Report No. 438026-01-R01

Test Report

Product	Multipurpose VHF Airband Radio
Name and address of the applicant	Jotron AS Ringdalskogen 8 3270 Larvik, Norway
Name and address of the manufacturer	Jotron AS Ringdalskogen 8 3270 Larvik, Norway
Model	TR-910
Rating	12.0 – 28.0 V_{DC}
Trademark	JOTRON
Serial number	107
Additional information	VHF, AM
Tested according to	**FCC Part 87** Aviation Services (118 – 137 MHz)
Order number	438026
Tested in period	2021-06-04 to 2021-06-11
Issue date	2021-09-06
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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1 INFORMATION

1.1 Test Item

Name	**JOTRON**
FCC ID	**RA9TR-910**
Model/version	**TR-910**
Serial number	**107**
Hardware identity and/or version	**Main Board: X102634:R2107**
Software identity and/or version	**6.03**
Frequency Range	**118.000 - 136.975 MHz**
Tunable Bands	**1**
Type of Modulation	**A3E**
Rated Output Power	**10.0 Watts**
Power Supply	**12.0 – 28.0 V DC (external power supply)**
Antenna Connector	**50 Ohm BNC-connector**
Interfaces	**Mic/Headset Connector (RJ45)** **I/O connector (RJ45)** **LAN connector (RJ45)**

Theory of Operation

The EUT is a VHF transceiver for AM modulated ground to air communications in the aeronautical VHF band.

1.2 Normal test conditions

Temperature:	**20 - 23 °C**
Relative humidity:	**30 - 50 %**
Normal test voltage:	**15.0 V DC**

The values are the limit registered during the test period. All tests were performed with a regulated power supply.

1.3 Test Engineer(s)

Frode Sveinsen

1.4 Description of modification for Modification Filing

Not applicable.

1.5 Family List Rationale

Not Applicable.

1.6 Test Configuration

Test Mode	**All tests were performed with the EUT transmitting in normal mode.**
EUT Configuration	**Radiated Emissions were performed with the antenna port terminated into 50 Ohms.**

1.7 Comments

All measurements were done with the EUT powered by 15.0 V_{DC}. It was checked that power variations between 10.8 V_{DC} and 30.8 V_{DC} did not have any influence on output power or frequency.

All ports were populated during spurious emission measurements.

2 TEST REPORT SUMMARY

2.1 General

All measurements are tracable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 87.

Test methods were in accordance with ANSI C63.26-2015 and ANSI C63.4-2014.

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
TNB Equipment Code	☐ Family Listing

Licensed Non-Broadcast Station Transmitter (Part 87)

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”.

2.2 Test Summary

Name of test	FCC Part 2 and Part 87 reference	RSS-141, Issue 2 reference	ANSI C63.26-2015 Reference	Result
RF Power Output	2.1046 87.131	4.1 / 5.1	5.2	Complies
Modulation Characteristics, - Audio Frequency Response - Audio Low Pass Filter - Modulation Limiting	2.1047 87.141	4.2 / 5.2	5.3	Complies
Occupied Bandwidth	2.1049 87.135	4.2 / 5.2 6.7 (RSS-GEN)	5.4	Complies
Spurious Emissions at antenna terminals	2.1051, 2.1057 87.139	4.2 / 5.2 6.13 (RSS-GEN)	5.7	Complies
Field Strength of Transmitter Spurious Radiations	2.1053, 2.1057 87.139	4.2 / 5.2 6.13 (RSS-GEN)	5.7	Complies
Frequency Stability	2.1055 87.133	5.1 6.11 (RSS-GEN)	5.6	Complies
Receiver Spurious Emissions	N/A	5.3 7.3 (RSS-GEN) 7.4 (RSS-GEN)	5.7	Complies

[1] The tested equipment transmits voice and uses Amplitude Modulation.

[2] The tested equipment has a 50 Ohm antenna connector.

3 TEST RESULTS

3.1 Average RF Output Power

FCC Parts: 2.1046, 87.131

ANSI C63.26-2015, Clause 5.2

Test Results: Complies

Measurement Data:

Carrier Frequency	Voltage	Measured Value	Measured Value	Nominal Value
118.000 MHz	15.0 V_{DC}	39.6 dBm	9.1 W	10 W
127.500 MHz	15.0 V_{DC}	39.7 dBm	9.3 W	10 W
	30.8 V_{DC}	39.7 dBm	9.3 W	10 W
	10.8 V_{DC}	39.7 dBm	9.3 W	10 W
136.975 MHz	15.0 V_{DC}	40.0 dBm	10.0 W	10 W

