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RADIO TEST REPORT

Report ID:
REP027584

Project ID:
PRJ0046365

Type of assessment:
Final product testing- Certification basis

Applicant:
Anodyne Electronics Manufacturing Corp

Product:
Mission Transceiver Panel Mount

Model number (HVIN):
MTPB1GN

PMN:
MTP136D-000GN, MTP138-000GN

FCC ID:
ZC7-MTPB1GN

ISED Certification number:
9601A-MTPB1GN

Specifications:

- FCC 47 CFR Part 90, Subpart I
- FCC 47 CFR Part 22, Subpart E
- FCC 47 CFR Part 74, Subpart D
- RSS-119 Issue 12, May 2015
- RSS-Gen Issue 5, March 2019

Date of issue: March 21, 2024

Ketav Jani, EMC/RF Specialist
Tested by

Signature

Andrey Adelberg, Senior EMC/RF Specialist
Reviewed by

Signature

Lab locations

Company name	Nemko Canada Inc.			
Facilities	*Ottawa site:* 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	*Montréal site:* 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	*Cambridge site:* 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811	*Almonte site:* 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117 Fax: +1 613 256-8848
Test site registration	**Organization**	**Recognition numbers and location**		
	FCC/ISED	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 90, Subpart I	Private land mobile radio services. General technical standards
FCC 47 CFR Part 22, Subpart E	Public Mobile Service
FCC 47 CFR Part 74, Subpart D	Experimental Radio, Auxiliary, Special Broadcast and other Program Distributional Service
RSS-119 Issue 12, May 2015	Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41–960 MHz

1.2 Test methods

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
TIA-603E-2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
TIA-102. CAAA-E, March 2016	Digital C4FM/CQPSK Transceiver Measurement Methods
FCC 47 CFR Part 2, Subpart J	Equipment authorization procedures
RSS-Gen Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. 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.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Date of issue	Details of changes made to test report
REP027584	March 21, 2024	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

2.2 Technical judgment

The product has two model variants MTP136D-000GN and MTP138-000GN. The listed models have identical electrical circuitry, components, RF power and layout. The models differ by software through a factory configurable software key. The functional differences are described by the table below.

Model	Digital Modulation (P25)	Frequency Range (MHz)
MTP136D-000GN	Yes	136-174
MTP138-000GN	No	138-174

Test results obtained for the MTP136D-000GN are applicable to the MTP138-000GN.

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (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.

3.2 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 ±5 %, for which the equipment was designed.

Section 4 Information provided by the applicant

4.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

4.2 Applicant/Manufacture

Applicant name	Anodyne Electronics Manufacturing Corp.
Applicant address	#100-966 Crowley Avenue, Kelowna, British Columbia, Canada, V1Y 0L1
Manufacture name	same as applicant
Manufacture address	same as applicant

4.3 EUT information

Product name	Mission Transceiver Panel Mount
Model (HVIN)	MTPB1GN
PMN	MTP136D-000GN, MTP138-000GN
Serial number	108161
Part number	MTP
Power supply requirements	DC: 28 V from aircraft DC essential bus
Product description and theory of operation	The MTP136D Mission Panel Mount Radio is a stand-alone APCO P25 Compatible VHF FM transceiver capable of operating in three modes: narrowband analog, wideband analog, or digital P25 Phase I. The MTP136D transmit and receive frequency range is the 136 – 174 MHz VHF band with high (10 W) or low (1 W) transmit output power selectable from the front panel interface. Continuous Tone Code Squelch System (CTCSS) and Continuous Digital Coded Squelch System (CDCSS) encoding/decoding are selectable in analog mode. Network Access Codes (NAC) are available in P25 digital mode. The programable guard transceiver can receive VHF guard frequencies. The panel mount radio is controlled using its front panel mounted number pad, knobs, and switches. Radio channel information and functions are displayed on a NVIS high-resolution screen.
Hardware revision	Rev 1.00 HW
Software details	Firmware ID: 35.12.16.0005

4.4 Technical information

Frequency band	136–174 MHz
Frequency Min (MHz)	CH001: 136.1 MHz (25 kHz), CH004: 136.1 MHz (12.5 kHz), CH007: 136.1 MHz (12.5 kHz)
Frequency Max (MHz)	CH003: 173.9875 MHz (25 kHz), CH004: 173.9875 MHz (12.5 kHz), CH007: 173.9875 MHz (12.5 kHz)
RF power Max (W), Conducted	10 W (40 dBm)
Measured BW (kHz), 99% OBW	Analog: 9.95 kHz (12.5 kHz), 14.88 kHz (25 kHz) Digital: 8.09 kHz (12.5 kHz)
Type of modulation	Digital: C4FM Analog: FM
Transmitter spurious, dBµV/m @ 3 m	47.73 (Peak) @347.97 MHz, Analog 25 kHz high channel
Emission classification	Analog: 11K0F3E (12.5 kHz), 16K0F3E (25 kHz) Digital: 8K10F1E (Digital Voice 12.5 kHz), 8K10F1D (Data/Control channel 12.5 kHz), 8K10F7W (Data/Control channel 12.5 kHz)
Antenna information	Manufacturer: Comant, RAMI Type: VHF Antenna, vertically polarized, Omni Antenna gain: 3.12 dBi Antenna model: CI 177-1, CI-177-13, CI-292-3, CI-292-4 or RAMI AV14 or equivalent 50 ohm aviation antennas.

4.5 EUT setup details

4.5.1 Radio exercise details

Operating conditions	EUT transmitter and receiver to be exercised during the test to establish compliant performance under the applicable radio certification rules and regulations. FCC and ISED.EUT was pre-programmed to exercise the analog channels and digital channels. A Laptop with control software was used for the digital channel testing and test pattern selection.
Transmitter state	Keyed transmission
Receiver state	Receive mode

4.5.2 EUT setup configuration

Table 4.5-1: *EUT interface ports*

Description	Qty.
System interface connector, J1	1
RF antenna BNC port, J2	1
Faceplate, USB type C data port	1

Table 4.5-2: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop	Samsung	MN: NP-R580, SN: ZWA593EZA00304H
Audio frequency generator	HP	MN: 33120A
Audio isolation transformer interface	AEM	MN: DM2-2XX
BAA test set	AEM	MN: TS-BAA, SN: 091922
RJ45 to USB type C adapter	ISO MAX	MN: TJ-1259
DC power supply	GW INSTEK	MN: GPR-30600
DC power supply	Hantek	MN: PPS2116A

Table 4.5-3: *Inter-connection cables*

Cable description	From	To	Length (m)
DC power input	DC power supply	BAA test set	1.5
USB C to RJ11	EUT	RJ45 to USB type C adapter	2
USB C to USB C	RJ45 to USB type C adapter	Laptop	1.5
BNC to XLR male adapter cable, AEM P/N: 108-65-185	Audio isolation transformer	BAA test set	1
MTP136D-000GN qualification test cable, AEM P/N 108-65-179	DC power supply, test set, audio isolation transformer	EUT	5

EUT setup configuration, continued

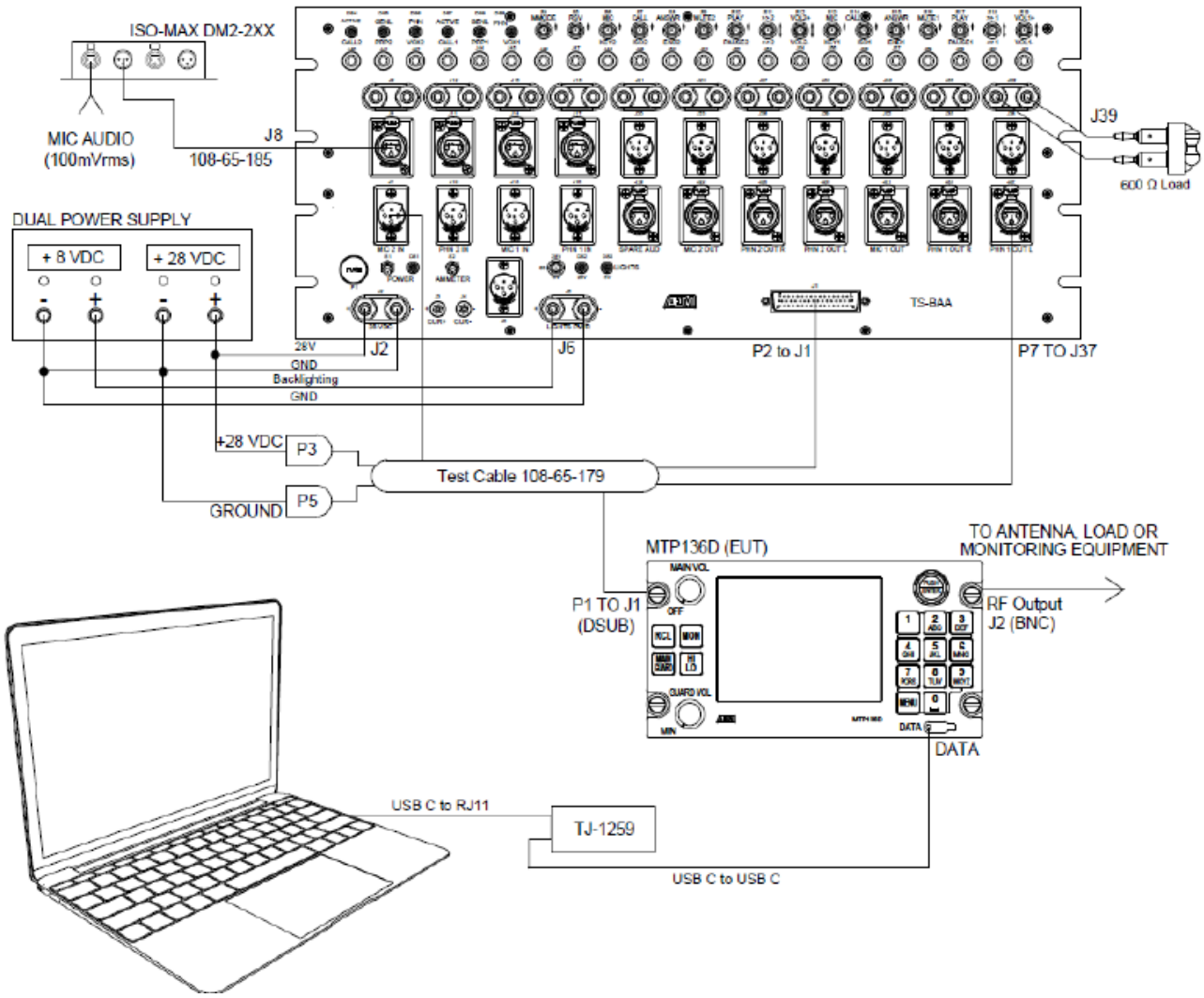


Figure 4.5-1: *EUT setup block diagram*

EUT setup configuration, continued

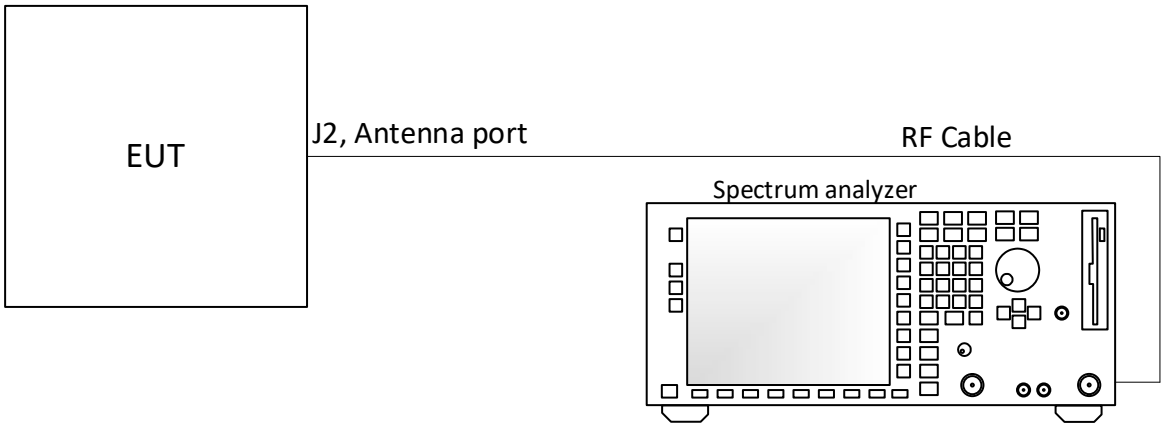


Figure 4.5-2: *Antenna port testing block diagram*

Section 5 Summary of test results

5.1 Testing location

Test location (s)	Cambridge

5.2 Testing period

Test start date	January 5, 2024	Test end date	February 8, 2024

5.3 Sample information

Receipt date	January 2, 2024	Nemko sample ID number(s)	PRJ00463650001, PRJ00463650002, PRJ00463650003, PRJ00463650004

5.4 FCC Part 2 and 90, 22, and 74 test requirements results

Table 5.4-1: *FCC requirements results*

Part	Test description	Verdict
2.1046, 90.205, 22.565, 74.461	Transmitter output power	Pass
2.1047(a)	Audio frequency response-Pre emphasis	Pass
2.1047(b)	Modulation limiting	Pass
2.1049 (c), 90.209, 90.210(b), 74.462	Bandwidth limitations and spectral mask	Pass
2.1051, 90.210, 22.357, 74.462	Transmitter spurious emissions (conducted)	Pass
2.1053, 90.210, 22.357, 74.462	Transmitter spurious emissions (radiated))	Pass
2.1055(d), 90.213(a), 22.355, 74.464	Transmitter frequency stability	Pass
90.214	Transient frequency behavior	Pass

5.5 ISED RSS-119, Issue 12 and RSS-Gen, Issue 5 test requirements results

Table 5.5-1: *ISED requirements results*

Section	Test description	Verdict
RSS-119, 5.3	Transmitter frequency stability	Pass
RSS-119, 5.4	Transmitter output power	Pass
RSS-119, 5.5	Bandwidth limitations	Pass
RSS-119, 5.5	Spectrum mask and spurious emissions	Pass
RSS-119, 5.8	Transmitter unwanted emissions	Pass
RSS-119, 5.9	Transient frequency behavior	Pass
RSS-Gen, 6.9	Operating bands and selection of test frequencies	Pass

Section 6 Test equipment

6.1 Test equipment list

Table 6.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	January 23, 2025
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	February 10, 2024
Bilog antenna (30–2000 MHz)	SUNAR	JB1	FA003010	1 year	July 14, 2024
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	May 31, 2024
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	March 27, 2024
50 Ω coax cable	Huber + Suhner	None	FA003047	1 year	July 27, 2024
50 Ω coax cable	Huber + Suhner	None	FA003402	1 year	July 27, 2024
Vector signal generator	Rohde & Schwarz	SMW200A	FA002970	1 Year	December 8, 2024
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	November 30, 2024
Digital oscilloscope	Rohde & Schwarz	RTO2044	FA002967	1 year	November 30, 2024
Vector signal generator	Rohde & Schwarz	SMW200A	FA002970	1 Year	December 08, 2024
Audio frequency generator	HP	33120A	FA001082	—	VOU
RF combiner	Mini-Circuits	ZFSC-3-4-N+	—	—	VOU
Temperature Chamber	Espec	EPX-4H	FA003033	1 year	March 8, 2024
Modulation Analyzer	HP	8901B	FA003465	1 year	April 30, 2024
RF detector	Pasternack	PE8012	—	—	NCR

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

Table 6.1-2: *Automation software details*

Test description	Manufacturer of Software	Details
Software for Radio/EMC Measurements	Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.60.00

Table 6.1-3: *Measurement uncertainty calculations based on equipment list*

Measurement	Measurement uncertainty, ±dB
Radiated spurious emissions (30 MHz to 1 GHz)	4.27
Radiated spurious emissions (1 GHz to 6 GHz)	4.74
Radiated spurious emissions (6 GHz to 18 GHz)	5.04
RF Output power measurement using Spectrum Analyzer	0.71
Conducted spurious emissions	0.90
Other antenna port measurements	0.81

Notes: UKAS Lab 34, TIA-603 and ETSI TR 100 028-1&2 have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Section 7 Testing data

7.1 Operating bands and selection of test frequencies

7.1.1 References, definitions and limits

ANSI C63.26, Clause 5.1.2:

Measurements of transmitters shall be performed and, if required, reported for each frequency band in which the EUT can be operated with the device transmitting at the number of frequencies in each band specified in table below.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 7.1-1: *Frequency Range of Operation*

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

7.1.2 Test summary

Verdict	Pass		
Tested by	Ketav Jani	Test date	January 5, 2024

7.1.3 Observations, settings and special notes

None

7.1.4 Test data

Table 7.1-2: *Test channels selection*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
136	174	38	136.1	155.1	173.9875

7.2 Modulation characteristic

7.2.1 References, definitions and limits

FCC §2.1047:

(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.

(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

7.2.2 Test summary

Verdict	Pass		
Tested by	Ketav Jani	Test date	January 29, 2024

7.2.3 Observations, settings and special notes

Per ANSI C63.26 Subclause 5.3.1 & TIA-603-E 2.2.6: The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.
Modulation analyzer settings:

Receiver mode	RMS deviation
Audio frequency generator tone	300 Hz—3000 Hz

Reference voltage measurement: Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation. Record the DMM reading as V_{REF}.
Calculation of the audio frequency response at the present frequency: $20 \times \text{Log}_{10} (V_{FREQ} / V_{REF})$

Per ANSI C63.26 Subclause 5.3.2 & TIA-603-E 2.2.3: Modulation limiting is the ability of a transmitter circuit to limit the transmitter from producing deviations in excess of a rated system deviation.
Modulation analyzer settings:

Receiver mode	Peak positive and negative deviation
Audio frequency generator tone	300 Hz—3000 Hz

Reference voltage measurement: Apply a 1000 Hz tone and adjust the audio frequency generator to produce 60% of the rated system deviation. This is the 0 dB reference level. Plot the data set as a percentage of deviation relative to the 0 dB reference point versus input voltage.

