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RADIO TEST REPORT

Report ID:
REP150724

Project number:
PRJ0092231

Type of assessment:
Final product testing

Applicant:
Summation Research, Inc.

Product:
STR-1900 Series Land Mobile Data Radios

Model (HVIN):
STR-1920

FCC ID:
OQW-STR1900

ISED certification number:
9110A-STR1900

Specifications:

- FCC 47 CFR Part 90, Subpart I
- RSS-119 Issue 12, July 2025

Date of issue: April 17, 2026

Alvin Liu, EMC/RF Specialist
Tested by


Signature

Dhara Patel, EMC/RF Specialist
Reviewed by


Signature

Lab locations

Company name	Nemko Canada Inc.
Facilities	**Ottawa site:** 303 River Road, Ottawa, ON, Canada, K1V 1H2 Tel: +1 613 737 9680 Test site registration number: CA2040 **Montréal site:** 292 Labrosse Avenue, Pointe-Claire, QC, Canada, H9R 5L8 Tel: +1 514 694 2684 Test site registration number: CA2041 **Cambridge site:** 1-130 Saltsman Drive, Cambridge, ON, Canada, N3E 0B2 Tel: +1 519 650 4811 Test site registration number: CA0101
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
RSS-119 Issue 12, July 2025	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
SRSP-501, Issue 5, December 2017	Technical Requirements for Land Mobile and Fixed Radio Services Operating in the Bands 406.1–430 MHz and 450–470 MHz
FCC 47 CFR Part 2, Subpart J	Equipment authorization procedures
RSS-Gen, Issue 5, February 2021	General Requirements for Compliance of Radio Apparatus

1.3 Exclusions

None

1.4 Statement of compliance

Statement of Conformity:

The reported results have been evaluated against the specified limits of the standard(s) listed in **Section 1.1** of this report.

Conformity with the specified requirements is determined by comparing the measured results directly to the applicable limits. Measurement uncertainty is not applied to adjust or attribute to the measured value for the purpose of compliance determination.

In the configuration tested, the **Equipment Under Test (EUT)** was found to be compliant. Unless otherwise noted in **Section 1.3**, all testing was performed against the relevant requirements of the applicable test standard(s).

The results obtained indicate that the product under test complies in full with the requirements tested, and the test results relate only to the items tested.

Refer to the **Summary of Test Results** section 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
REP150724	April 17, 2026	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 EUT can operate at various modulation, bandwidth and transmit power as allowable per local regulations.
During this assessment, all modulation and bandwidth configurations were tested with the max transmit power level.

Transmit Power Options are:

Name / Indicator	Power
High / H	30 W
Medium / M	25 W
Low / L	5 W

Modulation and bandwidth are:

Name / Indicator	Bandwidth	Modulation
Narrow / N	12.5 kHz	FFSK or FSK
Wide / W	25.0 kHz	FFSK or FSK
Digital / D	6.25 kHz	SOQPSK

2.3 Model variant declaration

There were no model variants declared by the applicant.

2.4 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/Manufacturer

Applicant name	Summation Research, Inc.
Applicant address	305 East Dr. Suite D, Melbourne, FL 32904 USA
Manufacturer name	Same as applicant
Manufacturer address	Same as applicant

4.3 EUT information

Product	STR-1900 Series Land Mobile Data Radios
Model	STR-1920
Serial number	11001013
Part number	70-1920-00
Power requirements	13.6 V_{DC}, 9.1 A
Description/theory of operation	The EUT is a Land Mobile Data Radio, point-to-point simplex data communications for vehicle telemetry. It modulates user analog and digital data to and from a 25 kHz, 12.5 kHz or 6.25 kHz carrier between the frequencies of 400 MHz and 470 MHz where allowed, approved for operation with external antenna with a gain of up to 0 dBd, with an output power up to 30 W maximum measured at the output of the transceiver.
Hardware revision	A1
Software details	Firmware rev. 1.9

4.4 Technical information

System type	☒ Mobile system
	☐ Base/Fixed point-to-point system
Frequency band	400–470 MHz
Frequency Min (MHz)	406.1125
Frequency Max (MHz)	469.9875
RF power Max (W), Conducted	31.62 (45.0 dBm)
Measured BW (kHz), 99% OBW	12.817 (25 kHz channel); 8.452 (12.5 kHz channel); 3.798 (6.25 kHz channel)
Type of modulation	Digital: SOQPSK Analog: FSK and FFSK
Emission classification	4K00G1D, 11K2F1D, 11K2F2D, 11K2F3D, 16K0F2D, 16K0F3D
Transmitter spurious, dBµV/m @ 3 m	65.2 dBµV/m @ 1415 MHz
Antenna information	Sinclair, MN: ST321-SF9SNF, Gain: 0 dBd (2.15 dBi) Kathrein, MN: K 70 20 21, Gain: 0 dBd (2.15 dBi)

4.5 EUT setup details

4.5.1 Radio exercise details

Operating conditions	– The EUT was running firmware that allows it to be commanded via RS-422 interface. Unique RS-422 commands contain data to be transmitted over the air or recovered data from over the air. Special test firmware was used to allow the radio to be keyed for longer than 15 seconds. – The EUT was controlled via laptop loaded with "STR-1x00 LMR Product BERT Tester" software, using the SW the EUT was forced into continuous transmission at various modulation and bandwidth with the max RF output power level.
Transmitter state	Continuous transmitting

4.5.2 EUT setup configuration

Table 4.5-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
Front Panel Card	Summation Research, Inc	PN: 50-1901-00 Rev C
Modem Data Card	Summation Research, Inc	PN: 50-1902-00 Rev C1
RF Transceiver	Icom Japan, Inc.	PN: IC-F6330DD

Table 4.5-2: *EUT interface ports*

Description	Qty.
DC power input	1
DB-9 Programming Port	1
D-25 Data Port	1
N-Female RF Port	1

Table 4.5-3: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop	Lenovo ThinkPad	MN: L15 Gen 1
Programmable AC Power source	Chroma	MN: 61605
DC power supply	GW INSTEK	MN: GPR-3060D

Table 4.5-4: *Inter-connection cables*

Cable description	From	To	Length (m)
DC power input wires	EUT	DC Power source	< 3
Data cable 30-6028-00, plus Com to USB cable	EUT	Laptop	< 3
Data cable 30-6027-01, plus Com to USB cable	EUT	Laptop	< 3

EUT setup configuration, continued

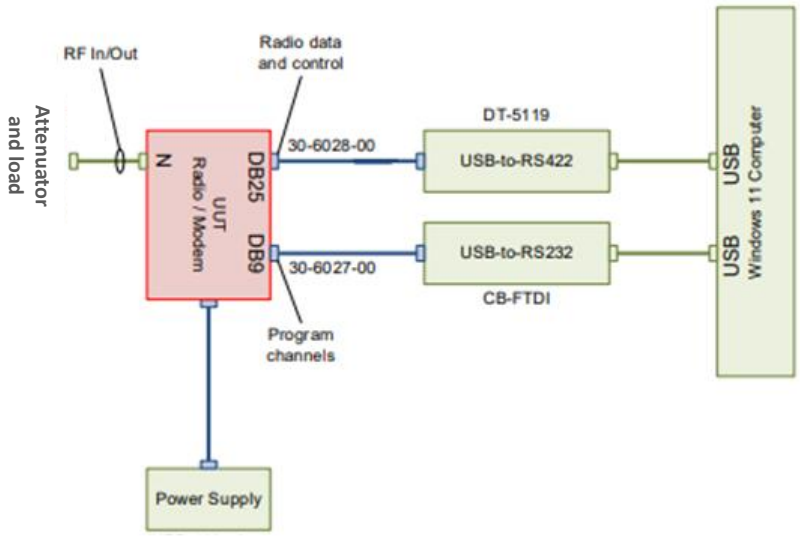


Figure 4.5-1: *Radiated testing block diagram*

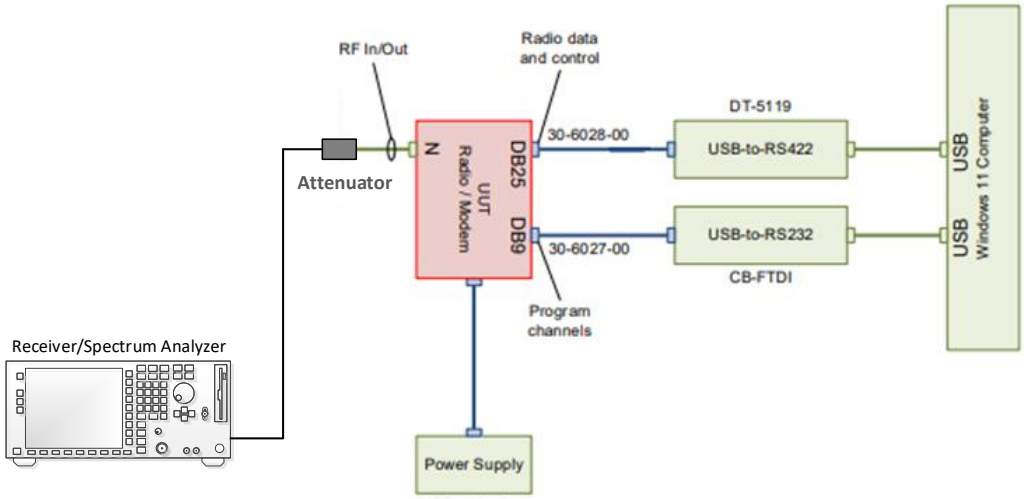


Figure 4.5-2: *Antenna port testing block diagram*

Section 5 Summary of test results

5.1 Testing period

Test start date	February 10, 2026	Test end date	March 6, 2026

5.2 Sample information

Receipt date	February 3, 2026	Nemko sample ID number	PRJ00922310001

5.3 FCC Part 2 and 90 Subpart J test requirements results

Table 5.3-1: *FCC requirements results*

Part	Test description	Verdict
§90.205(h)(s)	Transmitter output power	Pass
§90.209(b)	Bandwidth limitations	Pass
§90.210	Spectrum mask and spurious emissions	Pass
§90.214	Transient frequency behavior	Pass
§90.213(a)	Transmitter frequency stability	Pass
§2.1047	Modulation characteristics	Pass

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

Table 5.4-1: *ISED requirements results*

Section	Test description	Verdict
RSS-119, 5.4	Transmitter output power	Pass
RSS-119, 5.5	Bandwidth limitations	Pass
RSS-119, 5.5	Spectrum mask	Pass
RSS-119, 5.8	Transmitter Unwanted Emissions	Pass
RSS-119, 5.9	Transient frequency behavior	Pass
RSS-119, 5.3	Transmitter frequency stability	Pass
RSS-Gen, 6.9	Number of frequencies	Pass

Section 6 Test equipment

6.1 Test equipment list

Table 6.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal./Ver. cycle	Next cal./ver.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	March 9, 2026
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	May 28, 2026
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	November 24, 2026
Bilog antenna (30–2000 MHz)	Sunol	JB3	FA002108	1 year	April 8, 2026
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	June 2, 2026
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	April 11, 2026
50 Ω coax cable	Huber + Suhner	None	FA003047	1 year	August 6, 2026
50 Ω coax cable	Huber + Suhner	None	FA003402	1 year	August 6, 2026
50 Ω SMA coax cable	Huber + Suhner	None	FA003056	1 year	August 6, 2026
50 Ω SMA coax cable	Huber + Suhner	None	FA003055	1 year	August 6, 2026
50 Ω, 20 dB 100 W, attenuator	Weinschel Associates	WA91-20-43	FA003503	1 year	April 13, 2027
50 Ω, 30 dB 100 W, attenuator	Weinschel Associates	WA91-30-43	FA003505	1 year	April 13, 2027
50 Ω N-Type coaxial attenuator 20 dB	Weinschel Associates	WA8/12-20-34	FA003485	1 year	April 10, 2027
50 Ω N-Type coaxial attenuator 20 dB	Weinschel Associates	WA8/12-20-34	FA003486	1 year	April 10, 2027
RF power splitter (350–6000 MHz)	Mini-Circuits	ZN2PD2-63-S+	SUU04401222	—	NCR
Modulation Analyzer	HP	8901B	FA003465	3 year	October 30, 2027
Audio frequency generator	HP	33120A	FA001082	—	NCR
4 GHz oscilloscope	Rohde & Schwarz	RTO2044	FA002967	1 year	November 17, 2026
Temperature and Humidity Chamber	Espec	EPX-4H	FA003033	—	NCR
Temperature and Humidity Meter	VAISALA	HM70	FA003318	1 year	June 3, 2026

Notes: NCR - no calibration required

All equipment related to the contribution of measurement has been included in this list. Such items include, but are not limited to, cables, attenuators, directional couplers, and pre-amps.

Table 6.1-2: *Automation software details*

Test description	Manufacturer of Software	Details
Radiated spurious emissions	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)	4.14
Radiated spurious emissions (1 GHz to 6 GHz)	4.74
RF Output power measurement	1.46
Conducted spurious emissions	1.52
Signal path calibration (Insertion loss)	1.38
Occupied bandwidth	2.43 %
Frequency stability	0.03 ppm
Temperature stability	0.68 °C

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 Number of 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		
Test date	February 10, 2026	Temperature	25 °C
Tested by	Alvin Liu	Air pressure	970 mbar
Test location	Cambridge	Relative humidity	32 %

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 channels, MHz	High channel, MHz
400	470	70	406.1125	429.9875 and 450.0125	469.9875

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		
Test date	April 15, 2026	Temperature	24 °C
Tested by	Alvin Liu, Ibrahim Aksahin	Air pressure	975 mbar
Test location	Cambridge	Relative humidity	51 %

7.2.3 Observations, settings and special notes

Per ANSI C63.26 Subclause 5.3.3: The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.
Measurement of audio frequency response was performed per ANSI C63.26 subclause 5.3.3.2 Audio frequency response test methodology—Constant Input.
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} and record the RMS deviation reading as DEV_{REF}. Keep the audio frequency generator output level and set to the desired test frequency between 300 Hz and 3000 Hz. Record the RMS deviation reading as DEV_{FREQ}.
Calculation of the audio frequency response at the present frequency: $20 \times Log_{10} (DEV_{FREQ} / DEV_{REF})$

Modulation analyzer settings:

Analyzer mode	RMS deviation
Audio frequency generator tone	300 Hz—3000 Hz
Audio bandwidth filter	15 kHz HP

Per ANSI C63.26 Subclause 5.3.2: Modulation limiting is the ability of a transmitter circuit to limit the transmitter from producing deviations in excess of a rated system deviation.
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. Adjust the audio generator level by 20 dB in 5 dB increments and record the deviation measured in each step.
Repeat the step and record the frequency deviation from -20 dB to +20dB by 5 dB increments at different audio frequencies 300 Hz, 2.5 kHz and 3 kHz.
Measure peak positive deviation and peak negative deviation separately.

Modulation analyzer settings:

Analyzer mode	Peak positive and negative deviation
Audio frequency generator tone	300 Hz, 1000 Hz, 2500 Hz and 3000 Hz
Audio bandwidth filter	15 kHz HP

The applicant declared the EUT rated deviation: ± 2.5 kHz for 12.5 kHz Spacing.