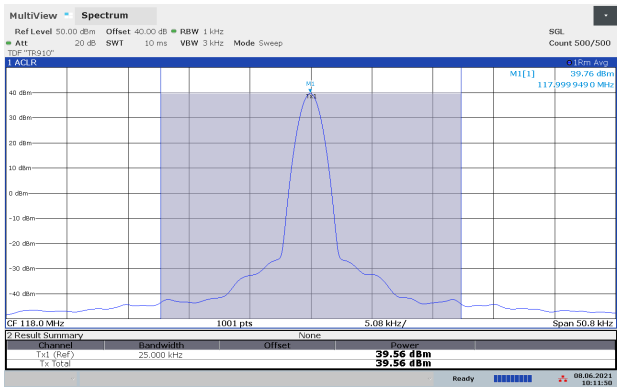
Carrier Frequency	Voltage	Measured Value	Measured Value	Nominal Value
118.000 MHz	15.0 V_{DC}	28.7 dBm	0.75 W	1 W
127.500 MHz	15.0 V_{DC}	28.5 dBm	0.70 W	1 W
136.975 MHz	15.0 V_{DC}	28.9 dBm	0.78 W	1 W

Values above are average power values with unmodulated carrier, measured with a spectrum analyzer.

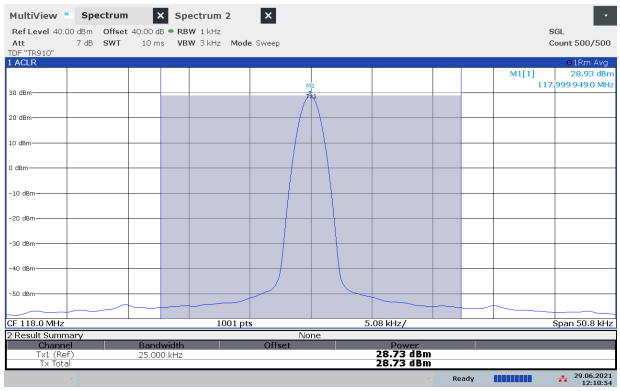
See plots.

Requirements:

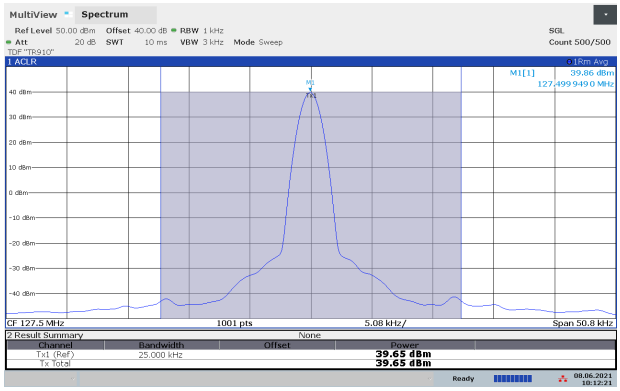
Class of Station	FCC 87.131
Aeronautical multicom (A3E)	10 W
Aeronautical utility mobile (A3E)	10 W
Airport control tower (A3E)	50 W
Aviation support (A3E)	50 W