7.2.4 Test data

Modulation Frequency, Tx freq 136.1 MHz, 12.5 kHz (Hz)	Dev ref. (kHz)	Dev Frequency (kHz)	Response data (dB)
300	0.343	0.088	-11.82
400	0.343	0.130	-8.43
500	0.343	0.169	-6.15
600	0.343	0.204	-4.51
700	0.343	0.238	-3.17
800	0.343	0.272	-2.01
900	0.343	0.307	-0.96
1000	0.343	0.344	0.03
1200	0.343	0.420	1.76
1400	0.343	0.488	3.06
1600	0.343	0.550	4.10
1800	0.343	0.623	5.18
2000	0.343	0.709	6.31
2200	0.343	0.781	7.15
2400	0.343	0.831	7.69
2600	0.343	0.900	8.38
2800	0.343	0.976	9.08
3000	0.343	0.823	7.60

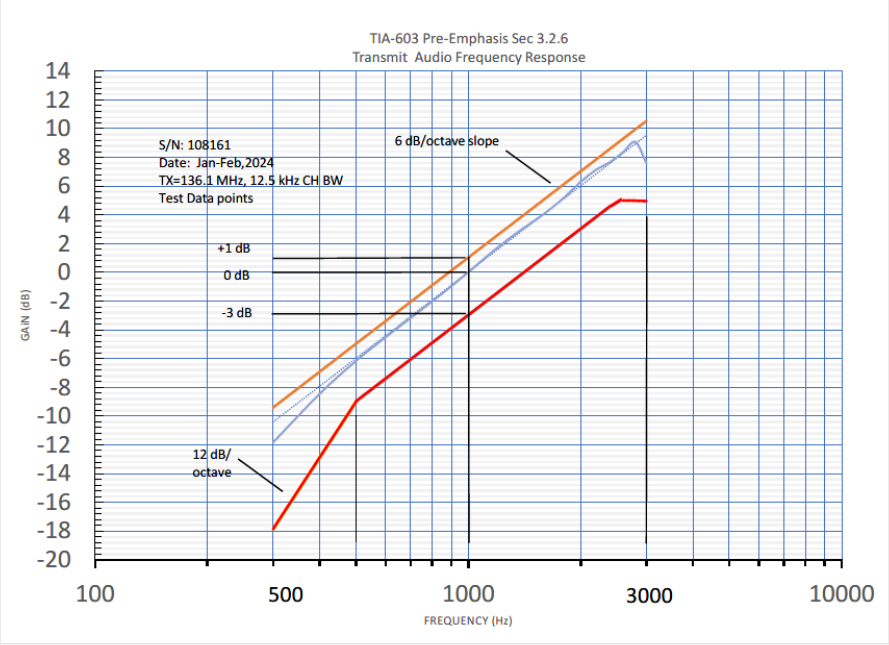


Figure 7.2-1: *Audio frequency response, Low channel, 12.5 kHz channel spacing*

Test data, continued

Modulation Frequency, Tx freq 136.1 MHz, 25 kHz (Hz)	Dev ref. (kHz)	Dev Frequency (kHz)	Response data (dB)
300	0.707	0.179	-11.93
400	0.707	0.265	-8.52
500	0.707	0.346	-6.21
600	0.707	0.42	-4.52
700	0.707	0.49	-3.18
800	0.707	0.56	-2.02
900	0.707	0.632	-0.97
1000	0.707	0.708	0.01
1200	0.707	0.865	1.75
1400	0.707	1.004	3.05
1600	0.707	1.131	4.08
1800	0.707	1.283	5.18
2000	0.707	1.46	6.30
2200	0.707	1.608	7.14
2400	0.707	1.71	7.67
2600	0.707	1.85	8.36
2800	0.707	2.005	9.05
3000	0.707	1.69	7.57

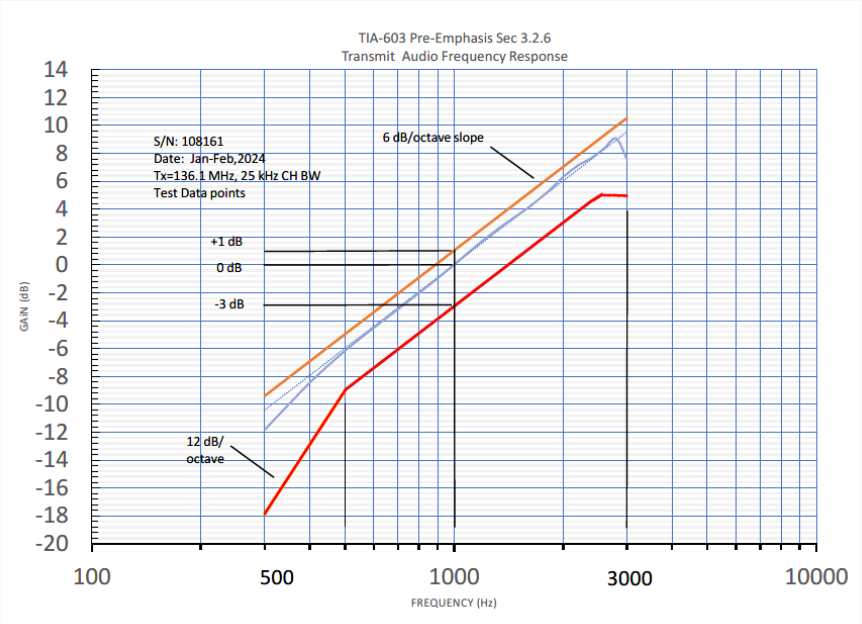


Figure 7.2-2: *Audio frequency response, Low channel, 25 kHz channel spacing*

Test data, continued

Audio Frequency, Tx freq 136.1 MHz, 12.5 kHz (Hz)	Steady state Dev., Peak+ (kHz)	Steady state Dev., Peak- (kHz)	Limit (kHz)
300	0.543	0.466	2.5
400	0.890	0.715	2.5
500	1.123	0.918	2.5
600	1.307	1.081	2.5
700	1.447	1.232	2.5
800	1.607	1.358	2.5
900	1.750	1.512	2.5
1000	1.751	1.681	2.5
1200	1.556	1.829	2.5
1400	1.585	1.892	2.5
1600	1.770	1.932	2.5
1800	1.986	1.972	2.5
2000	2.050	2.018	2.5
2200	2.104	2.060	2.5
2400	2.139	2.092	2.5
2600	2.171	2.134	2.5
2800	2.172	2.131	2.5
3000	1.944	1.908	2.5

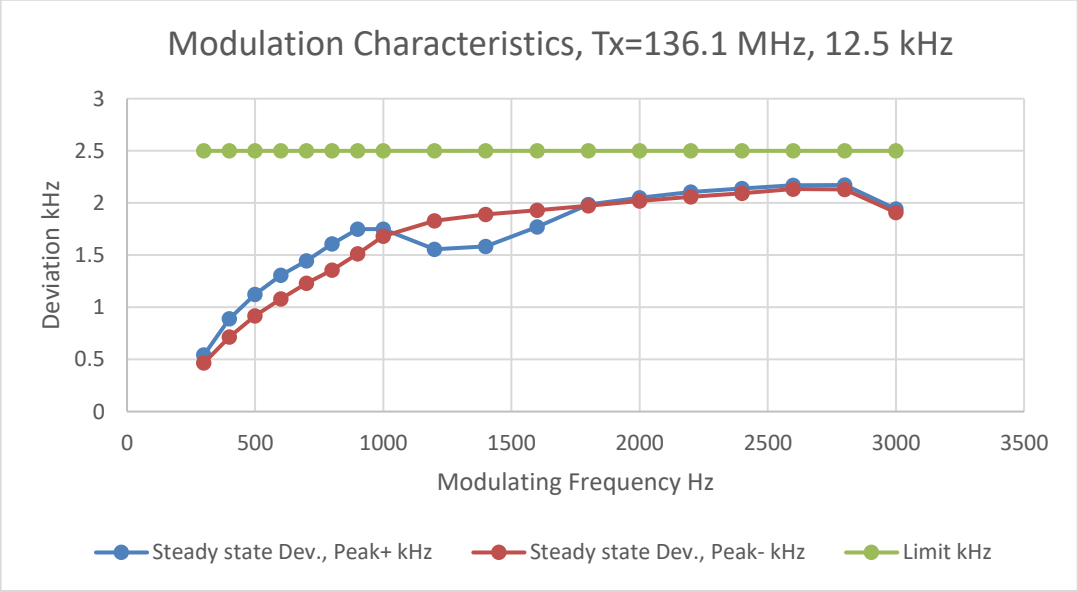


Figure 7.2-3: *Modulation Limiting, Low channel, 12.5 kHz channel spacing*

Test data, continued

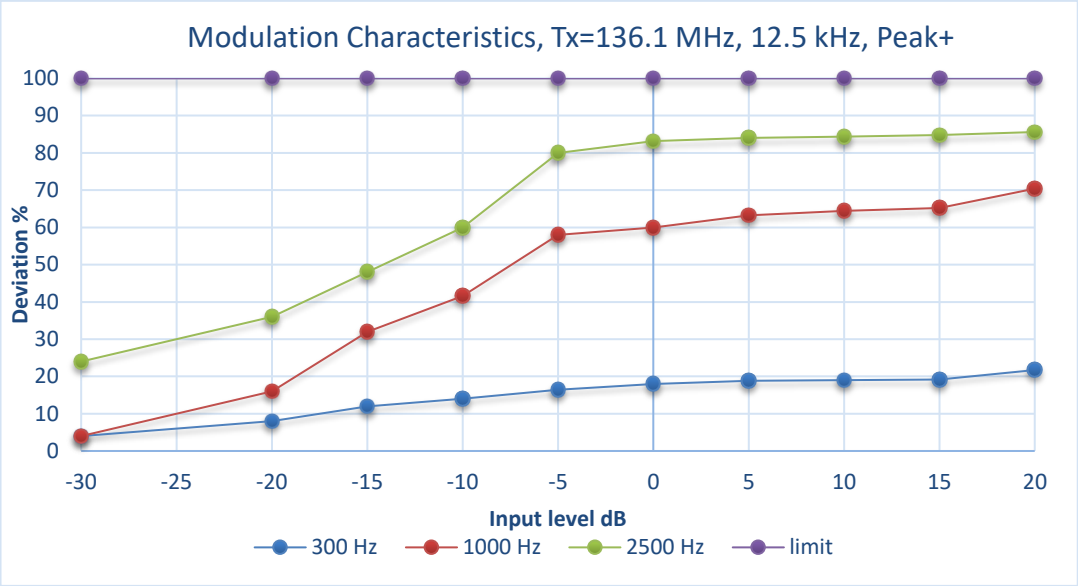


Figure 7.2-4: *Modulation Limiting, Low channel, 12.5 kHz channel spacing*

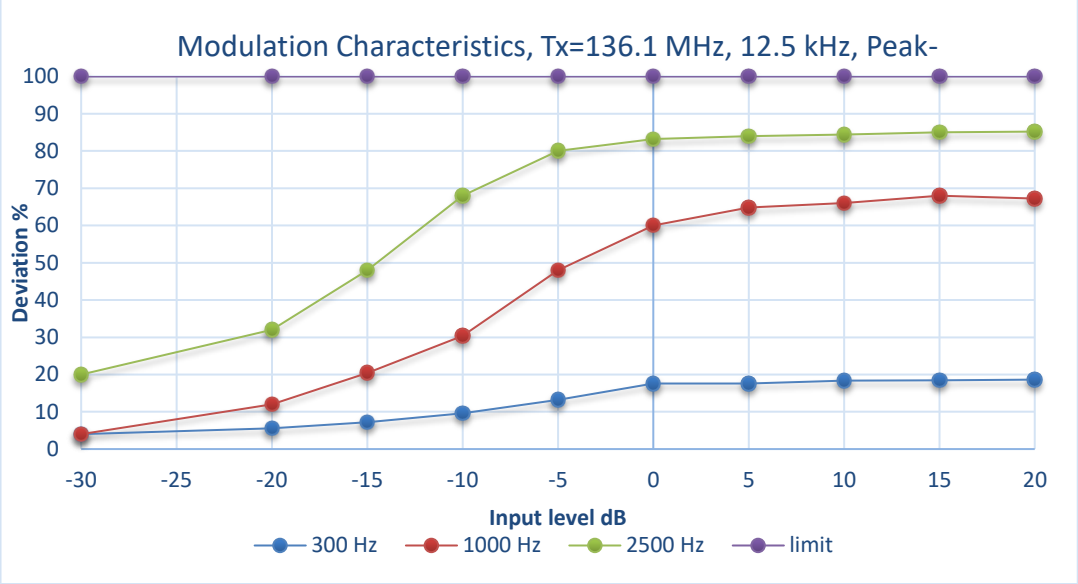


Figure 7.2-5: *Modulation Limiting, Low channel, 12.5 kHz channel spacing*

Test data, continued

Audio Frequency, Tx freq 136.1 MHz, 25 kHz (Hz)	Steady state Dev., Peak+ (kHz)	Steady state Dev., Peak- (kHz)	Limit (kHz)
300	1.485	0.855	5
400	2.065	1.444	5
500	2.501	1.837	5
600	2.896	2.208	5
700	3.275	2.588	5
800	3.217	2.909	5
900	3.454	3.239	5
1000	3.537	3.420	5
1200	3.171	3.656	5
1400	3.16	3.821	5
1600	3.285	3.831	5
1800	3.929	3.896	5
2000	4.050	4.000	5
2200	4.180	4.080	5
2400	4.240	4.170	5
2600	4.310	4.230	5
2800	4.320	4.230	5
3000	3.850	3.750	5

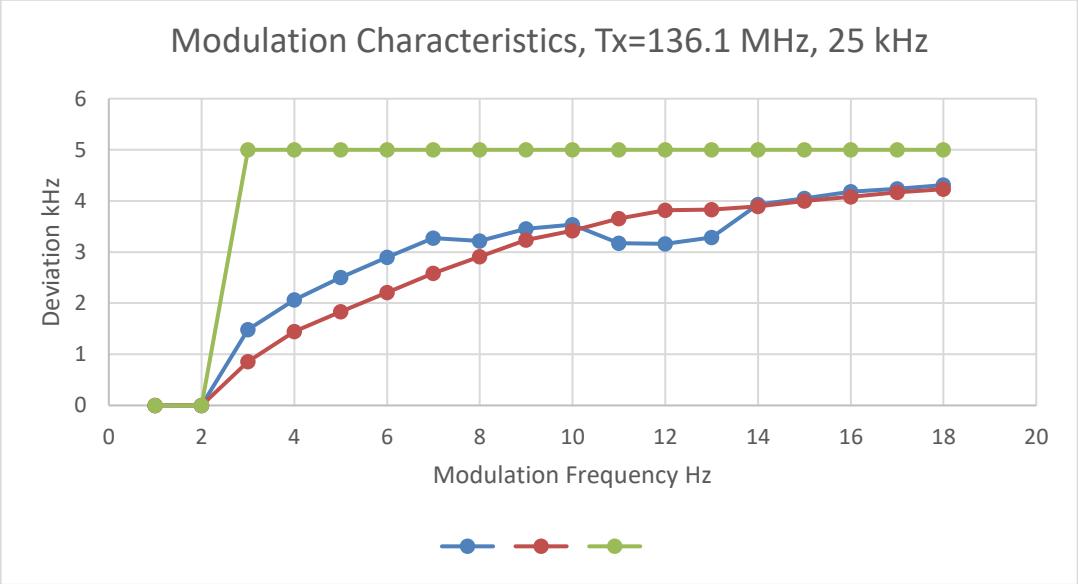


Figure 7.2-6: *Modulation Limiting, Low channel, 25 kHz channel spacing*

Test data, continued

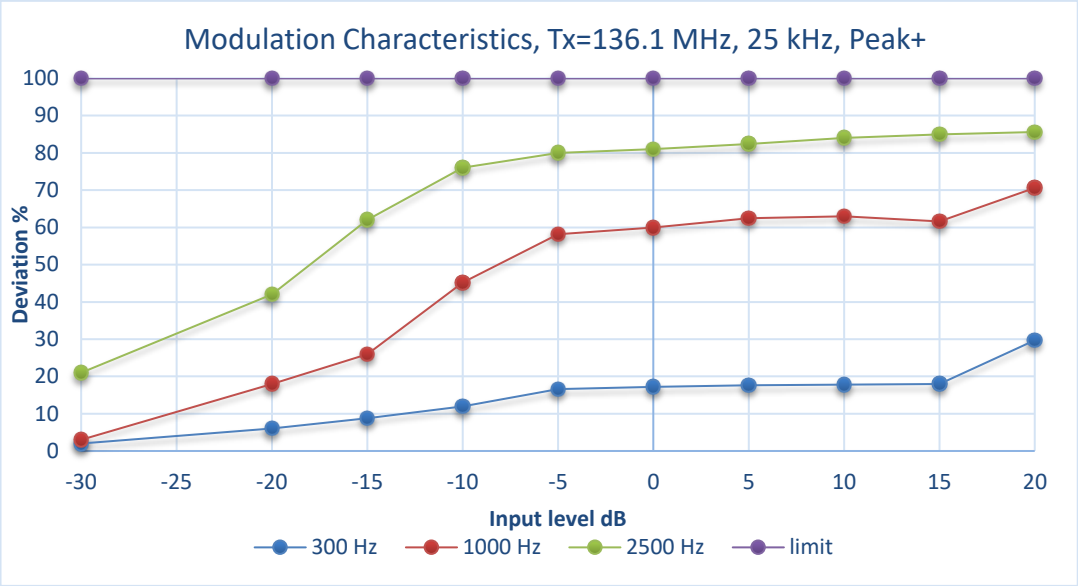


Figure 7.2-7: *Modulation Limiting, Low channel, 25 kHz channel spacing*

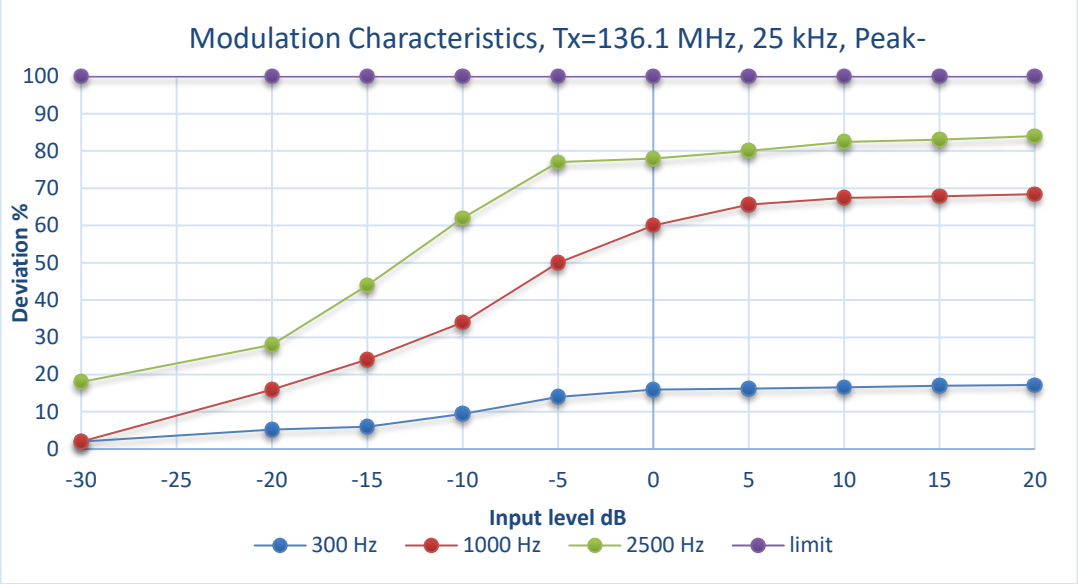


Figure 7.2-8: *Modulation Limiting, Low channel, 25 kHz channel spacing*

7.3 Transmitter Output Power

7.3.1 References, definitions and limits

FCC §90.205:

(d) Power and antenna height limits within 150–174 MHz

(1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table below. Applicants requesting an ERP in excess of that listed in table below must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table below will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 39 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 32 km (20 mi) must justify the requested service area radius, which may be authorized only in accordance with table below, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

Table 7.3-1: *Maximum ERP/Reference HAAT for a Specific Service Area Radius (FCC part 90)*

Service area radius (km):	3	8	13	16	24	32	40[4]	48[4]	64[4]	80[4]
Maximum ERP (W)[1]:	1	28	178	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500
Up to reference HAAT (m)[3]:	15	15	15	15	33	65	110	160	380	670

Notes: [1]Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See §73.699, Fig. 10 b).
[2]Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.
[3]When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation:
$ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})^2$.
[4]Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

RSS-119, Clause 5.4:

The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.
The transmitter output power limits set forth in Table below will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

