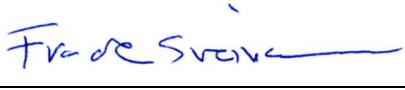




Report No. 407776-02-R02

Test Report

Product	Hearing Protection with 2-way UHF Transceiver
Name and address of the applicant	Hellberg Safety AB Stakebergsvägen 2 44361 Stenkullen, Sweden
Name and address of the manufacturer	Hellberg Safety AB Stakebergsvägen 2 44361 Stenkullen, Sweden
Model	LOCAL 465 HEADBAND, LOCAL 465 HELMET MOUNT
Rating	2.4 V _{DC} (Secondary Batteries, 2x NiMH cells)
Trademark	Hellberg
Serial number	PRE0100001
Additional information	Family Radio Service, Hearing Protection
Tested according to	FCC Part 95B Family Radio Service (FRS) Industry Canada RSS-210, Issue 10 License-Exempt Radio Apparatus: Category I Equipment
Order number	407776
Tested in period	2021-07-29 to 2021-08-19
Issue date	2021-10-19
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway www.nemko.com
	CAB Number: FCC: NO0001 ISED: NO0470 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50
	  An accredited technical test executed under the Norwegian accreditation scheme
	 Prepared by [Frode Sveinsen]
	 Approved by [G. Suhanthakumar]
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Template version: B

Nemko Norway

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1 INFORMATION

1.1 Test Item

Name	Hellberg
FCC ID	QF9LOCALUS
ISED ID	5808A-LOCALUS
Model/version	LOCAL 465 HEADBAND LOCAL 465 HELMET MOUNT
Serial number	PRE0100001
Hardware identity and/or version	HW 1.0 (PCBA 17423 ver B, 17426 ver C, 17425 ver E)
Software identity and/or version	1.1
Frequency Range	462.550 to 462.7250 and 467.5625 to 467.7125 MHz
Tunable Bands	None
Number of Channels	22
Type of Modulation	F3E
Channel Separation	12.5 kHz
User Frequency Adjustment	None
Rated Output Power	157 mW
Type of Power Supply	Secondary Batteries (2x 1.2V NiMH cells)
Antenna Connector	None (Integral Antenna)
Charger	USB Charger
Ports	3.5mm jack for microphone connection

Theory of Operation

The EUT is a Hearing Protection with two-way radio. The EUT also contains a Receiver.

The tested device was the Headband version, both versions are electrically identical.

1.2 Normal Test Conditions

Temperature:	21 - 24 °C
Relative humidity:	30 - 50 %
Normal test voltage:	2.5 V DC (Nominal Battery Voltage)

The values are the limit registered during the test period. All tests were performed with a fully charged battery.

1.3 Test Engineer(s)

Frode Sveinsen

1.4 EUT Operating Modes and Test Set-up

Description of operating modes	The EUT was in normal mode transmitting analogue speech during all tests. The transmitter was activated with the TX button.
Additional information	The EUT was modulated through the 3.5mm Mic Input connector. The audio signal from the tester was supplied through a 600 Ohm transformer. The EUT has no external antenna connector. Conducted measurements were performed on the internal U-FL connector.

1.5 Comments

All tests were performed with Output Power at maximum position.

All ports were populated during spurious emission measurements.



2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 95B and Industry Canada RSS-210 Issue 10.

Radiated tests were conducted in accordance with ANSI C63.4-2014 and ANSI C63.26-2015.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 3m.

A description of the test facility is on file with the FCC and Industry Canada.

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

FRE Equipment Code

Family Listing



THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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2.2 Test Summary

Name of test	FCC Parts 2 and Part 95 Reference	ISED Canada RSS-210, Issue 10 Reference	Test Method ANSI C63.26-2015 Reference	Result
RF Power Output	2.1046 95.567	E.1.5	5.2	Complies
Channel Bandwidth, Authorized Bandwidth, Occupied Bandwidth and Spectrum Masks	2.1049 95.573, 95.575	E.1.3 E.1.4 E.1.7	5.4	Complies
Spurious Emissions at antenna terminals	2.1051, 2.1057 95.579	E.1.8	5.7	Complies
Field Strength of Transmitter Spurious Radiations	2.1053, 2.1057 95.579	E.1.8	5.5	Complies
Frequency Stability	2.1055 95.565	E.1.9	5.6	Complies



3 TEST RESULTS

3.1 RF Output Power (ERP)

FCC Part 2.1046, 95.567

ISED Canada RSS-210 Issue 10, Clause E.1.5

Measurement Method: ANSI C63.26-2015 Clause 5.2

Test Results: Complies

Measurement Data:

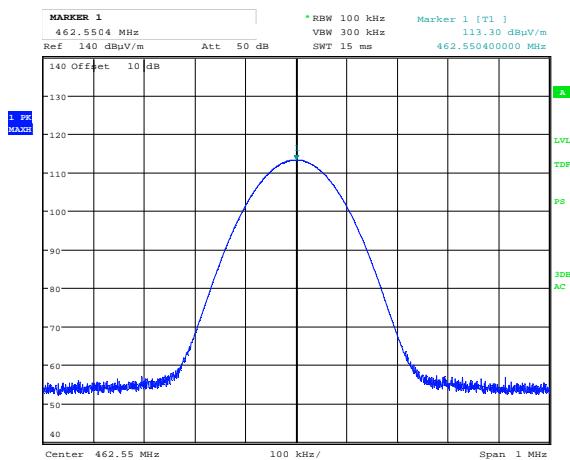
Frequency	Measured Field Strength	Calculated EIRP		Calculated ERP	
		dB μ V/m @3m	dBm	dBm	mW
462.5500 MHz	113.3		18.1	16.0	39.4
467.5625 MHz	113.1		17.9	15.8	37.8
467.7125 MHz	113.1		17.9	15.8	37.8

Effective Radiated Power is calculated from Field Strength using the formulas in KDB 412172 D01.

The measurement is performed with the EUT transmitting continuously and unmodulated.

