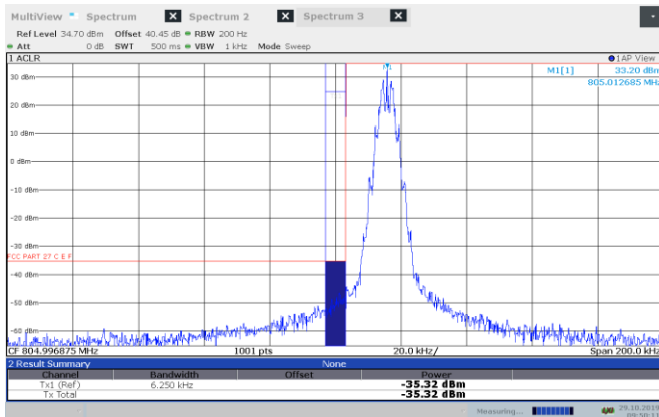
09:25:58 29.10.2019

Figure 8.2-28: Band edge on 805 MHz for protection band 788-805 MHz low channel 805.0125 MHz analogue FM



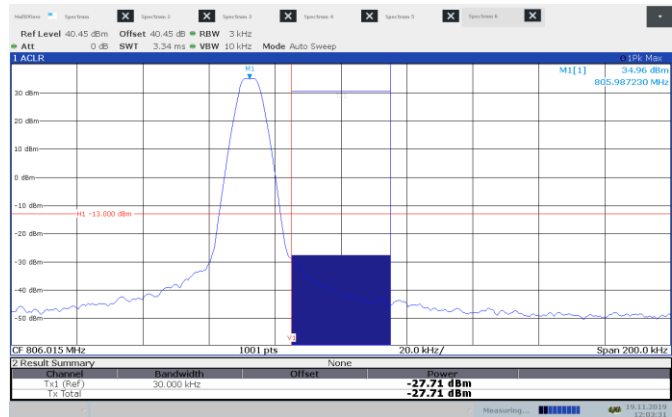
11:57:13 19.11.2019

Figure 8.2-29: High band edge for emissions outside operating band in high channel 805.9875 MHz analogue FM



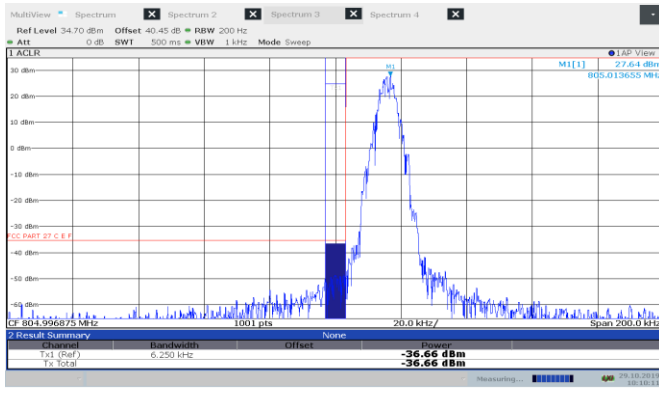
09:50:12 29.10.2019

Figure 8.2-30 : Band edge on 805 MHz for protection band 788-805 MHz low channel 805.0125 MHz FFSK



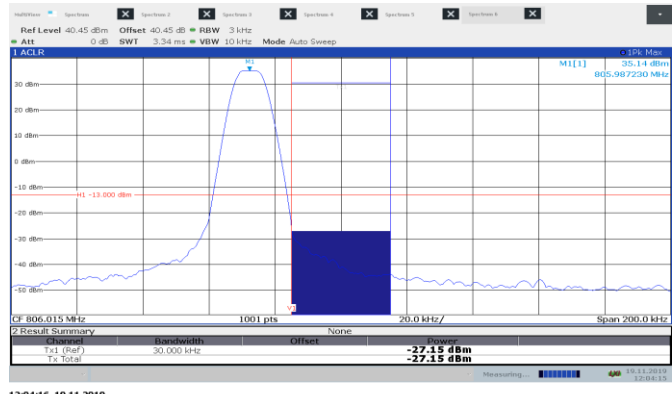
12:03:31 19.11.2019

Figure 8.2-31: High band edge for emissions outside operating band in high channel 805.9875 MHz FFSK



10:10:11 29.10.2019

Figure 8.2-32: Band edge on 805 MHz for protection band 788-805 MHz low channel 805.0125 MHz DMR



12:04:16 19.11.2019

Figure 8.2-33: High band edge for emissions outside operating band in high channel 805.9875 MHz DMR

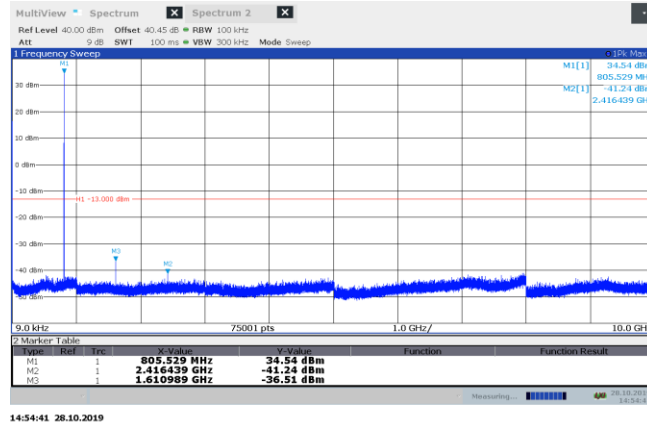


Figure 8.2-34: Conducted spurious emissions 9 kHz – 10 GHz mid channel 805.5 MHz analogue FM

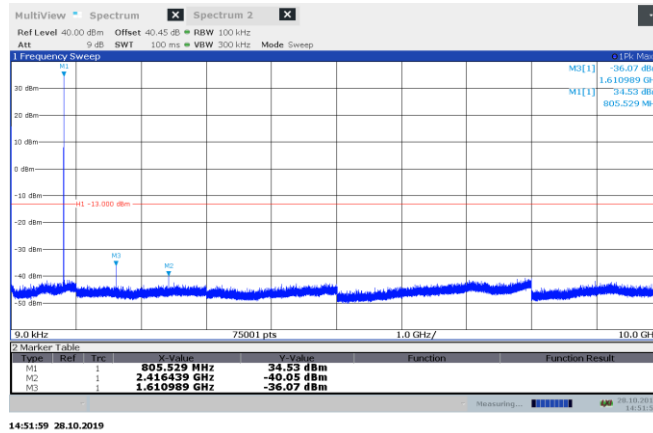


Figure 8.2-35 : Conducted spurious emissions 9 kHz – 10 GHz mid channel 805.5 MHz FFSK

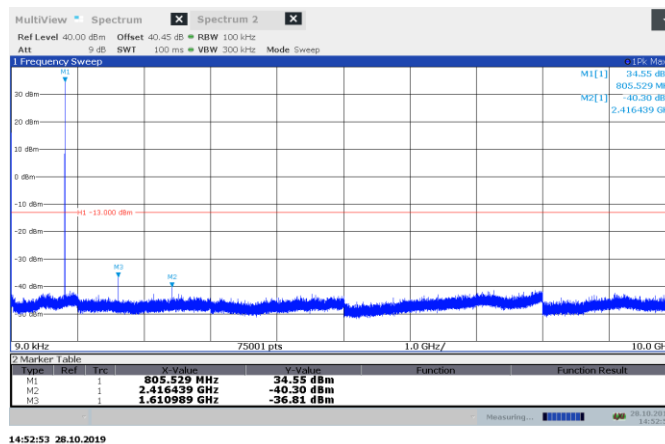


Figure 8.2-36 : Conducted spurious emissions 9 kHz – 10 GHz mid channel 805.5 MHz DMR

8.3 FCC 27.53 and RSS-130, 4.7 Radiated spurious emissions

8.3.1 Definitions and limits

FCC:

§27.53 Emission limits.

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the 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, in accordance with the following:

- 1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- 2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- 3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- 4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- 5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
- 6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(e) For operations in the 775-776 MHz and 805-806 MHz bands, transmitters must comply with either paragraphs (1) through (5) of this section or the ACP emission limitations set forth in paragraphs (6) to (9) of this section.