7.2.4 Test data

Table 7.2-1: *Audio frequency response results – 12.5 kHz channel spacing*

Audio Frequency (Hz)	$DEV_{REF.}$ (kHz)	DEV_{FREQ} (kHz)	Response data (dB)
300	0.5	0.467	-0.59
500	0.5	0.484	-0.28
1000	0.5	0.500	0.00
1500	0.5	0.509	0.15
2000	0.5	0.516	0.27
2500	0.5	0.543	0.72
3000	0.5	0.572	1.17

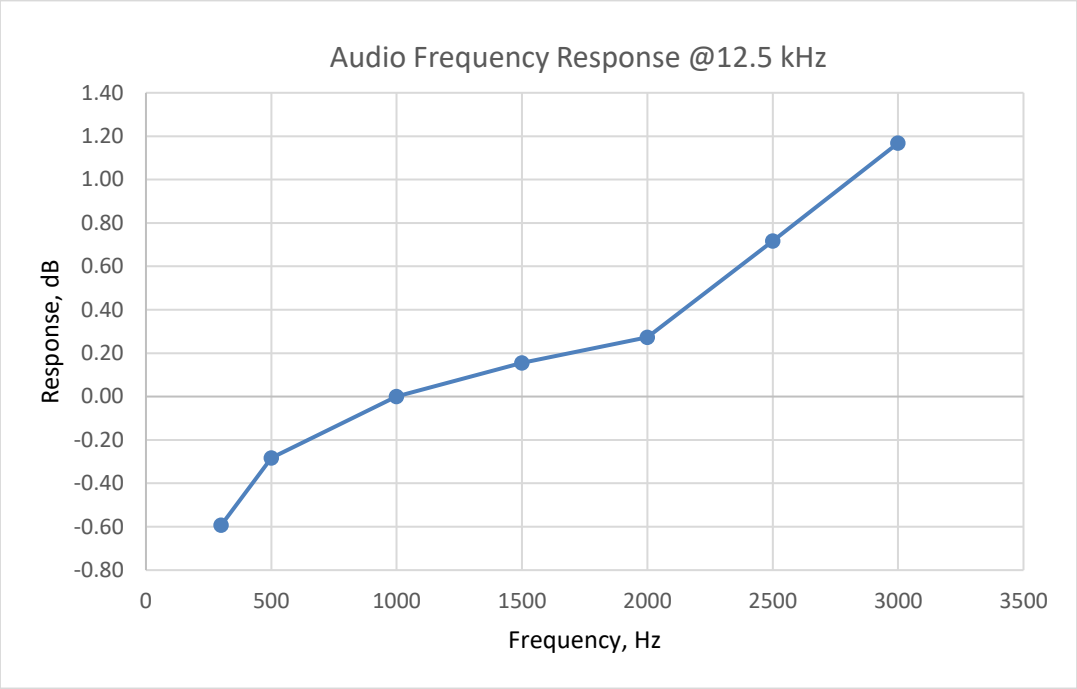


Figure 7.2-1: *Audio frequency response – 12.5 kHz channel spacing*

Test data, continued

Table 7.2-2: *Modulation Limiting results, Peak positive deviation – 12.5 kHz channel spacing*

Audio Frequency (Hz)	Reference input level (dBc)	Peak positive deviation (kHz)	Limit (kHz)	Deviation Ratio %
300	-20	0.216	2.5	8.6
	-15	0.307	2.5	12.3
	-10	0.472	2.5	18.9
	-5	0.795	2.5	31.8
	0	1.372	2.5	54.9
	5	2.045	2.5	81.8
	10	2.060	2.5	82.4
	15	2.048	2.5	81.9
	20	2.048	2.5	81.9
1000	-20	0.195	2.5	7.8
	-15	0.334	2.5	13.4
	-10	0.506	2.5	20.2
	-5	0.874	2.5	35.0
	0	1.503	2.5	60.1
	5	2.054	2.5	82.2
	10	2.051	2.5	82.0
	15	2.028	2.5	81.1
	20	2.041	2.5	81.6
2500	-20	0.269	2.5	10.8
	-15	0.383	2.5	15.3
	-10	0.605	2.5	24.2
	-5	1.040	2.5	41.6
	0	1.795	2.5	71.8
	5	2.052	2.5	82.1
	10	2.050	2.5	82.0
	15	2.049	2.5	82.0
	20	2.052	2.5	82.1
3000	-20	0.261	2.5	10.4
	-15	0.411	2.5	16.4
	-10	0.629	2.5	25.2
	-5	1.092	2.5	43.7
	0	1.901	2.5	76.0
	5	2.053	2.5	82.1
	10	2.045	2.5	81.8
	15	2.041	2.5	81.6
	20	2.075	2.5	83.0

Test data, continued

Table 7.2-3: *Modulation Limiting results, Peak negative deviation – 12.5 kHz channel spacing*

Audio Frequency (Hz)	Reference input level (dBc)	Peak negative deviation (kHz)	Limit (kHz)	Deviation Ratio %
300	-20	0.187	2.5	7.5
	-15	0.307	2.5	12.3
	-10	0.482	2.5	19.3
	-5	0.803	2.5	32.1
	0	1.386	2.5	55.4
	5	2.078	2.5	83.1
	10	2.036	2.5	81.4
	15	2.044	2.5	81.8
	20	2.031	2.5	81.2
1000	-20	0.206	2.5	8.2
	-15	0.323	2.5	12.9
	-10	0.503	2.5	20.1
	-5	0.878	2.5	35.1
	0	1.500	2.5	60.0
	5	2.050	2.5	82.0
	10	2.038	2.5	81.5
	15	2.010	2.5	80.4
	20	2.053	2.5	82.1
2500	-20	0.246	2.5	9.8
	-15	0.383	2.5	15.3
	-10	0.603	2.5	24.1
	-5	1.050	2.5	42.0
	0	1.808	2.5	72.3
	5	2.060	2.5	82.4
	10	2.043	2.5	81.7
	15	2.044	2.5	81.8
	20	2.045	2.5	81.8
3000	-20	0.257	2.5	10.3
	-15	0.399	2.5	16.0
	-10	0.631	2.5	25.2
	-5	1.096	2.5	43.8
	0	1.897	2.5	75.9
	5	2.065	2.5	82.6
	10	2.042	2.5	81.7
	15	2.051	2.5	82.0
	20	2.046	2.5	81.8

Test data, continued

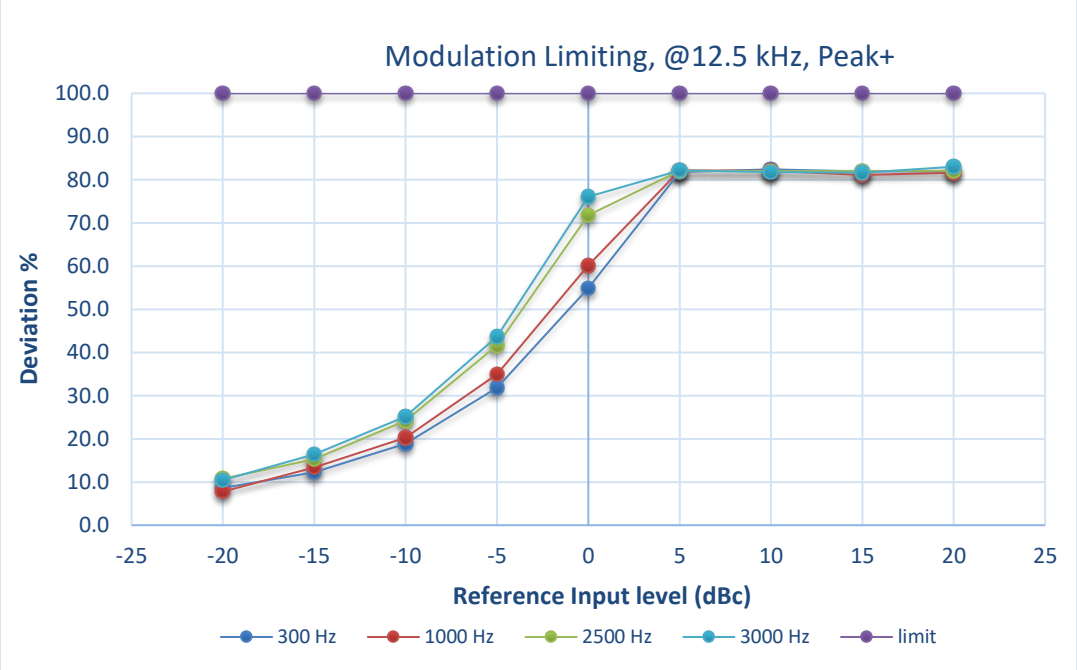


Figure 7.2-2: *Modulation Limiting, Peak positive deviation – 12.5 kHz channel spacing*

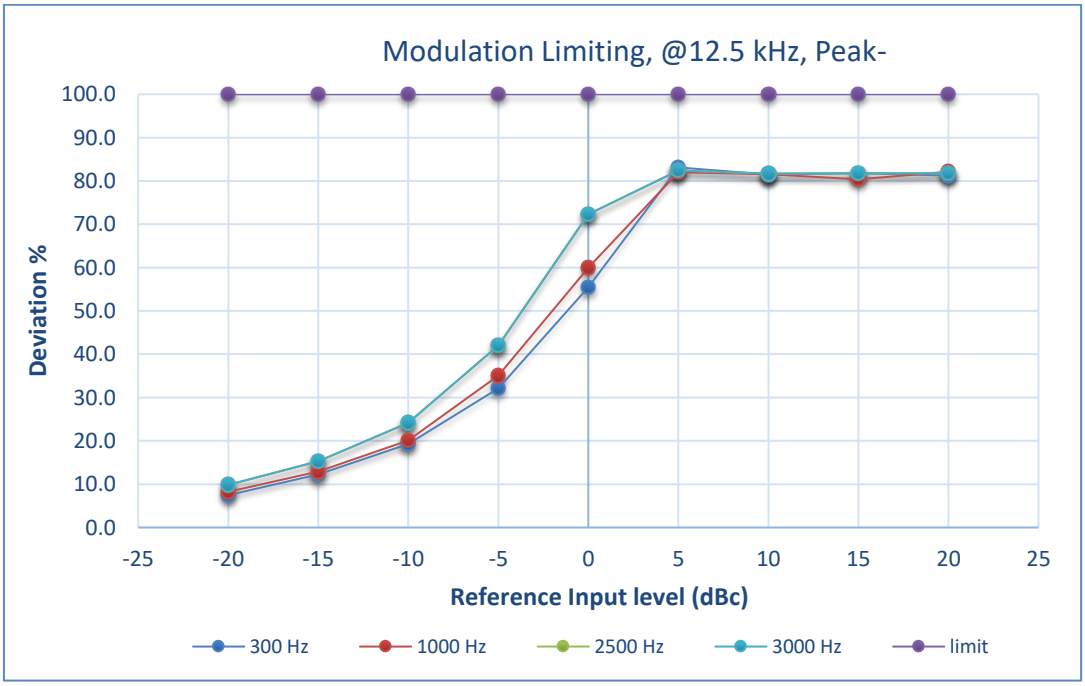


Figure 7.2-3: *Modulation Limiting, Peak negative deviation – 12.5 kHz channel spacing*

7.3 Transmitter Output Power

7.3.1 References, definitions and limits

FCC §90.205:

(h) Power and antenna height limits within 450–470 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)*

Service area radius (km):	**3**	**8**	**13**	**16**	**24**	**32**	**40[4]**	**48[4]**	**64[4]**	**80[4]**
Maximum ERP (w)[1]:	2	100	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500
Up to reference HAAT (m)[3]:	15	15	15	27	63	125	250	410	950	2700

Notes:
[1]Maximum ERP indicated provides for a 39 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 39 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 39 dBu.

(r) All other frequency bands. Requested transmitter power will be considered and authorized on a case by case basis.

(s) The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with § 90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

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**	**Transmitter Output Power for Mobile Equipment**
406.1–430 and 450–470	110 W (50.41 dBm)	60 W (47.78 dBm)

4.1 Transmitter Output Power
Measure and record the transmitter output power using a measurement (resolution) bandwidth at least two to three times the width of the occupied bandwidth for transmitters equipped with masks D and E to capture the true peak emission of the equipment under test. For transmitters equipped with other masks, a measurement bandwidth wider than the occupied bandwidth of the transmitter shall be used.

7.3.2 Test summary

Verdict	Pass		
Test date	February 10–11, 2026	Temperature	25 °C
Tested by	Alvin Liu	Air pressure	970–975 mbar
Test location	Cambridge	Relative humidity	32–35 %

7.3.3 Observations, settings and special notes

Measurement of peak power was performed per ANSI C63.26 subclause 5.2.3.3
Manufacturer's rated output power is 30 W or 44.77 dBm. FCC limit: 20% rated output power is 6 W, or $10 \times \text{Log}_{10}$ (36/30) = 0.79 dB

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 7.3-3: *Transmitter power results for FCC*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain, dBd	ERP, dBm	ERP limit, dBm	Margin, dB
SOQPSK @ 6.25 kHz	406.1125	44.88	0.00	44.88	50.00	5.12
	429.9875	44.94	0.00	44.94	50.00	5.06
	450.0125	44.99	0.00	44.99	50.00	5.01
	469.9875	44.80	0.00	44.80	50.00	5.20
FSK @ 12.5 kHz	406.1125	44.94	0.00	44.94	50.00	5.06
	429.9875	44.98	0.00	44.98	50.00	5.02
	450.0125	45.00	0.00	45.00	50.00	5.00
	469.9875	44.85	0.00	44.85	50.00	5.15
FFSK @ 12.5 kHz	406.1125	44.93	0.00	44.93	50.00	5.07
	429.9875	44.91	0.00	44.91	50.00	5.09
	450.0125	44.98	0.00	44.98	50.00	5.02
	469.9875	44.82	0.00	44.82	50.00	5.18
FSK @ 25 kHz	406.1125	44.87	0.00	44.87	50.00	5.13
	429.9875	44.91	0.00	44.91	50.00	5.09
	450.0125	45.00	0.00	45.00	50.00	5.00
	469.9875	44.75	0.00	44.75	50.00	5.25
FFSK @ 25 kHz	406.1125	44.90	0.00	44.90	50.00	5.10
	429.9875	44.89	0.00	44.89	50.00	5.11
	450.0125	44.96	0.00	44.96	50.00	5.04
	469.9875	44.79	0.00	44.79	50.00	5.21

Note: ERP limit of 100 W (50 dBm) was selected as the most stringent limit.

Table 7.3-4: *Rated vs Measured power for FCC*

Modulation	Frequency, MHz	Rated power, dBm	Measured power, dBm	Difference, dB	Difference limit, ±dB	Margin, dB
SOQPSK @ 6.25 kHz	406.1125	44.77	44.88	0.11	0.79	0.68
	429.9875	44.77	44.94	0.17	0.79	0.62
	450.0125	44.77	44.99	0.22	0.79	0.57
	469.9875	44.77	44.80	0.03	0.79	0.76
FSK @ 12.5 kHz	406.1125	44.77	44.94	0.17	0.79	0.62
	429.9875	44.77	44.98	0.21	0.79	0.58
	450.0125	44.77	45.00	0.23	0.79	0.56
	469.9875	44.77	44.85	0.08	0.79	0.71
FFSK @ 12.5 kHz	406.1125	44.77	44.93	0.16	0.79	0.63
	429.9875	44.77	44.91	0.14	0.79	0.65
	450.0125	44.77	44.98	0.21	0.79	0.58
	469.9875	44.77	44.82	0.05	0.79	0.74
FSK @ 25 kHz	406.1125	44.77	44.87	0.10	0.79	0.69
	429.9875	44.77	44.91	0.14	0.79	0.65
	450.0125	44.77	45.00	0.23	0.79	0.56
	469.9875	44.77	44.75	-0.02	0.79	0.77
FFSK @ 25 kHz	406.1125	44.77	44.90	0.13	0.79	0.66
	429.9875	44.77	44.89	0.12	0.79	0.67
	450.0125	44.77	44.96	0.19	0.79	0.60
	469.9875	44.77	44.79	0.02	0.79	0.77

Test data, continued

Table 7.3-5: *Transmitter power results for ISED*

Modulation	Frequency, MHz	Output power, dBm	Output power limit, dBm	Margin, dB
SOQPSK @ 6.25 kHz	406.1125	44.88	47.78	2.90
	429.9875	44.94	47.78	2.84
	450.0125	44.99	47.78	2.79
	469.9875	44.80	47.78	2.98
FSK @ 12.5 kHz	406.1125	44.94	47.78	2.84
	429.9875	44.98	47.78	2.80
	450.0125	45.00	47.78	2.78
	469.9875	44.85	47.78	2.93
FFSK @ 12.5 kHz	406.1125	44.93	47.78	2.85
	429.9875	44.91	47.78	2.87
	450.0125	44.98	47.78	2.80
	469.9875	44.82	47.78	2.96
FSK @ 25 kHz	406.1125	44.87	47.78	2.91
	429.9875	44.91	47.78	2.87
	450.0125	45.00	47.78	2.78
	469.9875	44.75	47.78	3.03
FFSK @ 25 kHz	406.1125	44.90	47.78	2.88
	429.9875	44.89	47.78	2.89
	450.0125	44.96	47.78	2.82
	469.9875	44.79	47.78	2.99

Table 7.3-6: *Rated vs measured power for ISED*

Modulation	Frequency, MHz	Rated power, dBm	Measured power, dBm	Difference, dB	Difference limit, ±dB	Margin, dB
SOQPSK @ 6.25 kHz	406.1125	44.77	44.88	0.11	1.00	0.89
	429.9875	44.77	44.94	0.17	1.00	0.83
	450.0125	44.77	44.99	0.22	1.00	0.78
	469.9875	44.77	44.80	0.03	1.00	0.97
FSK @ 12.5 kHz	406.1125	44.77	44.94	0.17	1.00	0.83
	429.9875	44.77	44.98	0.21	1.00	0.79
	450.0125	44.77	45.00	0.23	1.00	0.77
	469.9875	44.77	44.85	0.08	1.00	0.92
FFSK @ 12.5 kHz	406.1125	44.77	44.93	0.16	1.00	0.84
	429.9875	44.77	44.91	0.14	1.00	0.86
	450.0125	44.77	44.98	0.21	1.00	0.79
	469.9875	44.77	44.82	0.05	1.00	0.95
FSK @ 25 kHz	406.1125	44.77	44.87	0.10	1.00	0.90
	429.9875	44.77	44.91	0.14	1.00	0.86
	450.0125	44.77	45.00	0.23	1.00	0.77
	469.9875	44.77	44.75	-0.02	1.00	0.98
FFSK @ 25 kHz	406.1125	44.77	44.90	0.13	1.00	0.87
	429.9875	44.77	44.89	0.12	1.00	0.88
	450.0125	44.77	44.96	0.19	1.00	0.81
	469.9875	44.77	44.79	0.02	1.00	0.98