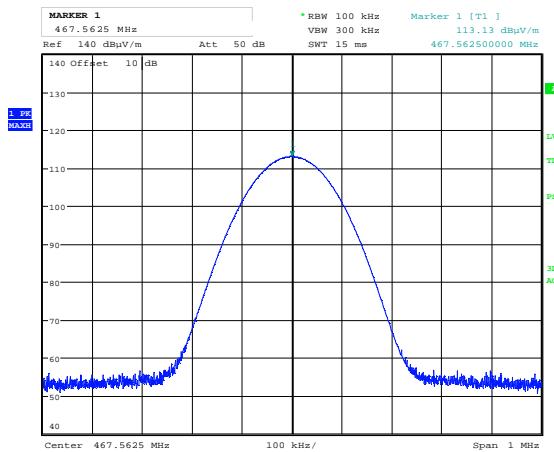
Requirements:

Type of Equipment	FCC §95.567	ISED Canada RSS-210, Issue 10
Channels 8 through 14	0.5 W	0.5 W
Channels 1 through 7 and 15 through 22	2 W	2 W



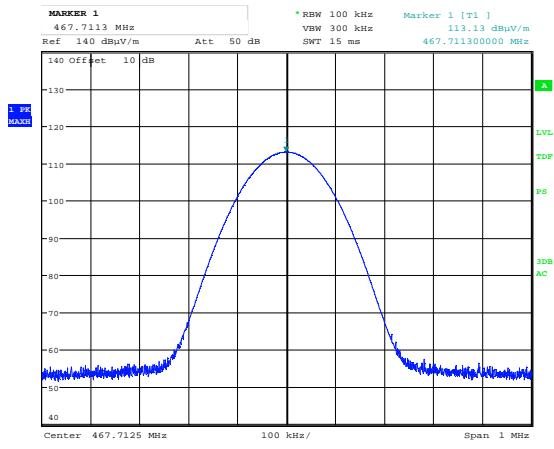
Date: 30.JUL.2021 11:56:56

Field Strength, 462.550 MHz



Date: 30.JUL.2021 11:59:42

Field Strength, 467.5625 MHz



Date: 30.JUL.2021 11:58:29

Field Strength, 467.7125 MHz

3.2 Modulation Characteristics - Audio Frequency Response

FCC Parts: 2.1047, 95.573, 95.575

ISED Canada RSS-210 Issue 10, Clause E.1.3, E.1.7

ANSI C63.26-2015, Clause 5.3

Test Results: Complies

Measurement Data:

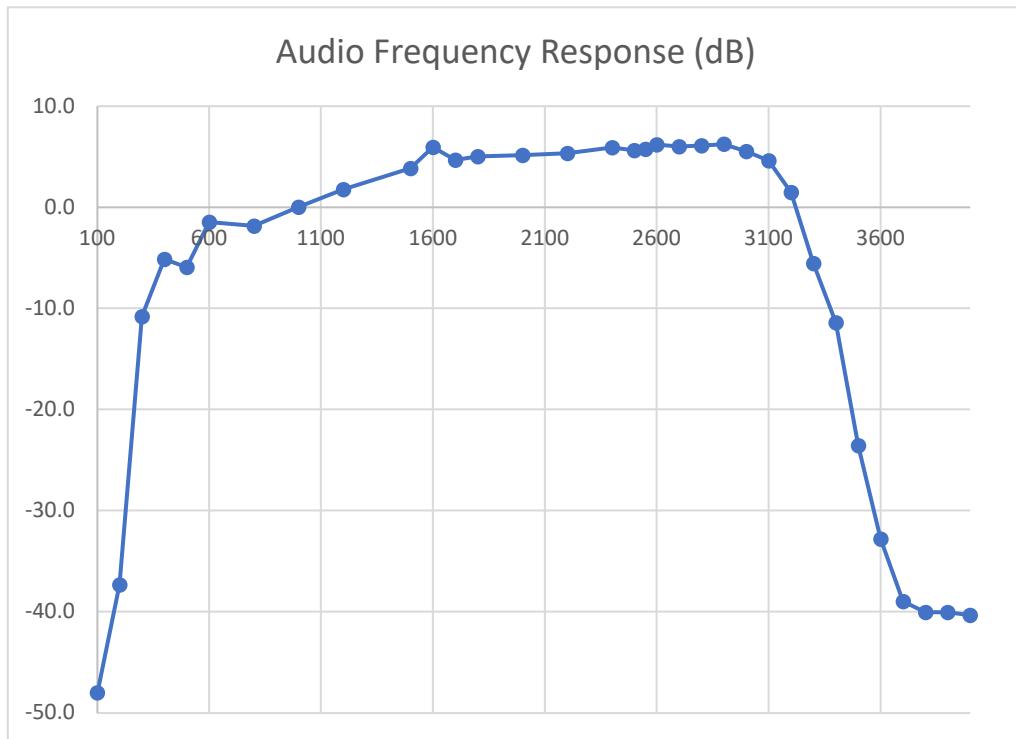
Carrier Frequency: 467.5625 MHz

Channel Spacing 12.5 kHz		
Freq (Hz)	Modulation (kHz)	Modulation (dB)
100	0.004	-48.0
200	0.014	-37.3
300	0.29	-10.8
400	0.55	-5.1
500	0.50	-5.9
600	0.84	-1.5
800	0.81	-1.9
1000	1.00	0.0
1200	1.22	1.7
1500	1.55	3.8
1700	1.71	4.7
2000	1.80	5.1
2200	1.85	5.3
2400	1.97	5.9
2550	1.93	5.7
2600	2.03	6.2
2700	1.99	6.0
3000	1.89	5.5
3200	1.18	1.5
3300	0.53	-5.6
3500	0.07	-23.6
3600	0.023	-32.8
3800	0.010	-40.1
4000	0.010	-40.4
4500	0.009	-41.0
5000	0.009	-41.0

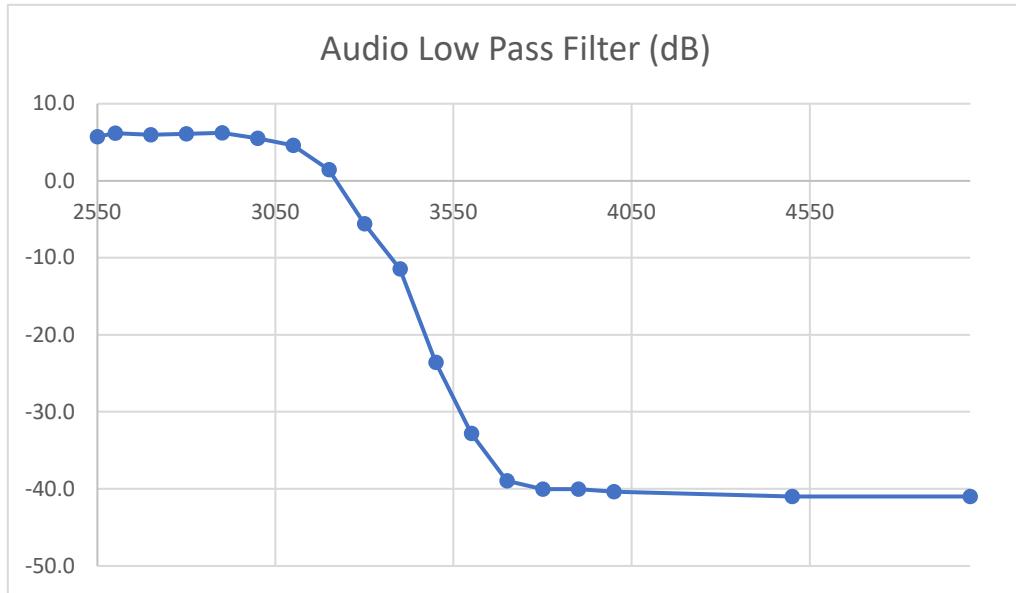
See plots.