- 1) On all frequencies between 758-775 MHz and 788-805 MHz, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- 2) On all frequencies between 758-775 MHz and 788-805 MHz, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- 3) On any frequency outside the 775-776 MHz and 805-806 MHz bands, the power of any emission shall be attenuated outside the band below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB;
- 4) Compliance with the provisions of paragraphs (e)(1) and (e)(2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment;
- 5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed.

RSS-130:

§4.7 Transmitter unwanted emissions

4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

4.7.2 Additional unwanted emissions limits

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

- $76 + 10 \log_{10} p$ (watts), dB, for base and fixed equipment and
- $65 + 10 \log_{10} p$ (watts), dB, for mobile and portable equipment

8.3.2 Test summary

Test date	November 4, 2019	Temperature	23 °C
Test engineer	Fahar A Sukkoor	Air pressure	985 mbar
Verdict	Pass	Relative humidity	30 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
The output terminal of EUT is connected to RF dummy load for radiated measurement.
Spectrum analyzer settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyzer settings for peak radiated measurements within restricted bands above 1 GHz:

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

8.3.4 Test data

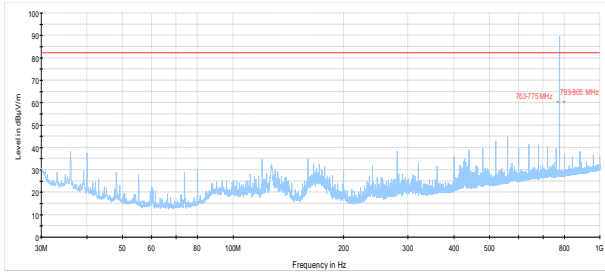


Figure 8.3-1: Radiated spurious below 1GHz low channel 776.0125 MHz analogue voice

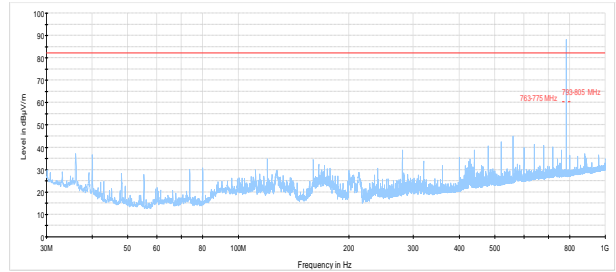


Figure 8.3-2: Radiated spurious below 1GHz mid channel 782 MHz analogue voice

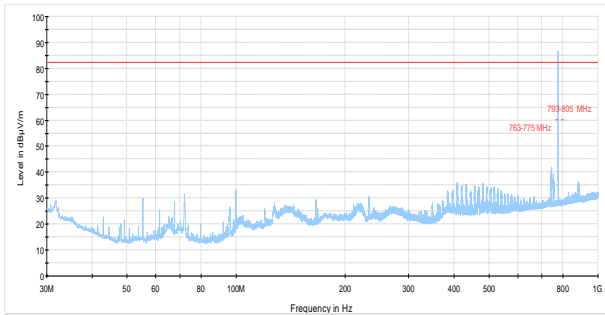


Figure 8.3-3 Radiated spurious below 1GHz low channel 776.0125 MHz FFSK

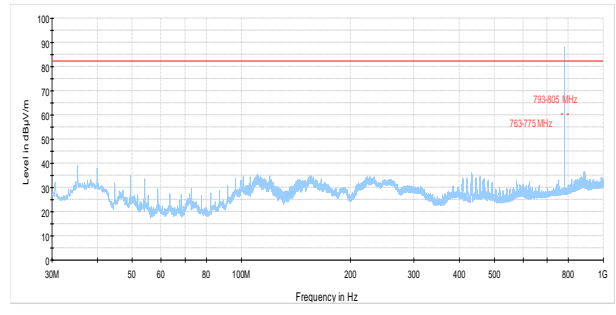


Figure 8.3-4: Radiated spurious below 1GHz mid channel 782 MHz FFSK

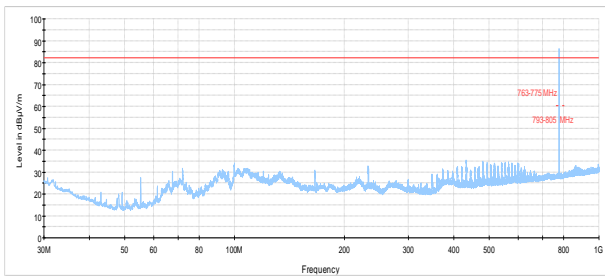


Figure 8.3-5 Radiated spurious below 1GHz low channel 776.0125 MHz DMR

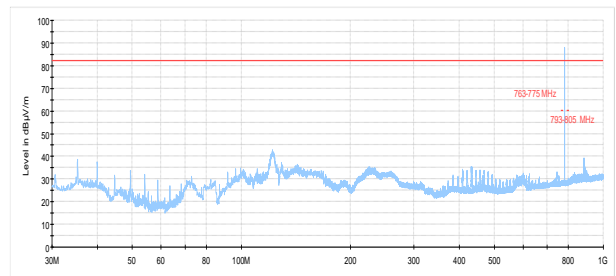
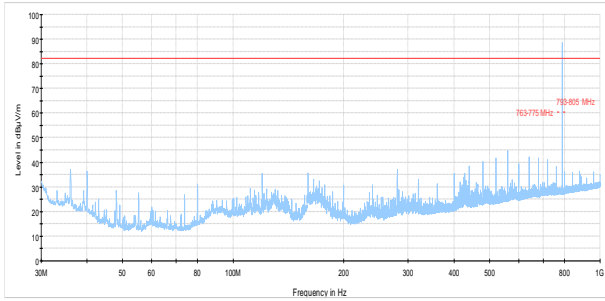
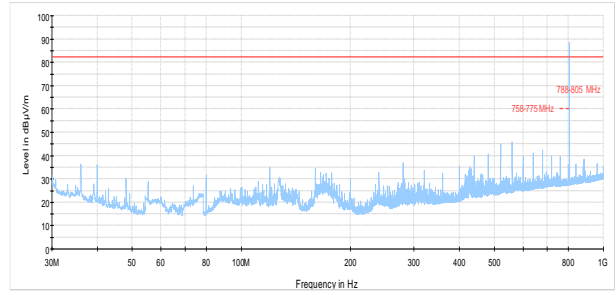


Figure 8.3-6: Radiated spurious below 1GHz mid channel 782 MHz DMR



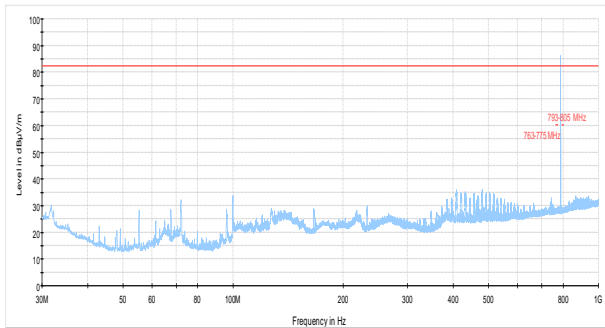
NEX-384990 Radiated emissions 30-1000 MHz high channel Analogue voice
 Preview Result 1-PK*
 763.775 MHz
 -13 dBm Limit line
 793.805 MHz

Figure 8.3-7: Radiated spurious below 1GHz high channel 787.9875 MHz analogue voice



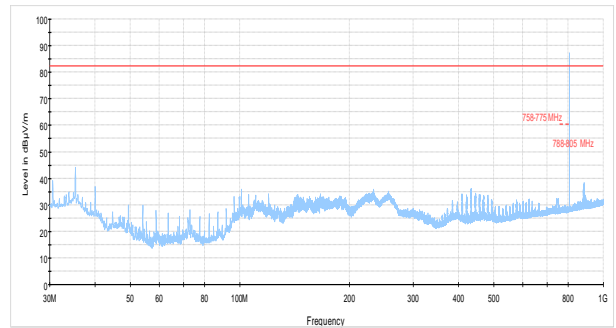
NEX-384990 Radiated spurious 30-1000 MHz 805.5 MHz Analogue voice
 Preview Result 1-PK*
 768.805 MHz
 -13 dBm Limit line
 758.775 MHz