Test data, continued

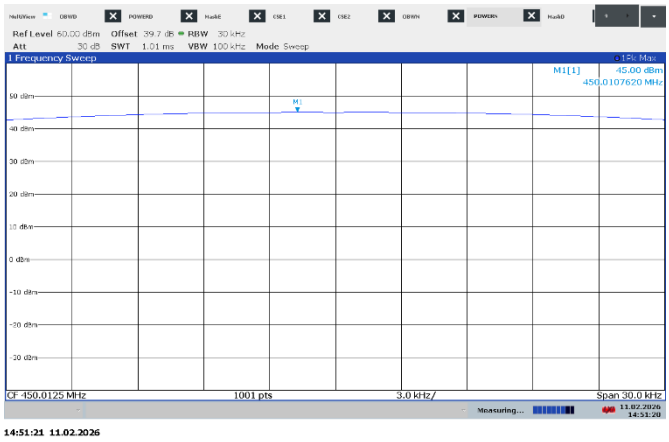


Figure 7.3-1: *Output power on FSK @ 12.5 kHz, sample plot*

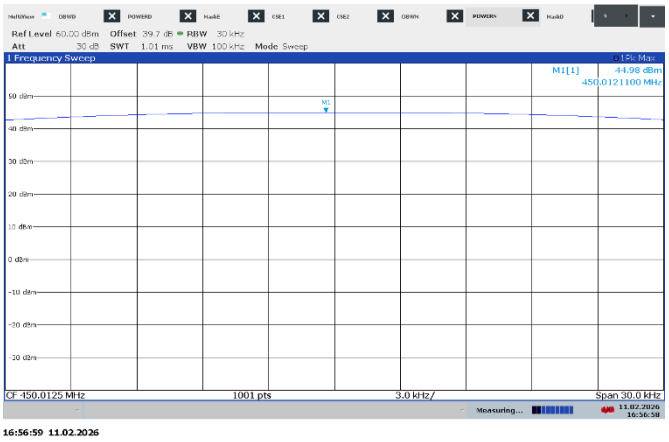


Figure 7.3-2: *Output power on FFSK @ 12.5 kHz, sample plot*

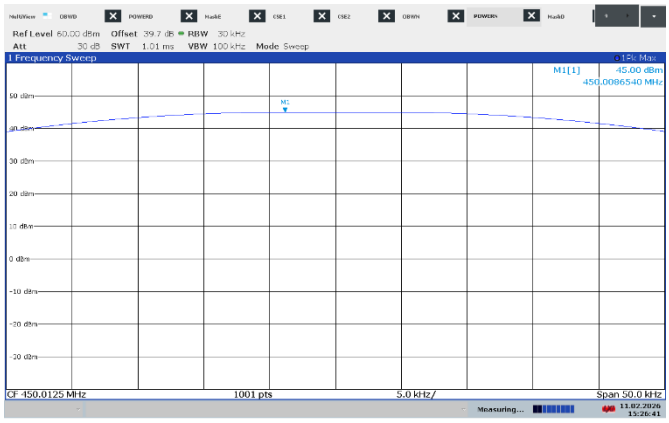


Figure 7.3-3: *Output power on FSK @ 25 kHz, sample plot*

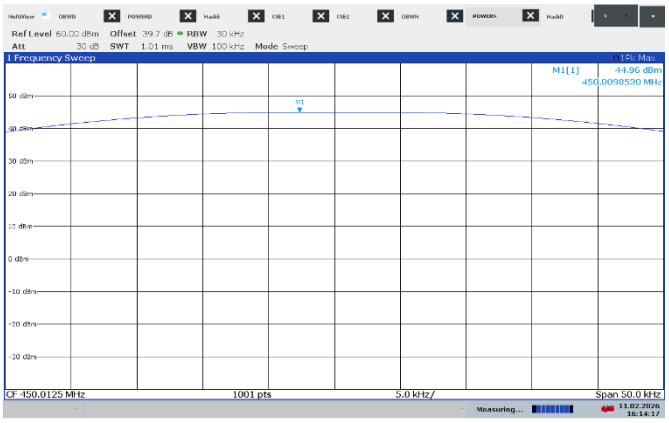


Figure 7.3-4: *Output power on FFSK @ 25 kHz, sample plot*

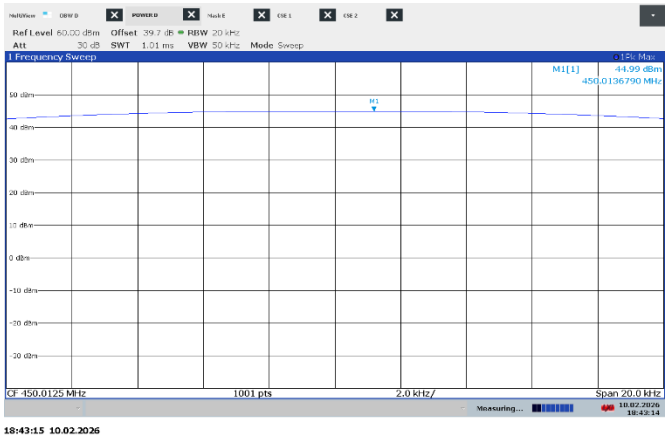


Figure 7.3-5: *Output power on SOQPSK @ 6.25 kHz, sample plot*

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 (FCC)*

Frequency Band, MHz	Channel Spacing, kHz	Authorized Bandwidth[1], kHz
406–512	6.25	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 421–512 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 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 and Authorized Bandwidths (ISED)*

Frequency Band, MHz	Channel Bandwidth, kHz	Authorized Bandwidth, kHz
406.1–430 and 450–470	25.00	20.00
	12.50	11.25
	6.25	6.00

7.4.2 Test summary

Verdict	Pass		
Test date	February 10–11, 2026	Temperature	25 °C
Tested by	Alvin Liu	Air pressure	970–975 mbar
Test location	Cambridge	Relative humidity	32–35 %

7.4.3 Observations, settings and special notes

The test was performed as per ANSI C63.26, subclause 5.4.4.
The applicant stated the 25kHz channel spacing is not applicable to FCC, so there is no authorized bandwidth exceeding 11.25 kHz.

Spectrum analyser 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 7.4-3: *99% occupied bandwidth results*

Modulation	Frequency, MHz	99% occupied bandwidth, kHz	Limit, kHz	Margin, kHz
SOQPSK @ 6.25 kHz	406.1125	3.798	6.000	2.202
	429.9875	3.785	6.000	2.215
	450.0125	3.761	6.000	2.239
	469.9875	3.793	6.000	2.207
FSK @ 12.5 kHz	406.1125	8.448	11.250	2.802
	429.9875	8.448	11.250	2.802
	450.0125	8.444	11.250	2.806
	469.9875	8.452	11.250	2.798
FFSK @ 12.5 kHz	406.1125	7.414	11.250	3.836
	429.9875	7.395	11.250	3.855
	450.0125	7.395	11.250	3.855
	469.9875	7.417	11.250	3.833
FSK @ 25 kHz	406.1125	12.801	20.000	7.199
	429.9875	12.801	20.000	7.199
	450.0125	12.801	20.000	7.199
	469.9875	12.817	20.000	7.183
FFSK @ 25 kHz	406.1125	11.400	20.000	8.600
	429.9875	11.371	20.000	8.629
	450.0125	11.371	20.000	8.629
	469.9875	11.404	20.000	8.596

Test data, continued

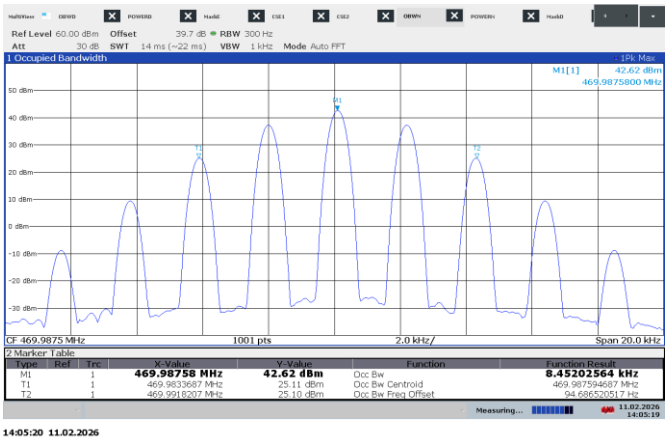


Figure 7.4-1: *99% occupied bandwidth on FSK @ 12.5 kHz, sample plot*

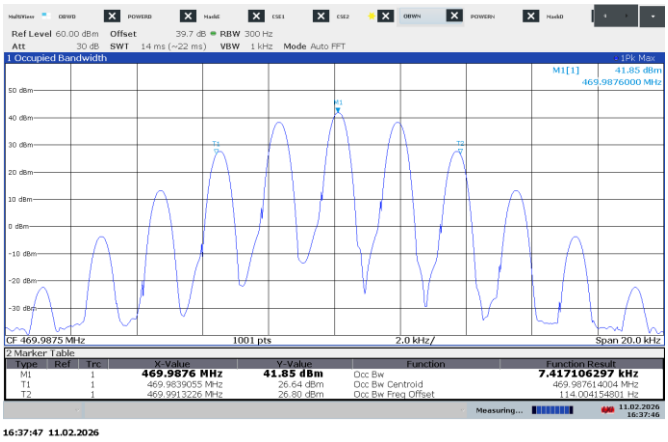


Figure 7.4-2: *99% occupied bandwidth on FFSK @ 12.5 kHz, sample plot*

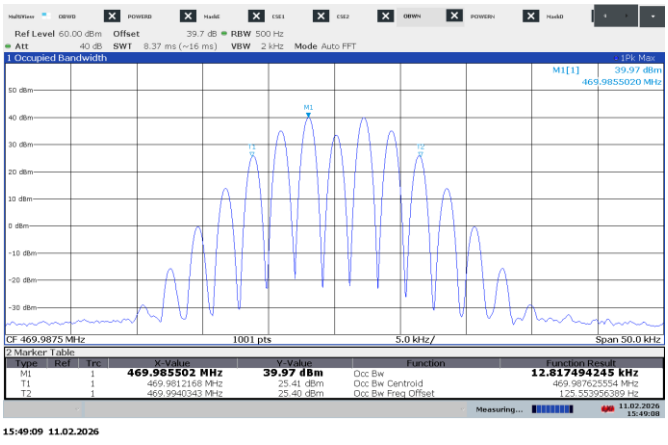


Figure 7.4-3: *99% occupied bandwidth on FSK @ 25 kHz, sample plot*

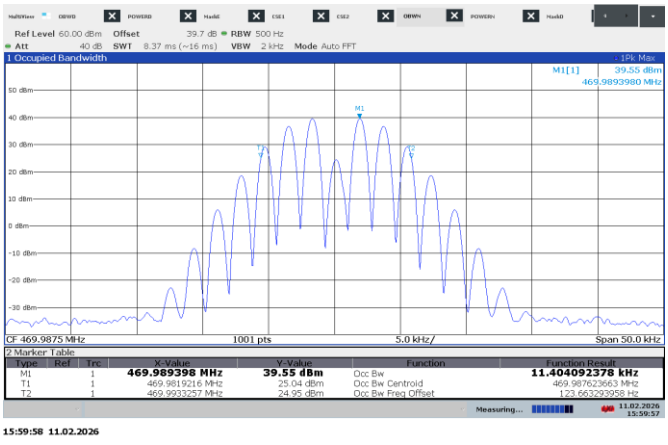


Figure 7.4-4: *99% occupied bandwidth on FFSK @ 25 kHz, sample plot*

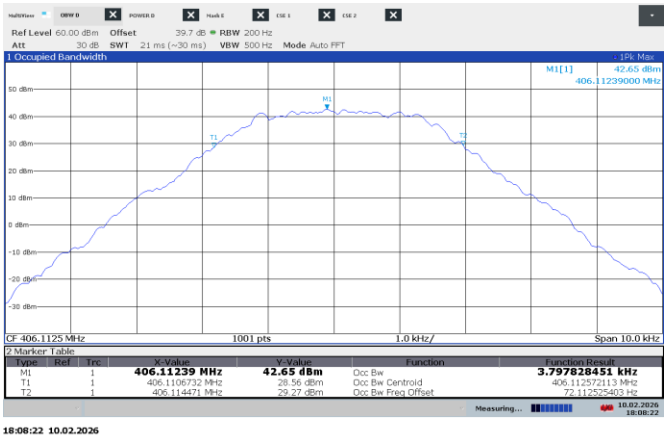


Figure 7.4-5: *99% occupied bandwidth on SOQPSK @ 6.25 kHz, sample plot*

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
421–512[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)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
406.1–430	25.00	20.00	B	C
and	12.50	11.25	D	D
450–470	6.25	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

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

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)
$5.625 < f_d \leq 12.5$	$7.27 \times (f_d - 2.88)$	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: $30 + 16.67 \times (f_d - 3)$ *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.

7.5.2 Test summary

Verdict	Pass		
Test date	February 10–11, 2026	Temperature	25 °C
Tested by	Alvin Liu	Air pressure	970–975 mbar
Test location	Cambridge	Relative humidity	32–35 %

7.5.3 Observations, settings and special notes

- The spurious emissions limits beyond 50 kHz from the edge of the authorized bandwidth were calculated:
  - BW 6.25 kHz channels: FCC limit = P (dBW) – 65 = **–20 dBm**, ISED limit = P (dBW) – 57 = **–12 dBm**.
  - BW 12.5 kHz channels: Limit = P (dBW) – (50 + 10 × Log10 (p)) = **–20 dBm**
  - BW 25 kHz channels: Limit = P (dBW) – (43 + 10 × Log10 (p)) = **–13 dBm**
- For conducted spurious emissions, the worst data table vs limit were provided.
- For radiated spurious emissions, only the worst spectral plots were provided.
- The spectral scan has been corrected with transducer factors (i.e. cable, antenna, amplifier, and attenuators where applicable) for determination of compliance.

Spectrum analyser settings for Spectrum mask:

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

Spectrum analyser settings for spurious emissions:

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

7.5.4 Test data

Table 7.5-7: *Conducted spurious emissions measurements results*

Modulation	Channel, MHz	Emission frequency, MHz	Measured level, dBm	Correction, dB	Corrected level, dBm	Limit, dBm	Margin, dB
SOQPSK @ 6.25 kHz	406.1125	1218.380	-20.85	0.31	-20.54	-20.00	0.54
	429.9875	859.963	-21.17	0.27	-20.90	-20.00	0.90
	429.9875	1289.970	-22.40	0.15	-22.25	-20.00	2.25
	450.0125	900.022	-20.77	0.13	-20.64	-20.00	0.64
	450.0125	1349.910	-21.67	-0.01	-21.68	-20.00	1.68
	469.9875	939.936	-20.17	-0.33	-20.50	-20.00	0.50
	469.9875	1409.850	-21.26	0.35	-20.91	-20.00	0.91
FSK @ 12.5 kHz	406.1125	1218.200	-22.75	0.31	-22.44	-20.00	2.44
	429.9875	859.963	-22.69	0.27	-22.42	-20.00	2.42
	429.9875	1289.970	-22.37	0.15	-22.22	-20.00	2.22
	450.0125	900.022	-20.21	0.13	-20.08	-20.00	**0.08**
	450.0125	1350.090	-21.77	-0.01	-21.78	-20.00	1.78
	469.9875	939.936	-20.36	-0.33	-20.69	-20.00	0.69
	469.9875	1409.850	-21.27	0.35	-20.92	-20.00	0.92
FFSK @ 12.5 kHz	406.1125	1218.380	-23.14	0.31	-22.83	-20.00	2.83
	429.9875	859.963	-22.65	0.27	-22.38	-20.00	2.38
	429.9875	1289.970	-22.80	0.15	-22.65	-20.00	2.65
	450.0125	900.022	-20.42	0.13	-20.29	-20.00	0.29
	450.0125	1349.910	-21.93	-0.01	-21.94	-20.00	1.94
	469.9875	939.936	-20.33	-0.33	-20.66	-20.00	0.66
	469.9875	1409.850	-21.36	0.35	-21.01	-20.00	1.01
FSK @ 25 kHz	406.1125	1218.380	-20.81	0.31	-20.50	-13.00	7.50
	429.9875	859.963	-21.89	0.27	-21.62	-13.00	8.62
	429.9875	1289.970	-20.74	0.15	-20.59	-13.00	7.59
	450.0125	900.022	-20.95	0.13	-20.82	-13.00	7.82
	450.0125	1350.090	-20.23	-0.01	-20.24	-13.00	7.24
	469.9875	939.936	-20.42	-0.33	-20.75	-13.00	7.75
	469.9875	1409.850	-19.03	0.35	-18.68	-13.00	5.68
FFSK @ 25 kHz	406.1125	1218.380	-20.98	0.31	-20.67	-13.00	7.67
	429.9875	859.963	-22.28	0.27	-22.01	-13.00	9.01
	429.9875	1289.970	-20.38	0.15	-20.23	-13.00	7.23
	450.0125	900.022	-20.45	0.13	-20.32	-13.00	7.32
	450.0125	1350.090	-20.06	-0.01	-20.07	-13.00	7.07
	469.9875	939.936	-20.44	-0.33	-20.77	-13.00	7.77
	469.9875	1409.850	-19.60	0.35	-19.25	-13.00	6.25

Notes: The emission level included correction factors of cable loss and attenuators. The conducted spurious emissions spectral scan utilized the offset which is the worst case found in the transmitter range. Additional offset correction is used to calculate the emission level at the measured frequency in this table.