Requirements:

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.



Audio Frequency Response (dB), Ch 12.5kHz, 467.5625 MHz



Audio Low Pass Filter (dB), Ch 12.5kHz, 467.5625 MHz

3.3 Modulation Characteristics - Modulation Limiting

Measurement Procedure:

FCC Parts: 2.1047, 95.575

ISED Canada RSS-210 Issue 10, Clause E.1.3

ANSI C63.26-2015, Clause 5.3

Test Results: Complies

Measurement Data:

Carrier Frequency = 467.5625 MHz, Channel Width 12.5 kHz, Maximum Modulation

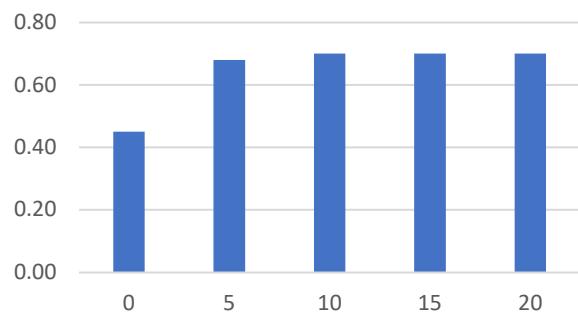
Input Level	Peak Modulation kHz			
	300 Hz	1000 Hz	2500 Hz	3000 Hz
0	0.45	1.50	1.80	1.75
5	0.68	1.78	1.83	1.83
10	0.70	1.79	1.84	1.84
15	0.70	1.80	1.84	1.84
20	0.70	1.80	1.84	1.81

See plots.

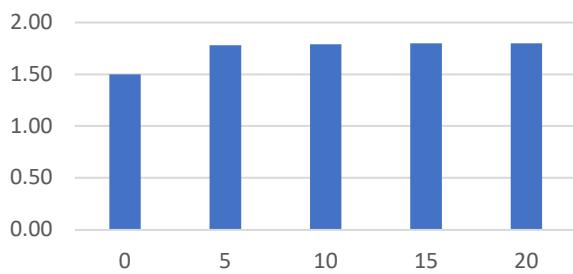
Requirements:

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.

Modulation Limiting 300Hz

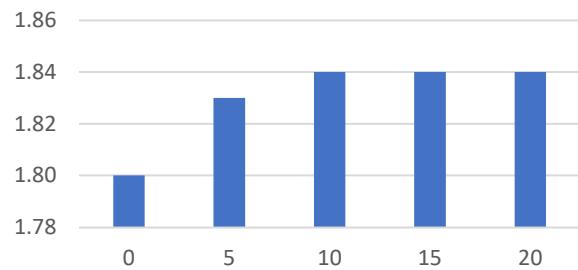


Modulation Limiting 1000Hz



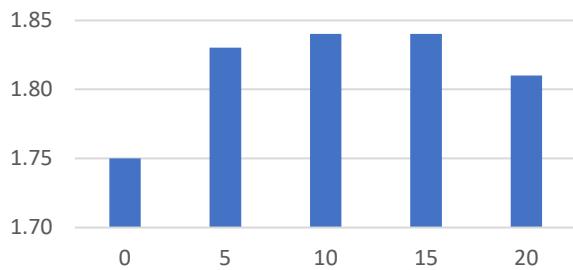
Modulation Limiting, 300 Hz

Modulation Limiting 2500Hz



Modulation Limiting, 1000 Hz

Modulation Limiting 3000Hz



Modulation Limiting, 2500 Hz

Modulation Limiting, 3000 Hz



3.4 Emission Mask and Occupied Bandwidth

FCC Parts 2.1049, 95.573, 95.579

ISED Canada RSS-210 Issue 10, Clause E.1.4, E.1.8(a)

Measurement Method: ANSI C63.26-2015, Clause 5.4

Test Results: Complies

Measurement Data: See plots

See attached graph.

For this test, the EUT was made to transmit continuously with modulation activated.

Requirements:

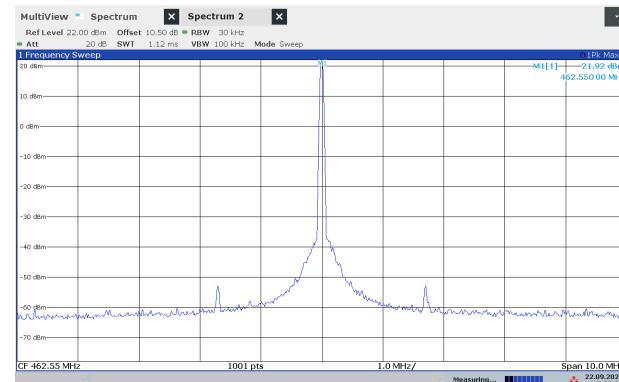
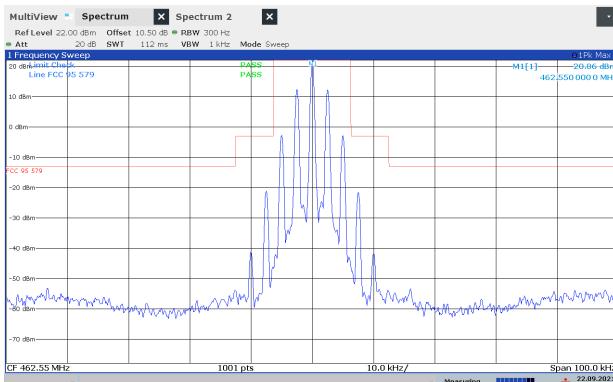
FCC §95.579 (d)

RSS-210 Issue 10, E.1.8(a)

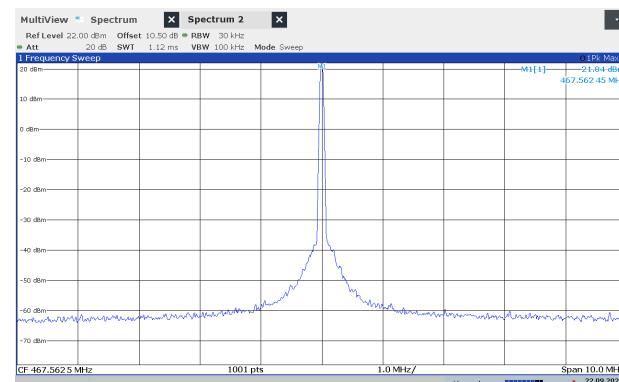
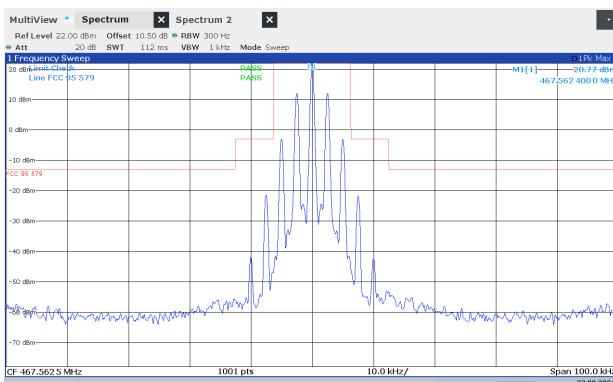
(a) **Attenuation requirements.** The power of unwanted emissions must be attenuated below the carrier power output in Watts (P) by at least:

- (1) 25 dB (decibels) in the frequency band 6.25 kHz to 12.5 kHz removed from the channel center frequency.
- (2) 35 dB in the frequency band 12.5 kHz to 31.25 kHz removed from the channel center frequency.
- (3) $43 + 10 \log (P)$ dB in any frequency band removed from the channel center frequency by more than 31.25 kHz.