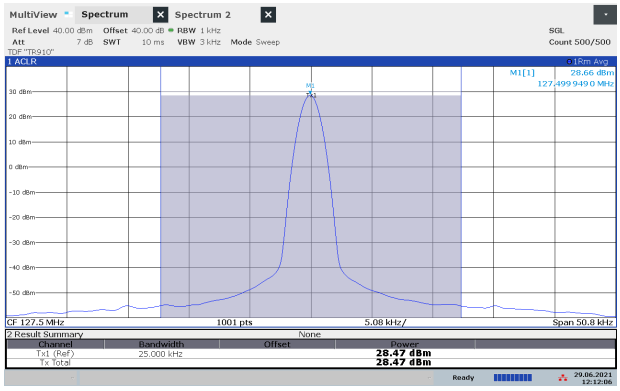
Output Power 118.000 MHz, 15.0V DC, 10W



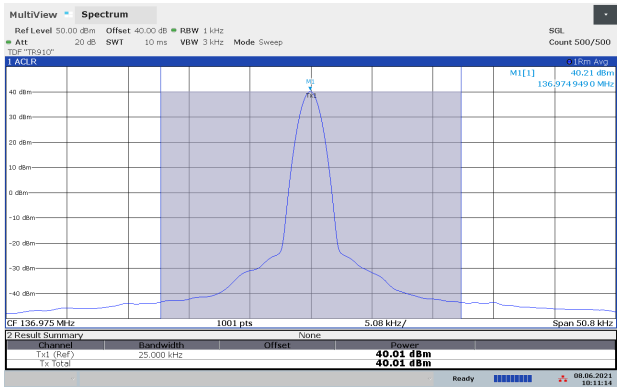
Output Power 118.000 MHz, 15.0V DC, 1W



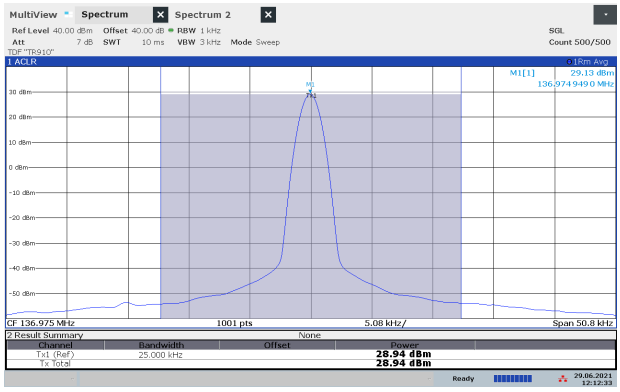
Output Power 127.500 MHz, 15.0V DC, 10W



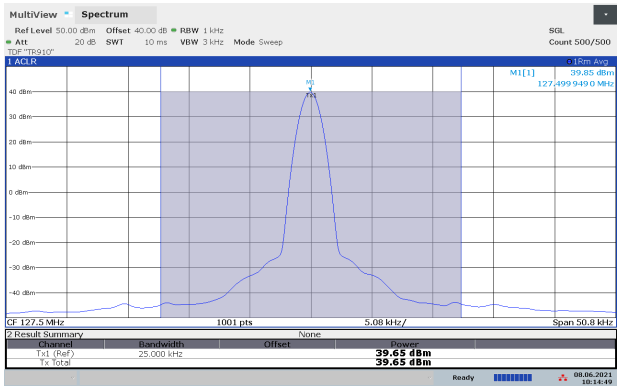
Output Power 127.500 MHz, 15.0V DC, 1W



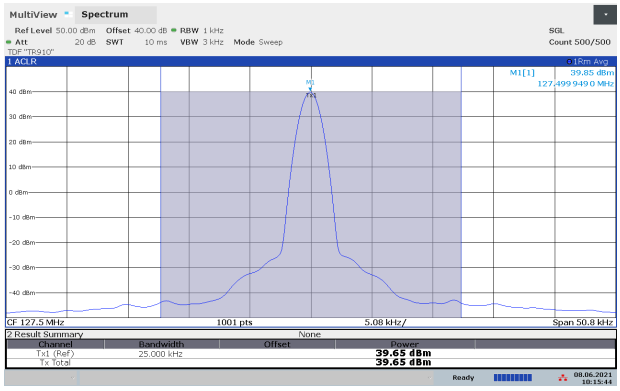
Output Power 136.975 MHz, 15.0V DC, 10W



Output Power 136.975 MHz, 15.0V DC, 1W



Output Power 127.500 MHz, 10.8V DC, 10W



Output Power 127.500 MHz, 30.8V DC, 10W

3.2 Modulation Characteristics - Audio Frequency Response

FCC Parts: 2.1047, 87.141

ISED Canada RSS-141 Issue 2, Clause 4.2 / 5.2

ANSI C63.26-2015, Clause 5.3

Test Results: Complies

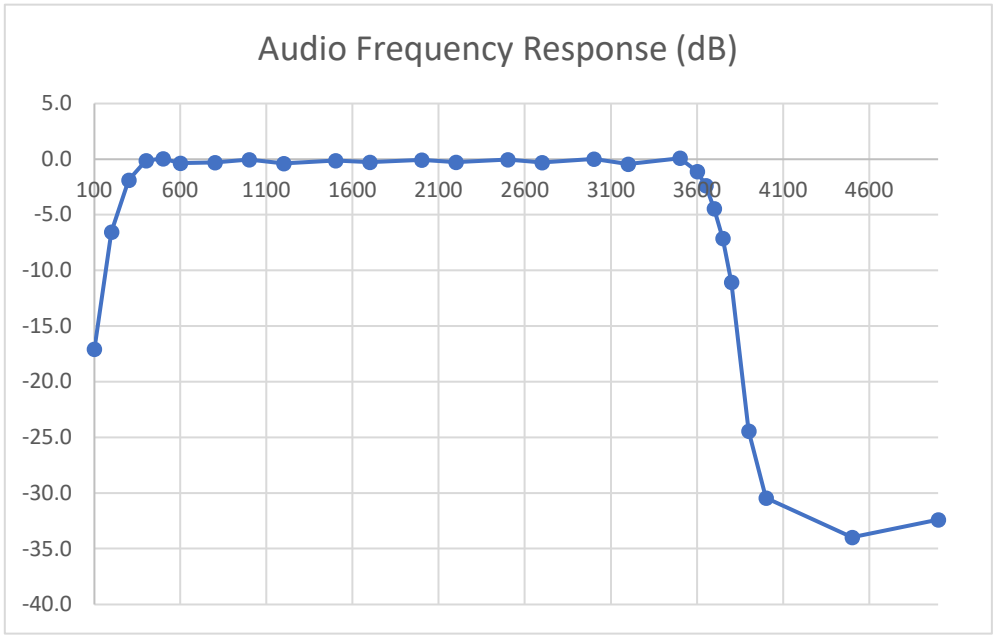
Measurement Data:

Carrier Frequency: 127.500MHz

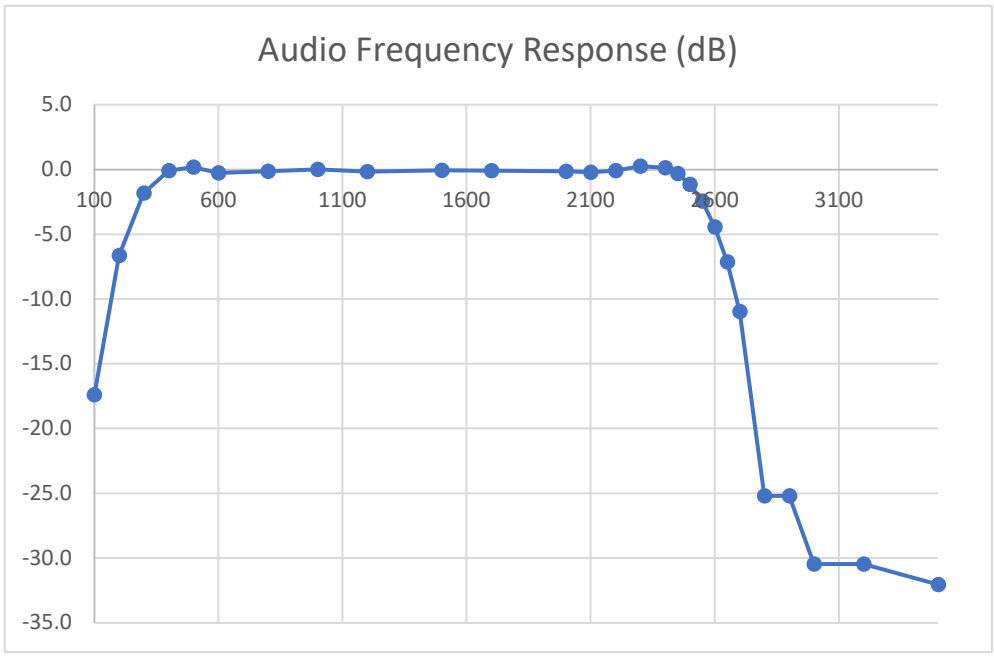
Channel Spacing 25 kHz		
Freq (Hz)	Mod (dB)	Mod (%)
100	-17.1	2.8
200	-6.5	9.4
300	-1.9	16.1
400	-0.1	19.7
500	0.0	20.1
600	-0.4	19.2
800	-0.3	19.3
1000	0.0	19.9
1200	-0.4	19.1
1500	-0.1	19.7
1700	-0.3	19.4
2000	-0.1	19.8
2200	-0.3	19.4
2500	0.0	19.9
2700	-0.3	19.3
3000	0.0	20.0
3200	-0.4	19.0
3500	0.1	20.2
3600	-1.1	17.6
3650	-2.4	15.2
3700	-4.4	12.0
3750	-7.1	8.8
3800	-11.1	5.6
3900	-24.4	1.2
4000	-30.5	0.6
4500	-34.0	0.4
5000	-32.4	0.5

Channel Spacing 8.33 kHz		
Freq (Hz)	Mod (dB)	Mod (%)
100	-17.4	2.7
200	-6.7	9.3
300	-1.8	16.2
400	-0.1	19.8
500	0.2	20.4
600	-0.3	19.4
800	-0.1	19.7
1000	0.0	20.0
1200	-0.2	19.6
1500	-0.1	19.9
1700	-0.1	19.8
2000	-0.1	19.7
2100	-0.2	19.5
2200	-0.1	19.8
2300	0.3	20.6
2400	0.1	20.3
2450	-0.3	19.3
2500	-1.2	17.5
2550	-2.4	15.1
2600	-4.4	12.0
2650	-7.1	8.8
2700	-11.0	5.7
2800	-25.2	1.1
2900	-25.2	1.1
3000	-30.5	0.6
3200	-30.5	0.6
3500	-32.0	0.5

See plots.



Audio Frequency Response (dB), Ch 25kHz, 127.500 MHz



Audio Frequency Response (dB), Ch 8.33kHz, 127.500 MHz

3.3 Modulation Characteristics - Audio Low Pass Filter

Measurement Procedure:

FCC Parts: 2.1047, 87.141

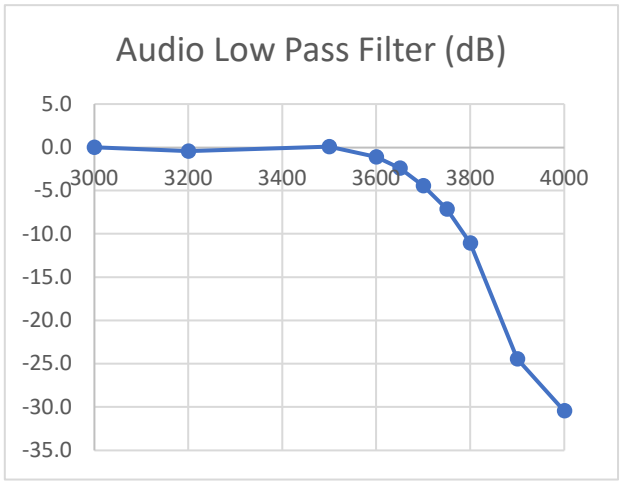
ISED Canada RSS-141 Issue 2, Clause 4.2 / 5.2