Worst case emission is at 900.022 MHz with field strength calculated as follows: EIRP + 95.23 dB = −20.08 + 95.23 = 75.15 dBµV/m

Test data, continued

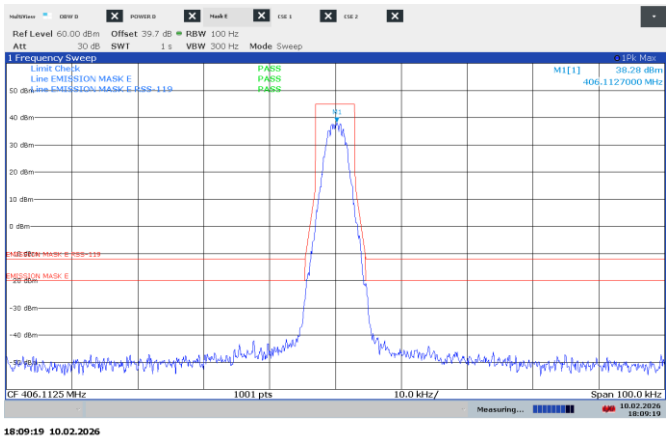


Figure 7.5-1: *Emission mask E for SOQPSK at Low CH*

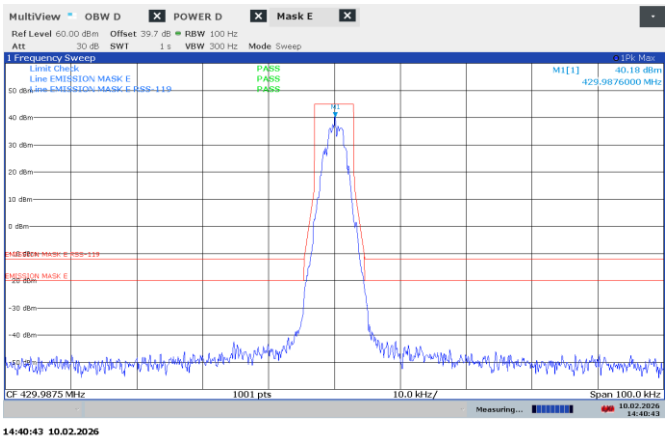


Figure 7.5-2: *Emission mask E for SOQPSK at Mid CH1*

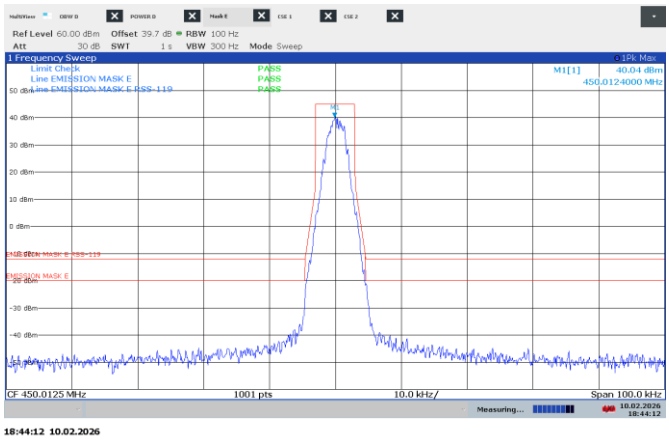


Figure 7.5-3: *Emission mask E for SOQPSK at Mid CH2*

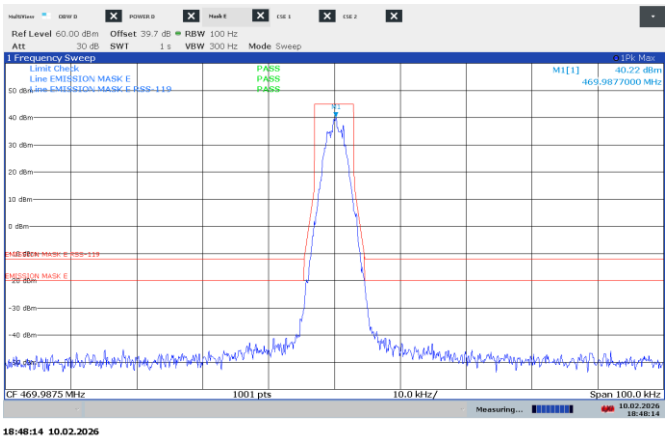


Figure 7.5-4: *Emission mask E for SOQPSK at High CH*

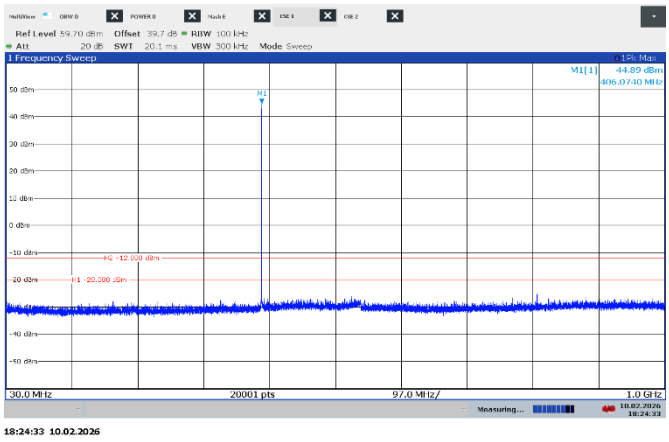


Figure 7.5-5: *Conducted spurious emissions below 1GHz, SOQPSK, Low CH*

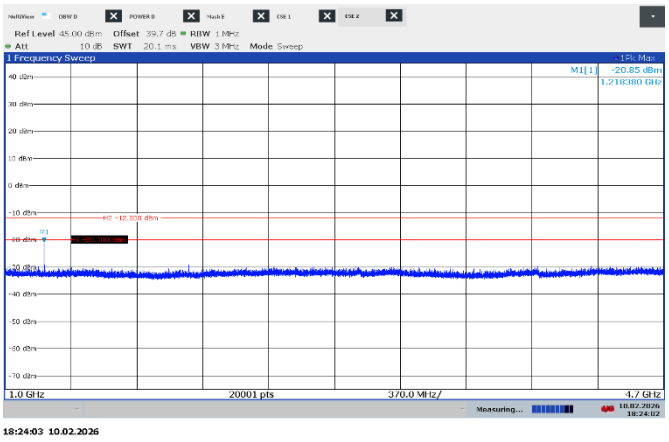


Figure 7.5-6: *Conducted spurious emissions above 1GHz, SOQPSK, Low CH*

Test data, continued

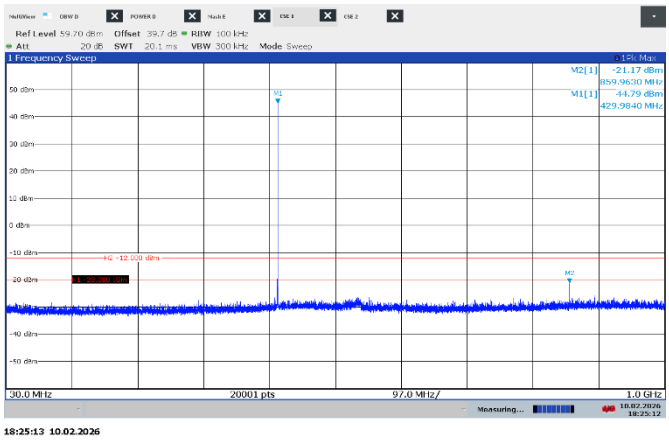


Figure 7.5-7: *Conducted spurious emissions below 1GHz, SOQPSK, Mid CH1*

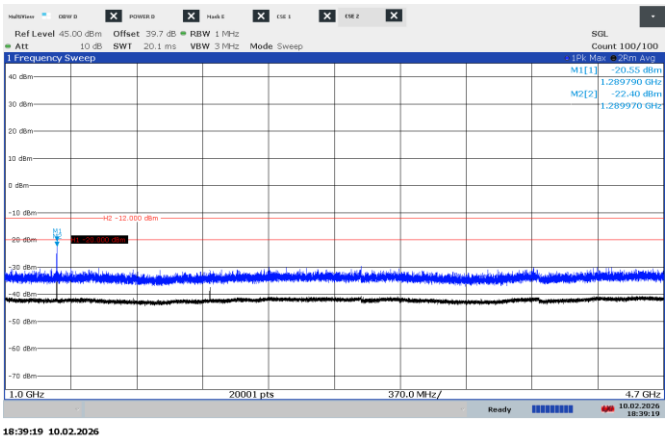


Figure 7.5-8: *Conducted spurious emissions above 1GHz, SOQPSK, Mid CH1*

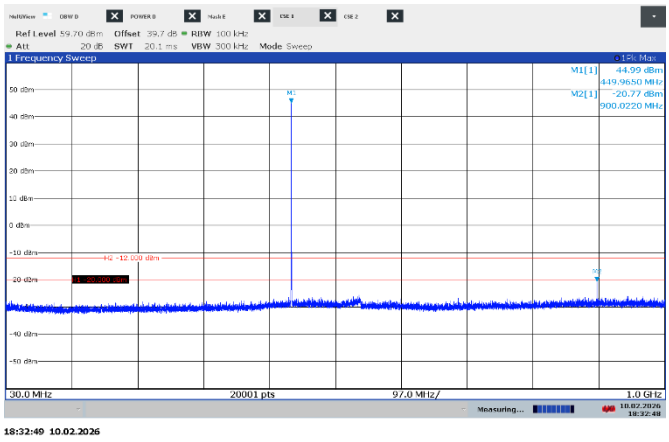


Figure 7.5-9: *Conducted spurious emissions below 1GHz, SOQPSK, Mid CH2*

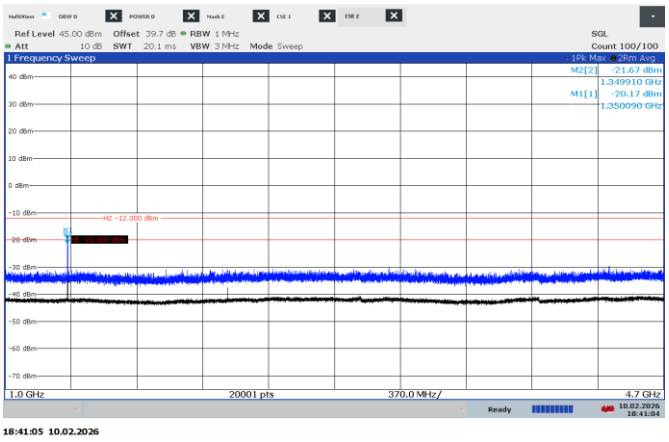


Figure 7.5-10: *Conducted spurious emissions above 1GHz, SOQPSK, Mid CH2*

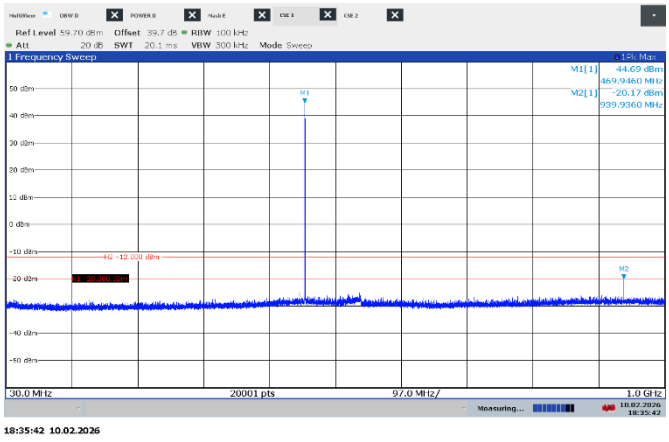
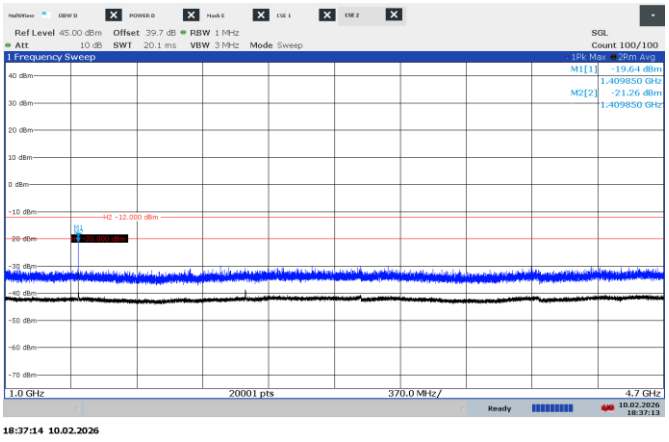


Figure 7.5-11: *Conducted spurious emissions below 1GHz, SOQPSK, High CH*



Note: M1 is Peak data, M2 is RMS data, see *table 7.5-7* for the detailed result.