Table 7.3-2: *Transmitter Output Power (ISED)*

Frequency Band, MHz	Transmitter Output Power for Base/Fixed Equipment, W	Transmitter Output Power for Mobile Equipment, W
138–174	110	60

FCC §22.565:

Table 7.3-3: *Transmitter Output Power (FCC part 22)*

Frequency Band, MHz	Maximum Transmitter Output Power, W
152–153	1400
157–159	150

FCC §74.461:

Table 7.3-4: *Transmitter Output Power (FCC part 74)*

Frequency Band, MHz	Maximum Transmitter Output Power, W
160.860–170.15	15

7.3.2 Test summary

Verdict	Pass		
Tested by	Ketav Jani	Test date	January 17, 2024

7.3.3 Observations, settings and special notes

Antenna gain = 3.12 dBi, Antenna gain in dBd = 3.12 – 2.15 = 0.97 dBd

Measurement of peak power was performed per ANSI C63.26 subclause 5.2.3.3. Spectrum analyser settings:

Resolution bandwidth	≥ OBW
Video bandwidth	≥ 3 × RBW
Frequency span	≥ 2 × OBW
Detector mode	Peak
Trace mode	Max Hold
Sweep time	≥ 10 × (number of points in sweep) × (transmission symbol period)

7.3.4 Test data

Table 7.3-5: *Transmitter power results for FCC part 90, 12.5 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
FM	136.1	40.03	0.97	41.00	56.99	15.99
FM	155.1	40.04	0.97	41.01	56.99	15.98
FM	173.9875	39.98	0.97	40.95	56.99	16.04

Table 7.3-6: *Transmitter power results for FCC part 90, 25 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
FM	136.1	40.04	0.97	41.01	56.99	15.98
FM	155.1	40.05	0.97	41.02	56.99	15.97
FM	173.9875	40.01	0.97	40.98	56.99	16.01

Table 7.3-7: *Transmitter power results for FCC part 90, 12.5 kHz, Digital*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
C4FM	136.1	40.01	0.97	40.98	56.99	16.01
C4FM	155.1	40.01	0.97	40.98	56.99	16.01
C4FM	173.9875	40.00	0.97	40.97	56.99	16.02

Table 7.3-8: *Transmitter power results for FCC part 22, 12.5 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
FM	136.1	40.03	0.97	41.00	51.76	10.76
FM	155.1	40.04	0.97	41.01	51.76	10.75
FM	173.9875	39.98	0.97	40.95	51.76	10.81

Table 7.3-9: *Transmitter power results for FCC part 22, 25 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
FM	136.1	40.04	0.97	41.01	51.76	10.75
FM	155.1	40.05	0.97	41.02	51.76	10.74
FM	173.9875	40.01	0.97	40.98	51.76	10.78

Test data, continued

Table 7.3-10: *Transmitter power results for FCC part 22, 12.5 kHz, Digital*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
C4FM	136.1	40.01	0.97	40.98	51.76	10.78
C4FM	155.1	40.01	0.97	40.98	51.76	10.78
C4FM	173.9875	40.00	0.97	40.97	51.76	10.79

Table 7.3-11: *Transmitter power results for FCC part 74, 12.5 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
FM	136.1	40.03	0.97	41.00	41.76	0.76
FM	155.1	40.04	0.97	41.01	41.76	0.75
FM	173.9875	39.98	0.97	40.95	41.76	0.81

Table 7.3-12: *Transmitter power results for FCC part 74, 25 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
FM	136.1	40.04	0.97	41.01	41.76	0.75
FM	155.1	40.05	0.97	41.02	41.76	0.74
FM	173.9875	40.01	0.97	40.98	41.76	0.78

Table 7.3-13: *Transmitter power results for FCC part 74, 12.5 kHz, Digital*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	ERP limit, dBm	Margin, dB
C4FM	136.1	40.01	0.97	40.98	41.76	0.78
C4FM	155.1	40.01	0.97	40.98	41.76	0.78
C4FM	173.9875	40.00	0.97	40.97	41.76	0.79

Test data, continued

Table 7.3-14: *Transmitter power results for ISED, 12.5 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	Output power limit, dBm	Margin, dB
FM	136.1	40.03	0.97	41.00	50.41	9.41
FM	155.1	40.04	0.97	41.01	50.41	9.40
FM	173.9875	39.98	0.97	40.95	50.41	9.46

Table 7.3-15: *Transmitter power results for ISED, 25 kHz, Analog*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	Output power limit, dBm	Margin, dB
FM	136.1	40.04	0.97	41.01	50.41	9.40
FM	155.1	40.05	0.97	41.02	50.41	9.39
FM	173.9875	40.01	0.97	40.98	50.41	9.43

Table 7.3-16: *Transmitter power results for ISED, 12.5 kHz, Digital*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain dBd	Peak ERP, dBm	Output power limit, dBm	Margin, dB
C4FM	136.1	40.01	0.97	40.98	50.41	9.43
C4FM	155.1	40.01	0.97	40.98	50.41	9.43
C4FM	173.9875	40.00	0.97	40.97	50.41	9.44

Test data, continued

Table 7.3-17: *Rated vs measured power, 12.5 kHz, Analog*

Modulation	Frequency, MHz	Rated output power, dBm	Measured output power, dBm	Difference, dB	Difference limit, ±dB	Margin, dB
FM	136.1	40.0	40.03	0.03	1.00	0.97
FM	155.1	40.0	40.04	0.04	1.00	0.96
FM	173.9875	40.0	39.98	-0.02	1.00	0.98

Table 7.3-18: *Rated vs measured power, 12.5 kHz, Analog*

Modulation	Frequency, MHz	Rated output power, dBm	Measured output power, dBm	Difference, dB	Difference limit, ±dB	Margin, dB
FM	136.1	40.0	40.04	0.04	1.00	0.96
FM	155.1	40.0	40.05	0.05	1.00	0.95
FM	173.9875	40.0	40.01	0.01	1.00	0.99

Table 7.3-19: *Rated vs measured power, 12.5 kHz, Digital*

Modulation	Frequency, MHz	Rated output power, dBm	Measured output power, dBm	Difference, dB	Difference limit, ±dB	Margin, dB
C4FM	136.1	40.0	40.01	0.01	1.00	0.99
C4FM	155.1	40.0	40.01	0.01	1.00	0.99
C4FM	173.9875	40.0	40.00	0.00	1.00	1.00

Test data, continued

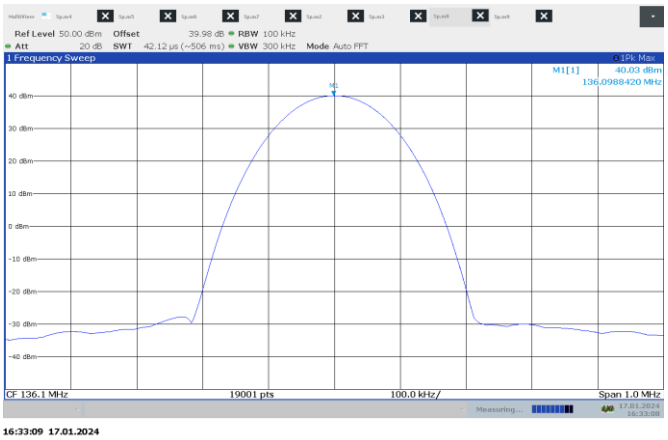


Figure 7.3-1: *Output power on low channel, 12.5 kHz, analog*

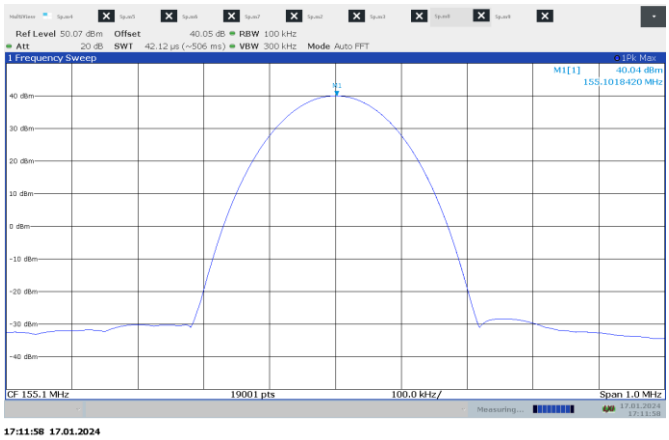


Figure 7.3-2: *Output power on mid channel, 12.5 kHz, analog*

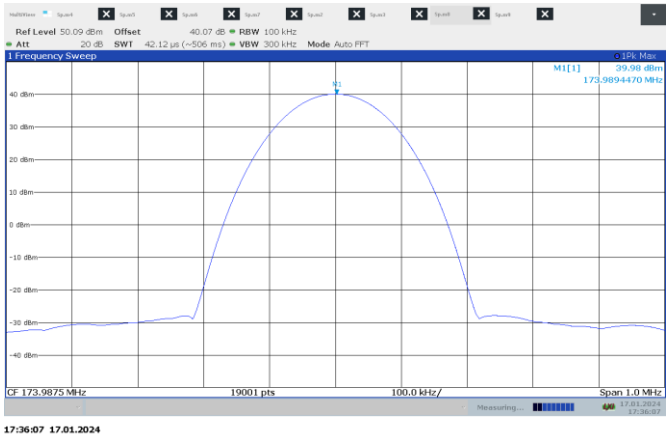


Figure 7.3-3: *Output power on high channel, 12.5 kHz, analog*

Test data, continued

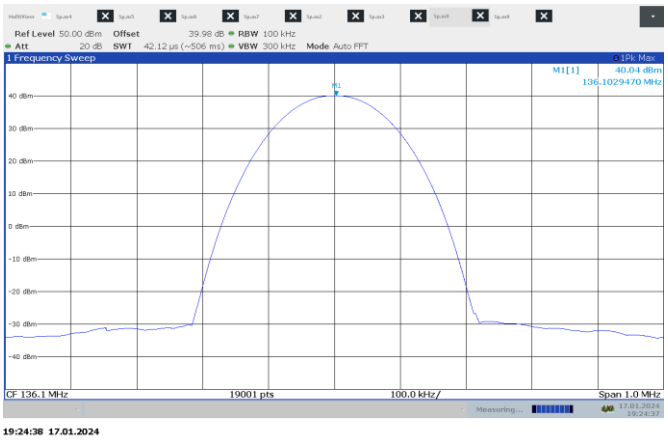


Figure 7.3-4: *Output power on low channel, 25 kHz, analog*

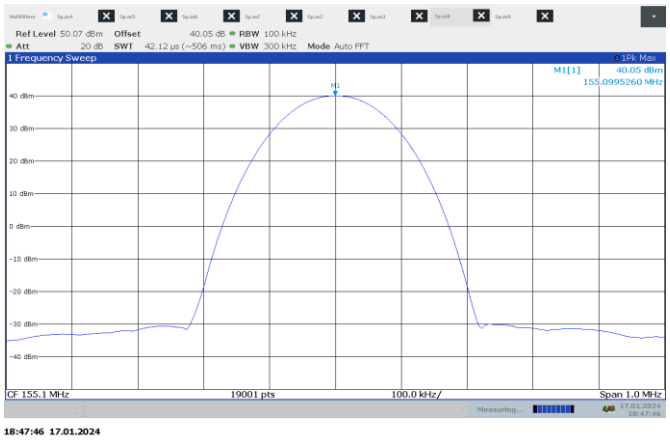


Figure 7.3-5: *Output power on mid channel, 25 kHz, analog*

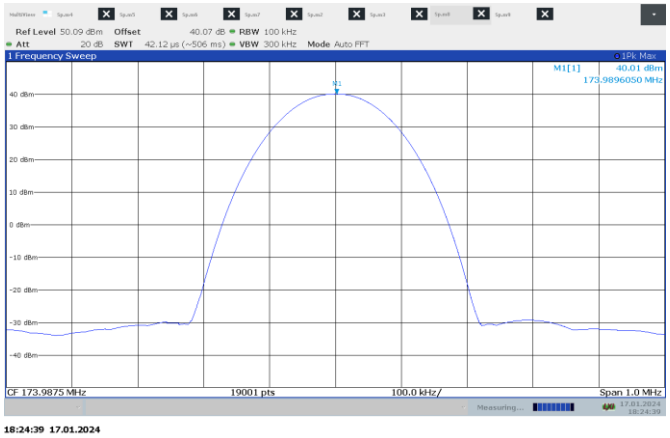


Figure 7.3-6: *Output power on high channel, 25 kHz, analog*

Test data, continued

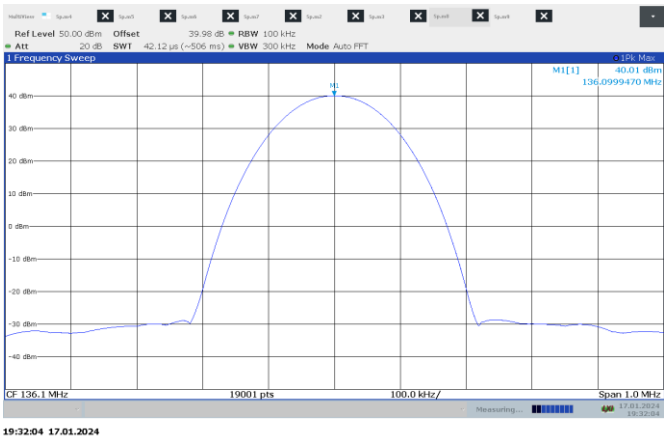


Figure 7.3-7: *Output power on low channel, 12.5 kHz, digital*

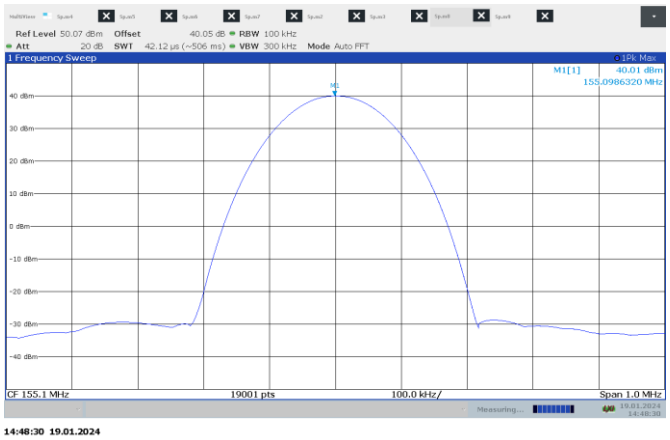


Figure 7.3-8: *Output power on mid channel, 12.5 kHz, digital*

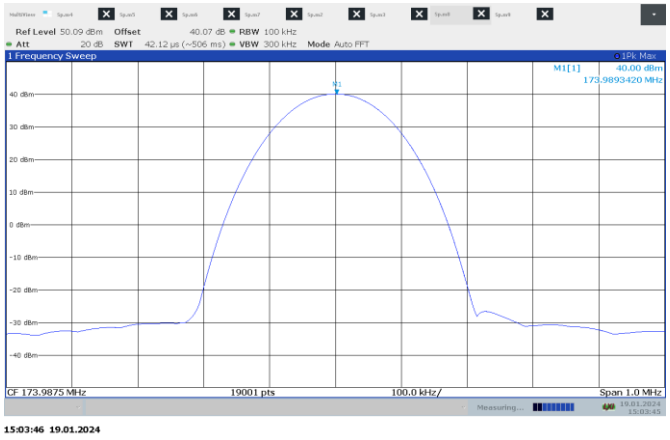


Figure 7.3-9: *Output power on high channel, 12.5 kHz, digital*

7.4 Bandwidth limitations

7.4.1 References, definitions, and limits

FCC §90.209:

(b) The maximum authorized single channel bandwidth of emission corresponding to the type of emission specified in §90.207 is as follows:

(5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table.

Table 7.4-1: *Standard Channel Spacing/Bandwidth*

Frequency band, MHz	Channel spacing, kHz	Authorized bandwidth[1], kHz
150–174	7.5	20 / 11.25 / 6

Note: [1]Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013

(6)(i) Beginning January 1, 2011, no new applications for the 150–174 MHz bands will be acceptable for filing if the applicant utilizes channels with an authorized bandwidth exceeding 11.25 kHz, unless specified elsewhere or the operations meet the efficiency standards of §90.203(j)(3).

RSS-119, Clause 5.5:

For the purpose of this document, channel bandwidth is the channel width in which the equipment is designed to operate.

The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified in Table 7.4-2 below for the equipment's frequency band. The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licences.

The channel bandwidths and authorized bandwidths are given in Table below for equipment having an output power greater than 120 mW. For equipment with an output power that does not exceed 120 mW, Section 5.10 applies.