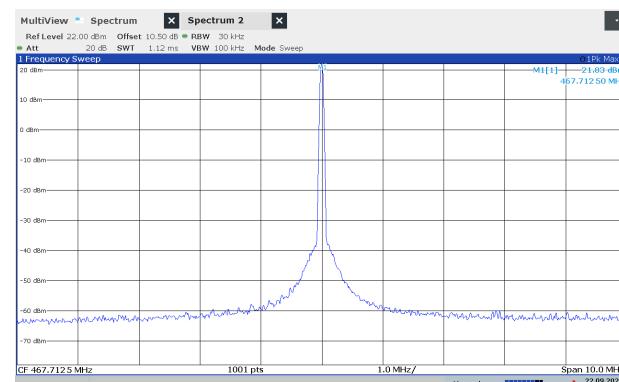
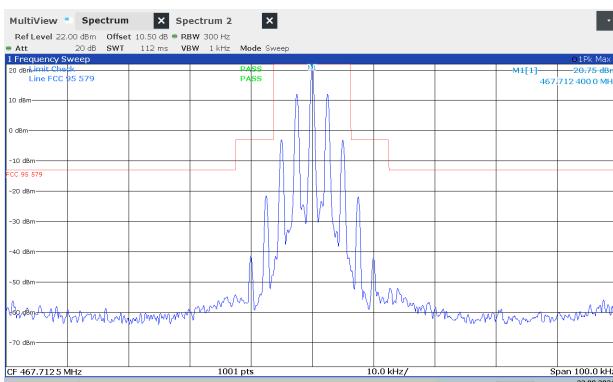
(b) **Measurement bandwidths.** The power of unwanted emissions in the frequency bands specified in [paragraphs \(a\)\(1\)](#) and [\(2\)](#) of this section is measured with a reference bandwidth of 300 Hz. The power of unwanted emissions in the frequency range specified in paragraph (a)(3) is measured with a reference bandwidth of at least 30 kHz.