Figure 7.5-12: *Conducted spurious emissions above 1GHz, SOQPSK, High CH*

Test data, continued

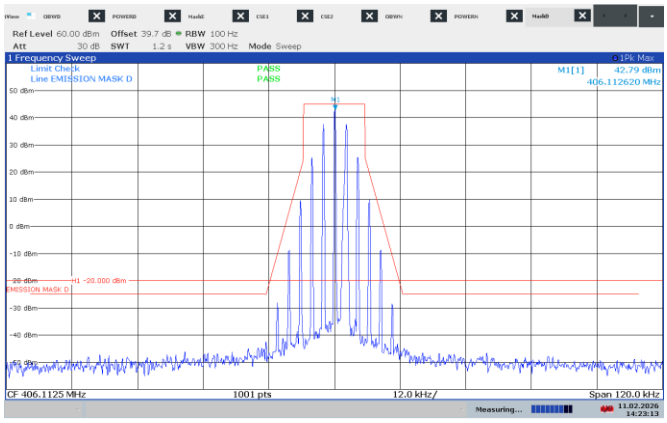


Figure 7.5-13: *Emission mask D for FSK@12.5kHz at Low CH*

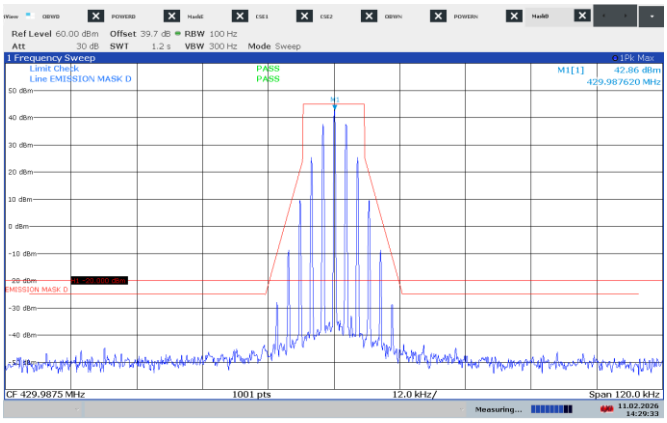


Figure 7.5-14: *Emission mask D for FSK@12.5kHz at Mid CH1*

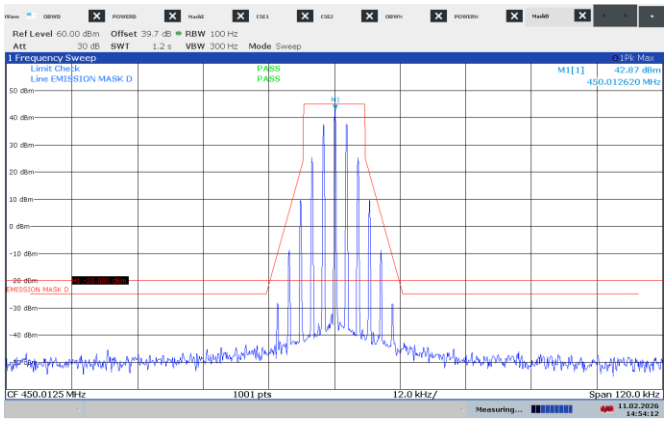


Figure 7.5-15: *Emission mask D for FSK@12.5kHz at Mid CH2*

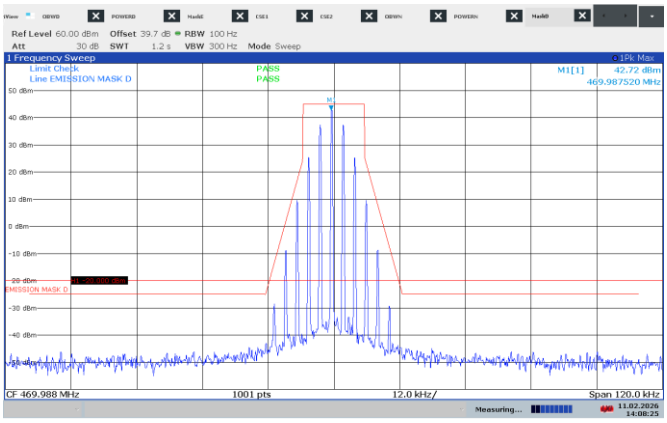


Figure 7.5-16: *Emission mask D for FSK@12.5kHz at High CH*

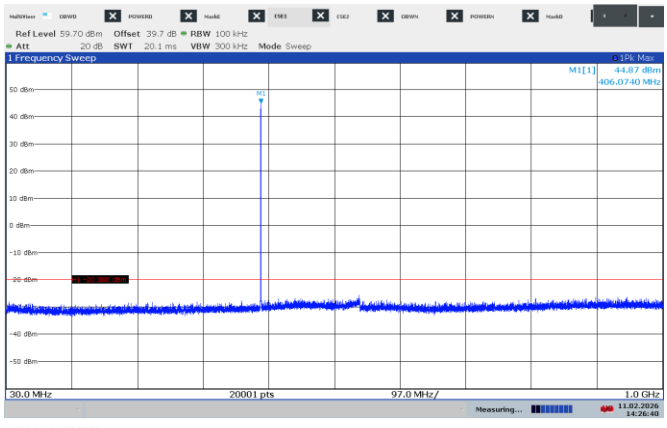


Figure 7.5-17: *Conducted spurious emissions below 1GHz, FSK@12.5kHz, Low CH*

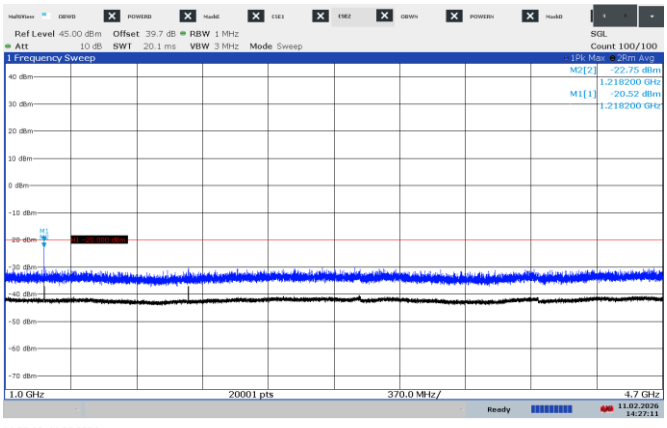


Figure 7.5-18: *Conducted spurious emissions above 1GHz, FSK@12.5kHz, Low CH*

Test data, continued

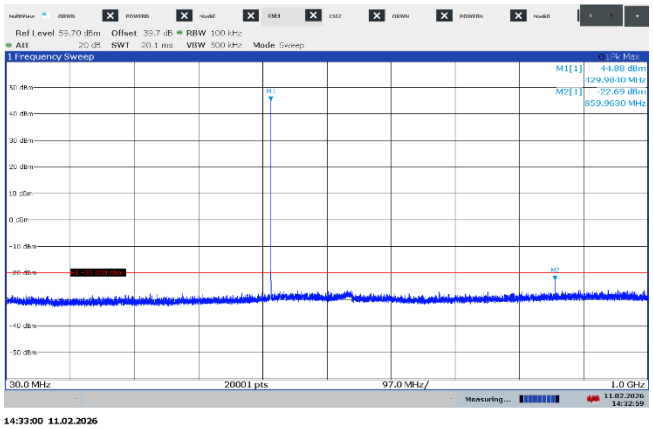


Figure 7.5-19: *Conducted spurious emissions below 1GHz, FSK@12.5kHz, Mid CH1*

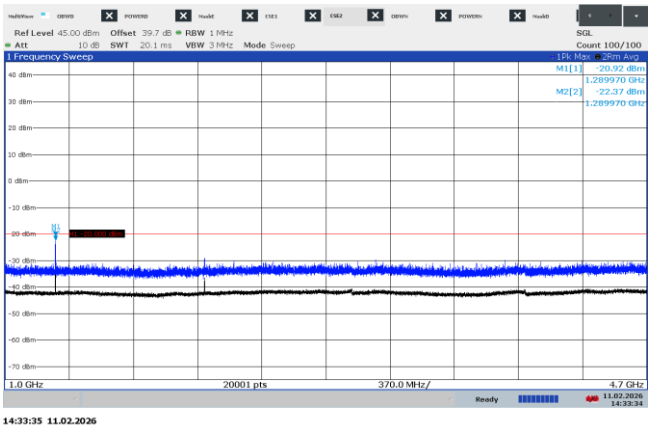


Figure 7.5-20: *Conducted spurious emissions above 1GHz, FSK@12.5kHz, Mid CH1*

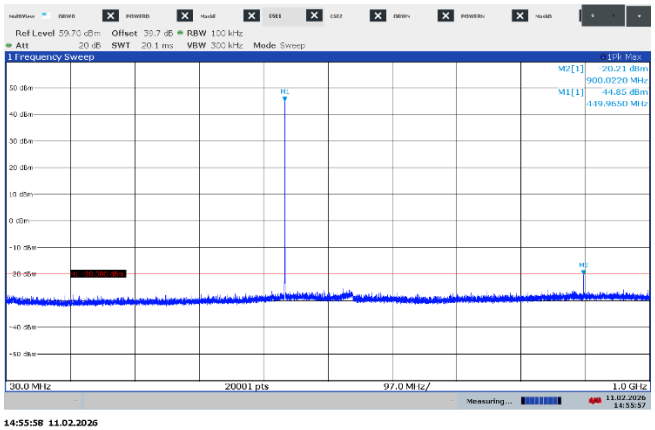


Figure 7.5-21: *Conducted spurious emissions below 1GHz, FSK@12.5kHz, Mid CH2*

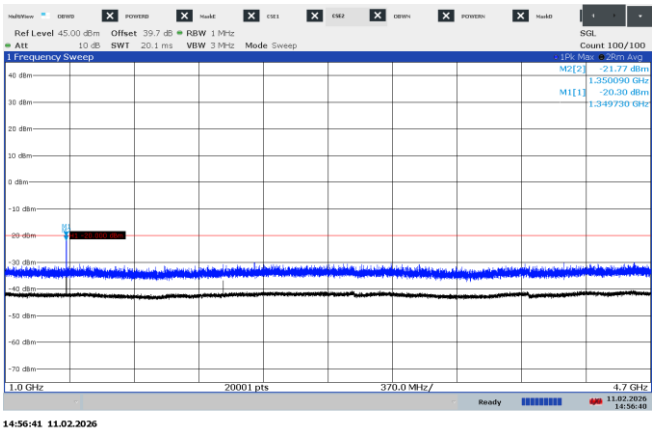


Figure 7.5-22: *Conducted spurious emissions above 1GHz, FSK@12.5kHz, Mid CH2*

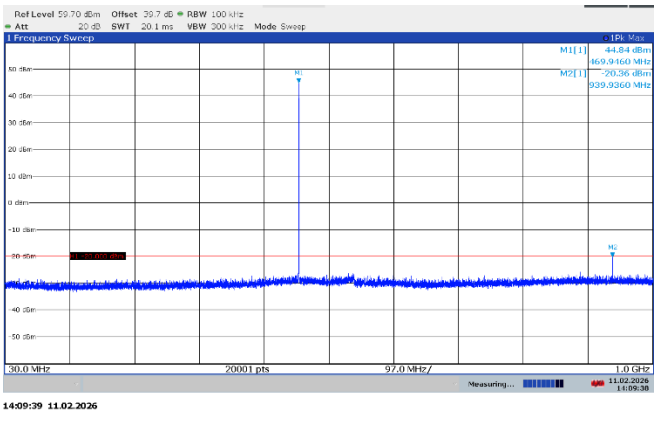
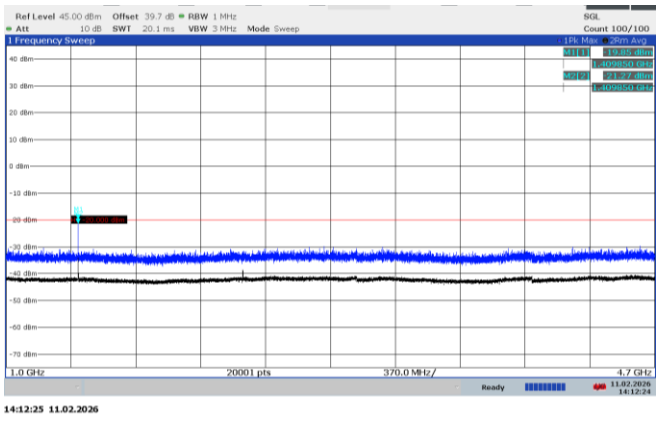


Figure 7.5-23: *Conducted spurious emissions below 1GHz, FSK@12.5kHz, High CH*



Note: M1 is Peak data, M2 is RMS data, see table 7.5-7 for the detailed result.

Figure 7.5-24: *Conducted spurious emissions above 1GHz, FSK@12.5kHz, High CH*

Test data, continued

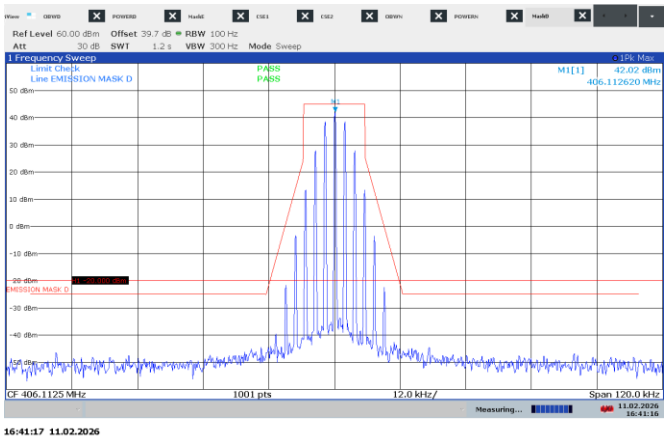


Figure 7.5-25: *Emission mask D for FFSK@12.5kHz at Low CH*

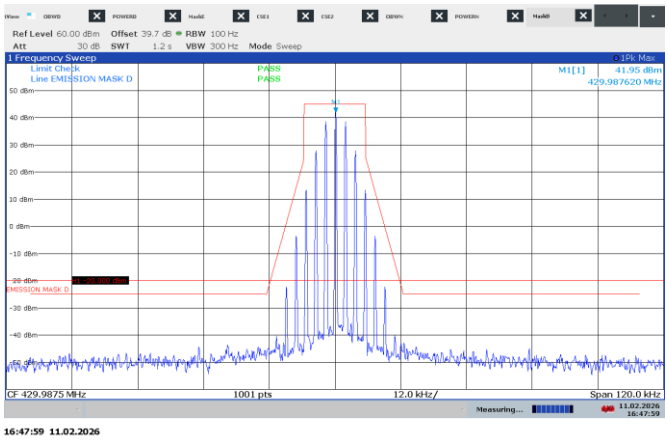


Figure 7.5-26: *Emission mask D for FFSK@12.5kHz at Mid CH1*

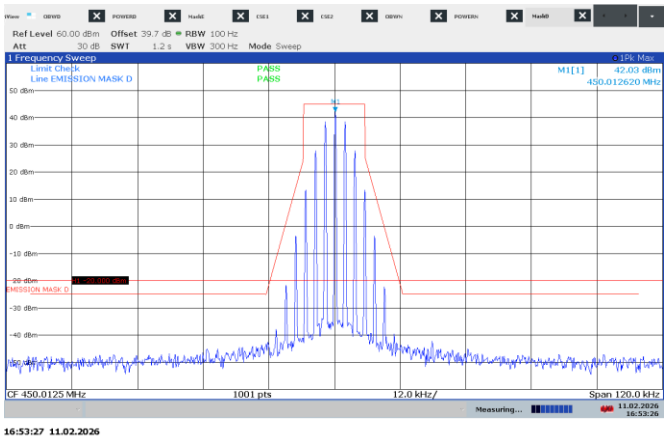


Figure 7.5-27: *Emission mask D for FFSK@12.5kHz at Mid CH2*

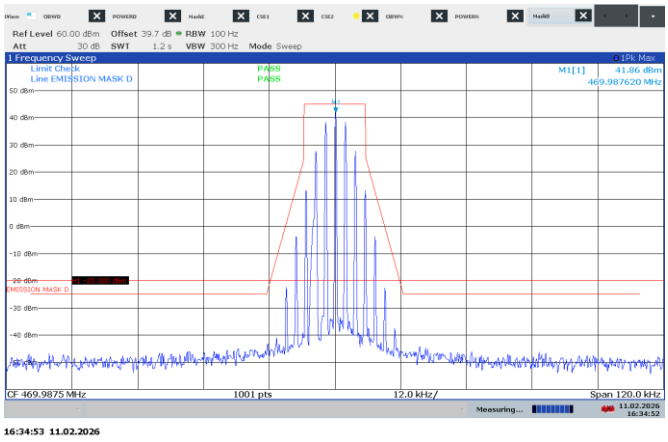


Figure 7.5-28: *Emission mask D for FFSK@12.5kHz at High CH*

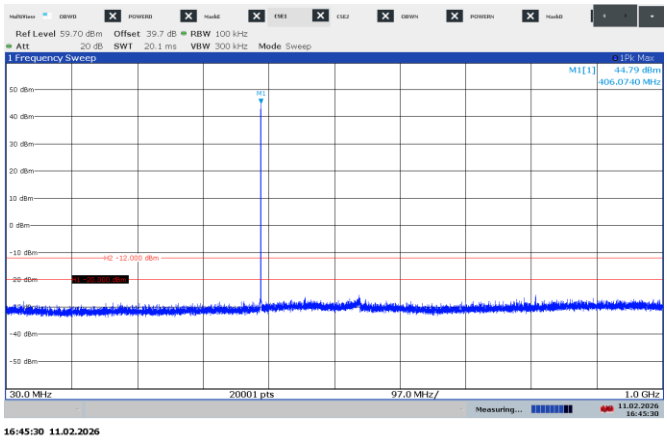


Figure 7.5-29: *Conducted spurious emissions below 1GHz, FFSK@12.5kHz, Low CH*

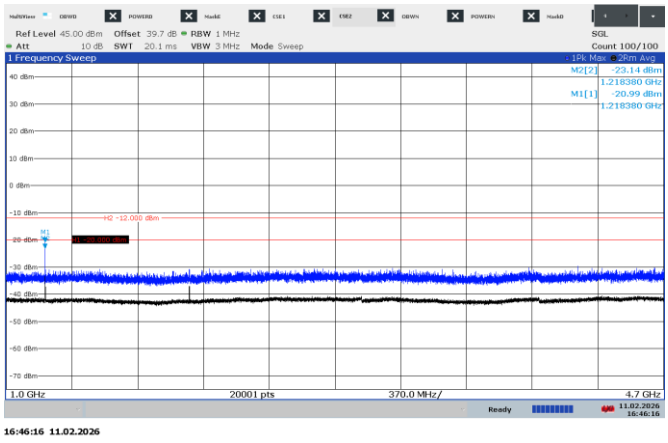


Figure 7.5-30: *Conducted spurious emissions above 1GHz, FFSK@12.5kHz, Low CH*

Test data, continued

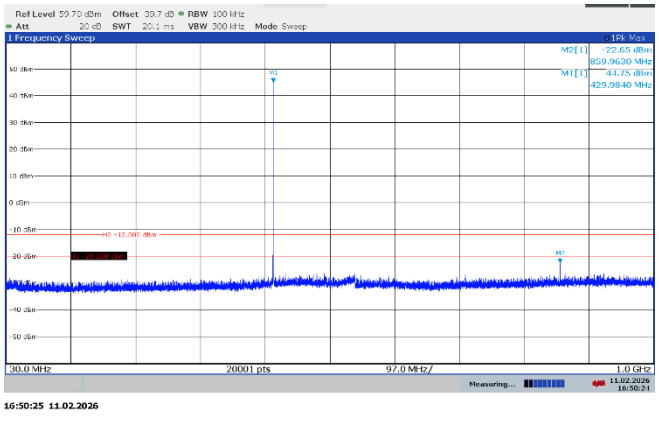


Figure 7.5-31: *Conducted spurious emissions below 1GHz, FFSK@12.5kHz, Mid CH1*

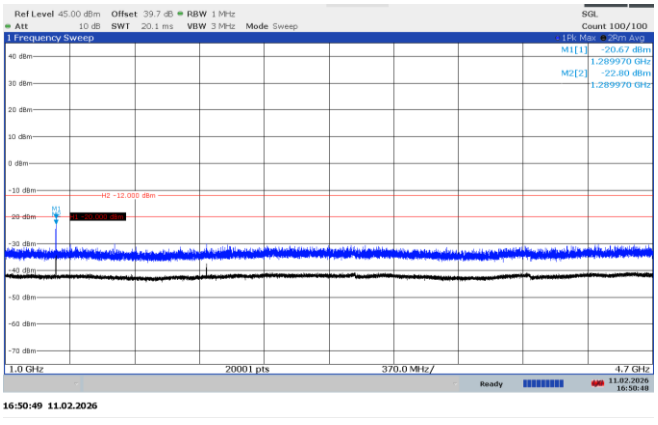


Figure 7.5-32: *Conducted spurious emissions above 1GHz, FFSK@12.5kHz, Mid CH1*

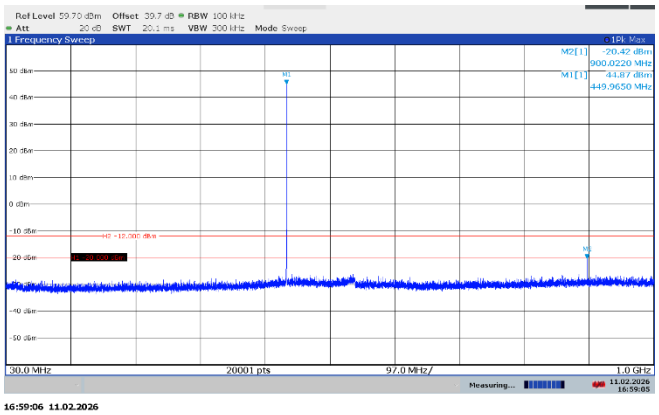
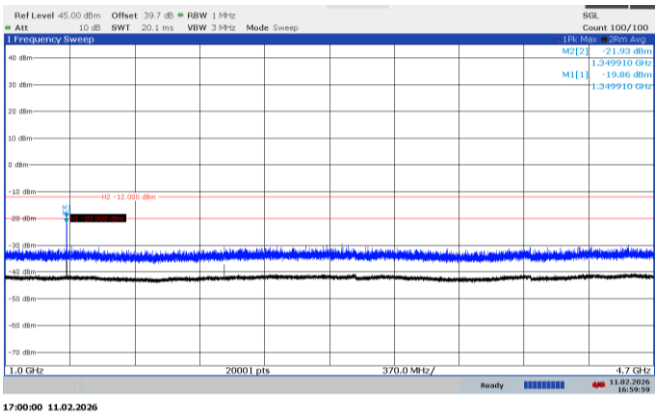


Figure 7.5-33: *Conducted spurious emissions below 1GHz, FFSK@12.5kHz, Mid CH2*



Note: M1 is Peak data, M2 is RMS data, see table 7.5-7 for the detailed result.