Table 7.4-2: *Channel Bandwidths, Authorized Bandwidths for 138–174 MHz frequency band*

Channel bandwidth, kHz	Authorized bandwidth, kHz
30.00	20.00
15.00	11.25
7.5	6.00

FCC §74.462:

(b) The maximum authorized bandwidth of emissions corresponding to the types of emissions specified below, and the maximum authorized frequency deviation in the case of frequency or phase modulated emission, shall be as follows:

Table 7.4-3: *Standard Channel Authorized Bandwidth*

Frequencies, MHz	Authorized bandwidth, kHz
160.860-161.400	60.00
161.625-161.775	30.00
166.25-170.15	12.5/25

7.4.2 Test summary

Verdict	Pass		
Tested by	Ketav Jani	Test date	January 17, 2024

7.4.3 Observations, settings, and special notes

The test was performed as per ANSI C63.26, subclause 5.4.4.
Spectrum analyzer settings:

Resolution bandwidth	1–5% of OBW
Video bandwidth	≥3 × RBW
Frequency span	1.5 × OBW
Detector mode	Peak
Trace mode	Max Hold

7.4.4 Test data

Table 7.4-4: *99% occupied bandwidth results,12.5 kHz, Analog*

Modulation	Frequency, MHz	99% occupied bandwidth, kHz	Limit, kHz	Margin, kHz
FM	136.1	9.95	11.25	1.30
FM	155.1	9.95	11.25	1.30
FM	173.9875	9.94	11.25	1.31

Table 7.4-5: *99% occupied bandwidth results,25 kHz, Analog*

Modulation	Frequency, MHz	99% occupied bandwidth, kHz	Limit, kHz	Margin, kHz
FM	136.1	14.88	20.00	5.12
FM	155.1	14.86	20.00	5.14
FM	173.9875	14.82	20.00	5.18

Table 7.4-6: *99% occupied bandwidth results,12.5 kHz, Digital*

Modulation	Frequency, MHz	99% occupied bandwidth, kHz	Limit, kHz	Margin, kHz
C4FM	136.1	8.09	11.25	3.16
C4FM	155.1	8.06	11.25	3.19
C4FM	173.9875	8.07	11.25	3.18

Test data, continued

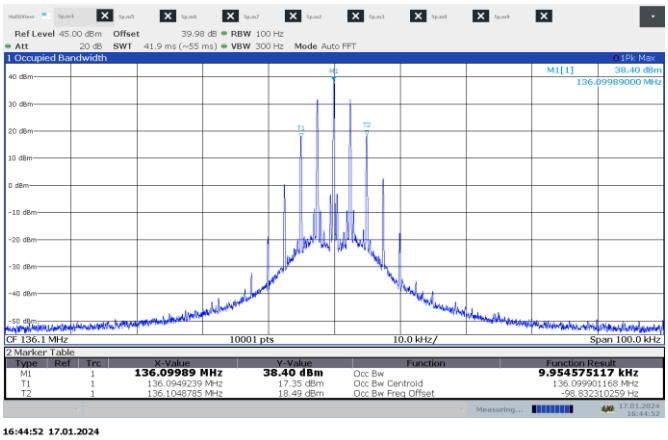


Figure 7.4-1: *99% occupied bandwidth on low channel, 12.5 kHz, Analog*

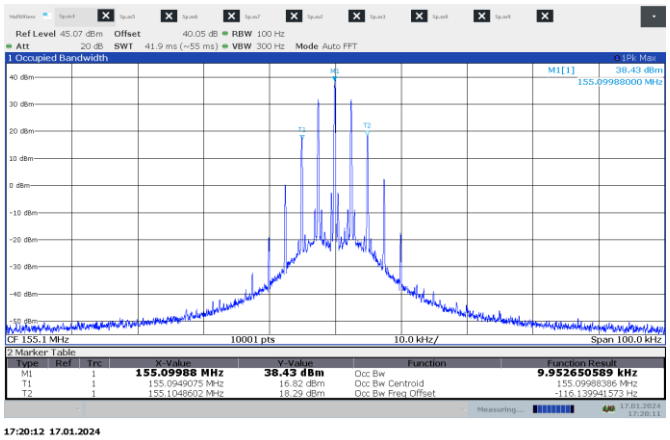


Figure 7.4-2: *99% occupied bandwidth on mid channel, 12.5 kHz, Analog*

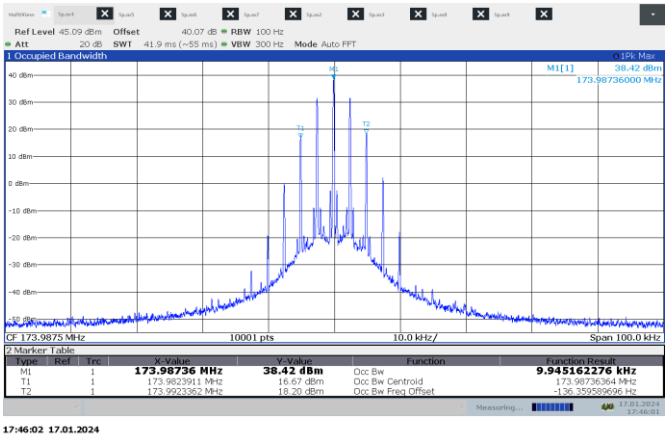


Figure 7.4-3: *99% occupied bandwidth on high channel, 12.5 kHz, Analog*

Test data, continued

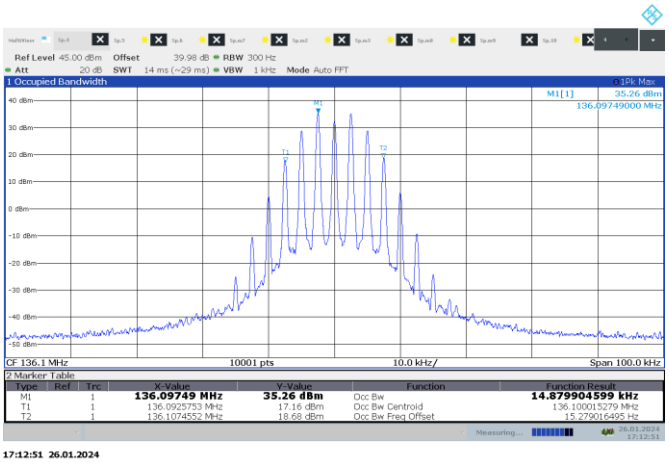


Figure 7.4-4: *99% occupied bandwidth on low channel, 25 kHz, Analog*

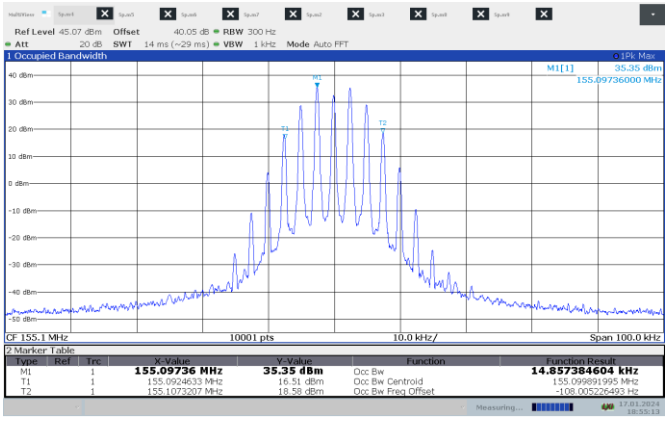


Figure 7.4-5: *99% occupied bandwidth on mid channel, 25 kHz, Analog*

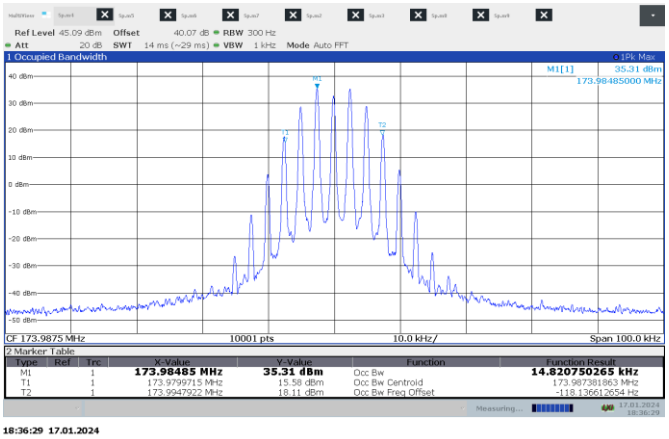


Figure 7.4-6: *99% occupied bandwidth on high channel, 25 kHz, Analog*

Test data, continued

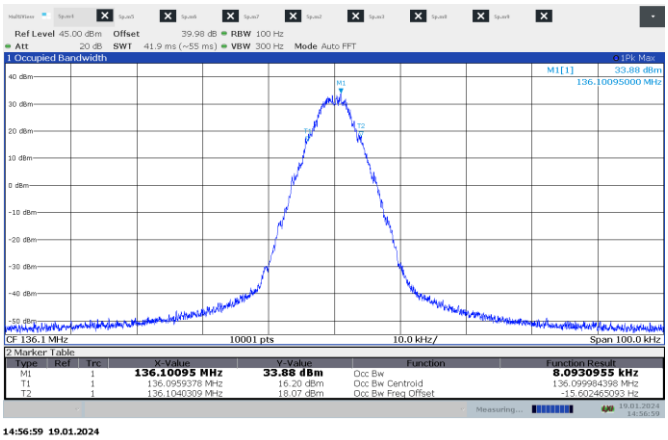


Figure 7.4-7: *99% occupied bandwidth on low channel, 12.5 kHz, Digital*

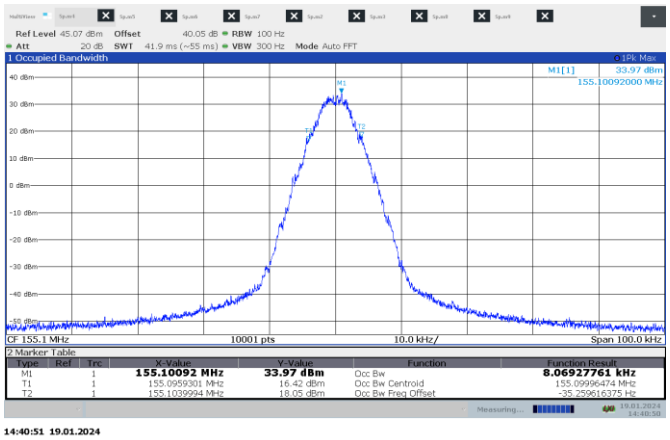


Figure 7.4-8: *99% occupied bandwidth on mid channel, 12.5 kHz, Digital*

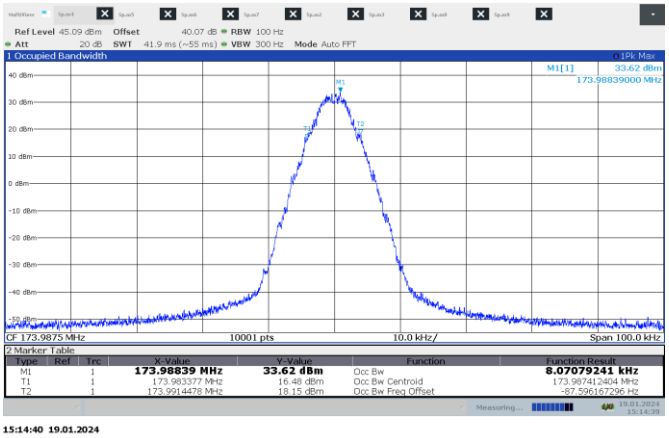


Figure 7.4-9: *99% occupied bandwidth on high channel, 12.5 kHz, Digital*

Test data, continued

Table 7.4-7: *26 dB emission bandwidth results,12.5 kHz, Analog*

Modulation	Frequency, MHz	26 dB emission bandwidth, kHz	Limit, kHz	Margin, kHz
FM	136.1	10.15	11.25	1.10
FM	155.1	10.19	11.25	1.06
FM	173.9875	10.19	11.25	1.06

Table 7.4-8: *26 dB emission bandwidth results,25 kHz, Analog*

Modulation	Frequency, MHz	26 dB emission bandwidth, kHz	Limit, kHz	Margin, kHz
FM	136.1	15.63	20.0	4.37
FM	155.1	15.62	20.0	4.38
FM	173.9875	15.62	20.0	4.38

Table 7.4-9: *26 dB emission bandwidth results,12.5 kHz, Digital*

Modulation	Frequency, MHz	26 dB emission bandwidth, kHz	Limit, kHz	Margin, kHz
C4FM	136.1	10.01	11.25	1.24
C4FM	155.1	10.02	11.25	1.23
C4FM	173.9875	10.00	11.25	1.25

Test data, continued

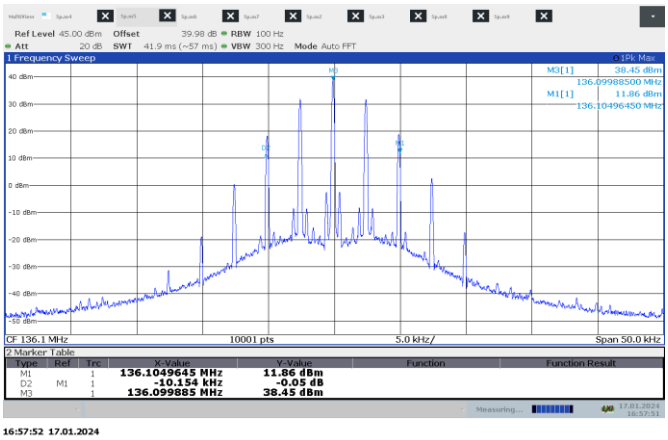


Figure 7.4-10: *26 dB emission bandwidth on low channel, 12.5 kHz, Analog*

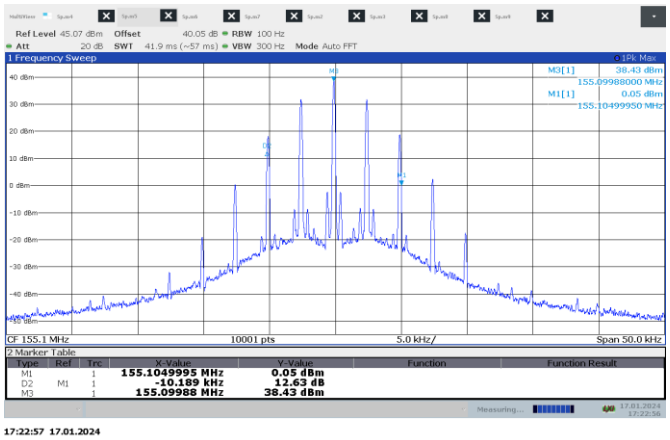


Figure 7.4-11: *26 dB emission bandwidth on mid channel, 12.5 kHz, Analog*

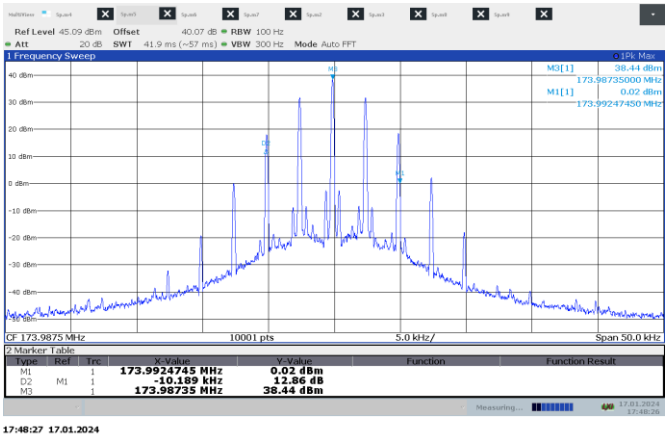


Figure 7.4-12: *26 dB emission bandwidth on high channel, 12.5 kHz, Analog*

Test data, continued

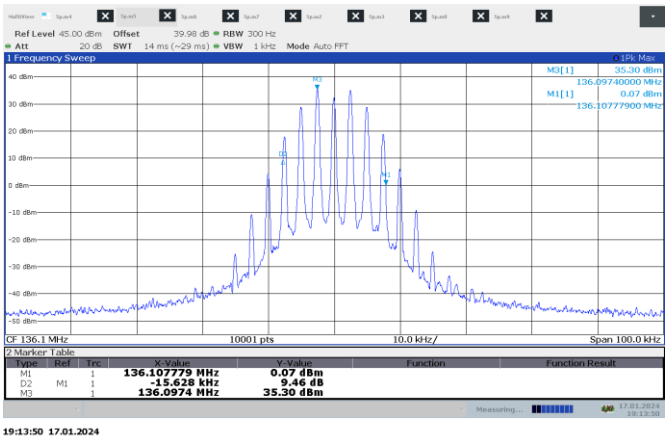


Figure 7.4-13: *26 dB emission bandwidth on low channel, 25 kHz, Analog*

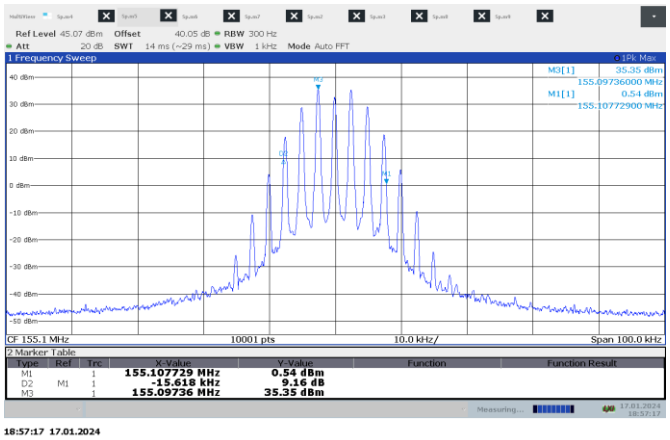


Figure 7.4-14: *26 dB emission bandwidth on mid channel, 25 kHz, Analog*

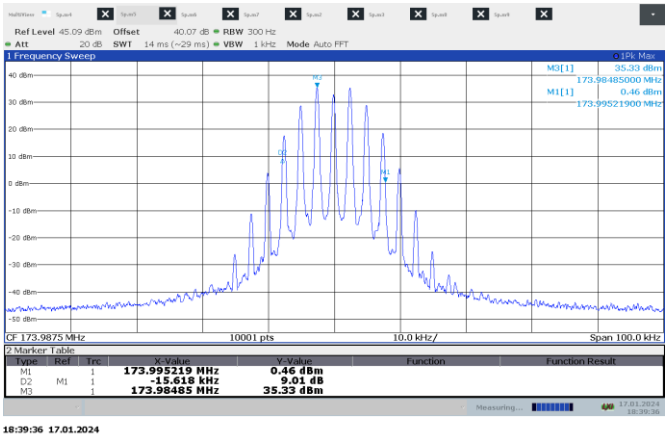


Figure 7.4-15: *26 dB emission bandwidth on high channel, 25 kHz, Analog*

Test data, continued

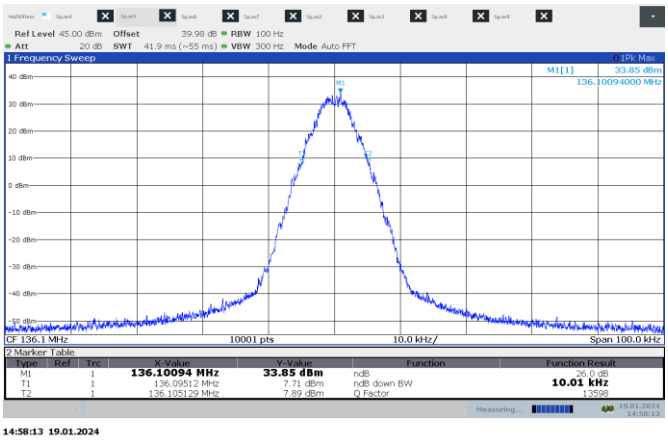


Figure 7.4-16: *26 dB emission bandwidth on low channel, 12.5 kHz, Digital*

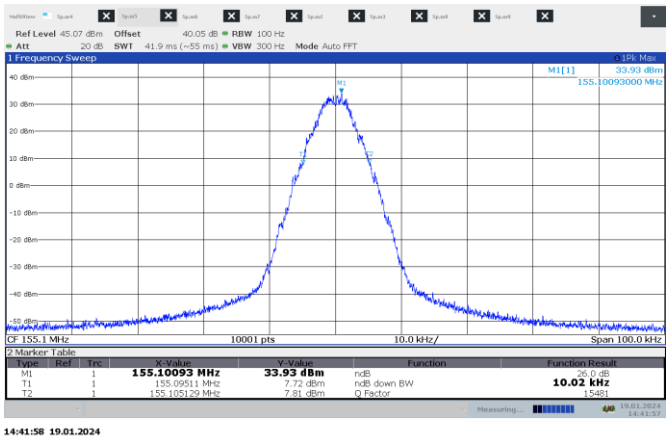


Figure 7.4-17: *26 dB emission bandwidth on mid channel, 12.5 kHz, Digital*

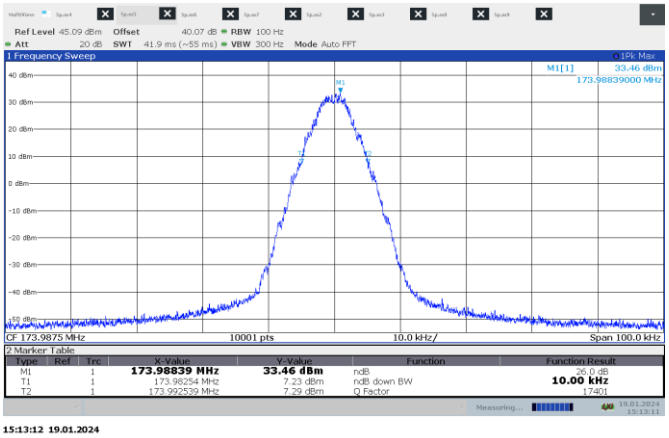


Figure 7.4-18: *26 dB emission bandwidth on high channel, 12.5 kHz, Digital*

7.5 Spectrum mask and spurious emissions

7.5.1 References, definitions and limits

FCC §90.210:

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

Table 7.5-1: *Applicable Emission Masks*

Frequency band, MHz	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
150–174[1,2]	B, D, or E	C, D, or E

Notes: [1]Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
[2]Equipment designed to operate on 25 kilohertz bandwidth channels must meet the requirements of either Emission Mask B or G, whichever is applicable, while equipment designed to operate on 12.5 kilohertz bandwidth channels must meet the requirements of Emission Mask D. Equipment designed to operate on 25 kilohertz bandwidth channels may alternatively meet the Adjacent Channel Power limits of §90.221.