Figure 8.3-8: Radiated spurious below 1GHz 805.5 MHz analogue voice



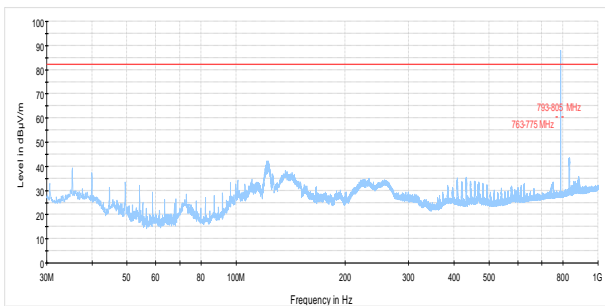
NEX-384990 Radiated emissions 30-1000 MHz high channel FFSK
 Preview Result 1-PK*
 763.775 MHz
 -13 dBm Limit line
 793.805 MHz

Figure 8.3-9 Radiated spurious below 1GHz high channel 787.9875 MHz FFSK



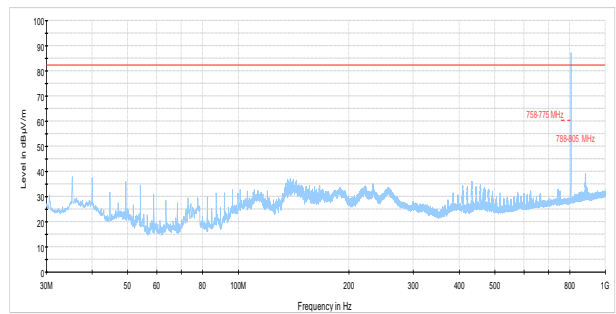
NEX-384990 Radiated spurious 30-1000 MHz 805.5 MHz FFSK
 Preview Result 1-PK*
 768.805 MHz
 -13 dBm Limit line
 758.775 MHz

Figure 8.3-10: Radiated spurious below 1GHz 805.5 MHz FFSK



NEX-384990 Radiated spurious 30-1000 MHz high channel DMR
 Preview Result 1-PK*
 763.775 MHz
 -13 dBm Limit line
 793.805 MHz

Figure 8.3-11 Radiated spurious below 1GHz high channel 787.9875 MHz DMR



NEX-384990 Radiated spurious 30-1000 MHz 805.5 MHz DMR
 Preview Result 1-PK*
 768.805 MHz
 -13 dBm Limit line
 758.775 MHz

Figure 8.3-12: Radiated spurious below 1GHz 805.5 MHz DMR

Section 8
Test name
Specification

Testing data
 FCC 27.53 and RSS-130, 4.7 Radiated spurious emissions
 FCC Part 27, RSS-130, Issue 2

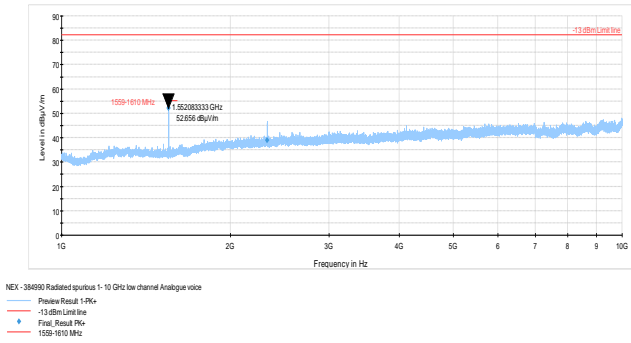


Figure 8.3-13: Radiated spurious above 1GHz low channel 776.0125 MHz analogue voice

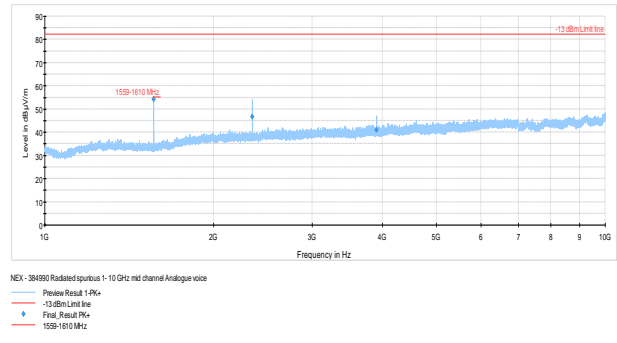


Figure 8.3-14: Radiated spurious above 1GHz mid channel 782 MHz analogue voice

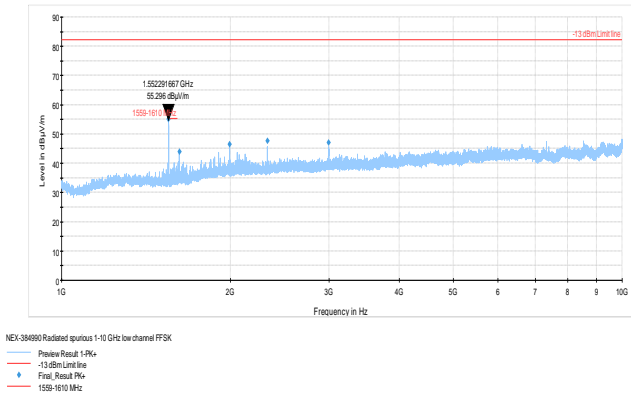


Figure 8.3-15: Radiated spurious above 1GHz low channel 776.0125 MHz FFSK

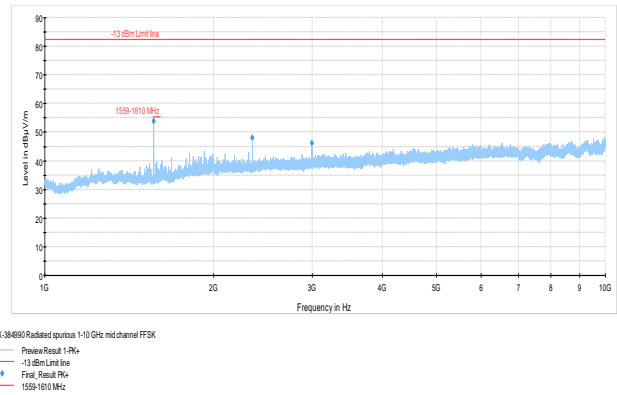


Figure 8.3-16: Radiated spurious above 1GHz mid channel 782 MHz FFSK

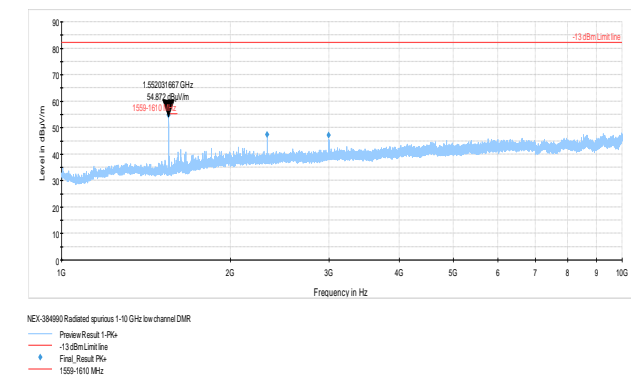


Figure 8.3-17: Radiated spurious above 1GHz low channel 776.0125 MHz DMR

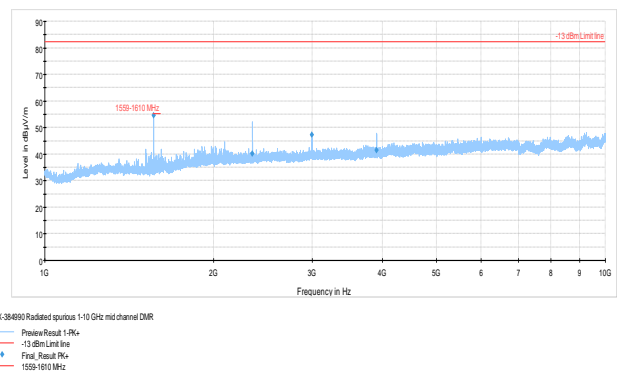
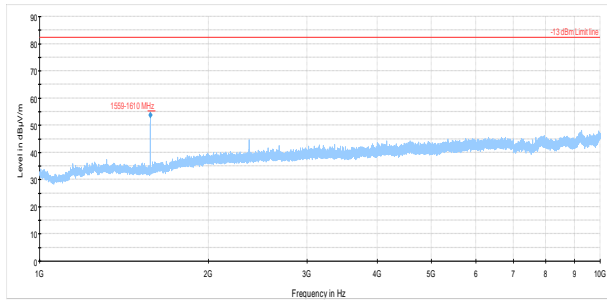
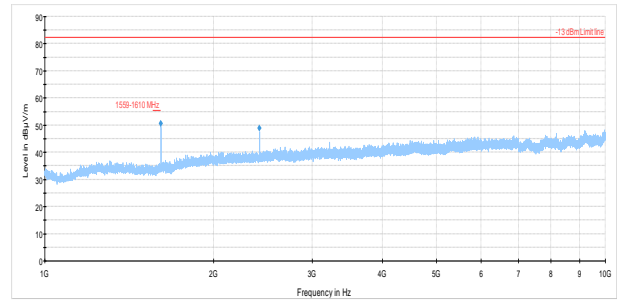