ANSI C63.26-2015, Clause 5.3

Test Results: Complies

Measurement Data:

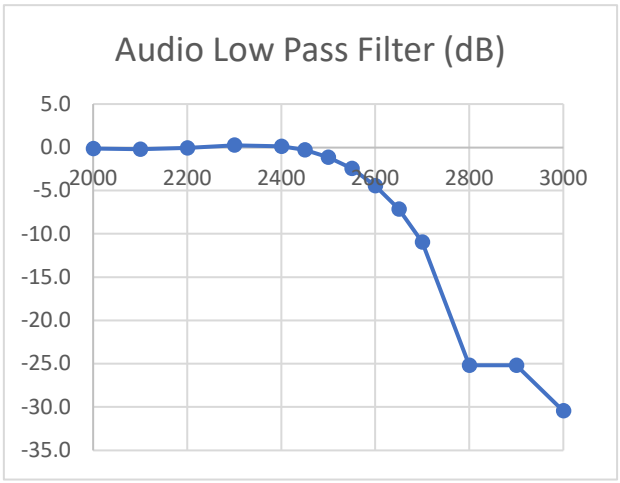
Channel Separation 25 kHz:



Low Pass Filter, 127.500MHz

Low Pass Filter is at 3500Hz for 25kHz channels

Channel Separation 8.33 kHz:



Low Pass Filter, 127.500MHz

Low Pass Filter is at 2500Hz for 8.33kHz channels

3.4 Modulation Characteristics - Modulation Limiting

Measurement Procedure:

FCC Parts: 2.1047, 87.141

ISED Canada RSS-141 Issue 2, Clause 4.2 / 5.2

ANSI C63.26-2015, Clause 5.3

Test Results: Complies

Measurement Data:

Carrier Frequency = 127.500 MHz, Channel Width 25 kHz, Maximum Modulation

Input Level	Modulation %		
dBm	300 Hz	1000 Hz	3000 Hz
0	70.6	87.8	88.6
-5	70.5	87.8	88.7
-10	70.5	87.8	88.7
-15	70.5	87.7	88.8
-20	70.4	87.4	88.7
-21	72.0	87.0	87.5
-22	63.8	77.5	78.0
-24	50.7	61.5	61.7
-25	45.1	55.0	55.1
-27	35.8	43.6	43.9
-30	25.6	31.2	31.3
-35	14.5	17.5	17.6
-40	8.2	10.1	10.0
-45	4.8	5.7	5.7
-50	2.8	3.4	3.3
-55	1.6	1.9	2.0
-60	1.1	1.3	1.2
-65	0.7	0.8	1.0
-70	0.7	0.7	0.7
-75	0.6	0.6	0.7
-80	0.6	0.6	0.6
-85	0.6	0.5	0.5
-90	0.6	0.5	0.5

Carrier Frequency = 127.500 MHz, Channel Width 8.33 kHz, Maximum Modulation

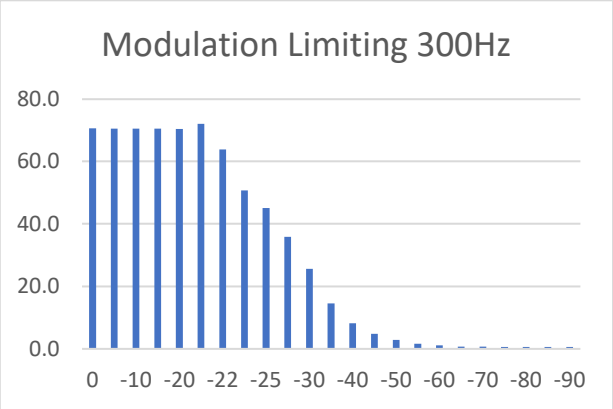
Input Level	Modulation %		
dBm	300 Hz	1000 Hz	3000 Hz
0	68.5	84.4	90.5
-5	68.5	84.4	90.4
-10	68.5	84.4	90.3
-15	68.5	84.4	90.3
-20	68.5	84.2	90.1
-21	68.5	84.1	87.7
-22	62.1	77.0	78.1
-24	49.3	61.1	62.1
-25	43.9	54.6	55.4
-27	34.8	43.3	44.1
-30	24.8	30.9	31.4
-35	14.0	17.4	17.7
-40	7.9	9.8	10.0
-45	4.5	5.6	5.7
-50	2.6	3.3	3.3
-55	1.5	1.8	1.8
-60	0.9	1.2	1.2
-65	0.6	0.7	0.8
-70	0.4	0.6	0.5
-75	0.4	0.4	0.3

See plots.