(b) **Emission Mask B.** For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(c) **Emission Mask C.** For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (f_d/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (f_d^2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(d) **Emission Mask D**—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d–2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

References, definitions and limits, continued

FCC §90.210:

(e) **Emission Mask E**—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 3.0 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(f_d–3 kHz) or 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

RSS-119, Clause 5.5:

The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licences.

Table 7.5-2: *Spectrum Masks*

Frequency band, MHz	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Spectral Mask for equipment with audio low pass filter	Spectral Mask for equipment without audio low pass filter
138–174	30.00	20.00	B	C
	15.00	11.25	D	D
	7.50	6.00	E	E

Notes: The spectrum masks are given in the table for equipment having an output power greater than 120 mW. For equipment with an output power that does not exceed 120 mW, Section 5.10 applies.

RSS-119, Clause 5.8:

The spectrum plots of the unwanted emissions shall comply with the masks specified in tables below.

The term *displacement frequency, f_d*, used in these sections refers to the difference between the channel frequency and the emission component frequency expressed in kilohertz, and *p* is the transmitter output power in Watts.

5.8.1 **Emission Mask B** for Transmitters Equipped With an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.5-3: *Emission Mask B*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$10 < f_d \leq 20$	25	300
$20 < f_d \leq 50$	35	300
$f_d > 50$	$43 + 10 \times \text{Log}_{10}$ (p)	Specified in Section 4.2.1 of standard

5.8.2 **Emission Mask C** for Transmitters not Equipped With an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.5-4: *Emission Mask C*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5 < f_d \leq 10$	$83 \times \text{Log}_{10}(f_d / 5)$	300
$10 < f_d \leq 50$	Whichever is the lesser: 50 *or* $29 \times \text{Log}_{10}(f_d^2 / 11)$	300
$f_d > 50$	$43 + 10 \times \text{Log}_{10}$ (p)	Specified in Section 4.2.1 of standard

References, definitions and limits, continued

RSS-119, Clause 5.8:

5.8.3 **Emission Mask D** for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.5-5: *Emission Mask D*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	$7.27(f_d - 2.88$ kHz)	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser: 70 *or* $50 \times \text{Log}_{10}(p)$	Specified in Section 4.2.2

5.8.4 **Emission Mask E** for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.5-6: *Emission Mask E*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$3 < f_d \leq 4.6$	Whichever is the lesser: $30 + 16.67\ (f_d - 3)$ *or* $55 + 10 \times \text{Log}_{10}(p)$	Specified in Section 4.2.2
$f_d > 4.6$	Whichever is the lesser: 57 *or* $55 \times \text{Log}_{10}(p)$	Specified in Section 4.2.2

RSS-119, Clause 4.2:

When the transmitter unwanted emissions are being measured, a sufficient number of sweeps must be measured to ensure that the emission profile is developed. The video bandwidth shall be at least three times the width of the instrument resolution bandwidth.

For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated carrier power refers to the total output power contained in the occupied bandwidth when the transmitter is modulated with signals representative of those encountered in a real system operation.

4.2.1 Emission Masks B, C, G, I and J

Unwanted emission measurements can be in peak or averaging mode, provided that the same parameter, peak power or average power, used for the transmitter's output power measurement is also used for the unwanted emission measurements.

Except where otherwise stated, on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth, a resolution bandwidth of at least 100 kHz must be used for frequencies to be measured at or below 1 GHz, and a resolution bandwidth of at least 1 MHz must be used for frequencies to be measured above 1 GHz. If a narrower resolution bandwidth is used, power integration shall be applied.

4.2.2 Emission Masks D, E, F and Y

In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz. However, for emission mask F, at a displacement frequency of less than 3.75 kHz, the resolution bandwidth shall be 30 Hz.

FCC §22.357:

(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

(b)	Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 30 kHz or more. In the 60 kHz bands immediately outside and adjacent to the authorized frequency range or channel, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e., 30 kHz or 1 percent of emission bandwidth, as specified). 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.

References, definitions and limits, continued

FCC §74.462:

(c) For emissions on frequencies above 25 MHz with authorized bandwidths up to 30 kHz, the emissions shall comply with the emission mask and transient frequency behavior requirements of §§ 90.210 and 90.214 of this chapter. For all other emissions, the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) On any frequency removed from the assignment frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB:

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent on the authorized bandwidth; at least 43 plus 10 $\log^{10}$ (mean output power, in watts) dB.

7.5.2 Test summary

Verdict	Pass		
Tested by	Ketav Jani	Test date	January 19, 2024

7.5.3 Observations, settings and special notes

Spectrum analyser settings for spectrum mask:

Resolution bandwidth:	100 Hz / 300 Hz
Video bandwidth:	> RBW
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for spurious emissions:

Resolution bandwidth:	100k Hz (below 1 GHz); 1 MHz (above 1 GHz)
Video bandwidth:	> RBW
Detector mode:	Peak
Trace mode:	Max Hold

7.5.4 Test data

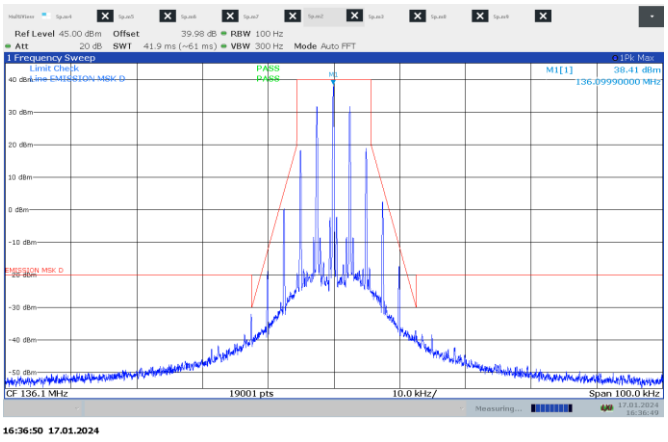


Figure 7.5-1: *Emission mask D for low channel, 12. 5 kHz, Analog*

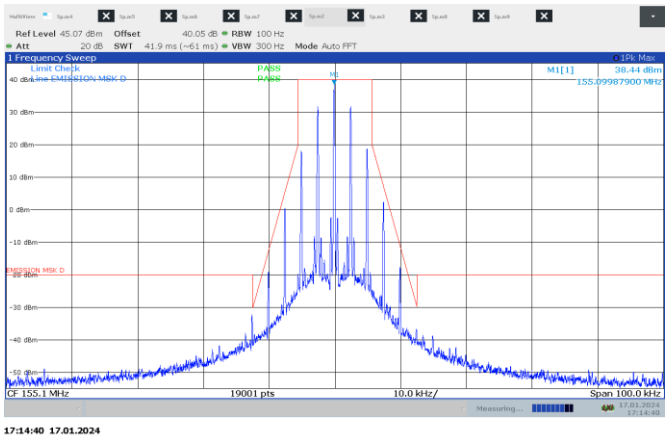


Figure 7.5-2: *Emission mask D for mid channel, 12.5 kHz, Analog*

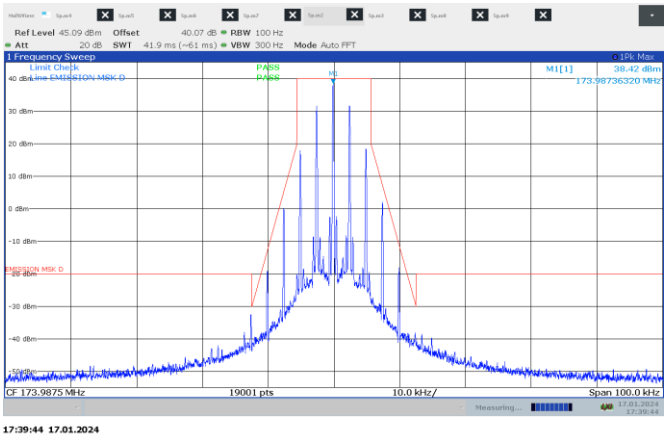


Figure 7.5-3: *Emission mask D for high channel, 12.5 kHz, Analog*

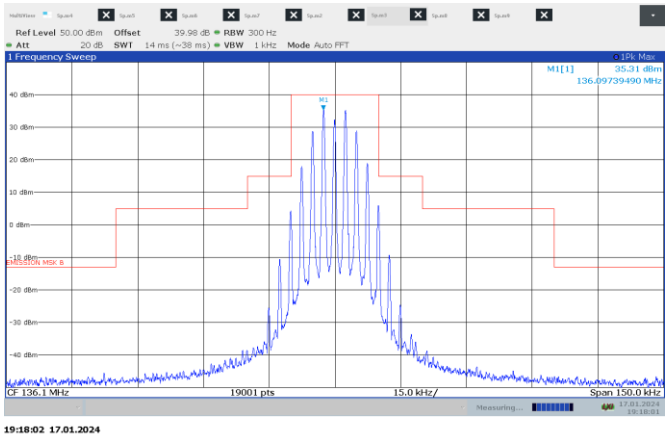


Figure 7.5-4: *Emission mask B for low channel, 25 kHz, Analog*

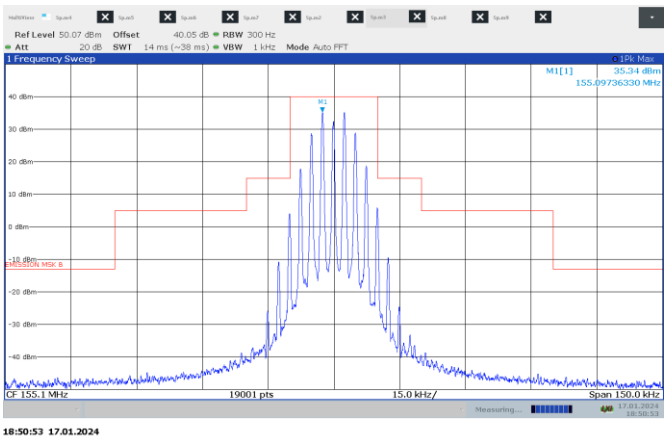


Figure 7.5-5: *Emission mask B for mid channel, 25 kHz, Analog*

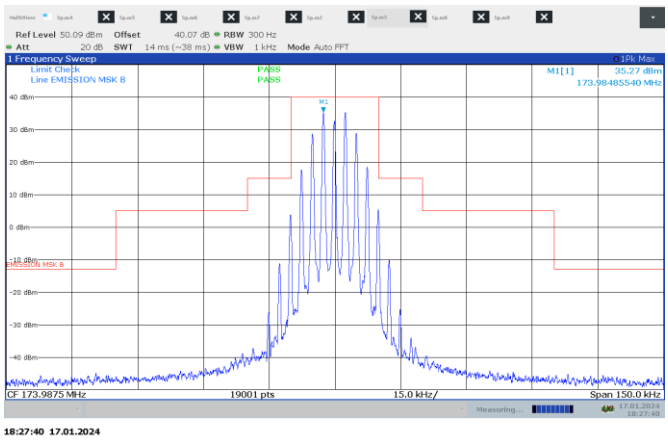


Figure 7.5-6: *Emission mask B for high channel, 25 kHz, Analog*

Figure 7.5-5: *Emission mask B for mid channel, 25 kHz, Analog*

Figure 7.5-6: *Emission mask B for high channel, 25 kHz, Analog*

Test data, continued

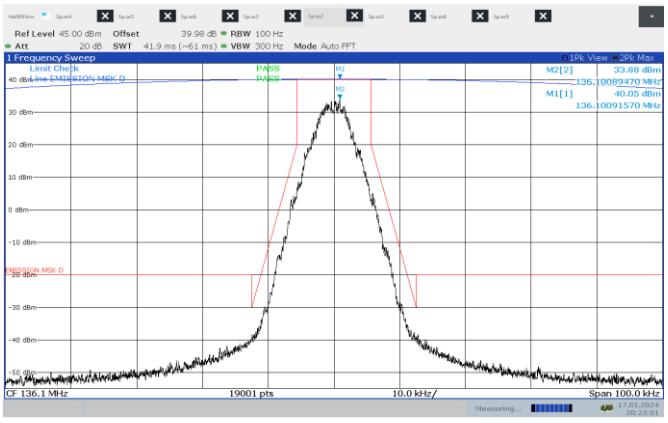


Figure 7.5-7: *Emission mask D for low channel, 12.5 kHz digital*

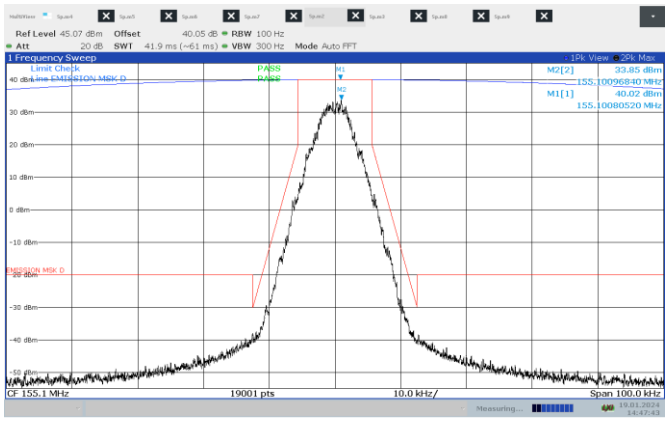


Figure 7.5-8: *Emission mask D for mid channel, 12.5 kHz digital*

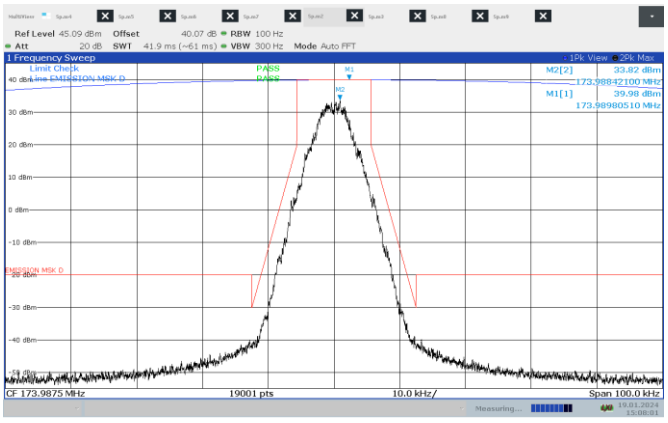


Figure 7.5-9: *Emission mask D for high channel, 12.5 kHz digital*

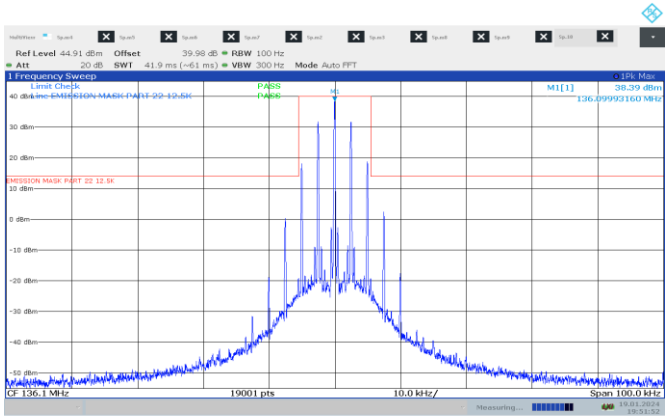
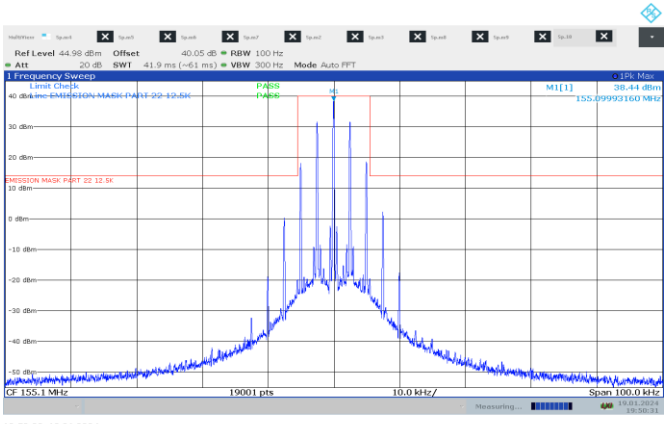