Figure 7.5-34: *Conducted spurious emissions above 1GHz, FFSK@12.5kHz, Mid CH2*

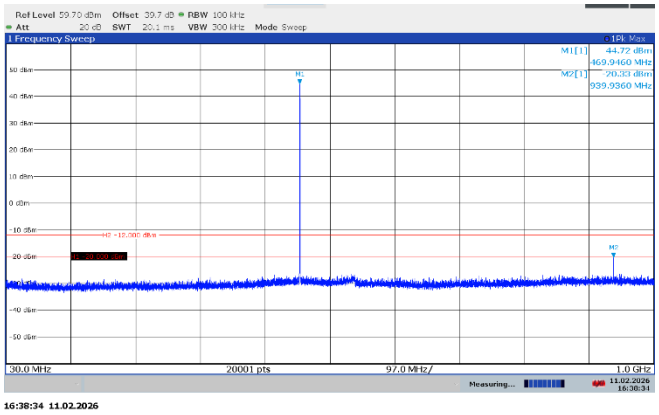
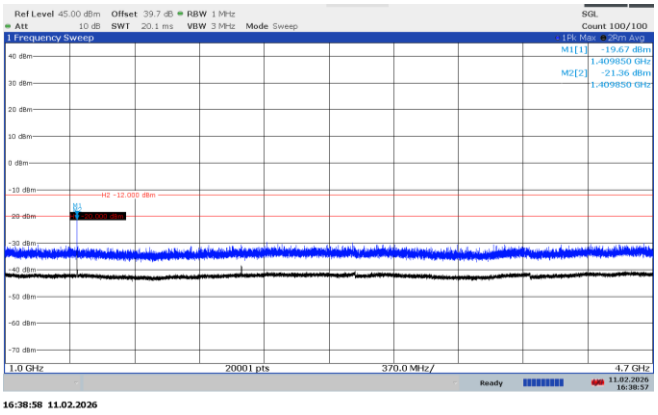


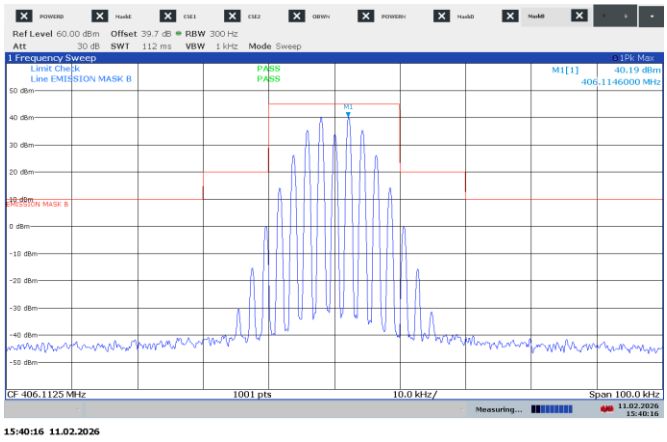
Figure 7.5-35: *Conducted spurious emissions below 1GHz, FFSK@12.5kHz, High CH*



Note: M1 is Peak data, M2 is RMS data, see table 7.5-7 for the detailed result.

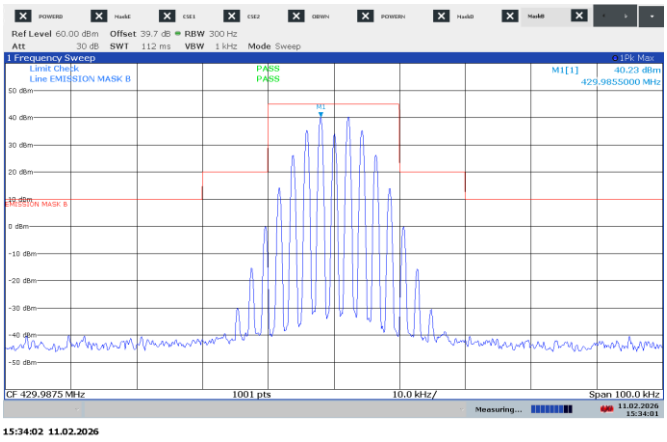
Figure 7.5-36: *Conducted spurious emissions above 1GHz, FFSK@12.5kHz, High CH*