Figure 8.3-18: Radiated spurious above 1GHz mid channel 782 MHz DMR



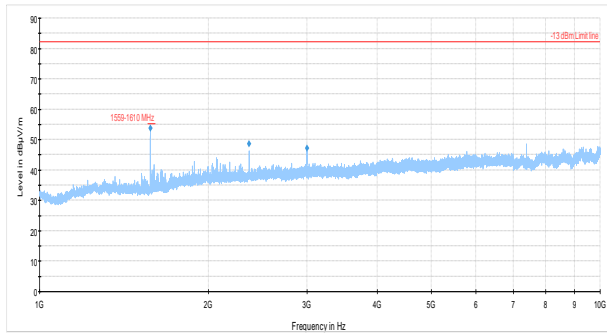
NEX-384990 Radiated spurious 1-10 GHz high channel Analogue voice
 — Preview Result 1-PK+
 — -13 dBm Limit line
 ◆ Final Result PK+
 — 1559-1610 MHz

Figure 8.3-19: Radiated spurious above 1GHz high channel 787.9875 MHz analogue voice



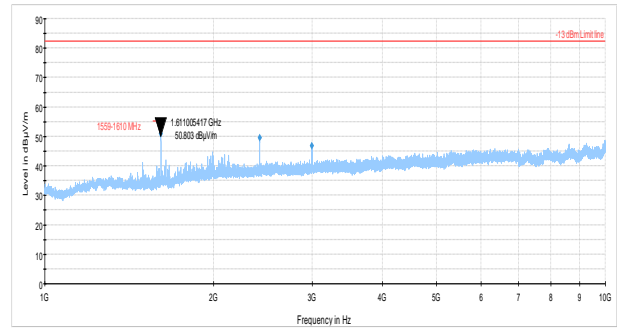
NEX-384990 Radiated spurious 1-10 GHz 805.5 MHz channel Analogue voice
 — Preview Result 1-PK+
 — -13 dBm Limit line
 ◆ Final Result PK+
 — 1559-1610 MHz

Figure 8.3-20: Radiated spurious above 1GHz 805.5 MHz analogue voice



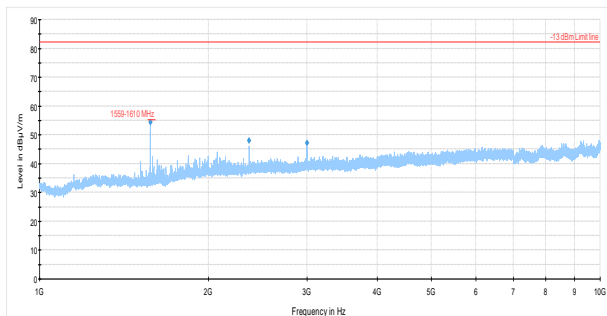
NEX-384990 Radiated spurious 1-10 GHz high channel FFSK
 — Preview Result 1-PK+
 — -13 dBm Limit line
 ◆ Final Result PK+
 — 1559-1610 MHz

Figure 8.3-21 Radiated spurious above 1GHz high channel 787.9875 MHz FFSK



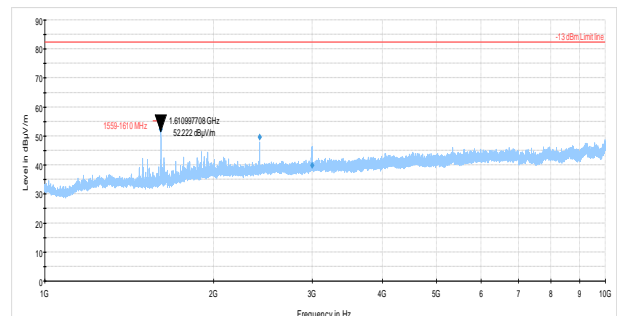
NEX-384990 Radiated spurious 1-10 GHz 805.5 MHz channel FFSK
 — Preview Result 1-PK+
 — -13 dBm Limit line
 ◆ Final Result PK+
 — 1559-1610 MHz

Figure 8.3-22: Radiated spurious above 1GHz 805.5 MHz FFSK



NEX-384990 Radiated spurious 1-10 GHz high channel DMR
 — Preview Result 1-PK+
 — -13 dBm Limit line
 ◆ Final Result PK+
 — 1559-1610 MHz

Figure 8.3-23 Radiated spurious above 1GHz high channel 787.9875 MHz DMR



NEX-384990 Radiated spurious 1-10 GHz 805.5 MHz channel DMR
 — Preview Result 1-PK+
 — -13 dBm Limit line
 ◆ Final Result PK+
 — 1559-1610 MHz

Figure 8.3-24: Radiated spurious above 1GHz 805.5 MHz DMR

8.4 FCC 27.53(f) and RSS-130, 4.6.2(b) Radiated spurious emissions within 1559–1610 MHz band

8.4.1 Definitions and limits

FCC:

§27.53 Emission limits.

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to –70 dBW/MHz equivalent isotopically radiated power (EIRP) for wideband signals, and –80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

RSS-130:

§4.7.2 Additional unwanted emissions limits

(b)The e.i.r.p. in the band 1559-1610 MHz shall not exceed –70 dBW/MHz for wideband signal and –80 dBW for discrete emission with bandwidth less than 700 Hz.

8.4.2 Test summary

Test date	November 4, 2019	Temperature	24 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	31 %

8.4.3 Observations, settings and special notes

The spectrum was searched from 1559–1610 MHz.

The measurements were performed at the distance of 3 m for radiated measurement.

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

8.4.4 Test data

Table 8.4-1: Radiated field strength measurement results for protection band 1559–1610 MHz

Tx. Frequency, MHz	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB
		Measured	Limit	
786.9875 (F3E)	1574	53.07	55.23	2.16
786.9875 (F2D)	1574	54.25	55.23	0.98
786.9875 (FXW)	1574	55.22	55.23	0.01
805.0125(F3E)	1610	52.90	55.23	2.33
805.0125(F2D)	1610	49.40	55.23	5.83
805.0125(FXW)	1610	50.14	55.23	5.09

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

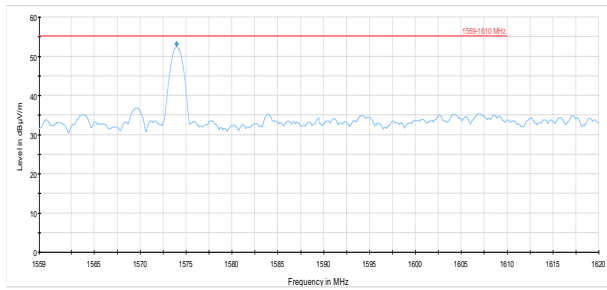


Figure 8.4-1: Field strength within 1559-1610 MHz band 786.9875 MHz analogue voice