Figure 7.5-10: *Emission mask FCC part 22 for low channel, 12.5 kHz analog*



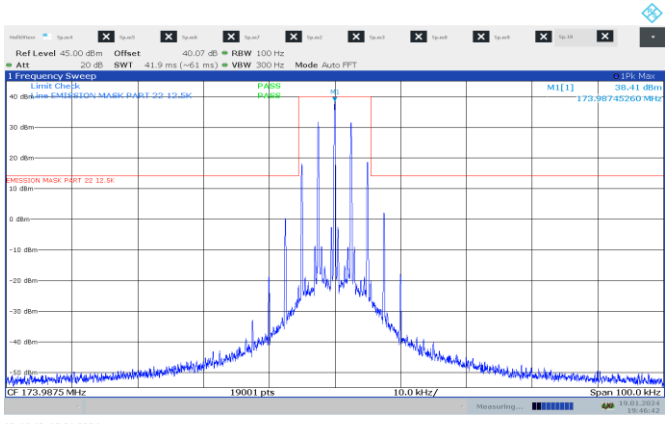


Figure 7.5-11: *Emission mask FCC part 22 for mid channel, 12.5 kHz analog*

Figure 7.5-12: *Emission mask FCC part 22 for high channel, 12.5 kHz analog*

Test data, continued

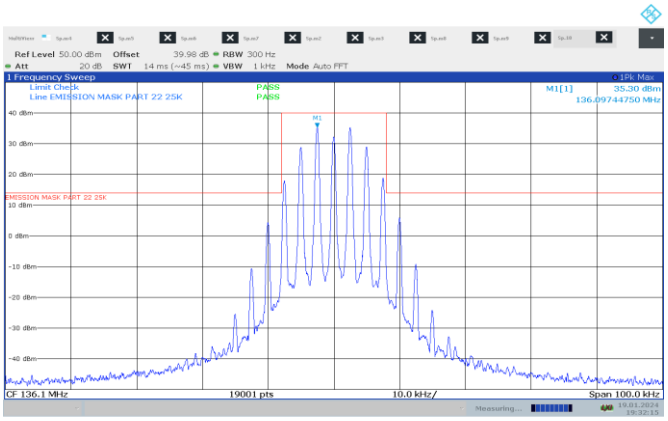


Figure 7.5-13: *Emission mask FCC part 22 for low channel, 25 kHz analog*

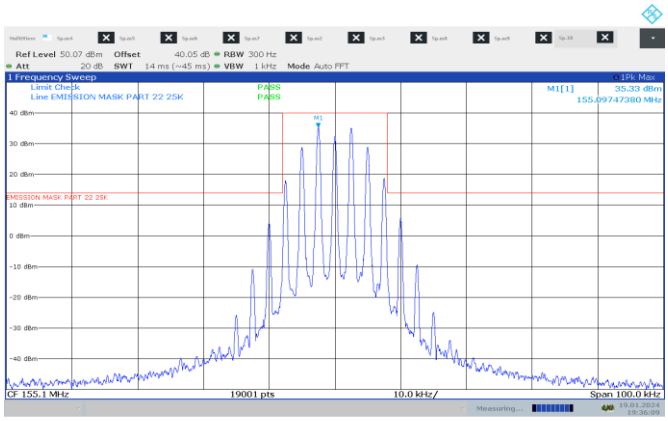


Figure 7.5-14: *Emission mask FCC part 22 for low channel, 25 kHz analog*

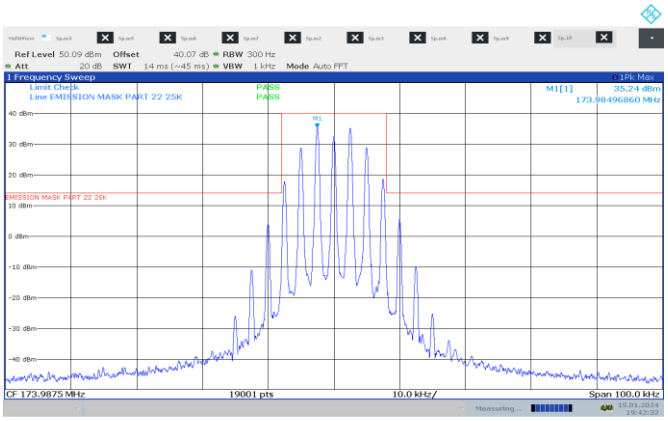


Figure 7.5-15: *Emission mask FCC part 22 for low channel, 25 kHz analog*

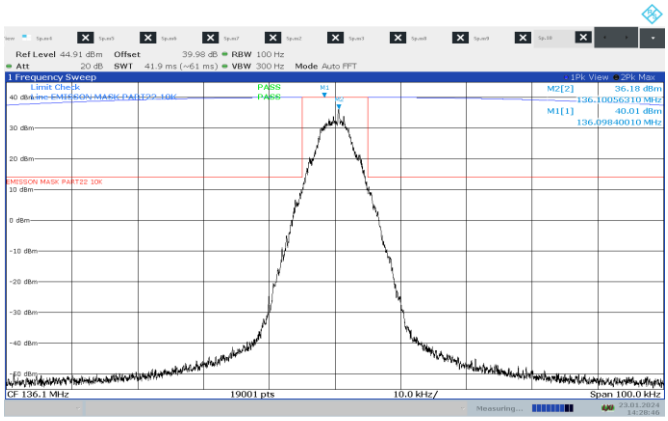
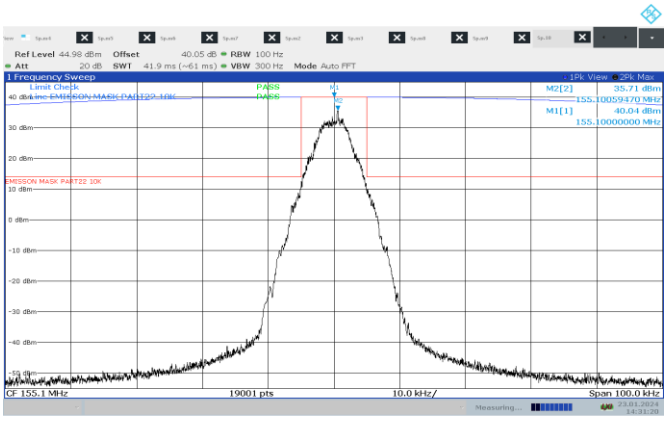


Figure 7.5-16: *Emission mask FCC part 22 for low channel, 12.5 kHz digital*



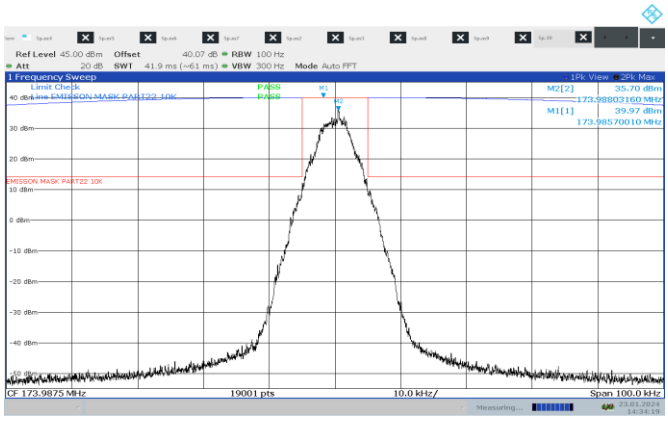


Figure 7.5-17: *Emission mask FCC part 22 for mid channel, 12.5 kHz digital*

Figure 7.5-18: *Emission mask FCC part 22 for high channel, 12.5 kHz digital*

Test data, continued

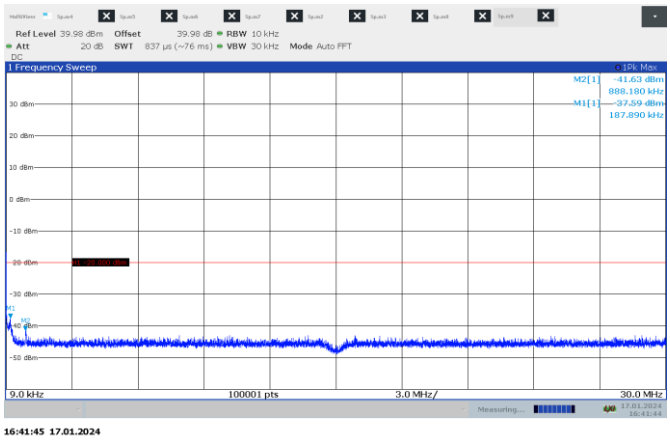


Figure 7.5-19: *Conducted spurious emissions 9k- 30 MHz, low channel, 12.5 kHz, analog, FCC part 90, RSS 119*

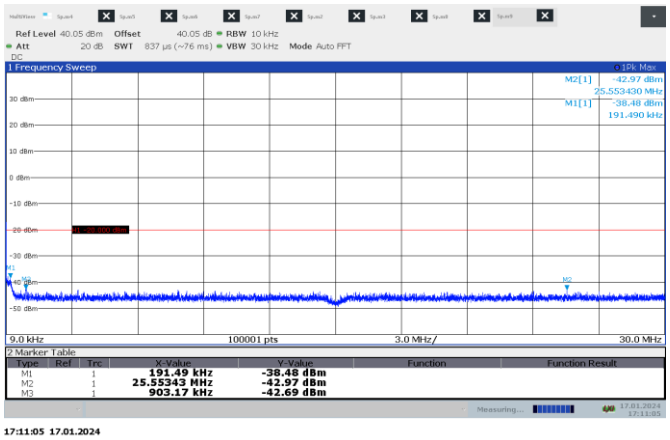


Figure 7.5-20: *Conducted spurious emissions 9k 30 MHz, mid channel, 12.5 kHz, analog, FCC part 90, RSS 119*

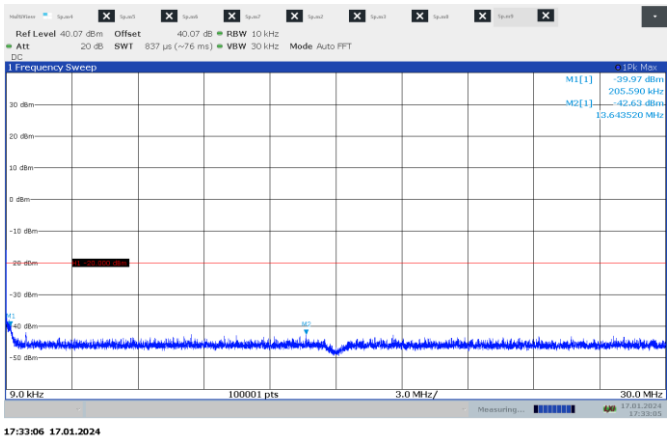


Figure 7.5-21: *Conducted spurious emissions 9k- 30 MHz, high channel, 12.5 kHz, analog, FCC part 90, RSS 119*

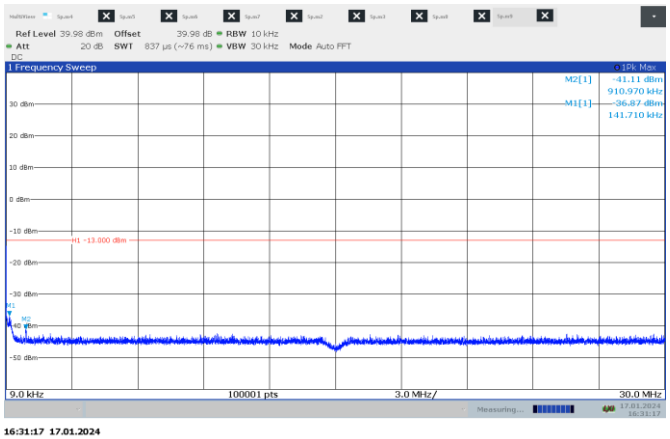


Figure 7.5-22: *Conducted spurious emissions 9k- 30 MHz, low channel, 12.5 kHz, analog, FCC part 22 & 74*

Test data, continued

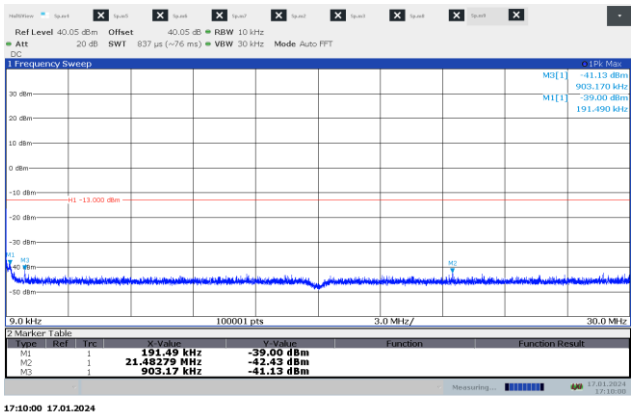


Figure 7.5-23: *Conducted spurious emissions 9k- 30 MHz, mid channel, 12.5 kHz, analog, FCC part 22 & 74*

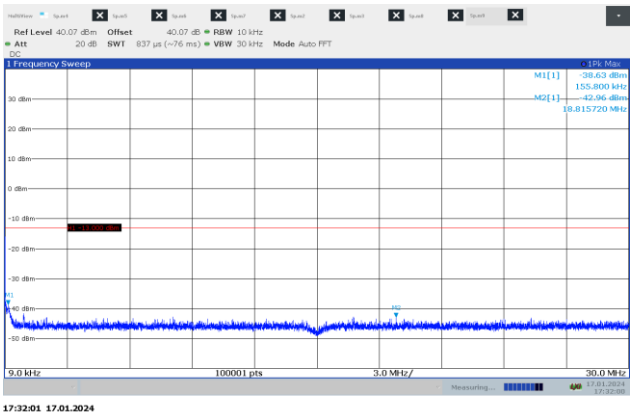


Figure 7.5-24: *Conducted spurious emissions 9k- 30 MHz, high channel, 12.5 kHz, analog, FCC part 22 & 74*

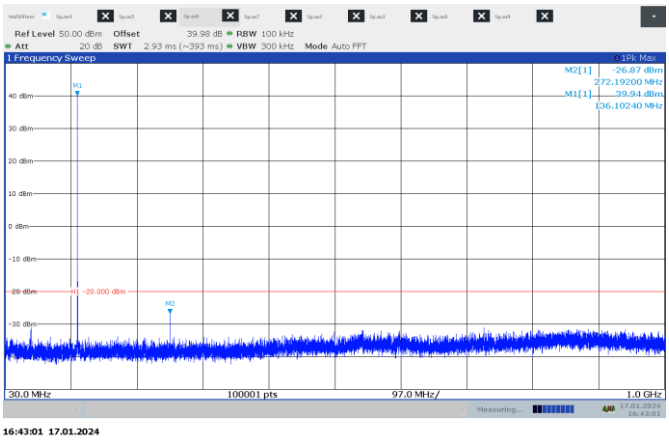


Figure 7.5-25: *Conducted spurious emissions 0.03- 1 GHz, low channel, 12.5 kHz, analog, FCC part 90, RSS 119*

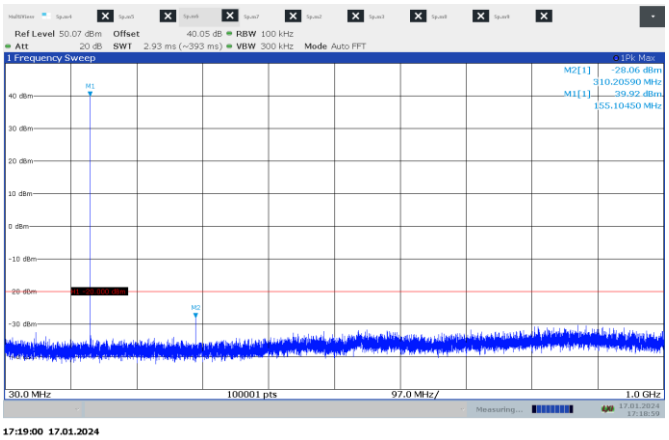


Figure 7.5-26: *Conducted spurious emissions 0.03- 1 GHz, mid channel, 12.5 kHz, analog, FCC part 90, RSS 119*

Test data, continued

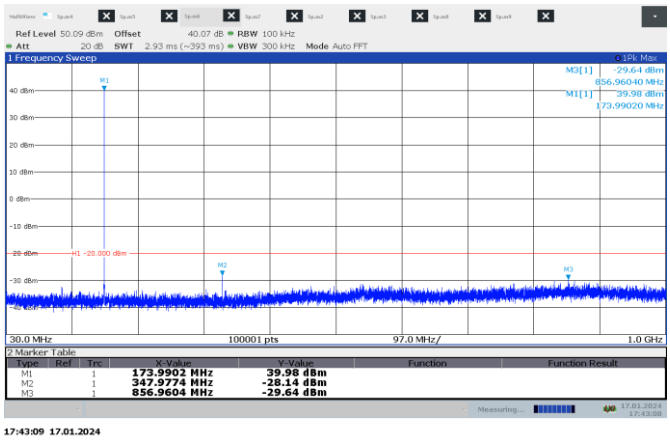


Figure 7.5-27: *Conducted spurious emissions 0.03- 1 GHz, high channel, 12.5 kHz, analog, FCC part 90, RSS 119*

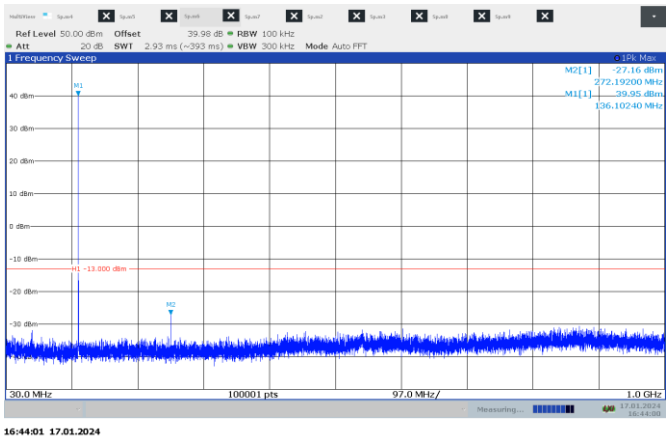


Figure 7.5-28: *Conducted spurious emissions 0.03- 1 GHz, low channel, 12.5 kHz, analog, FCC part 22 & 74*

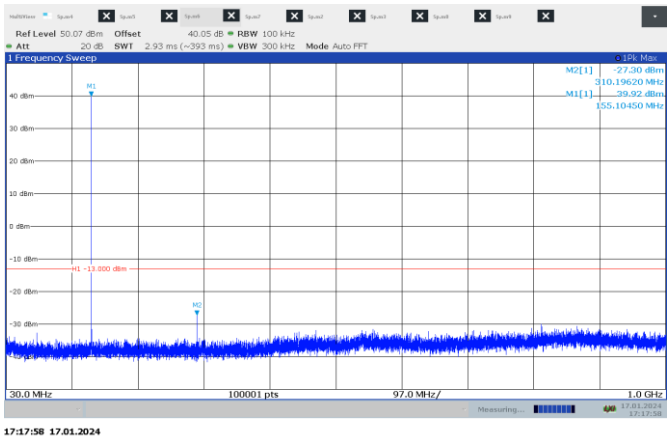


Figure 7.5-29: *Conducted spurious emissions 0.03- 1 GHz, mid channel, 12.5 kHz, analog, FCC part 22 & 74*

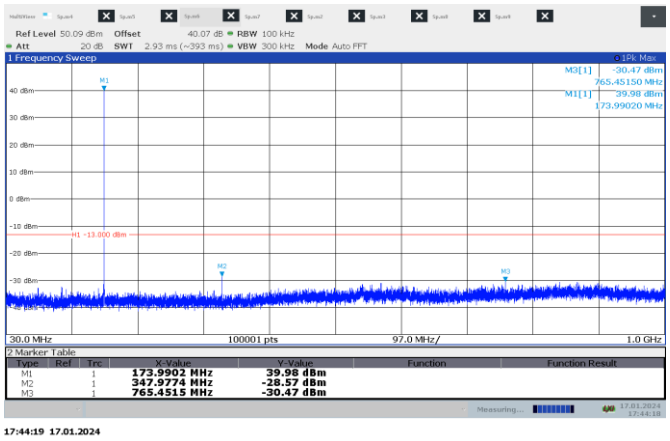


Figure 7.5-30: *Conducted spurious emissions 0.03- 1 GHz, high channel, 12.5 kHz, analog, FCC part 22 & 74*

Test data, continued

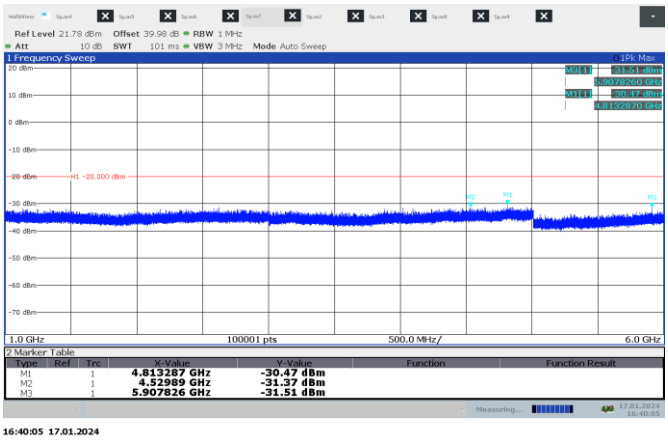


Figure 7.5-31: *Conducted spurious emissions 1- 6 GHz, low channel, 12.5 kHz, analog, FCC part 90, RSS 119*

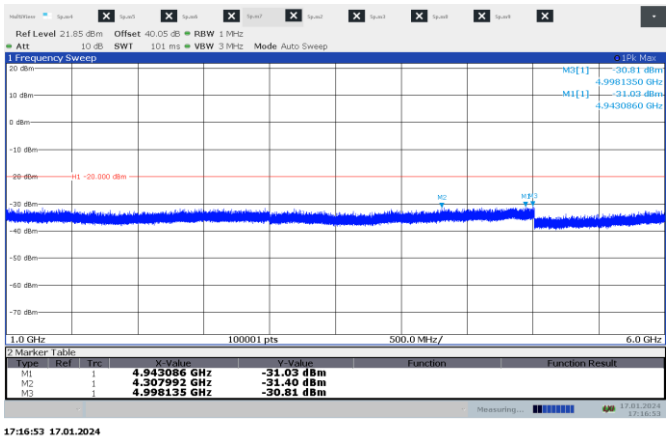


Figure 7.5-32: *Conducted spurious emissions 1- 6, mid channel, 12.5 kHz, analog, FCC part 90, RSS 119*