Test data, continued



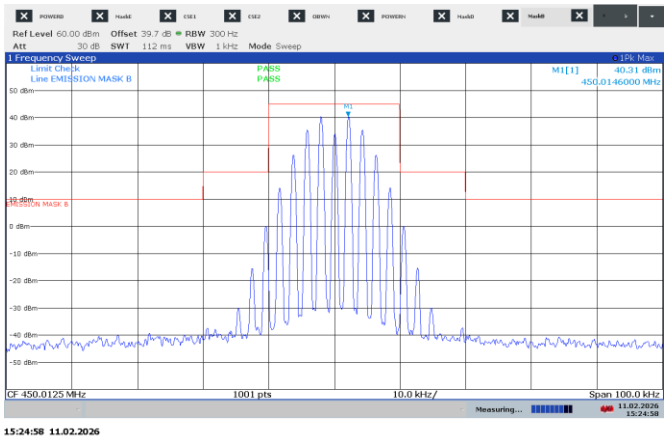
15:40:16 11.02.2026

Figure 7.5-37: *Emission mask B for FSK@25kHz at Low CH*



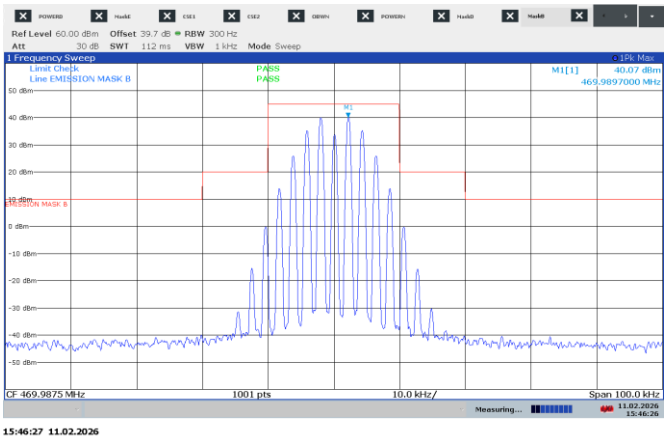
15:34:02 11.02.2026

Figure 7.5-38: *Emission mask B for FSK@25kHz at Mid CH1*



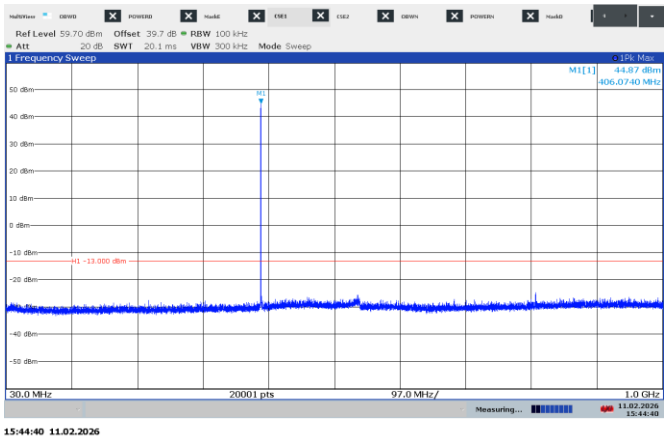
15:24:58 11.02.2026

Figure 7.5-39: *Emission mask B for FSK@25kHz at Mid CH2*



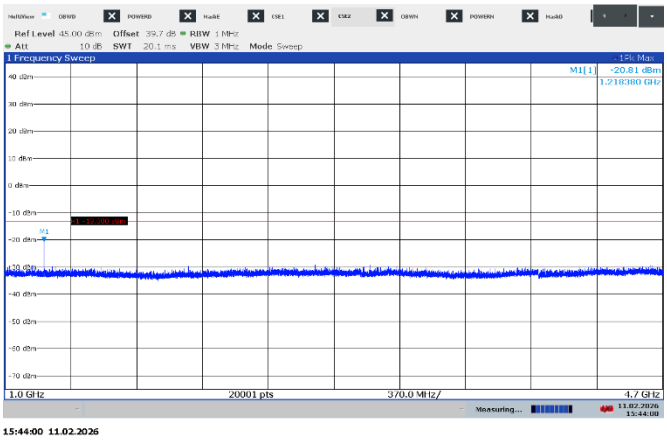
15:46:27 11.02.2026

Figure 7.5-40: *Emission mask B for FSK@25kHz at High CH*



15:44:40 11.02.2026

Figure 7.5-41: *Conducted spurious emissions below 1GHz, FSK@25kHz, Low CH*



15:44:00 11.02.2026

Figure 7.5-42: *Conducted spurious emissions above 1GHz, FSK@25kHz, Low CH*

Test data, continued

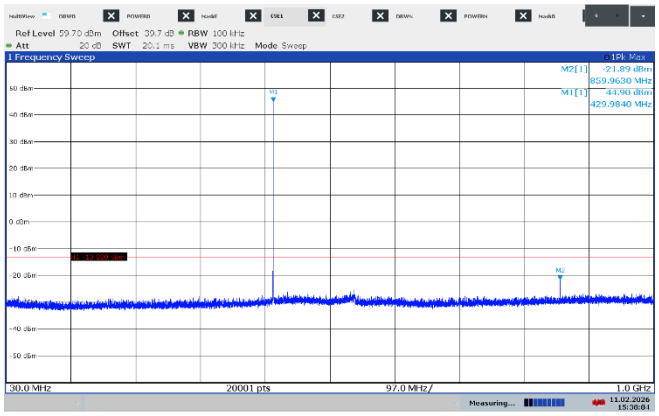


Figure 7.5-43: *Conducted spurious emissions below 1GHz, FSK@25kHz, Mid CH1*

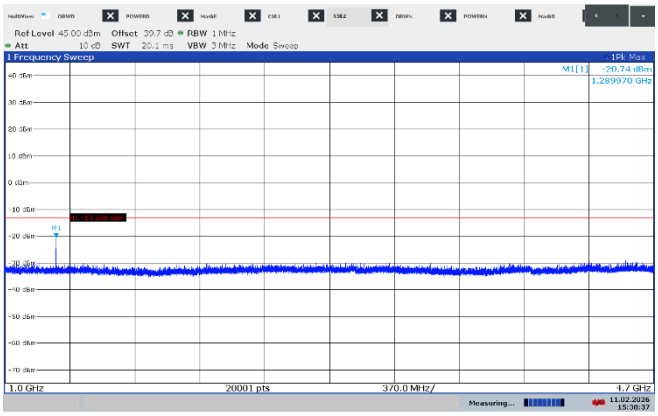


Figure 7.5-44: *Conducted spurious emissions above 1GHz, FSK@25kHz, Mid CH1*

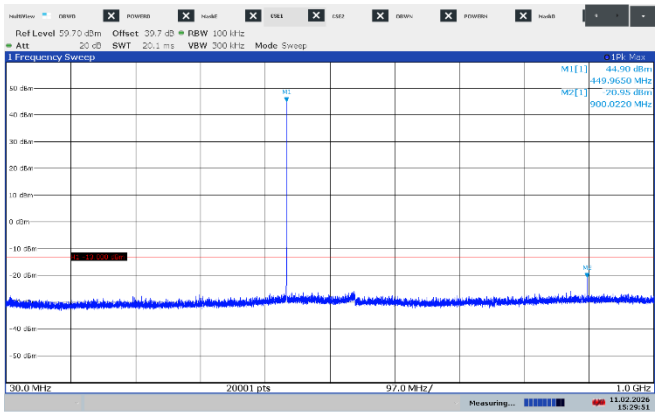


Figure 7.5-45: *Conducted spurious emissions below 1GHz, FSK@25kHz, Mid CH2*

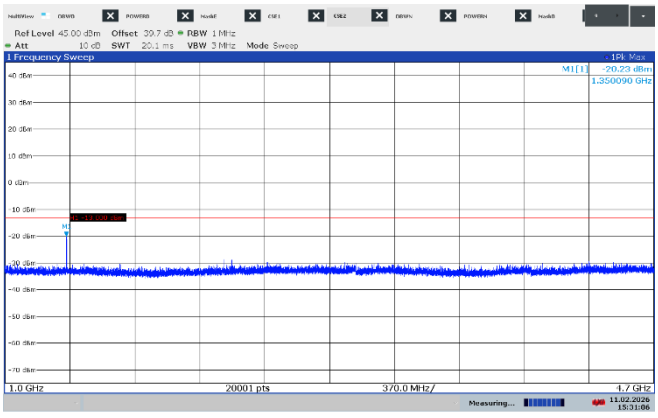


Figure 7.5-46: *Conducted spurious emissions above 1GHz, FSK@25kHz, Mid CH2*

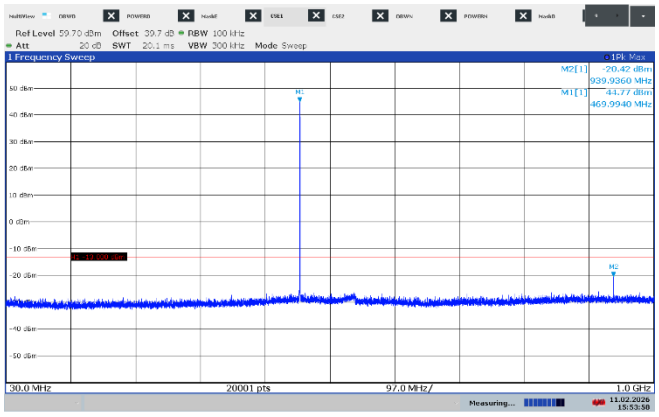


Figure 7.5-47: *Conducted spurious emissions below 1GHz, FSK@25kHz, High CH*

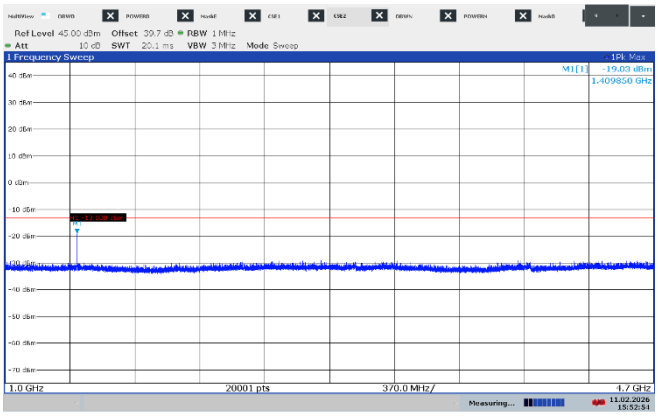


Figure 7.5-48: *Conducted spurious emissions above 1GHz, FSK@25kHz, High CH*

Test data, continued

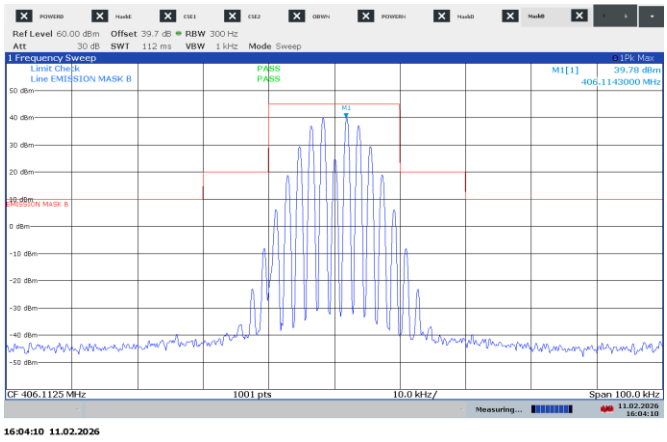


Figure 7.5-49: *Emission mask B for FFSK@25kHz at Low CH*

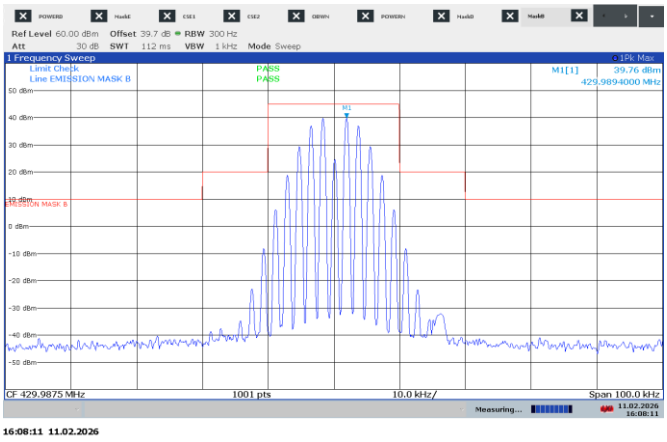


Figure 7.5-50: *Emission mask B for FFSK@25kHz at Mid CH1*

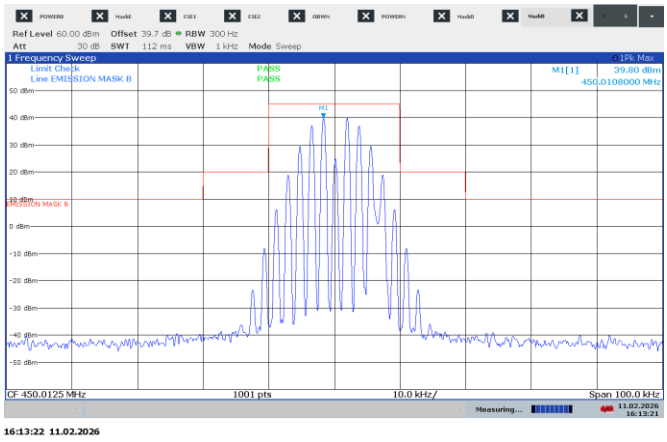


Figure 7.5-51: *Emission mask B for FFSK@25kHz at Mid CH2*

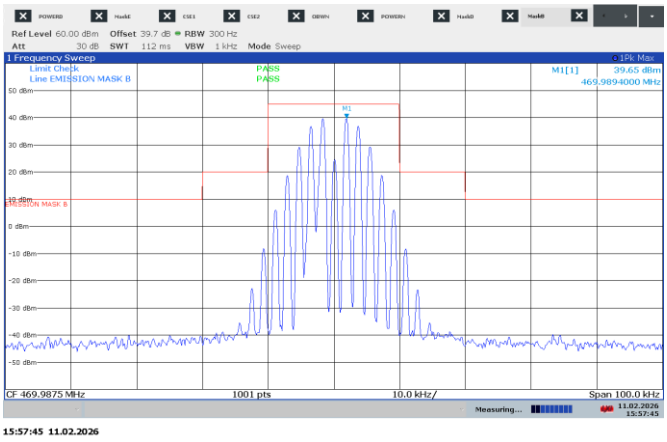


Figure 7.5-52: *Emission mask B for FFSK@25kHz at High CH*

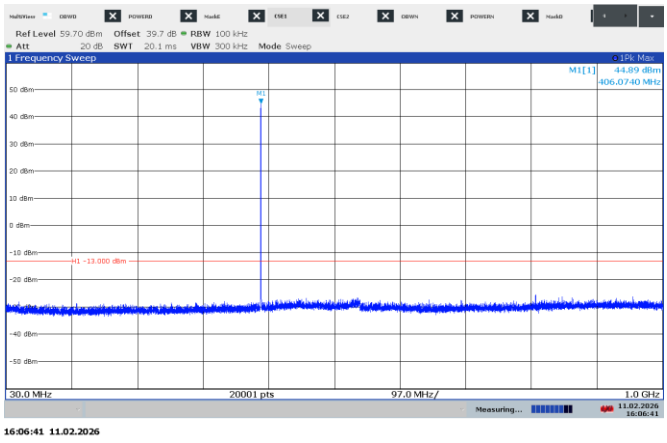


Figure 7.5-53: *Conducted spurious emissions below 1GHz, FFSK@25kHz, Low CH*

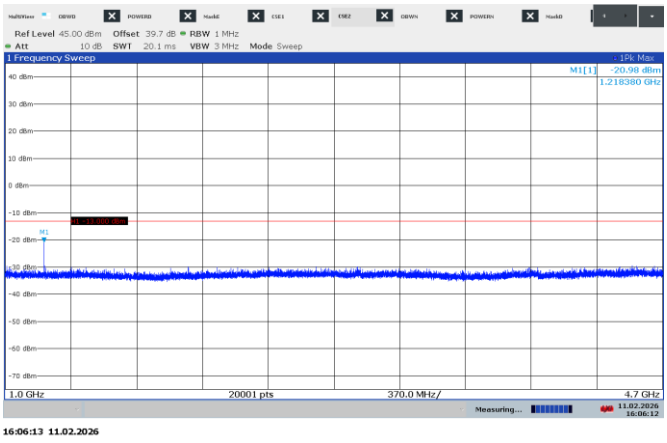


Figure 7.5-54: *Conducted spurious emissions above 1GHz, FFSK@25kHz, Low CH*

Test data, continued

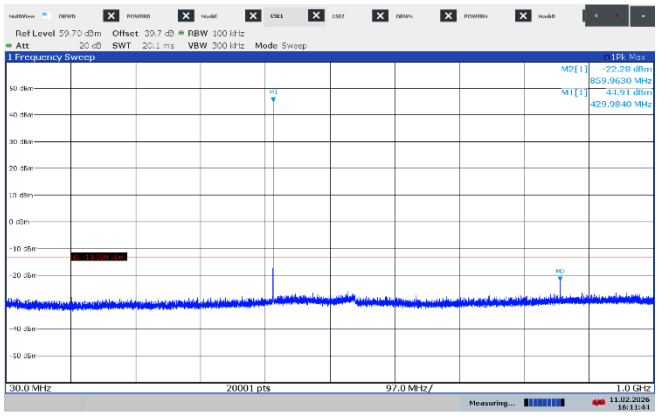


Figure 7.5-55: *Conducted spurious emissions below 1GHz, FFSK@25kHz, Mid CH1*

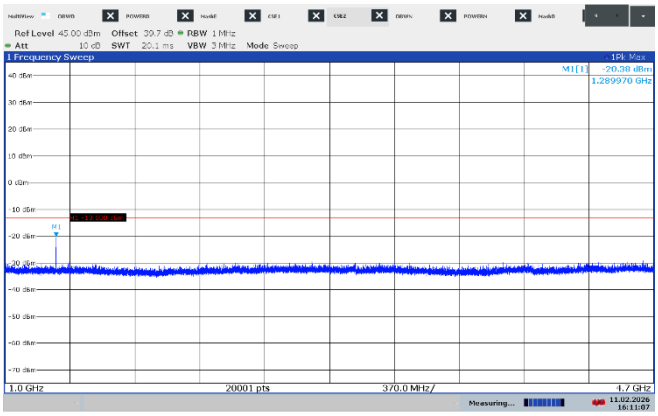


Figure 7.5-56: *Conducted spurious emissions above 1GHz, FFSK@25kHz, Mid CH1*

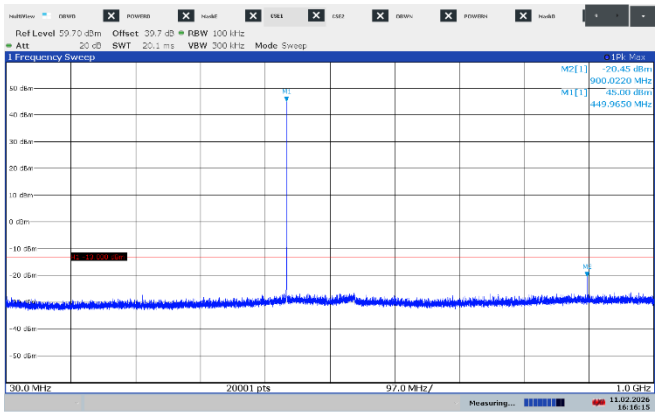


Figure 7.5-57: *Conducted spurious emissions below 1GHz, FFSK@25kHz, Mid CH2*

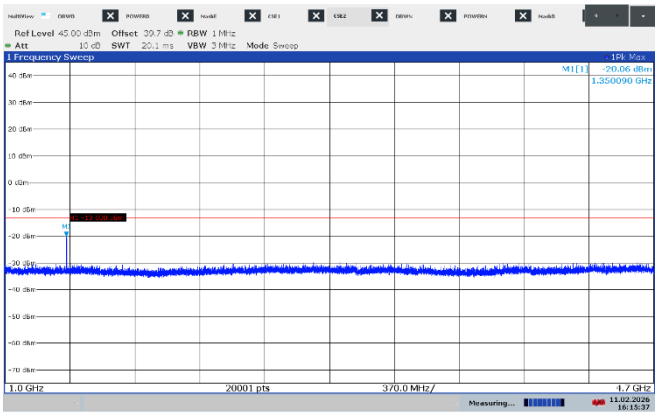


Figure 7.5-58: *Conducted spurious emissions above 1GHz, FFSK@25kHz, Mid CH2*

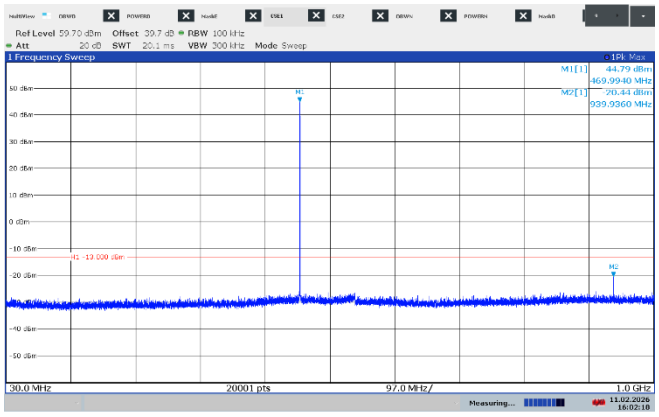


Figure 7.5-59: *Conducted spurious emissions below 1GHz, FFSK@25kHz, High CH*

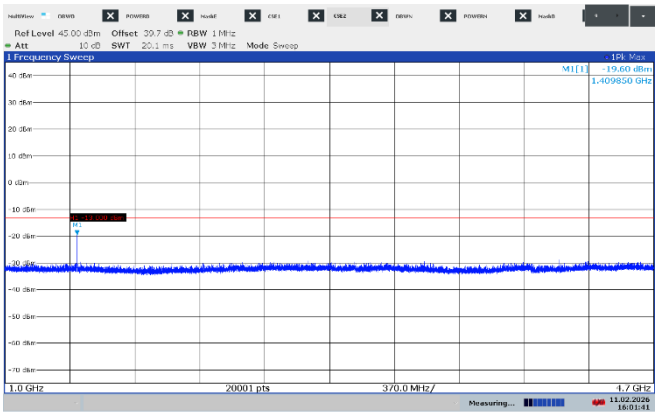


Figure 7.5-60: *Conducted spurious emissions above 1GHz, FFSK@25kHz, High CH*

Test data, continued

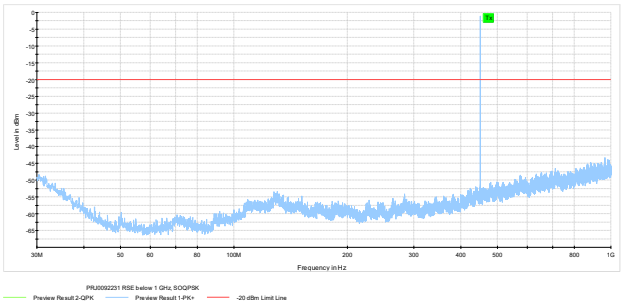


Figure 7.5-61: *Radiated spurious emissions below 1GHz, SOQPSK*

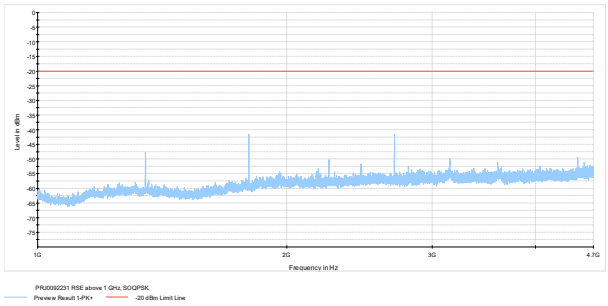


Figure 7.5-62: *Radiated spurious emissions above 1GHz, SOQPSK*

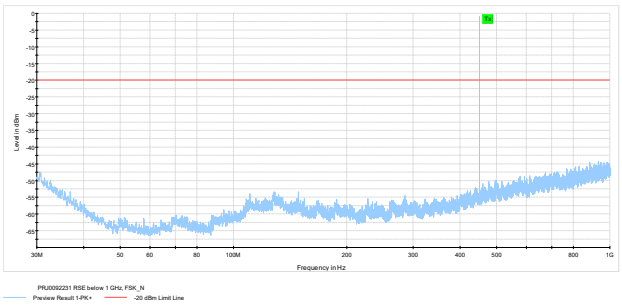


Figure 7.5-63: *Radiated spurious emissions below 1GHz, FSK@12.5kHz*

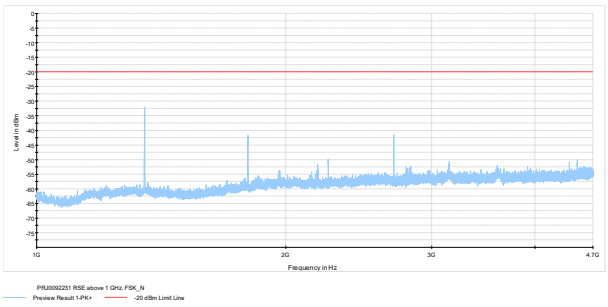


Figure 7.5-64: *Radiated spurious emissions above 1GHz, FSK@12.5kHz*

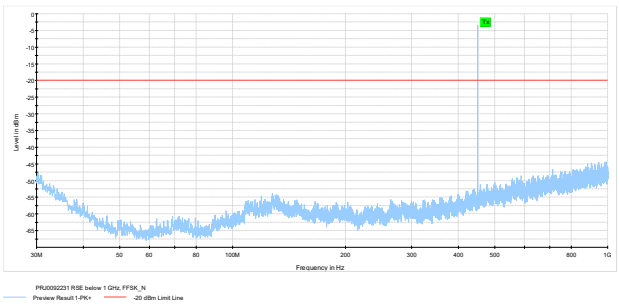


Figure 7.5-65: *Radiated spurious emissions below 1GHz, FFSK@12.5kHz*

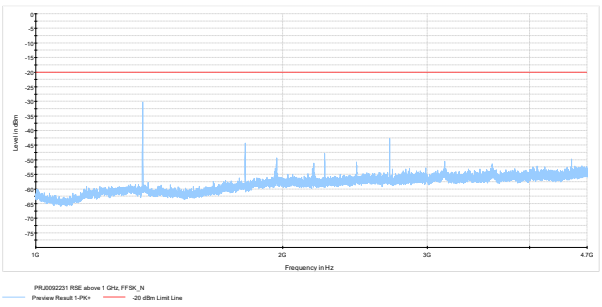


Figure 7.5-66: *Radiated spurious emissions above 1GHz, FFSK@12.5kHz*

Test data, continued

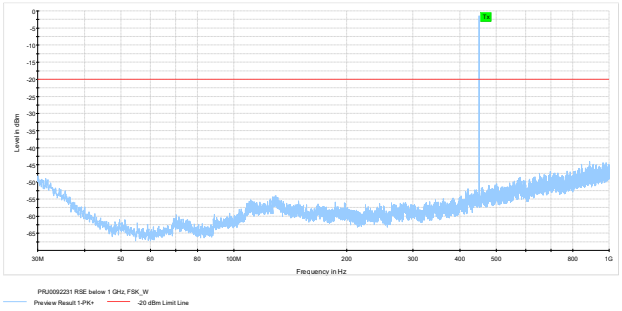


Figure 7.5-67: *Radiated spurious emissions below 1GHz, FSK@25kHz*

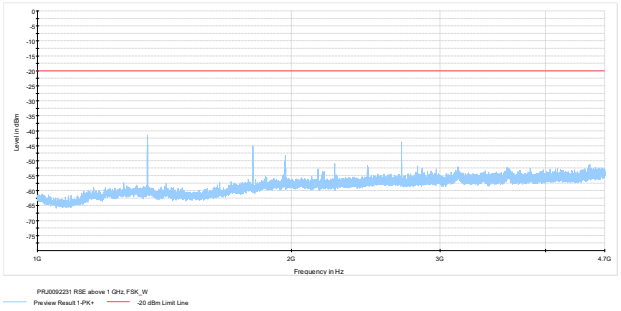


Figure 7.5-68: *Radiated spurious emissions above 1GHz, FSK@25kHz*

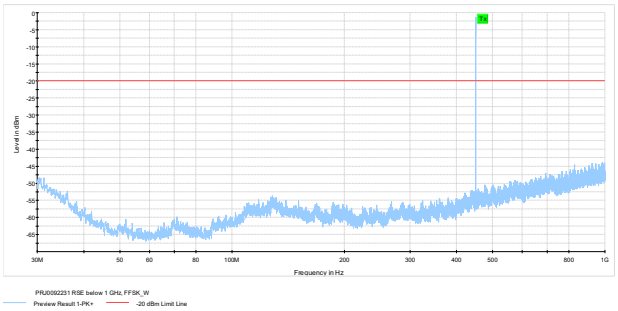


Figure 7.5-69: *Radiated spurious emissions below 1GHz, FFSK@25kHz*

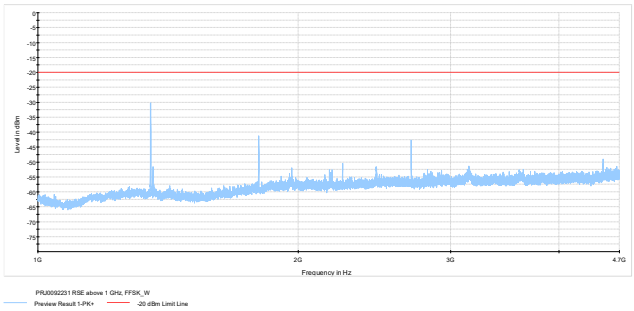


Figure 7.5-70: *Radiated spurious emissions above 1GHz, FFSK@25kHz*

7.6 Transient frequency behavior

7.6.1 References, definitions and limits

FCC §90.214:

Transmitters designed to operate in the 421–512 MHz frequency band must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Table 7.6-1: *Transient frequency behavior*

Time intervals[1,2]	Maximum frequency difference[3]	Transient duration limit
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels		
t_1[4]	±25.0 kHz	10.0 ms
t_2	±12.5 kHz	25.0 ms
t_3[4]	±25.0 kHz	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels		
t_1[4]	±12.5 kHz	10.0 ms
t_2	±6.25 kHz	25.0 ms
t_3[4]	±12.5 kHz	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels		
t_1[4]	±6.25 kHz	10.0 ms
t_2	±3.125 kHz	25.0 ms
t_3[4]	±6.25 kHz	10.0 ms

Notes: [1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{off} is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

RSS-119, Clause 5.9:

When a transmitter is turned on, the radio frequency may take some time to stabilize. During this initial period, the frequency error or frequency difference (i.e., between the instantaneous and the steady state frequencies) shall not exceed the limits specified in Table below.
Any suitable method of measurement can be used provided that it is fully described in the test report. A suitable and recommended method is given in TIA Standard 603.