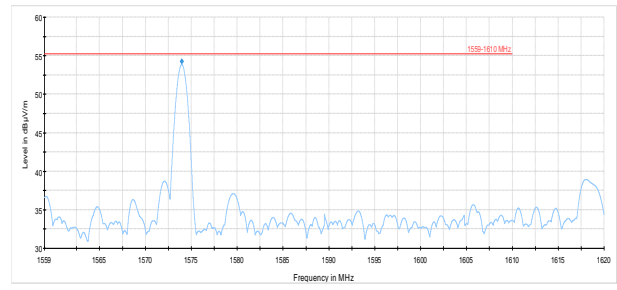


Figure 8.4-2: Field strength within 1559-1610 MHz band 786.9875 MHz FFSK

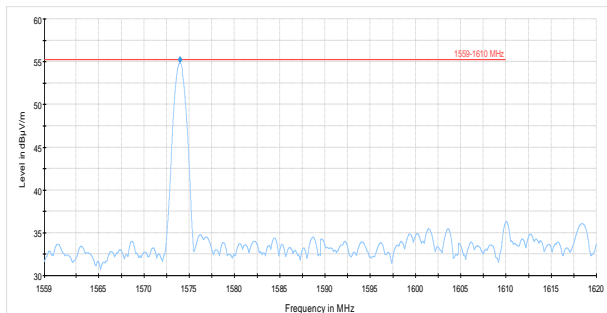


Figure 8.4-3: Field strength within 1559-1610 MHz band 786.9875 MHz DMR

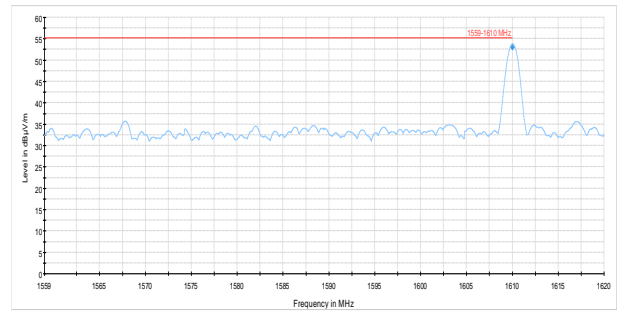


Figure 8.4-4: Field strength within 1559-1610 MHz band 805.0125 MHz analogue voice

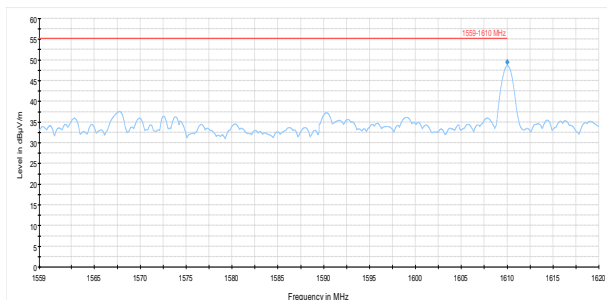


Figure 8.4-5: Field strength within 1559-1610 MHz band 805.0125 MHz FFSK

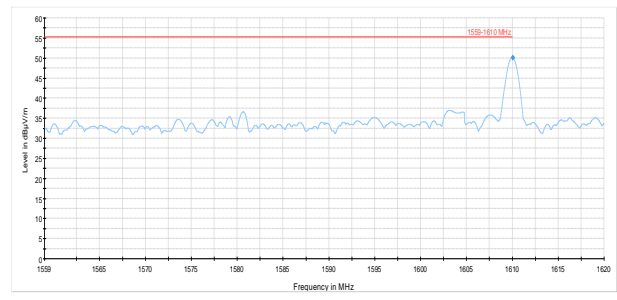


Figure 8.4-6: Field strength within 1559-1610 MHz band 805.0125 MHz DMR

8.4.4 Test data continued

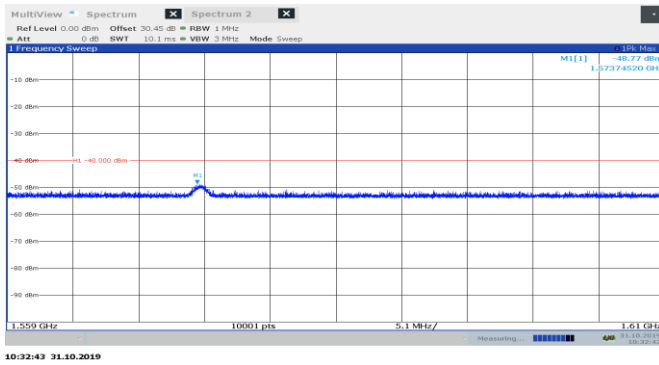


Figure 8.4-7: Conducted spurious within 1559-1610 MHz band 786.9875 MHz analogue voice

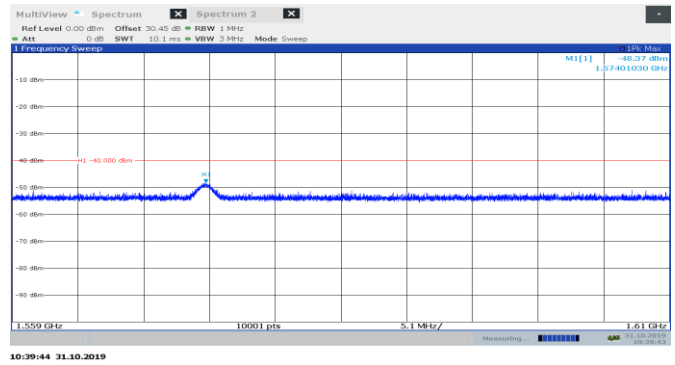


Figure 8.4-8: Conducted spurious within 1559-1610 MHz band 786.9875 MHz FFSK

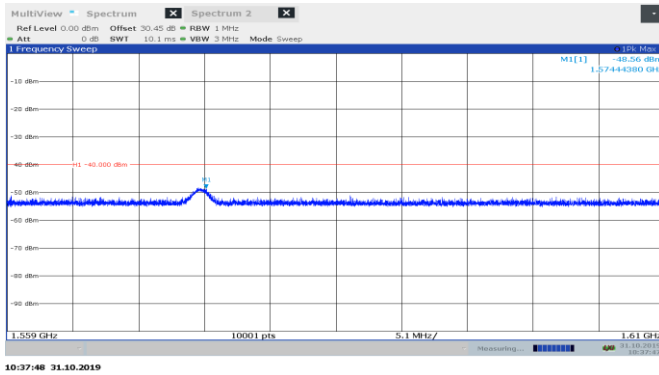


Figure 8.4-9: Conducted spurious within 1559-1610 MHz band 786.9875 MHz DMR

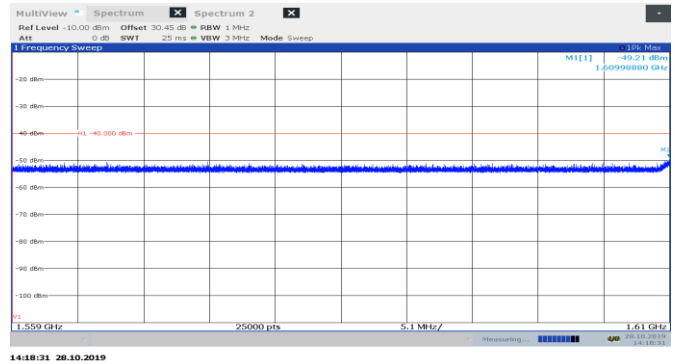


Figure 8.4-10: Conducted spurious within 1559-1610 MHz band 805.0125 MHz analogue voice