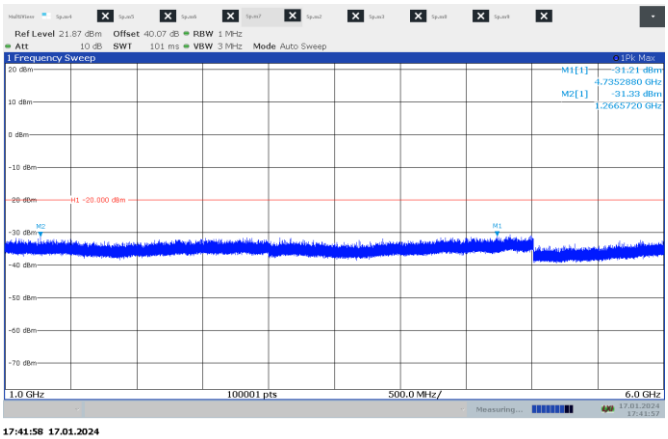


Figure 7.5-33: *Conducted spurious emissions 1- 6, high channel, 12.5 kHz, analog, FCC part 90, RSS 119*

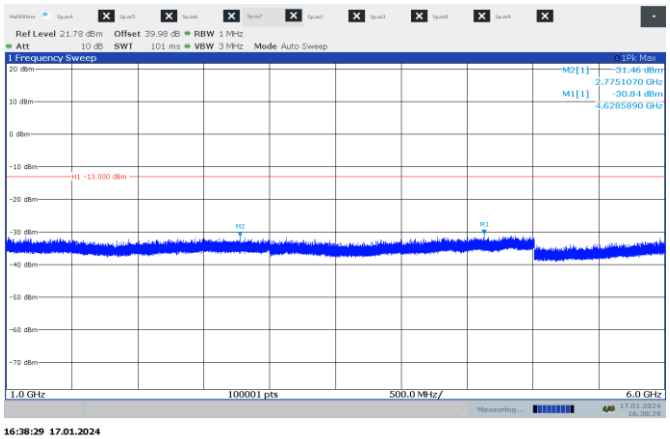


Figure 7.5-34: *Conducted spurious emissions 1- 6, low channel, 12.5 kHz, analog, FCC part 22 & 74*

Test data, continued

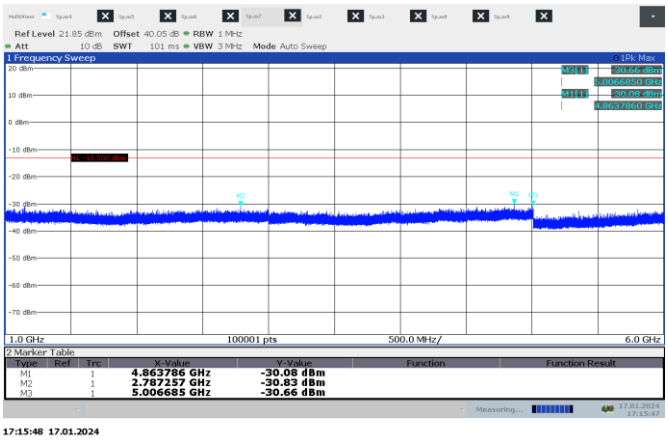


Figure 7.5-35: *Conducted spurious emissions 1- 6 GHz, mid channel, 12.5 kHz, analog, FCC part 22 & 74*

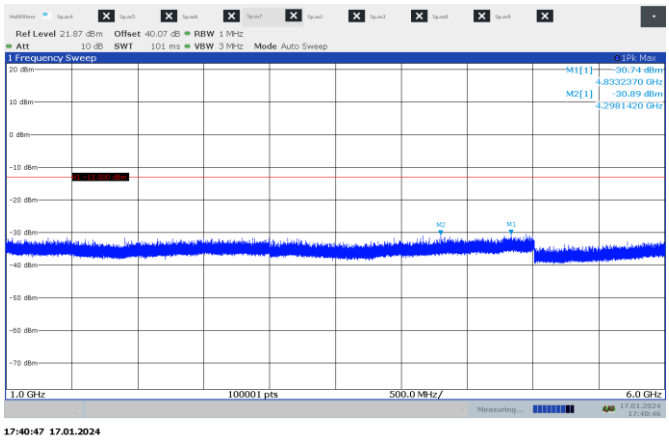


Figure 7.5-36: *Conducted spurious emissions 1- 6, high channel, 12.5 kHz, analog, FCC part 22 & 74*

Test data, continued

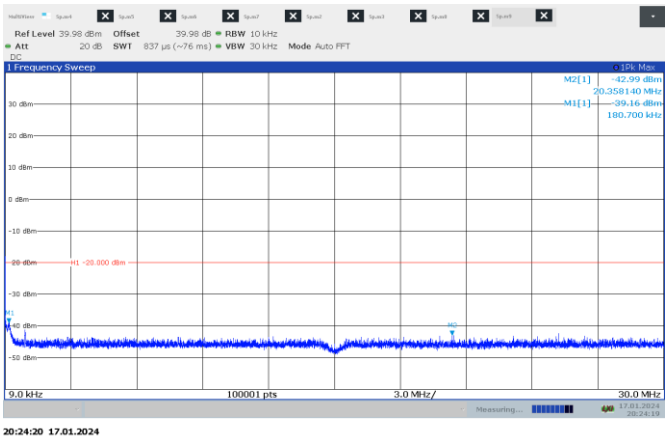


Figure 7.5-37: *Conducted spurious emissions 9k- 30 MHz, low channel, 12.5 kHz, digital, FCC part 90, RSS 119*

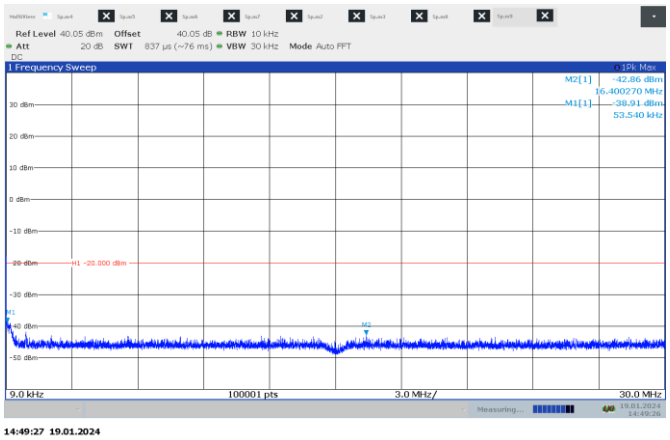


Figure 7.5-38: *Conducted spurious emissions 9k 30 MHz, mid channel, 12.5 kHz, digital, FCC part 90, RSS 119*

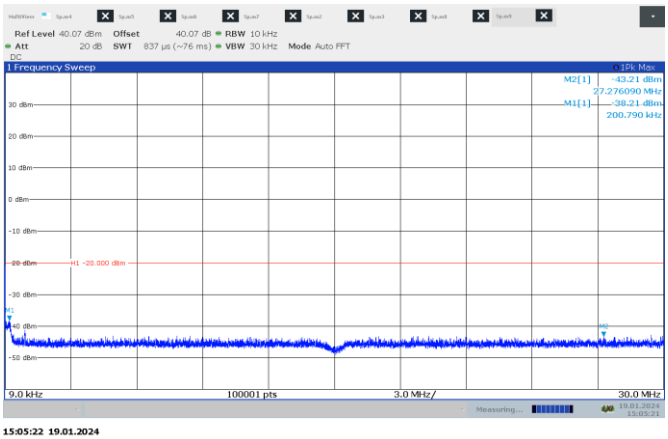


Figure 7.5-39: *Conducted spurious emissions 9k- 30 MHz, high channel, 12.5 kHz, digital, FCC part 90, RSS 119*

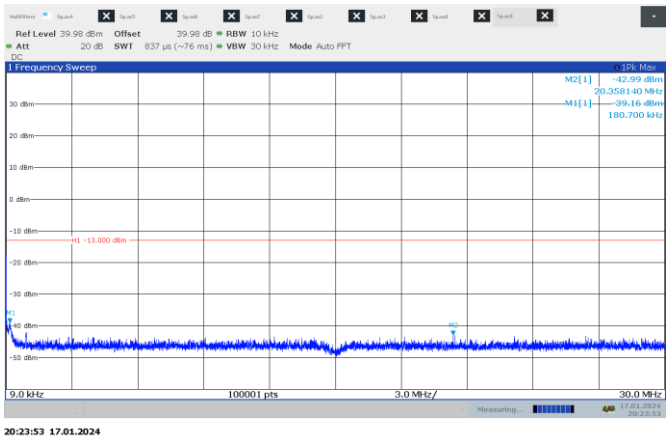


Figure 7.5-40: *Conducted spurious emissions 9k- 30 MHz, low channel, 12.5 kHz, digital, FCC part 22 & 74*

Test data, continued

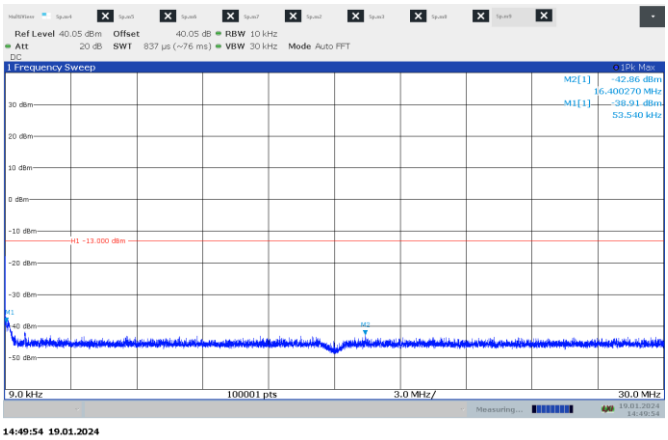


Figure 7.5-41: *Conducted spurious emissions 9k- 30 MHz, mid channel, 12.5 kHz, digital, FCC part 22 & 74*

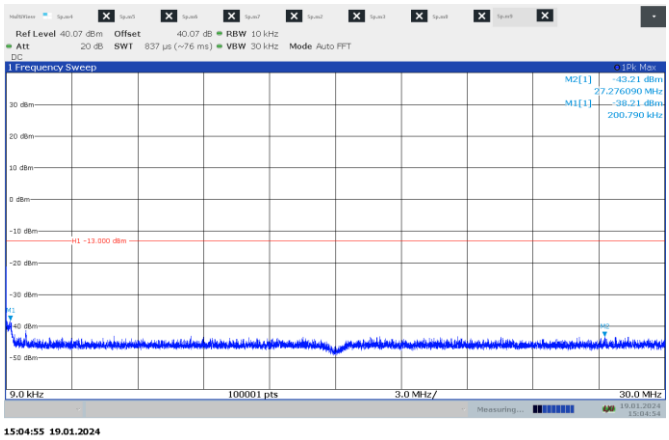


Figure 7.5-42: *Conducted spurious emissions 9k- 30 MHz, high channel, 12.5 kHz, digital, FCC part 22 & 74*

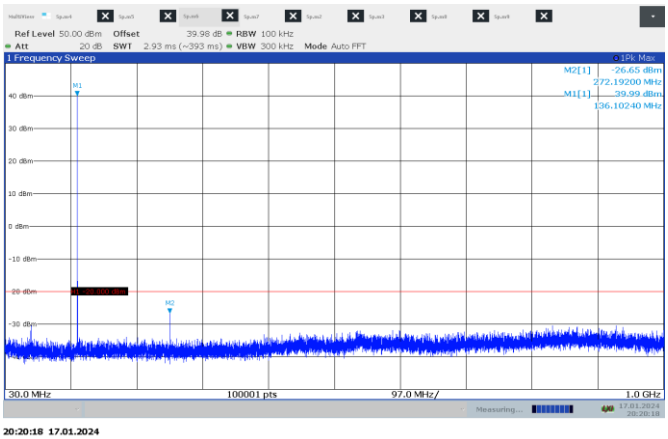


Figure 7.5-43: *Conducted spurious emissions 0.03- 1 GHz, low channel, 12.5 kHz, digital, FCC part 90, RSS 119*

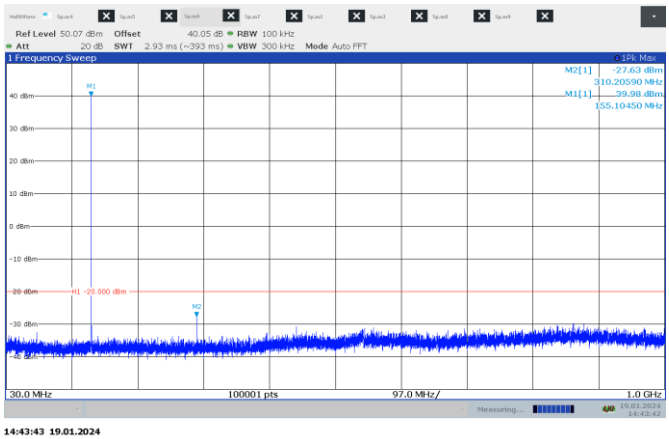


Figure 7.5-44: *Conducted spurious emissions 0.03- 1 GHz, mid channel, 12.5 kHz, digital, FCC part 90, RSS 119*

Test data, continued

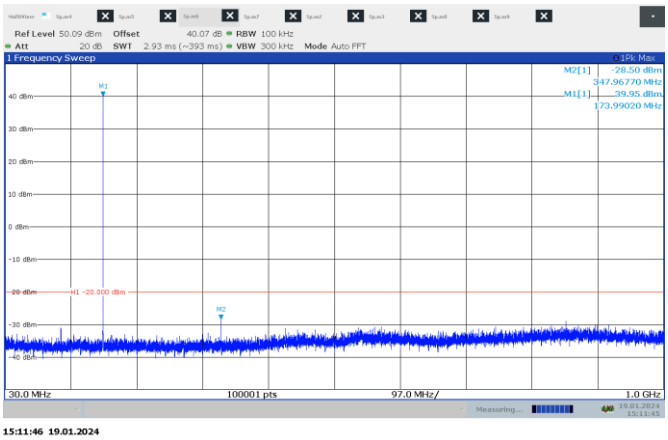


Figure 7.5-45: *Conducted spurious emissions 0.03- 1 GHz, high channel, 12.5 kHz, digital, FCC part 90, RSS 119*

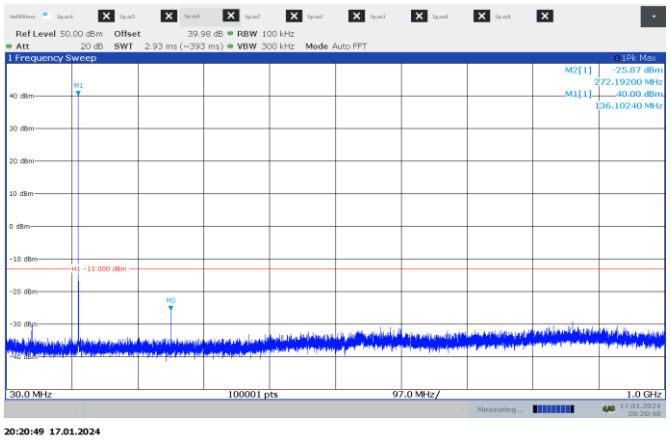


Figure 7.5-46: *Conducted spurious emissions 0.03- 1 GHz, low channel, 12.5 kHz, digital, FCC part 22 & 74*

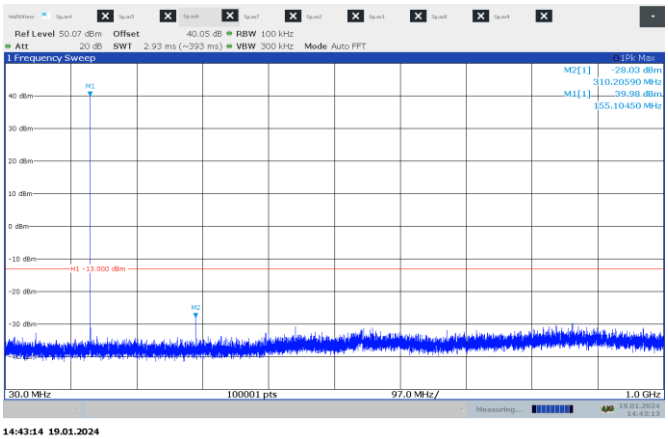


Figure 7.5-47: *Conducted spurious emissions 0.03- 1 GHz, mid channel, 12.5 kHz, digital, FCC part 22 & 74*

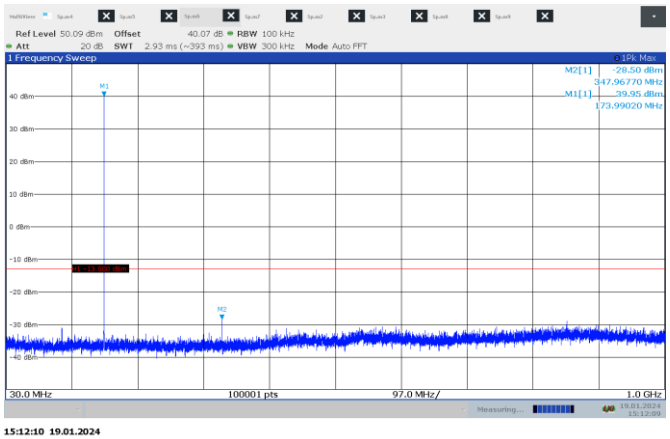


Figure 7.5-48: *Conducted spurious emissions 0.03- 1 GHz, high channel, 12.5 kHz, digital, FCC part 22 & 74*

Test data, continued

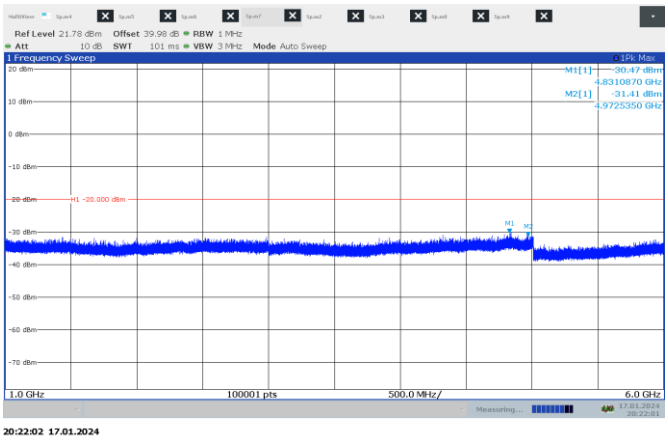


Figure 7.5-49: *Conducted spurious emissions 1- 6 GHz, low channel, 12.5 kHz, digital, FCC part 90, RSS 119*