Table 7.6-2: *Transient frequency behavior*

Channel Bandwidth, kHz	Time intervals[1,2]	Maximum frequency difference	Transient duration limit
25	t_1	±25.0 kHz	10.0 ms
	t_2	±12.5 kHz	25.0 ms
	t_3	±25.0 kHz	10.0 ms
12.5	t_1	±12.5 kHz	10.0 ms
	t_2	±6.25 kHz	25.0 ms
	t_3	±12.5 kHz	10.0 ms
6.25	t_1	±6.25 kHz	10.0 ms
	t_2	±3.125 kHz	25.0 ms
	t_3	±6.25 kHz	10.0 ms

Notes: [1] t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1: the time period immediately following t_{on}.
t_2: the time period immediately following t_1.
t_3: the time period from the instant when the transmitter is turned off until t_{off}.
t_{off}: the instant when the 1 kHz test signal starts to rise.
[2] If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t_1 and t_3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t_1 and t_3 shall be recorded in the test report.

7.6.2 Test summary

Verdict	Pass		
Test date	March 6, 2026	Temperature	24 °C
Tested by	Alvin Liu	Air pressure	980 mbar
Test location	Cambridge	Relative humidity	45 %

7.6.3 Observations, settings and special notes

None

7.6.4 Test data

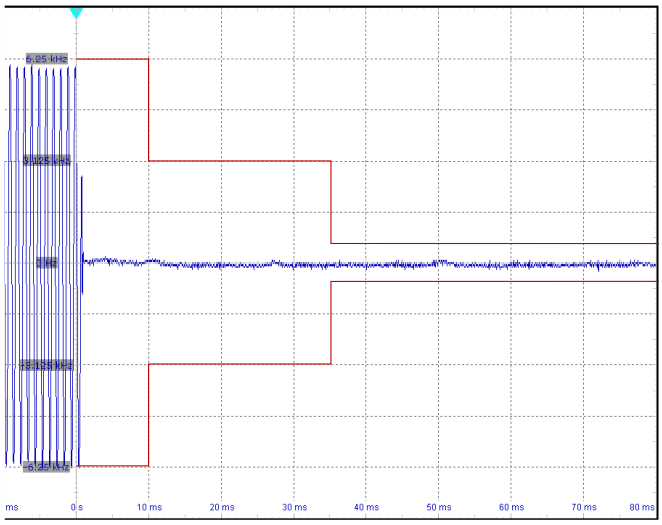


Figure 7.6-1: *Transient Frequency behavior for 6.25 kHz, switch ON*

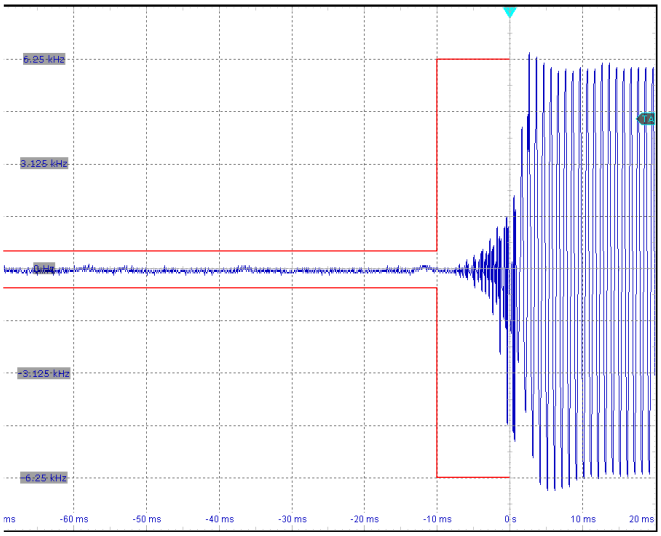


Figure 7.6-2: *Transient Frequency behavior for 6.25 kHz, switch OFF*

Test data, continued

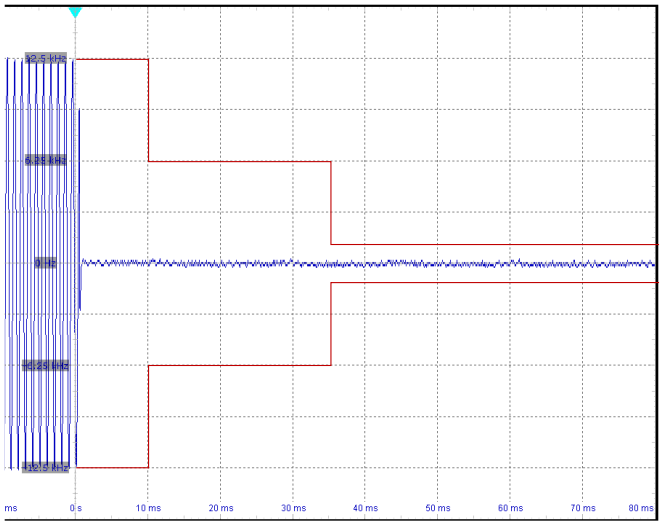


Figure 7.6-3: *Transient Frequency behavior for 12.5kHz, switch ON*

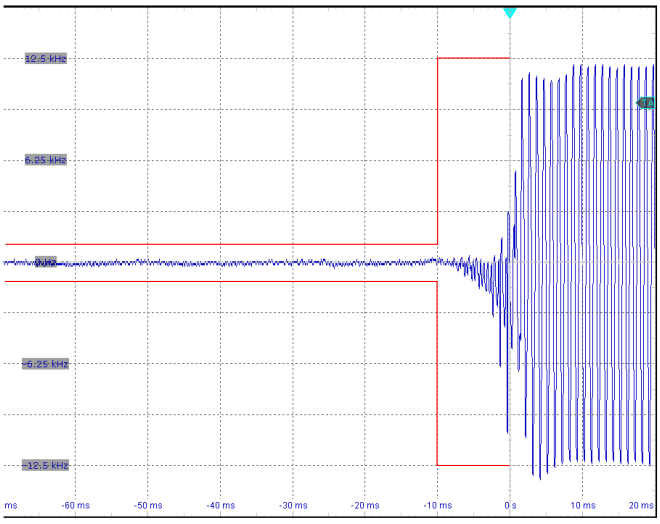


Figure 7.6-4: *Transient Frequency behavior for 12.5kHz, switch OFF*

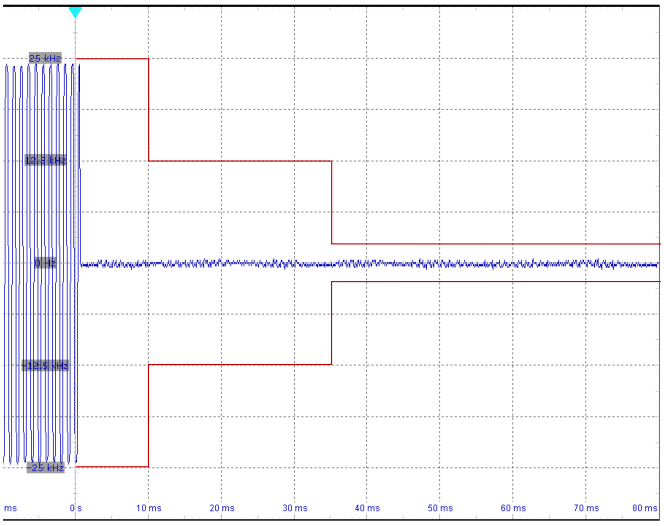


Figure 7.6-5: *Transient Frequency behavior for 25kHz, switch ON*

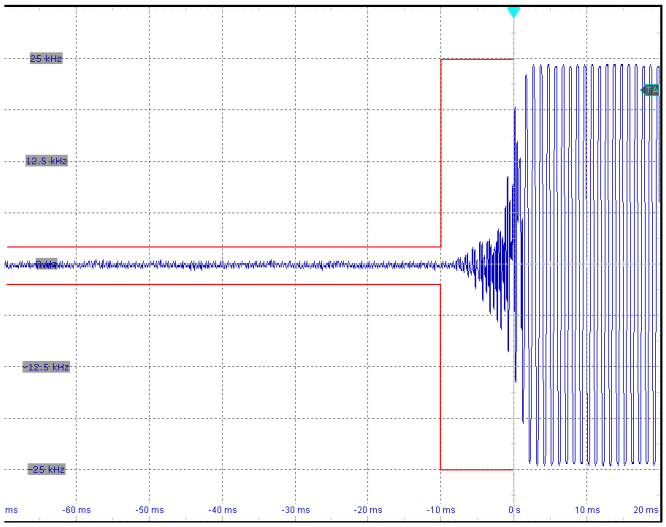


Figure 7.6-6: *Transient Frequency behavior for 25kHz, switch OFF*

7.7 Transmitter frequency stability

7.7.1 References, definitions and limits

FCC §90.213:

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Table 7.7-1: *Minimum frequency stability*

Frequency range (MHz)	Fixed and base stations	Mobile stations over 2 watts output power	Mobile stations 2 watts or less output power
421–512	±2.5 ppm[1]	±5 ppm[2]	±5 ppm[2]

Notes: [1]In the 421–512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.
[2]In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

RSS-119, Clause 5.3:

The carrier frequency shall not depart from the reference frequency in excess of the values given in Table below. For transmitters that have an output power of less than 120 mW, the frequency stability shall comply with the limits listed in Table below or, alternatively, with the conditions in Section 5.10.

For fixed and base station equipment, in lieu of meeting the frequency stability limit specified in Table below, the test report can show that the frequency stability is met by demonstrating that the unwanted emission limits, related to the equipment's nominal carrier frequency measured under normal operation, are met when the equipment is tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

Table 7.7-2: *Transmitter frequency stability*

Frequency range (MHz)	Channel bandwidth (kHz)	Frequency stability for Base/Fixed stations (±ppm)	Frequency stability for mobile stations with output power > 2 W (±ppm)	Frequency stability for mobile stations with output power ≤ 2 W (±ppm)
406.1–430	25	2.5	5	5
and	12.5	1.5	2.5	2.5
450–470	6.25	0.5	1	1

7.7.2 Test summary

Verdict	Pass		
Test date	March 5, 2026	Temperature	24 °C
Tested by	Alvin Liu	Air pressure	985 mbar
Test location	Cambridge	Relative humidity	43 %

7.7.3 Observations, settings and special notes

- Frequency stability measurements were performed with reference to ANSI 63.26 section 5.6.3 and section 5.6.5
- Test was performed while EUT was transmitting at middle channel with unmodulated carrier (CW). The minimum limit of Channel bandwidth 6.25 kHz was selected as a representative one.
- Offset was calculated as per the following formula: $\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^6$

Spectrum analyser settings:

Resolution bandwidth	1 kHz
Video bandwidth	3 kHz
Detector mode	RMS
Trace mode	Max hold

7.7.4 Test data

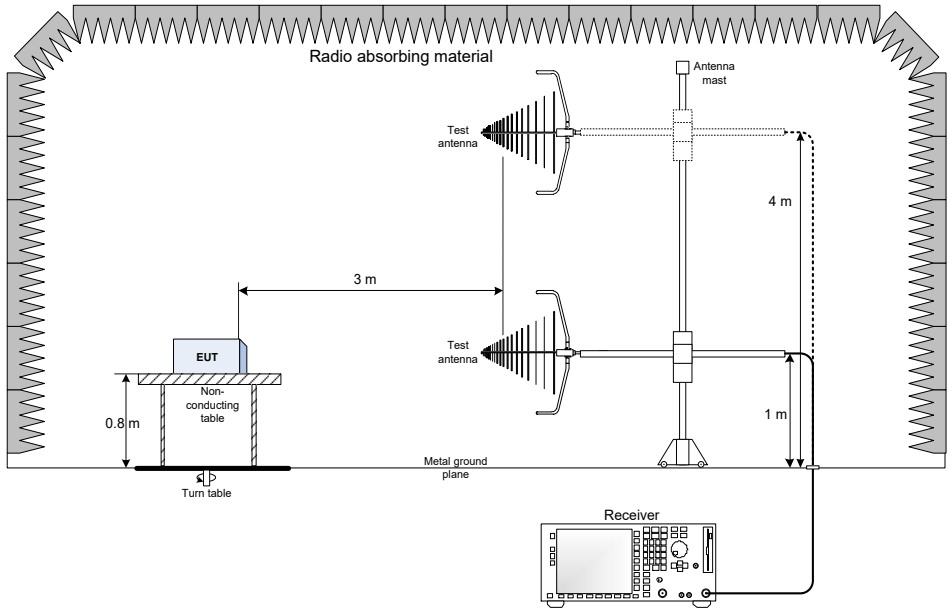
Table 7.7-3: *Transmitter frequency stability results*

Test conditions	Frequency, Hz	Drift, Hz	Drift, ppm	Limit ±ppm	Margin, ppm
+50 °C, Nominal	450012663	125	0.278	1.000	0.722
+40 °C, Nominal	450012650	112	0.249	1.000	0.751
+30 °C, Nominal	450012606	68	0.151	1.000	0.849
+20 °C, +15 %	450012538	0	0.000	1.000	1.000
+20 °C, Nominal	**450012538**		***Reference***		
+20 °C, −15 %	450012536	-2	-0.004	1.000	0.996
+10 °C, Nominal	450012530	-8	-0.018	1.000	0.982
0 °C, Nominal	450012512	-26	-0.058	1.000	0.942
−10 °C, Nominal	450012506	-32	-0.071	1.000	0.929
−20 °C, Nominal	450012495	-43	-0.096	1.000	0.904
−30 °C, Nominal	450012486	-52	-0.116	1.000	0.884

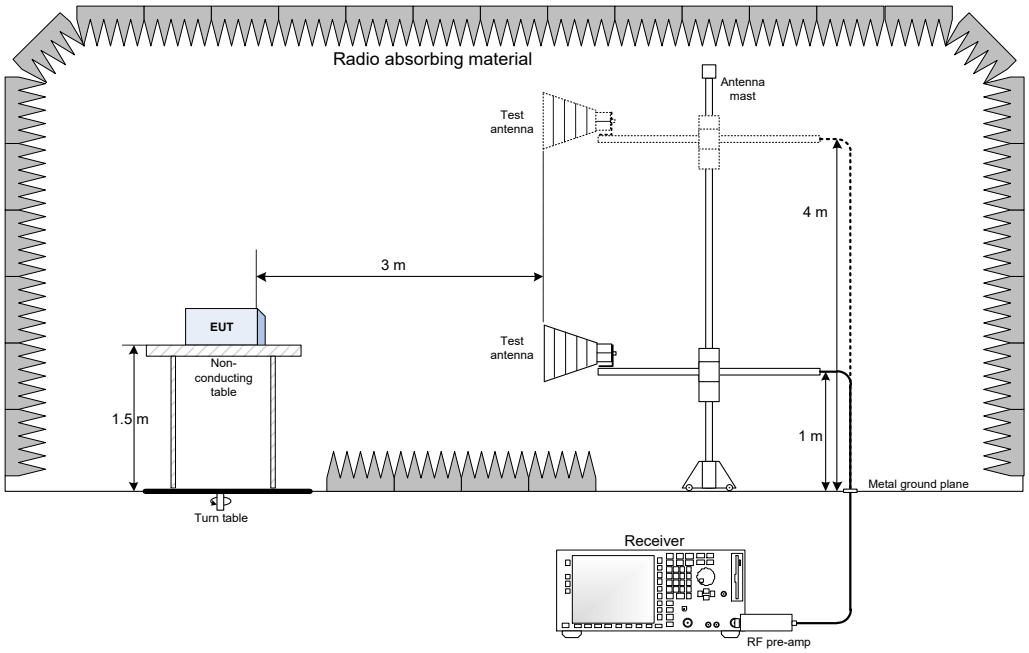
Note: Parts per million (ppm) is obtained as the difference from the reference frequency (in Hz) divided by the reference frequency (in MHz).

Section 8 Test setup diagrams

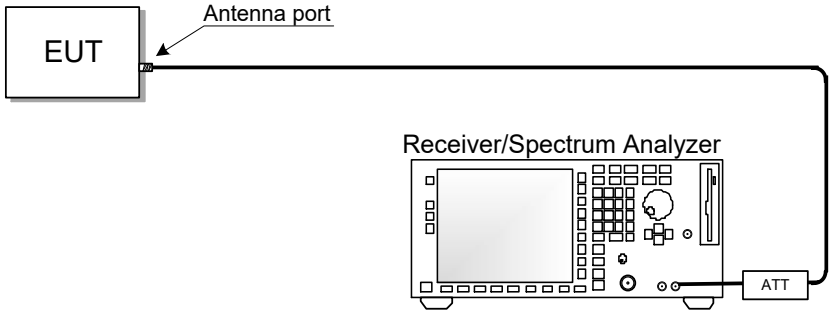
8.1 Radiated emissions set-up for frequencies below 1 GHz



8.2 Radiated emissions set-up for frequencies above 1 GHz



8.3 Antenna port set-up



End of the test report