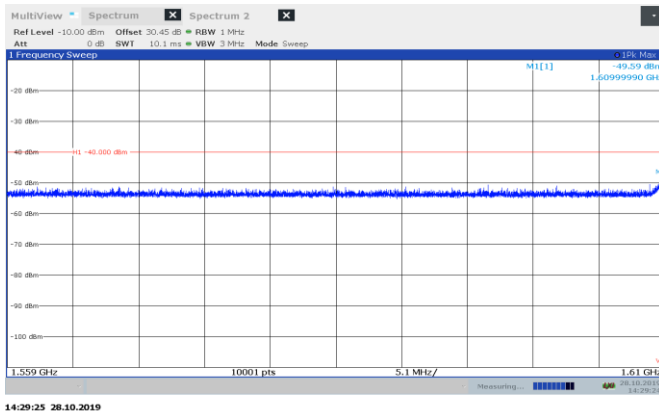


Figure 8.4-11: Conducted spurious within 1559-1610 MHz band 805.0125 MHz FFSK

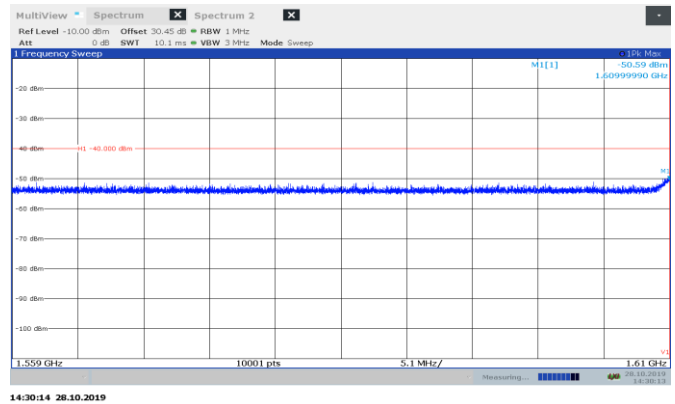


Figure 8.4-12: Conducted spurious within 1559-1610 MHz band 805.0125 MHz DMR

8.5 FCC 27.54 and RSS-130, 4.5 Transmitter Frequency stability

8.5.1 Definitions and limits

FCC:
 §27.54 Frequency stability.
 The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-130:
 The frequency stability shall be sufficient to ensure that the occupied bandwidth remains within each frequency block range when tested at the temperature and supply voltage variations specified in RSS-Gen.

For licensed devices, the following measurement conditions apply:

- at the temperatures of -30°C (-22°F), +20°C (+68°F) and +50°C (+122°F), and at the manufacturer’s rated supply voltage
- at the temperature of +20°C (+68°F) and at ±15% of the manufacturer’s rated supply voltage

8.5.2 Test summary

Test date	October 31, 2019	Temperature	23 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	31 %

8.5.3 Observations, settings and special notes

CW unmodulated frequency tolerance was assessed to remain within assigned band.
 Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	300 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

0.

8.5.4 Test data

Table 8.5-1: Frequency stability results for 782 MHz

Test Conditions	Frequency, MHz	Offset, ppm
+50 °C, Nominal	782.0002400	0.13
+40 °C, Nominal	782.0002400	0.13
+30 °C, Nominal	782.0001800	0.05
+20 °C, +15 %	782.0001600	0.03
+20 °C, Nominal	782.0001400	Reference
+20 °C, -15 %	782.0001400	0.00
+10 °C, Nominal	782.0001400	0.00
0 °C, Nominal	782.0001200	-0.03
-10 °C, Nominal	782.0000800	-0.08
-20 °C, Nominal	782.0001400	0.00
-30 °C, Nominal	782.0001600	0.03

Notes: Limit= 10.2 ppm (8 kHz)

8.5.4 Test data, continued

Table 8.5-2: Frequency stability results for 805.5 MHz

Test Conditions	Frequency, MHz	Offset, ppm
+50 °C, Nominal	805.5002435	0.12
+40 °C, Nominal	805.5002435	0.12
+30 °C, Nominal	805.5002035	0.07
+20 °C, +15 %	805.5001435	0.00
+20 °C, Nominal	805.5001435	Reference
+20 °C, -15 %	805.5001435	0.00
+10 °C, Nominal	805.5001435	0.00
0 °C, Nominal	805.5001235	-0.02
-10 °C, Nominal	805.5000835	-0.07
-20 °C, Nominal	805.5001435	0.00
-30 °C, Nominal	805.5001835	0.05

Notes: Limit= 10.2 ppm (8 kHz)

8.6 FCC 2.1047 (a) Audio Frequency Response

8.6.1 Definitions and limits

FCC:

§2.1047 Modulation characteristics.

(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

8.6.2 Test summary

Test date	October 31, 2019	Temperature	23 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	31 %

8.6.3 Observations, settings and special notes

Constant input-Audio frequency response test methodology is used.

An audio input of 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This is used as 0 dB reference point.

Frequency response from 100 – 5000 Hz in dB relative to 1000 Hz was measured.

Audio frequency response = $20 \log_{10} (DEV_{freq} / DEV_{ref})$

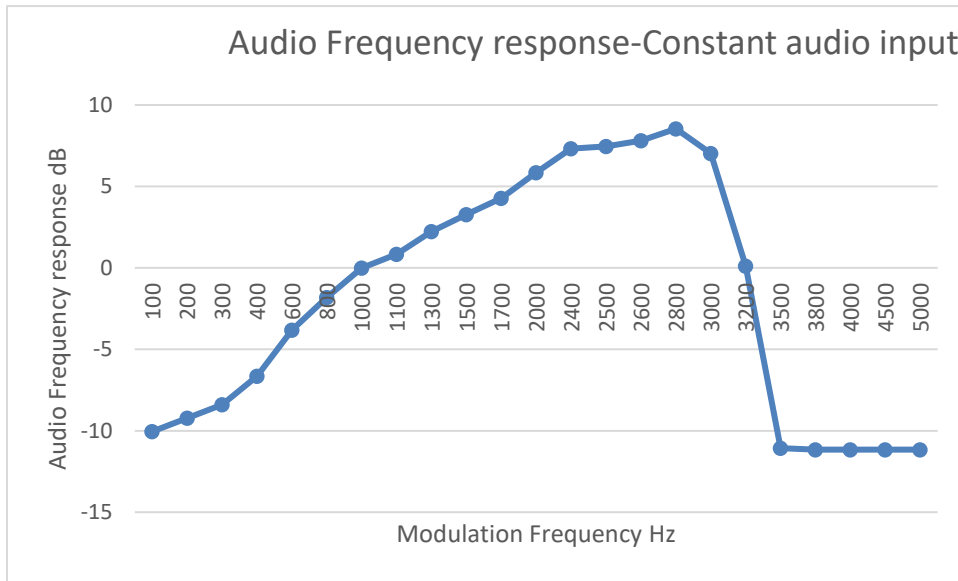
Tx test frequency used was 782 MHz.

Audio response plot from 100 to 5000 Hz in reference to 1000 Hz is shown in plot below.

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	12.5 kHz (DBW)
Trace mode	Max Hold

8.6.4 Test data



8.7 FCC 2.1047 (b) Modulation limiting characteristics

8.7.1 Definitions and limits

FCC:

§2.1047 Modulation characteristics.

b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

8.7.2 Test summary

Test date	October 31, 2019	Temperature	23 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	31 %