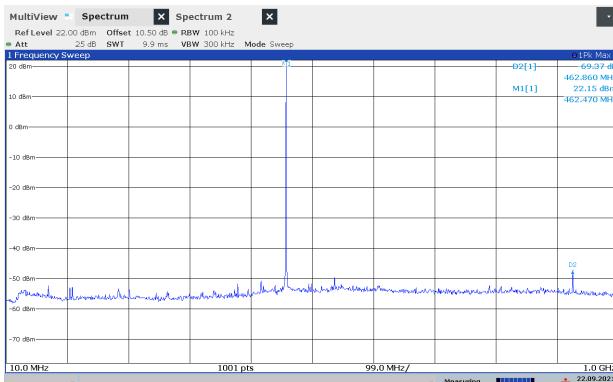
Emission Mask 2500Hz, 462.5500 MHz



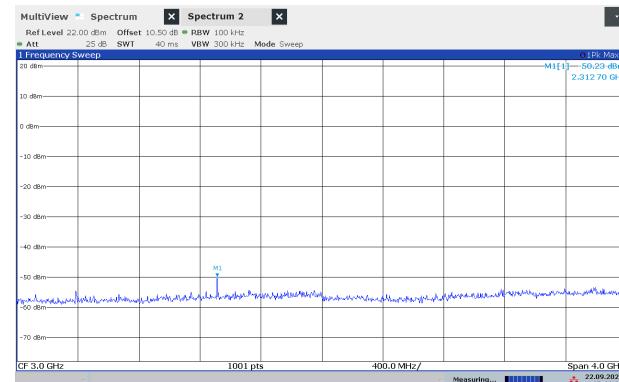
Emission Mask 2500Hz, 467.5625 MHz



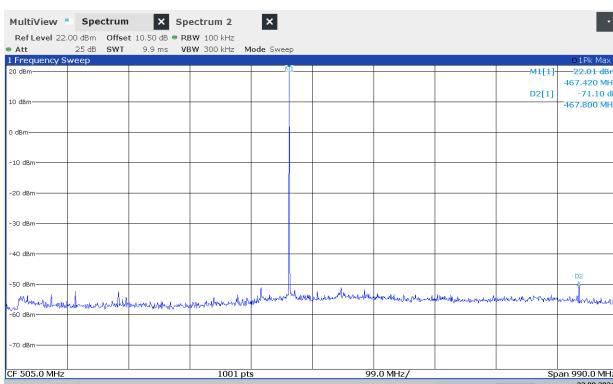
Emission Mask 2500Hz, 467.7125 MHz



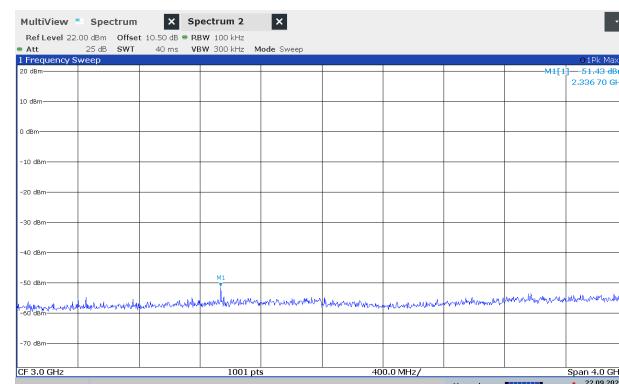
Emissions 10-1000MHz, 462.5500 MHz



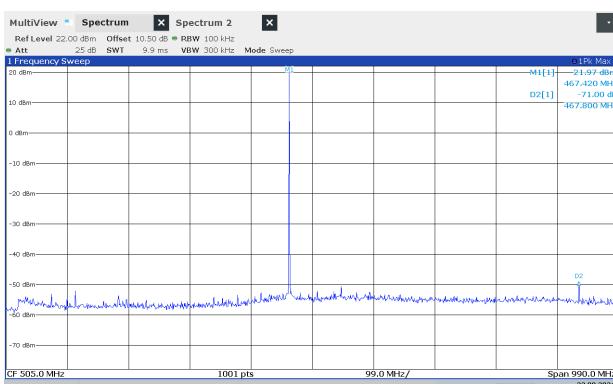
Emissions 1000-5000MHz, 462.5500 MHz



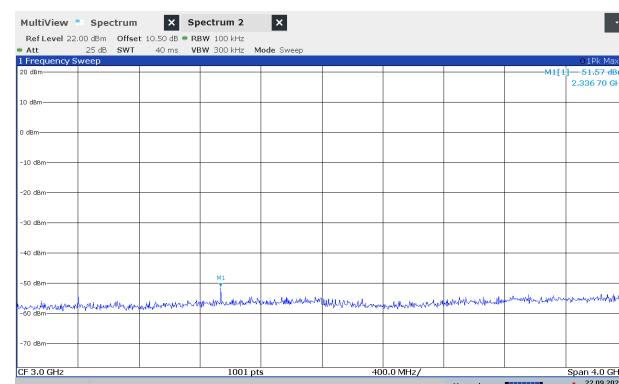
Emissions 10-1000MHz, 467.5625 MHz



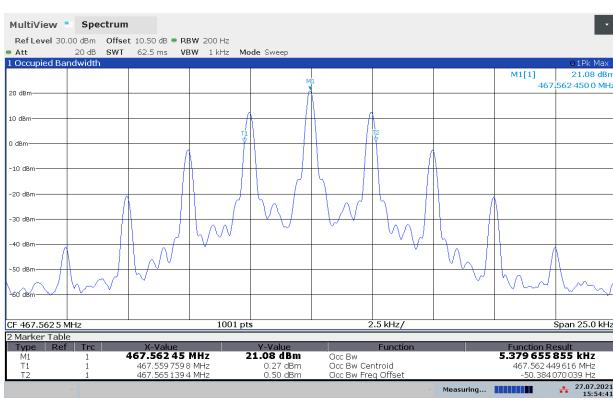
Emissions 1000-5000MHz, 467.5625 MHz



Emissions 10-1000MHz, 467.7125 MHz



Emissions 1000-5000MHz, 467.7125 MHz



99% Occupied Bandwidth, 2500 Hz



3.5 Field Strength of Transmitter Spurious Radiations

FCC Part 2.1053, 2.1057, 95.579

ISED Canada RSS-210 Issue 10, Clause E.1.8

Measurement Method: ANSI C63.26-2015 Clause 5.5

Test Results: Complies

Measurement Data:

Carrier Frequency (MHz)	Spurious Frequency (MHz)	Measurement BW (MHz)	Measured Value (dB μ V/m @3m)	Calculated EIRP Value (dBm)	Limit (dB)	Margin (dB)
462.5500	925.1	0.1	30.53	-64.7	-20	44.7
467.5625	935.1	1.0	34.65	-60.6	-20	40.6
462.5500	1387.7	1.0	61.96	-33.3	-20	13.3
467.5625	1402.7	1.0	64.59	-30.6	-20	10.6
467.5625	1870.3	1.0	46.48	-48.7	-20	28.7
467.5625	2337.8	1.0	49.03	-46.2	-20	26.2
462.5500	2775.3	1.0	48.41	-46.8	-20	26.8

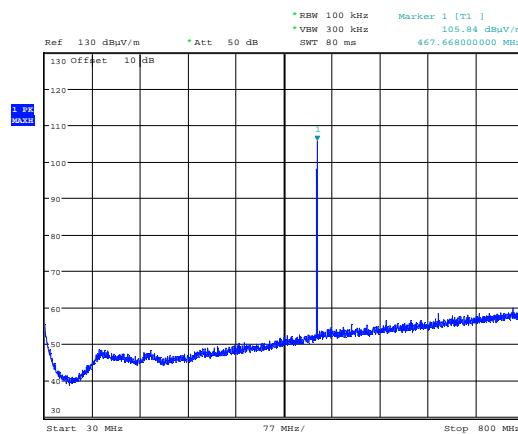
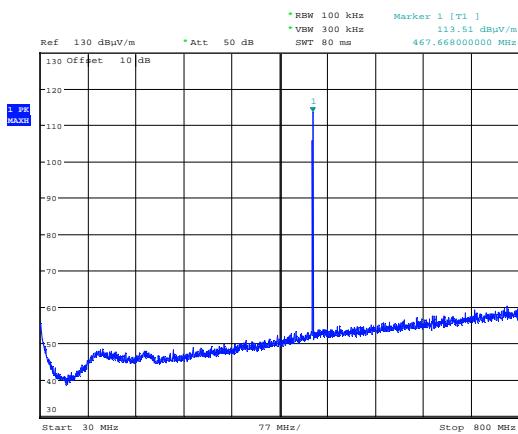
EUT was transmitting continuously during this test.

Requirements:

Each FRS transmitter type must be designed to satisfy the applicable unwanted emissions limits in this paragraph.

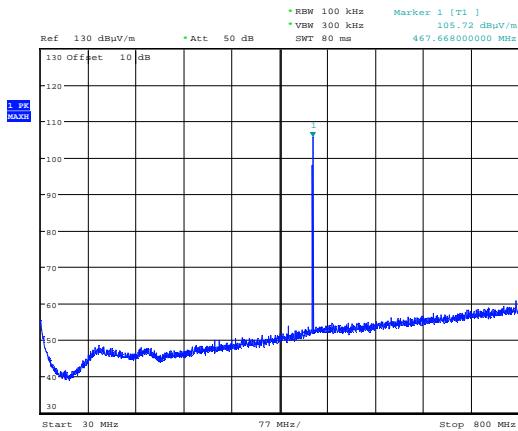
(a) *Attenuation requirements.* The power of unwanted emissions must be attenuated below the carrier power output in Watts (P) by at least:

- (1) 25 dB (decibels) in the frequency band 6.25 kHz to 12.5 kHz removed from the channel center frequency.
- (2) 35 dB in the frequency band 12.5 kHz to 31.25 kHz removed from the channel center frequency.
- (3) $43 + 10 \log (P)$ dB in any frequency band removed from the channel center frequency by more than 31.25 kHz.