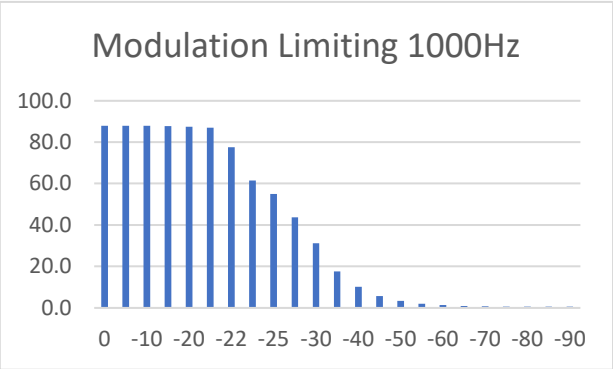
Requirements:

When A3E emission is used, the modulation percentage must not exceed 100 percent.

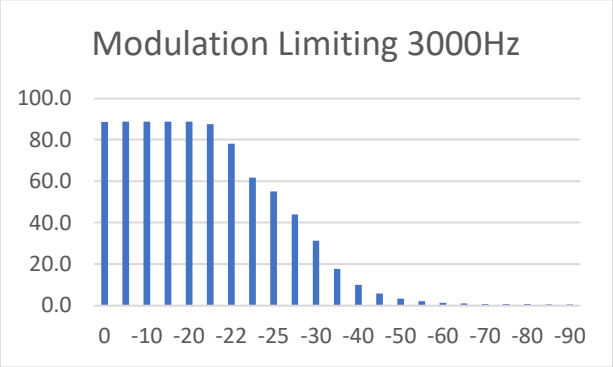
Channel Separation 25 kHz:



Modulation Limiting, 300 Hz, Ch 25kHz, 127.500 MHz

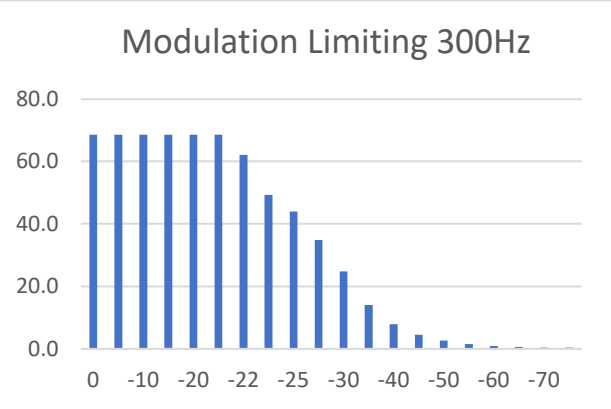


Modulation Limiting, 1000 Hz, Ch 25kHz, 127.500 MHz

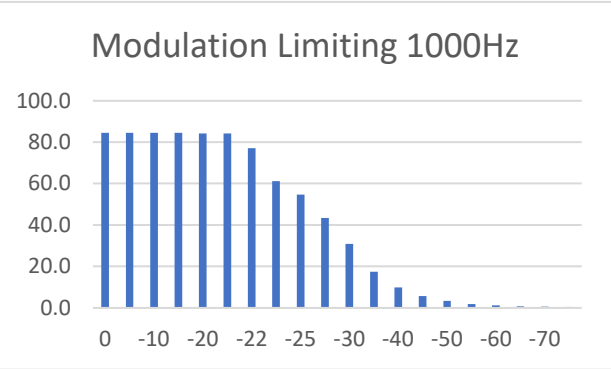


Modulation Limiting, 3000 Hz, Ch 25kHz, 127.500 MHz

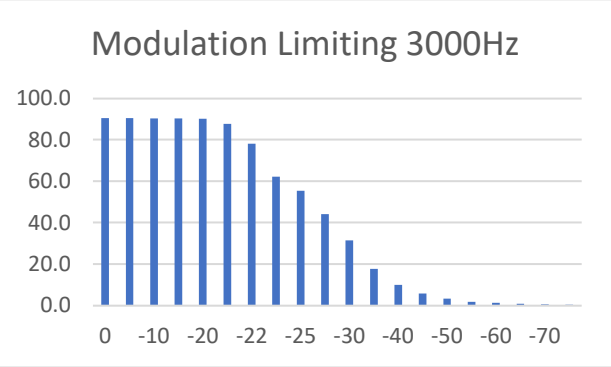
Channel Separation 8.33 kHz:



Modulation Limiting, 300 Hz, Ch 8.33kHz, 127.500 MHz



Modulation Limiting, 1000 Hz, Ch 8.33kHz, 127.500 MHz



Modulation Limiting, 3000 Hz, Ch 8.33kHz, 127.500 MHz

3.5 Emission Mask and Occupied Bandwidth

Measurement Procedure:

FCC Parts: 2.1049, 80.135

ANSI C63.26-2015, Clause 5.4

Test Results: Complies

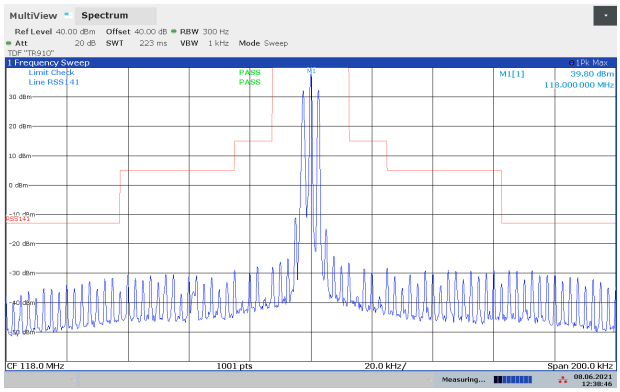
Measurement Data:

See attached plots.

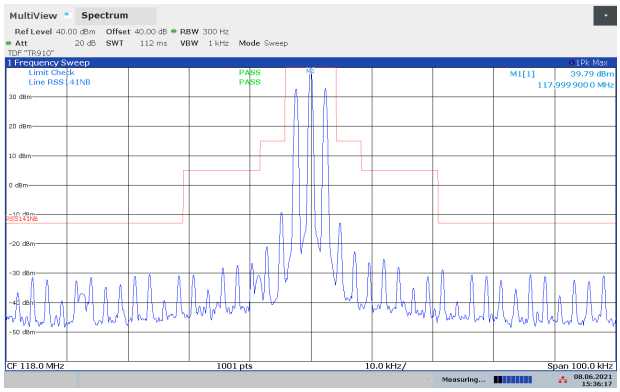
For this test, the EUT was made to transmit continuously with modulation activated.

Requirements:

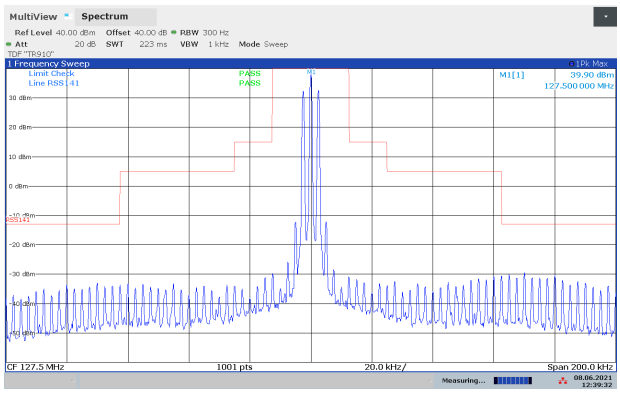
FCC Part 87.135
(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.
(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.
(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.



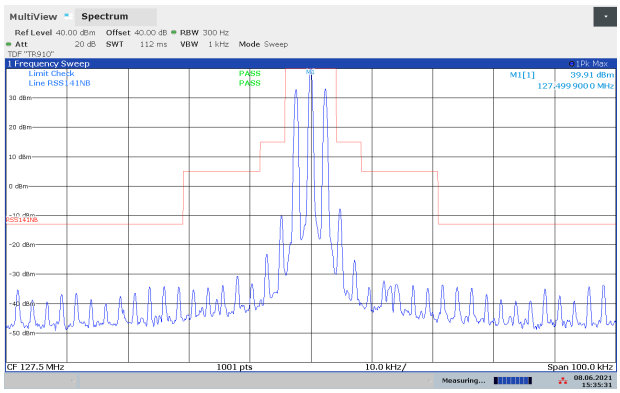
Emission Mask 2500Hz, 85% Mod, 118.000 MHz, Ch25kHz



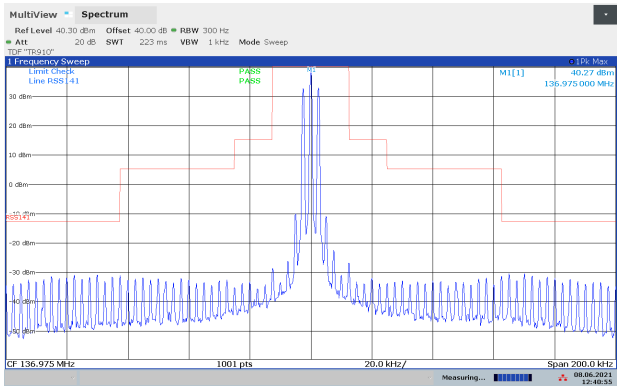
Emission Mask 2400Hz, 85% Mod, 118.000 MHz, Ch8.33kHz