8.7.3 Observations, settings and special notes

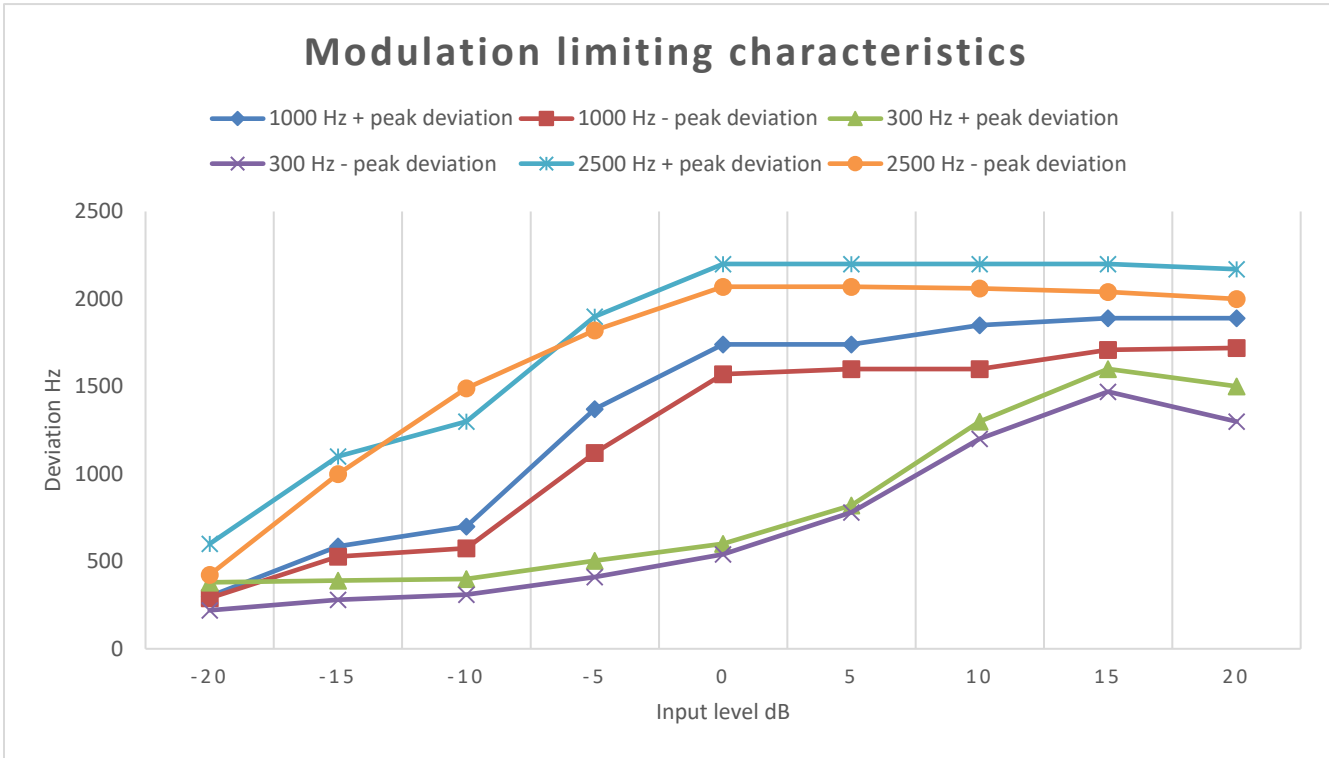
Audio input of 1000 Hz is applied with level set to obtain 60% of full rated system deviation. This is 0 dB reference point. The modulation response is measured at three audio frequencies 300, 1000 and 2500 Hz while varying the input level. Measurements were made for both positive and negative deviation.

Tx. Frequency used is 782 MHz Measurement plots were shown below for modulation deviation versus input voltage at 300,1000 and 2500 Hz.

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	12.5 kHz
Trace mode	Max Hold

8.7.4 Test data



8.8 FCC Part 2.1049 and RSS-Gen, 6.7 Occupied bandwidth

8.8.1 Definitions and limits

FCC:

§2.1049:Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emissions.

RSS-Gen:

§6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

8.8.2 Test summary

Test date	October 30, 2019	Temperature	23 °C
Test engineer	Fahar A Sukkoor	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	23 %

8.8.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of span
Video bandwidth	RBW × 3
Trace mode	Max Hold

Table 8.8-1: Occupied Bandwidth results for 782 and 805.5 MHz

Modulation	Frequency, MHz	OBW, kHz
11K0F3E	782	9.92
7K60F2D	782	5.87
7K60FXW	782	7.64
11K0F3E	805.5	9.81
7K60F2D	805.5	6.07
7K60FXW	805.5	7.64