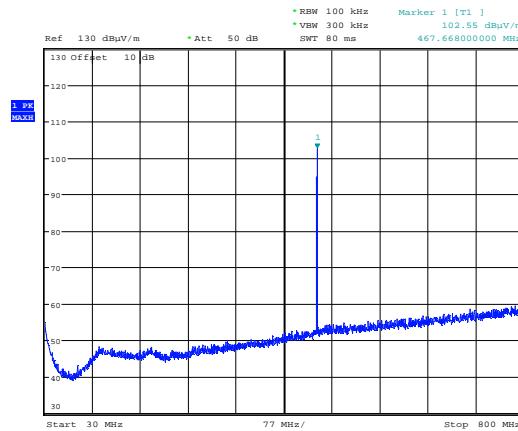
Date: 29.JUL.2021 11:02:16

Radiated Emissions, 30 -800 MHz, EUT V, VP



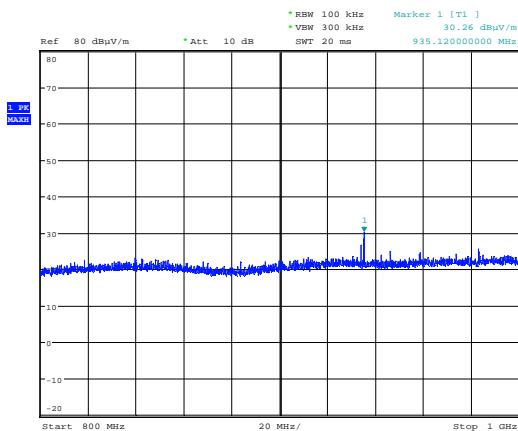
Date: 29.JUL.2021 11:04:18

Radiated Emissions, 30 -800 MHz, EUT V, HP



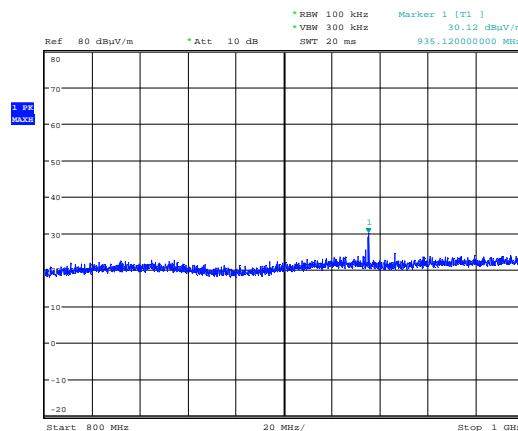
Date: 29.JUL.2021 10:46:23

Radiated Emissions, 30 -800 MHz, EUT H, VP



Date: 29.JUL.2021 10:52:15

Radiated Emissions, 30 -800 MHz, EUT H, HP

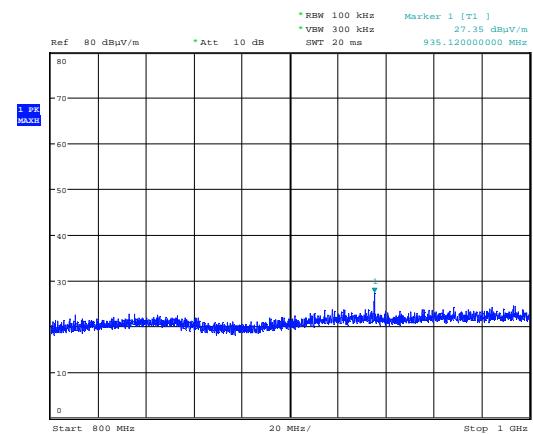
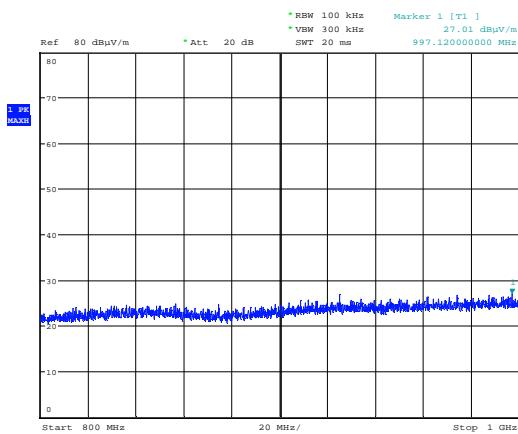