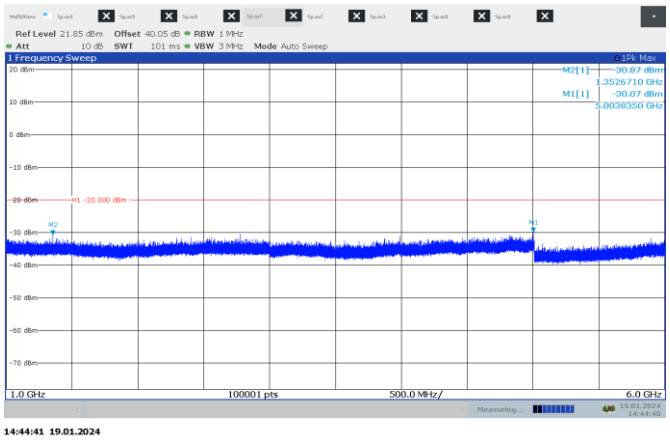


Figure 7.5-50: *Conducted spurious emissions 1- 6, mid channel, 12.5 kHz, digital, FCC part 90, RSS 119*

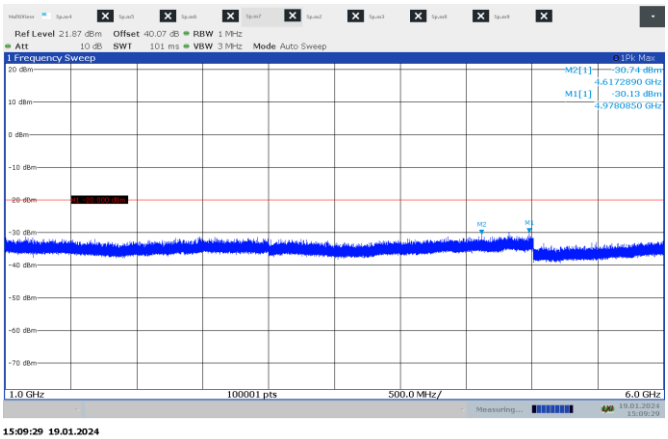


Figure 7.5-51: *Conducted spurious emissions 1- 6, high channel, 12.5 kHz, digital, FCC part 90, RSS 119*

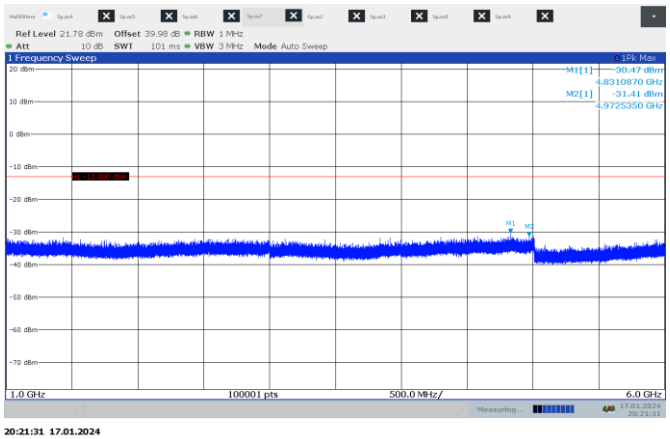


Figure 7.5-52: *Conducted spurious emissions 1- 6, low channel, 12.5 kHz, digital, FCC part 22 & 74*

Test data, continued

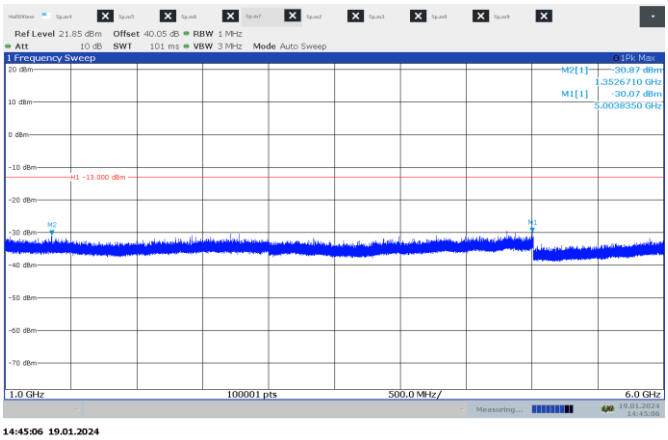


Figure 7.5-53: *Conducted spurious emissions 1- 6 GHz, mid channel, 12.5 kHz, digital, FCC part 22 & 74*

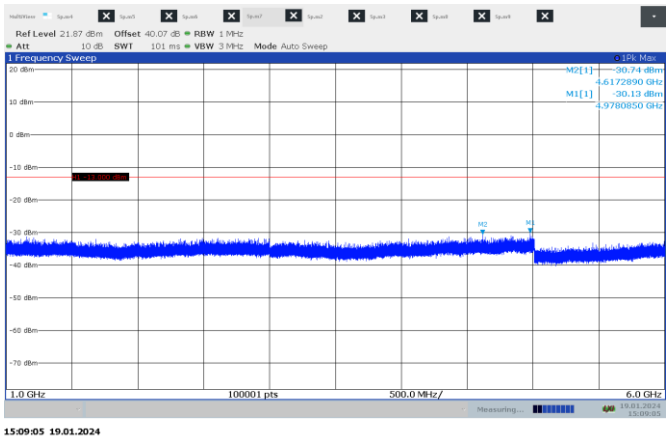


Figure 7.5-54: *Conducted spurious emissions 1- 6, high channel, 12.5 kHz, digital, FCC part 22 & 74*

Test data, continued

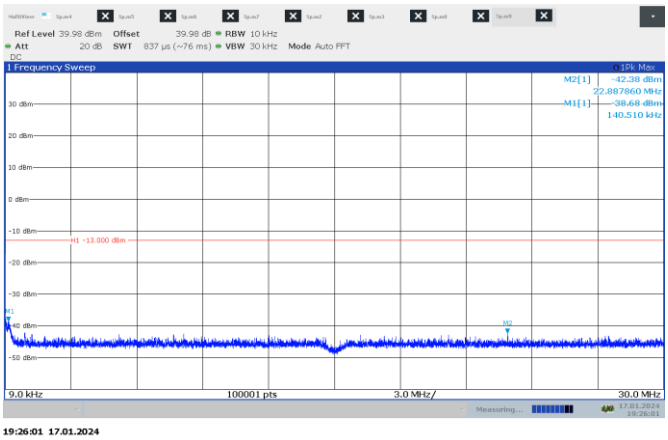


Figure 7.5-55: *Conducted spurious emissions 9k- 30 MHz, low channel,25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

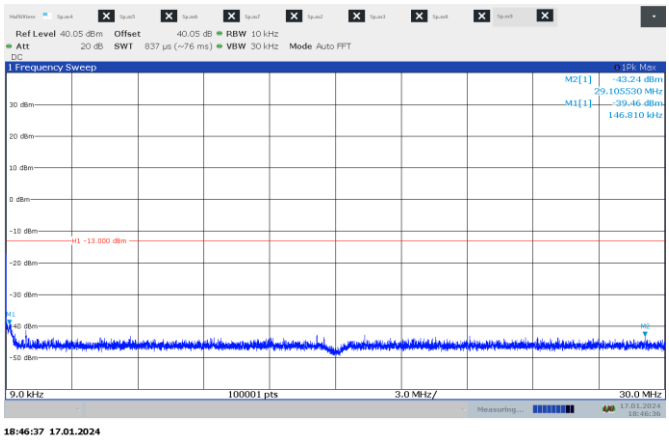


Figure 7.5-56: *Conducted spurious emissions 9k- 30 MHz, mid channel,25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

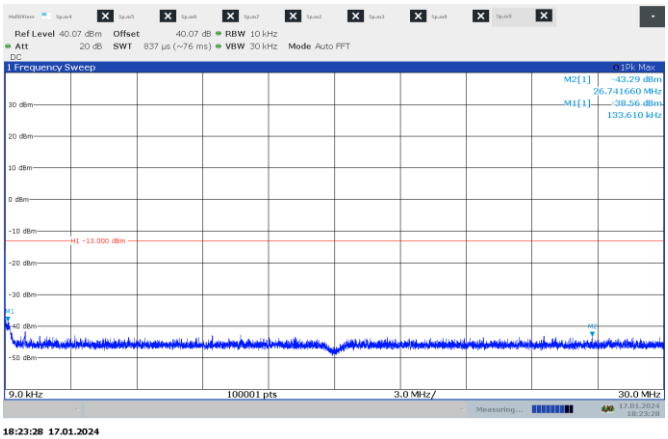


Figure 7.5-57: *Conducted spurious emissions 9k- 30 MHz, high channel,25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

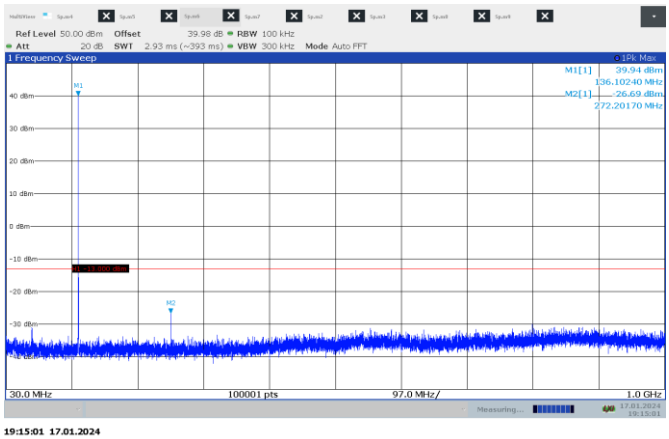


Figure 7.5-58: *Conducted spurious emissions 0.03- 1 GHz, low channel, 25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

Test data, continued

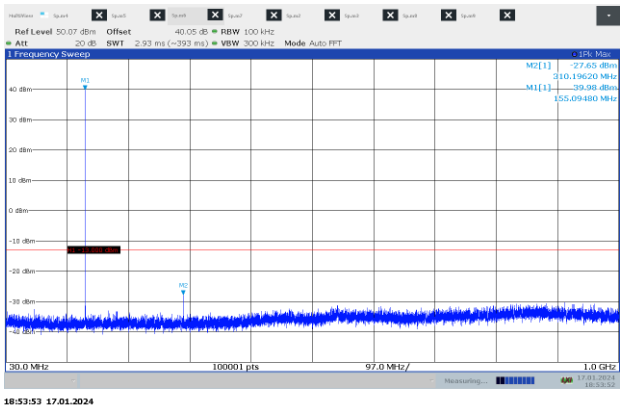


Figure 7.5-59: *Conducted spurious emissions 0.03- 1 GHz, mid channel, 25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

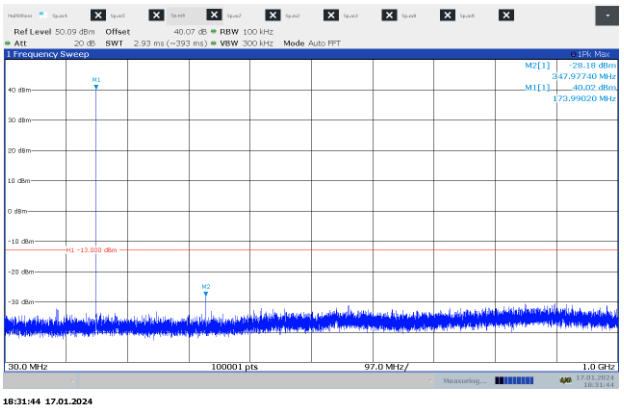


Figure 7.5-60: *Conducted spurious emissions 0.03- 1 GHz, high channel, 25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

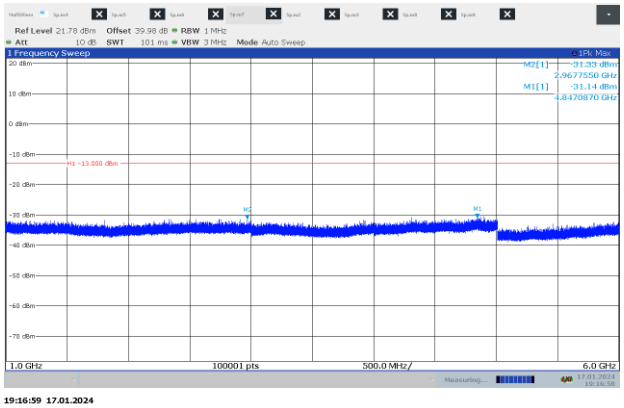


Figure 7.5-61: *Conducted spurious emissions 1- 6 GHz, low channel, 25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

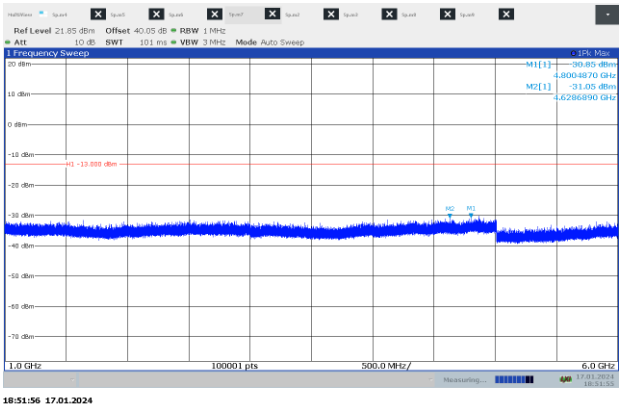


Figure 7.5-62: *Conducted spurious emissions 1- 6 GHz, mid channel, 25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

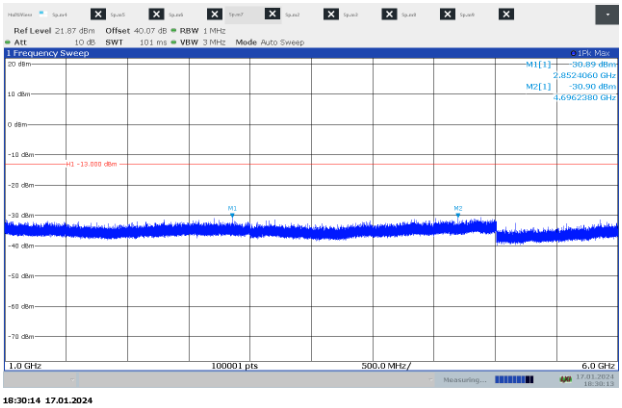


Figure 7.5-63: *Conducted spurious emissions 1- 6 GHz, high channel,25 kHz, analog, FCC part 90, 22 & 74, RSS 119*

Test data, continued

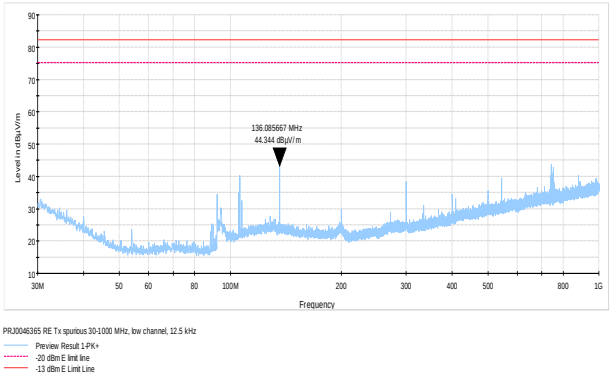


Figure 7.5-64: *Radiated spurious emissions 0.03-1 GHz, low channel, 12.5 kHz, analog*

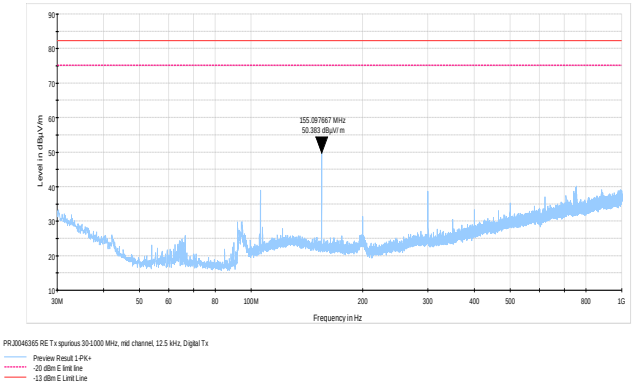


Figure 7.5-65: *Radiated spurious emissions 0.03-1 GHz, mid channel, 12.5 kHz, analog*

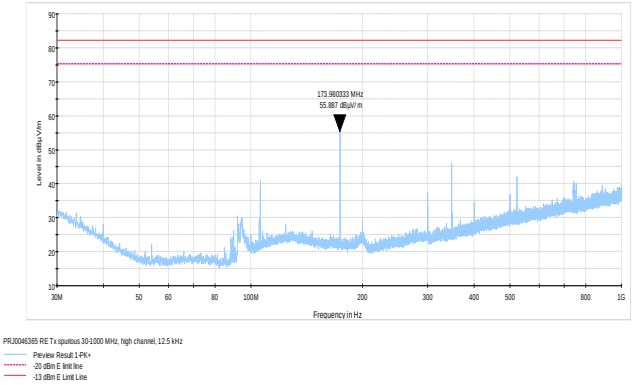


Figure 7.5-66: *Radiated spurious emissions 0.03-1 GHz, high channel, 12.5 kHz, analog*

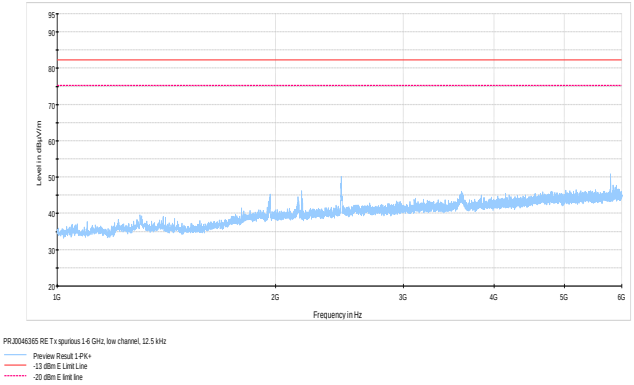


Figure 7.5-67: *Radiated spurious emissions 1-6 GHz, low channel, 12.5 kHz, analog*

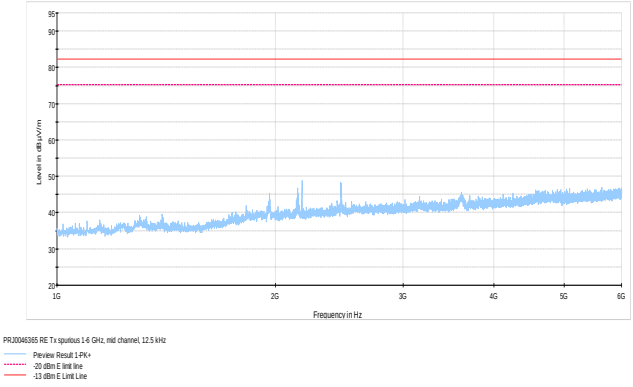


Figure 7.5-68: *Radiated spurious emissions 1-6 GHz, mid channel, 12.5 kHz, analog*

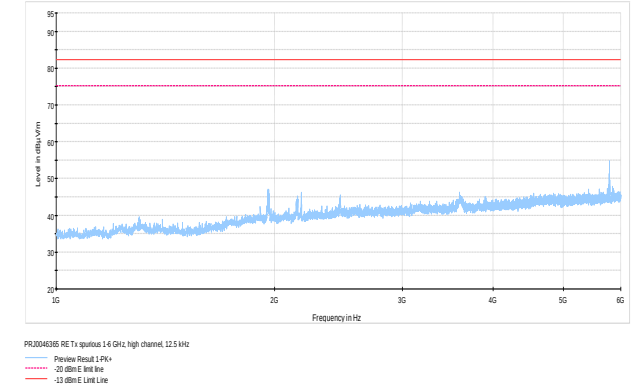


Figure 7.5-69: *Radiated spurious emissions 1-6 GHz, high channel, 12.5 kHz, analog*