8.8.4 Test data

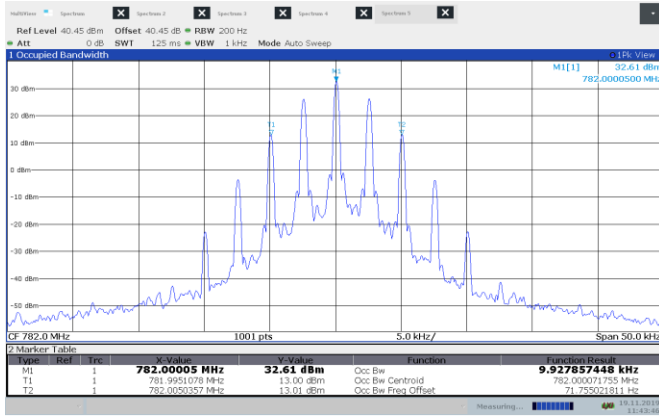


Figure 8.8-1:OBW plot for 782 MHz Analogue FM

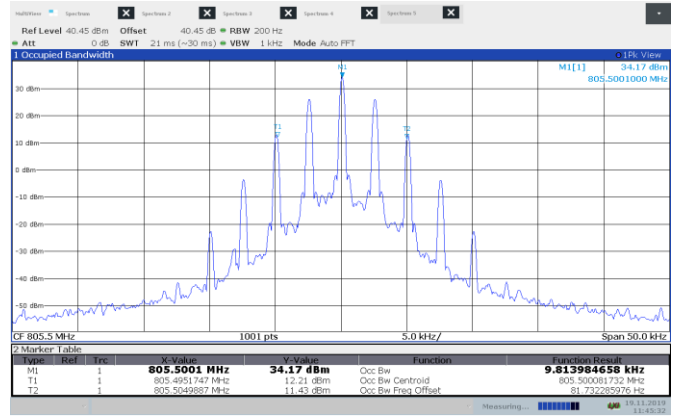


Figure 8.8-2: OBW plot for 805.5 MHz Analogue FM

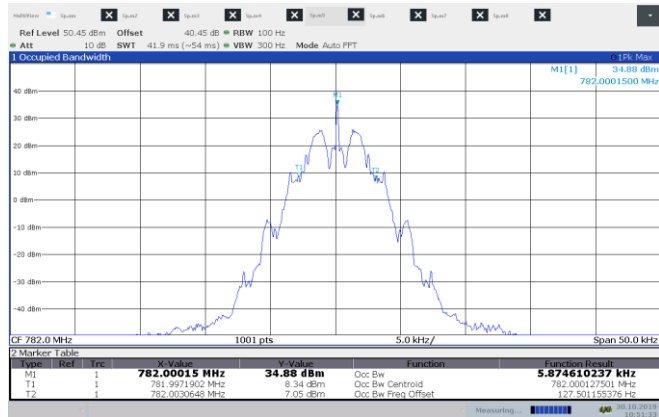


Figure 8.8-3: OBW plot for 782 MHz FFSK



Figure 8.8-4: OBW plot for 805.5 MHz FFSK

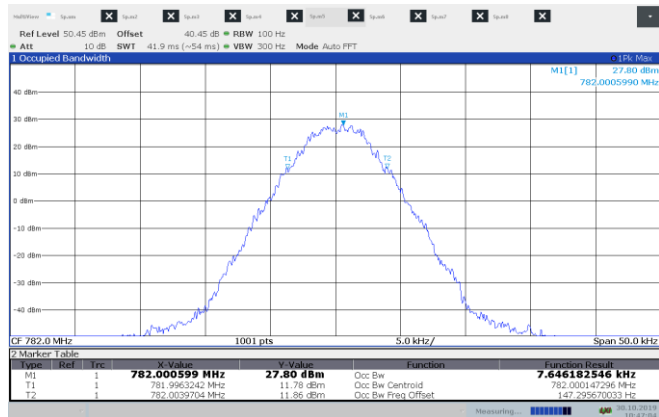


Figure 8.8-5: OBW plot for 782 MHz DMR

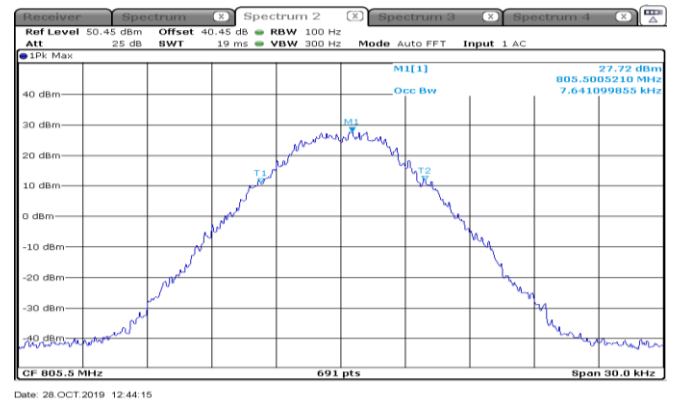
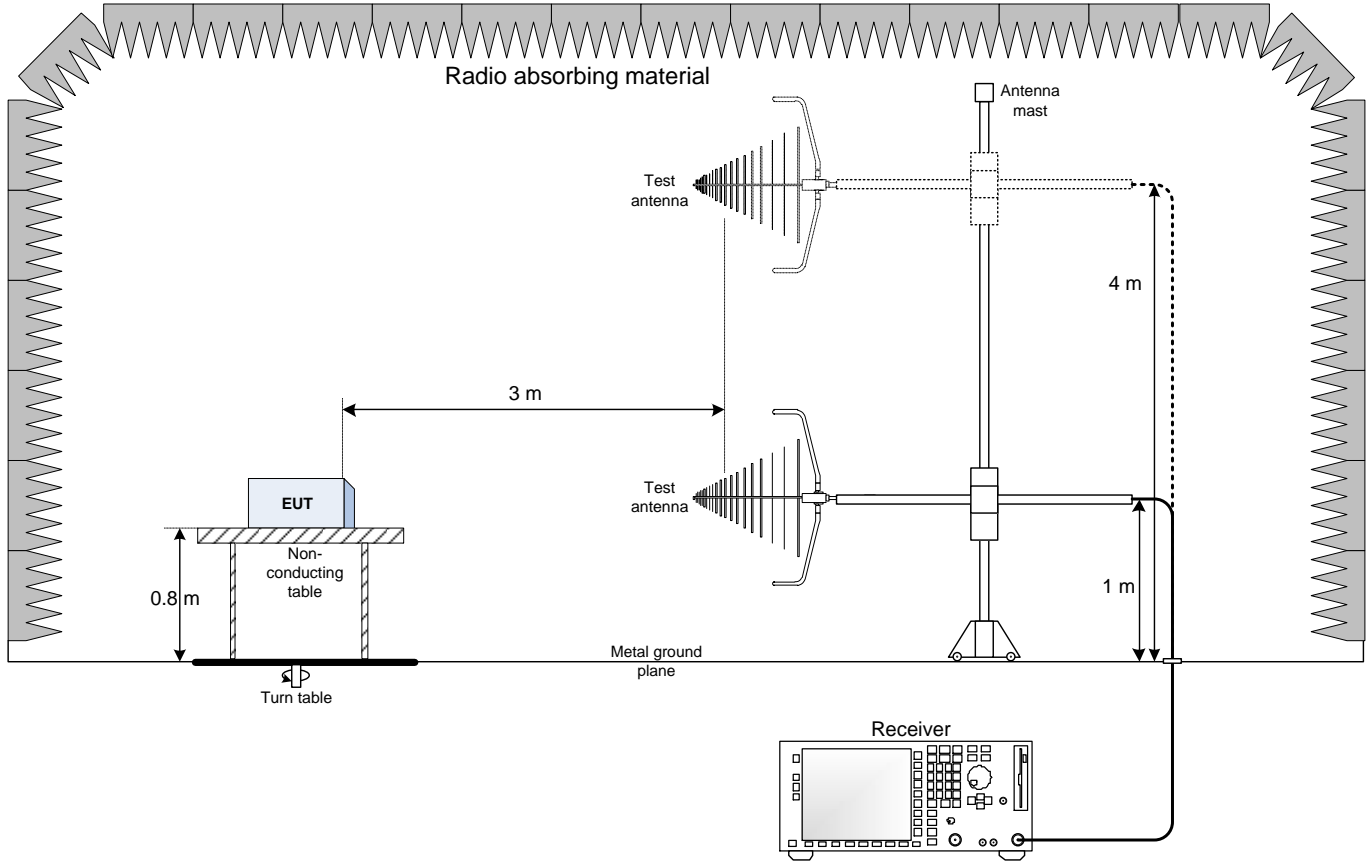


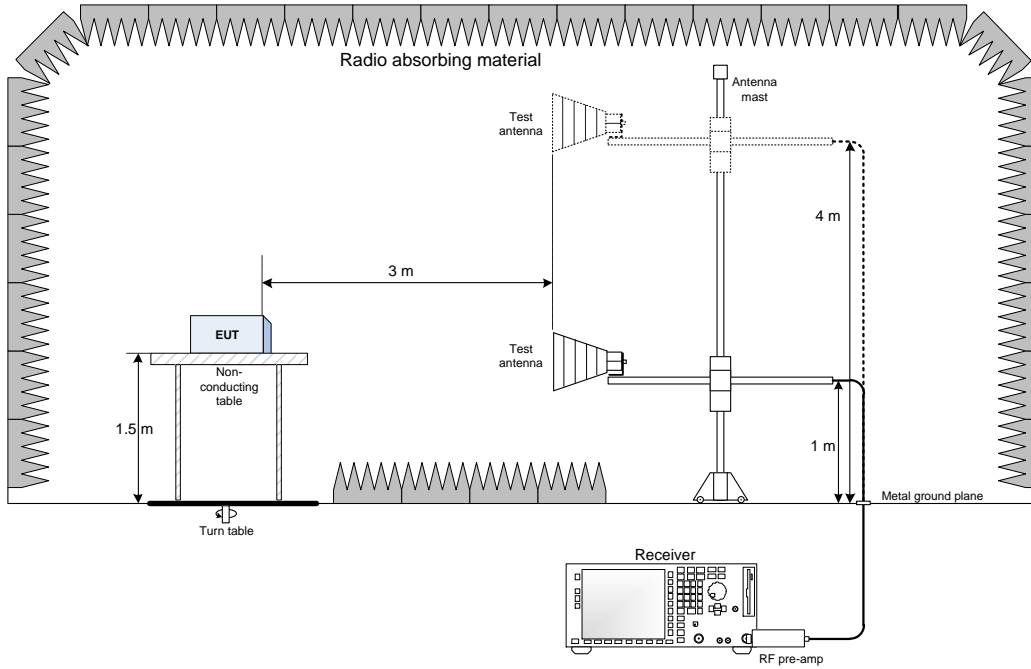
Figure 8.8-6: OBW plot for 805.5 MHz DMR

Section 9. Block diagrams of test set-ups

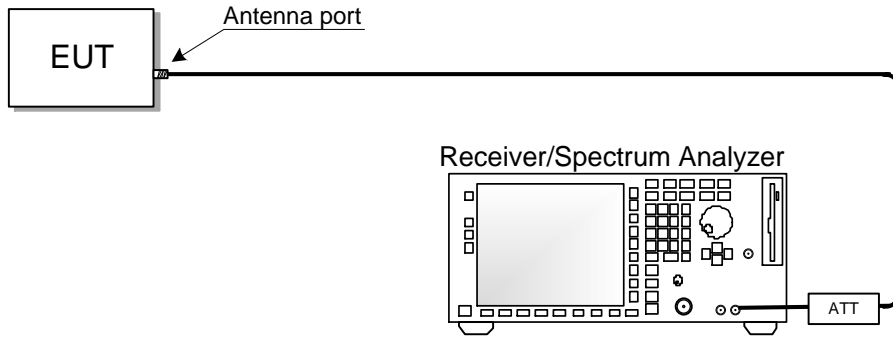
9.1 Radiated emissions setup for frequencies below 1 GHz



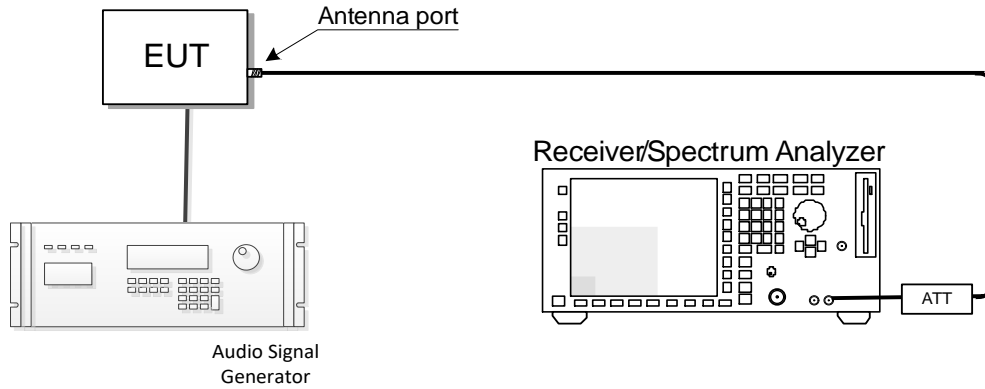
9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Antenna port set-up



9.4 Modulation limiting and audio frequency response characteristics setup



-End of test report-