Date: 29.JUL.2021 11:10:50

Radiated Emissions, 800 -1000 MHz, EUT V, VP

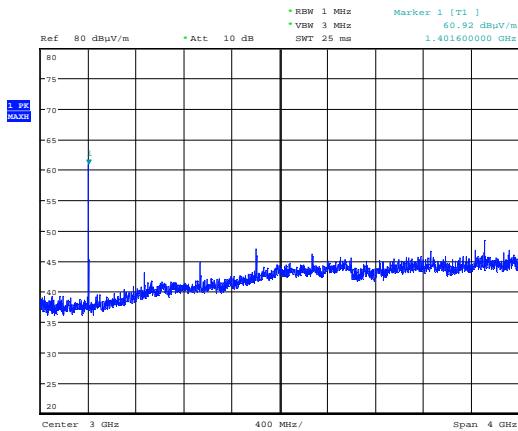
Date: 29.JUL.2021 11:12:49

Radiated Emissions, 800 -1000 MHz, EUT V, HP



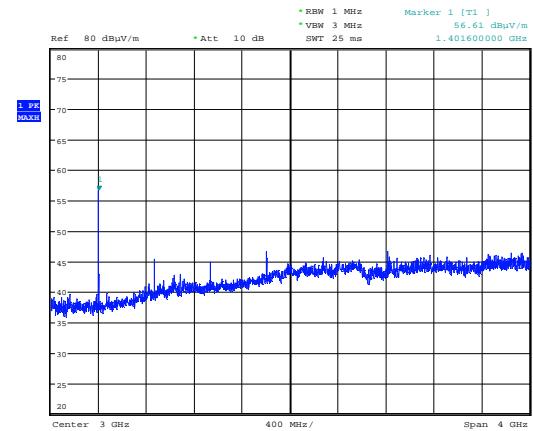
Date: 30.JUL.2021 09:56:10

Radiated Emissions, 800 -1000 MHz, EUT H, VP



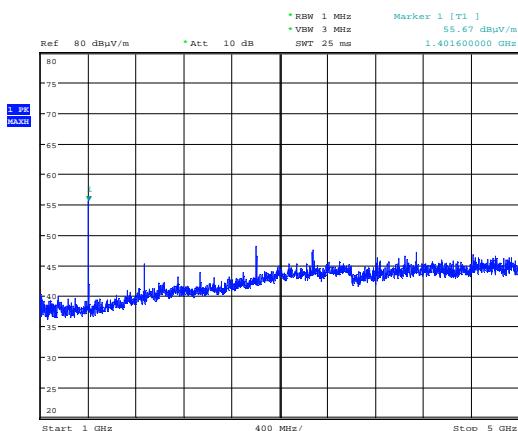
Date: 29.JUL.2021 12:12:10

Radiated Emissions, 800 -1000 MHz, EUT H, HP



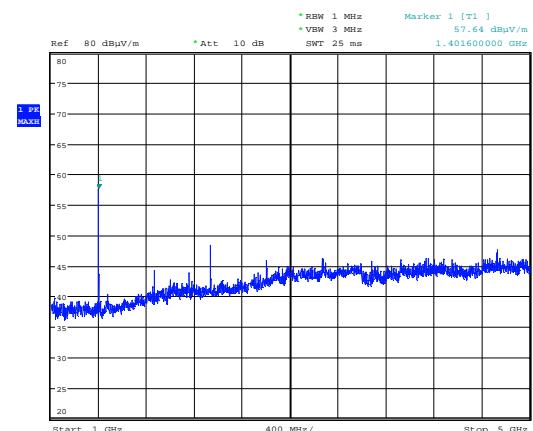
Date: 29.JUL.2021 14:32:07

Radiated Emissions, 1 -5 GHz, EUT V, VP



Date: 29.JUL.2021 14:34:20

Radiated Emissions, 1 -5 GHz, EUT V, HP

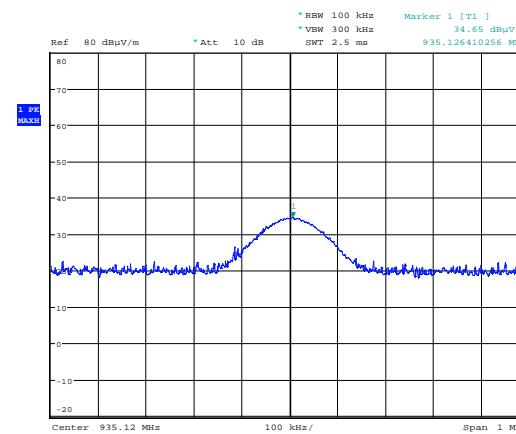
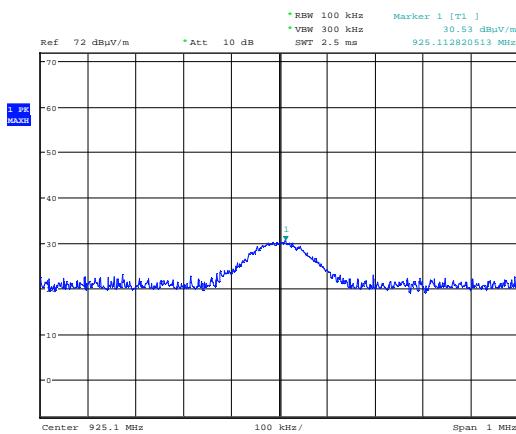


Date: 29.JUL.2021 12:58:33

Radiated Emissions, 1 -5 GHz, EUT H, VP

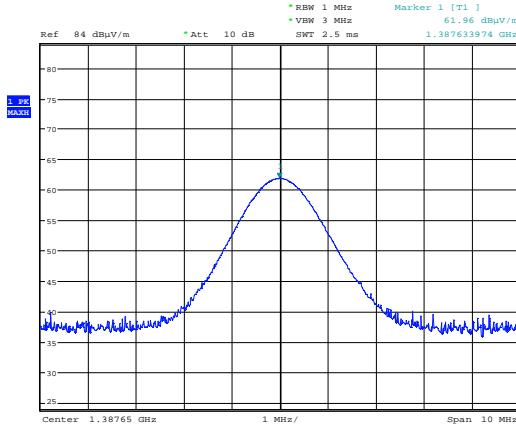
Date: 29.JUL.2021 13:00:48

Radiated Emissions, 1 -5 GHz, EUT H, HP



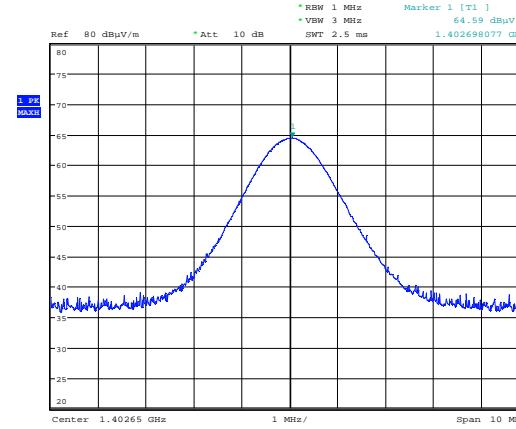
Date: 30.JUL.2021 10:25:13

Radiated Emissions, 925.1 MHz (Max: EUT H, HP)



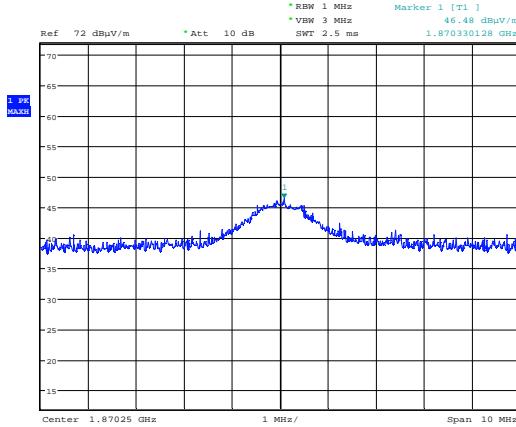
Date: 29.JUL.2021 12:00:52

Radiated Emissions, 935.1 MHz (Max: EUT H, HP)



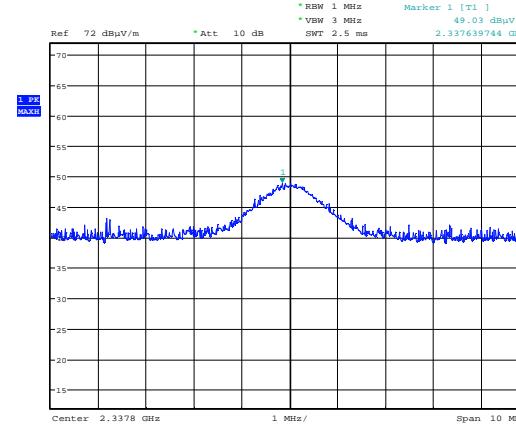
Date: 29.JUL.2021 15:25:03

Radiated Emissions, 1387.7 MHz (Max: EUT H, HP)



Date: 29.JUL.2021 13:10:32

Radiated Emissions, 1402.7 MHz (Max: EUT H, HP)

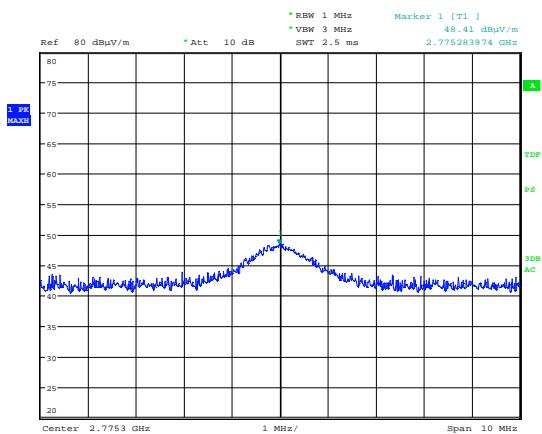


Date: 29.JUL.2021 13:28:48

Radiated Emissions, 1870.3 MHz (Max: EUT H, HP)

Date: 29.JUL.2021 13:43:14

Radiated Emissions, 2337.8 MHz (Max: EUT H, HP)



Date: 29.JUL.2021 16:01:50

Radiated Emissions, 2775.3 MHz (Max: EUT V, VP)



3.6 Frequency Stability

FCC Part 2.1055, 95.565

ISED Canada RSS-210 Issue 10, Clause E.1.9

ANSI C63.26-2015 Clause 5.6

Test Results: Complies

Measurement Data:

Carrier Frequency: 467.5625 MHz

Temperature	Measured Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
+50 °C	467.5624160	-84.0	-0.180
+40 °C	467.5624160	-84.0	-0.180
+30 °C	467.5625100	10.0	0.021
+20 °C	467.5625860	86.0	0.184
+10 °C	467.5626090	109.0	0.233
0 °C	467.5626440	144.0	0.308
-10 °C	467.5626330	133.0	0.284
-20 °C	467.5625260	26.0	0.056
-30 °C	467.5625080	8.0	0.017

Requirements:

Each FRS transmitter type must be designed such that the carrier frequencies remain within ± 2.5 parts-per-million of the channel center frequencies specified in §95.563 during normal operating conditions.

3.7 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item	Uncertainty	
Output Power	± 0.5 dB	
Power Spectral Density	± 0.5 dB	
Out of Band Emissions, Conducted (RBW < 100 kHz)	< 3.6 GHz	± 0.6 dB
	> 3.6 GHz	± 0.9 dB
Spurious Emissions, Radiated	< 1 GHz	± 2.5 dB
	> 1 GHz	± 2.2 dB
Emission Bandwidth	± 4 %	
Power Line Conducted Emissions	$+2.9 / -4.1$ dB	
Spectrum Mask Measurements	Frequency	± 5 %
	Amplitude	± 1.0 dB
Frequency Error	± 0.6 ppm	
Temperature Uncertainty	± 1 °C	

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

4 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	R&S	LR 1690	2020-10	2022-10
2	ESU40	Measuring Receiver	R&S	LR 1639	2021-02	2022-02
3	CMA180	Radiocom Analyzer	R&S	LR 1776	2021-01	2023-01
4	6810.17B	Attenuator	Suhner	LR 1669	2020-08 2021-08	2021-08 2022-08
5	WHK6-790-1000-7000-40SS	Highpass Filter	Wainwright	LR 1781	COU	
6	Model 317	Pre-amplifier	Sonoma	LR 1687	2020-08 2021-08	2021-08 2022-08
7	3115	Horn Antenna	EMCO	LR 1330	2016-10	2026-10
8	JB3	BiLog Antenna	Sunol Sciences	N-4525	2020-03	2023-03
9	TY 80	Climatic Chamber	ACS	LR 1083	2020-06	2022-06
9	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2020-08 2021-08	2021-08 2022-08

COU = Calibrate on Use

The software listed below has been used for one or more tests in this report.

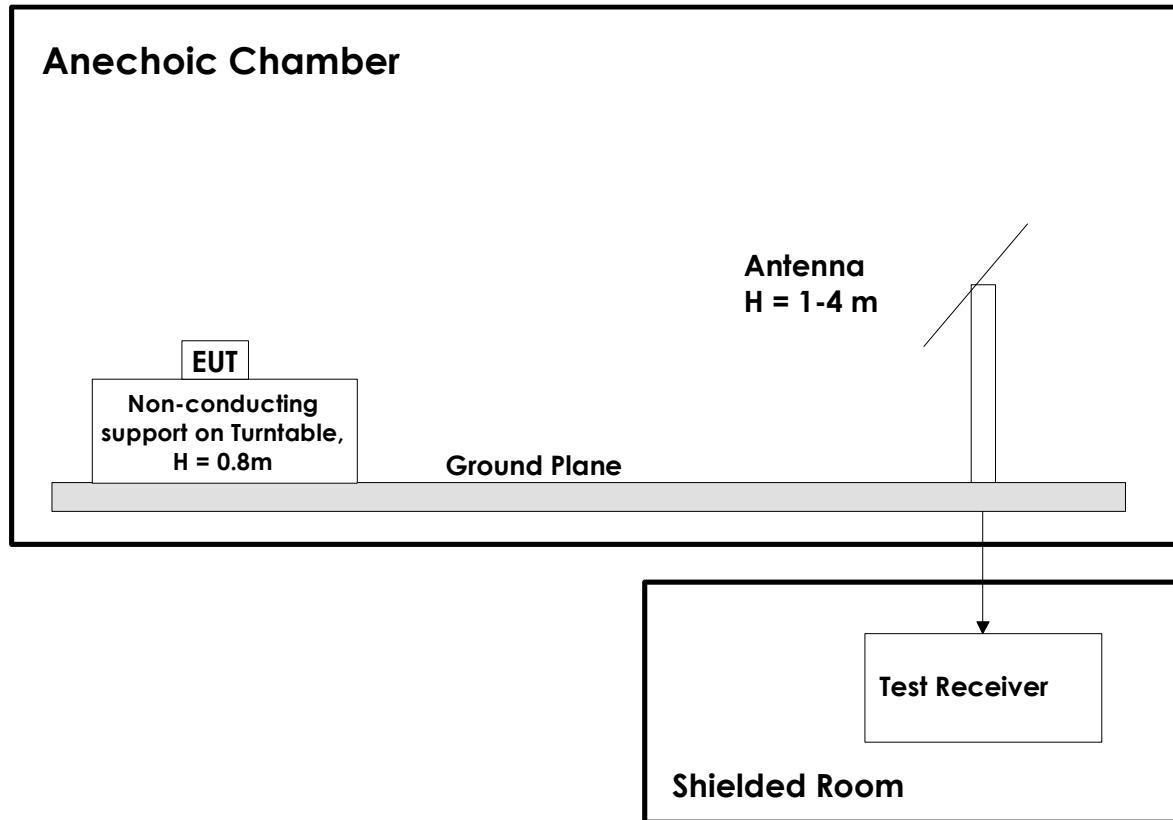
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.10	Radiated Emission test software
2	Nemko AS	RSPlot	1.0.8.0	Captures screenshots from R&S Analyzers

Revision history

Revision	Date	Comment	Sign
00	2021-08-31	First Edition	FS
01	2021-09-30	Corrected Conducted Emission plots and model numbers.	FS
02	2021-10-18	Corrected ERP values	FS

5 BLOCK DIAGRAM

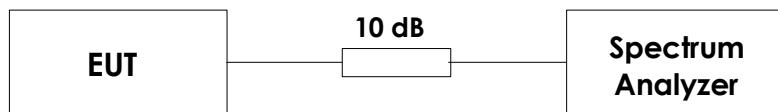
5.1 Test Site Radiated Emission



For measurements above 1 GHz the ground plane is covered by absorbers.

Below 30 MHz, measuring distance of 10m is used for spurious emissions measurements.

5.2 Conducted Test



This setup is used for all conducted tests where a spectrum analyser is used. If the Output power of the EUT is higher than 100mW or so it may be necessary to use more attenuation to avoid damaging the input stage of the spectrum analyser.