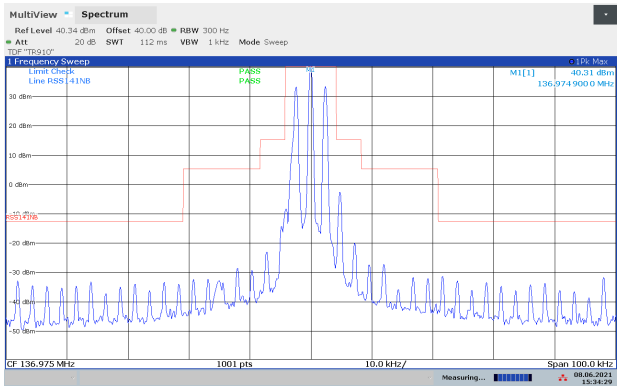
Emission Mask 2500Hz, 85% Mod, 127.500 MHz, Ch25kHz



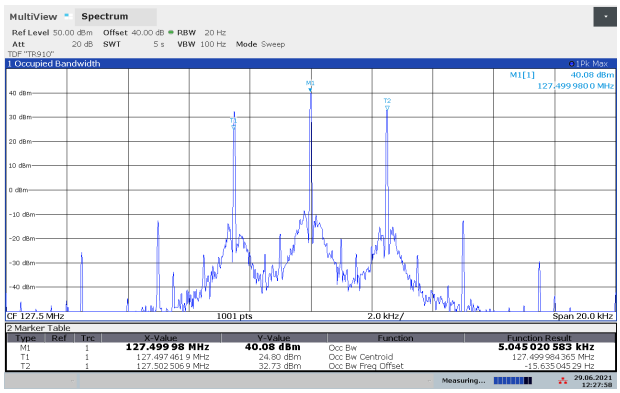
Emission Mask 2400Hz, 85% Mod, 127.500 MHz, Ch8.33kHz



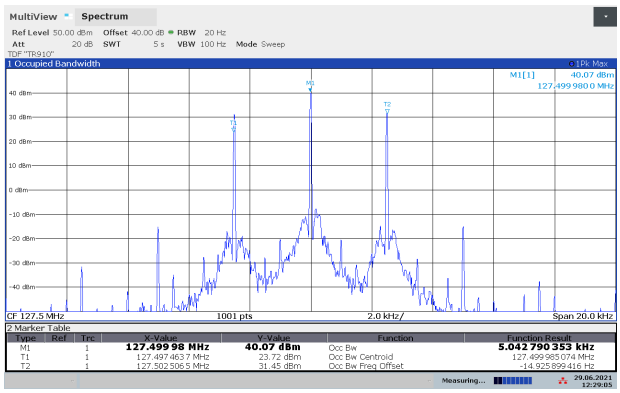
Emission Mask 2500Hz, 85% Mod, 136.975 MHz, Ch25kHz



Emission Mask 2400Hz, 85% Mod, 136.975 MHz, Ch8.33kHz



OBW 99%, 2500Hz, 85% Mod 127.500MHz, Ch25kHz



OBW 99%, 2500Hz, 85% Mod 127.500MHz, Ch8.33kHz

3.6 Spurious Emissions at Antenna Terminal

Measurement Procedure:

FCC Parts: 2.1051, 87.139

ANSI C63.26-2015, Clause 5.6

Test Results: Complies

Measurement Data:

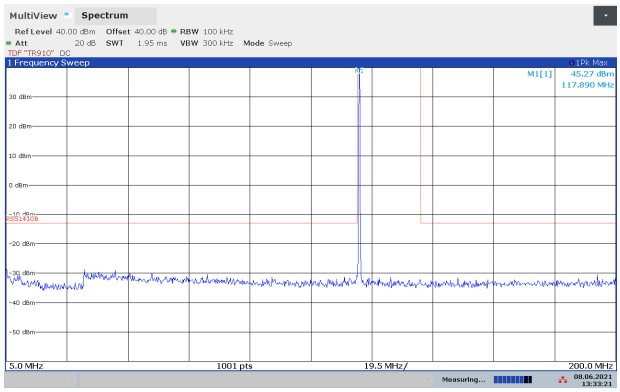
No emissions detected. See plots.

Requirements:

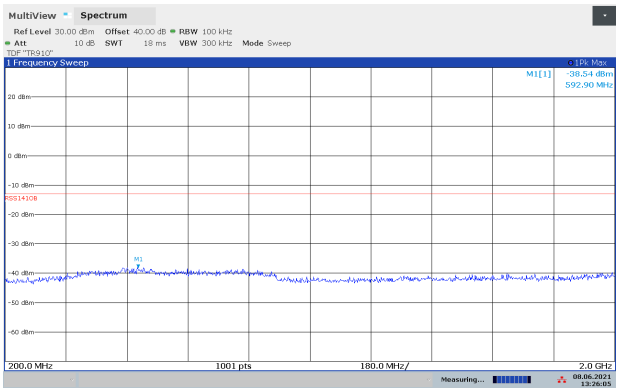
Transmitters with A3E Modulation

Frequency relative to Channel Centre Frequency	Measuring Bandwidth	Attenuation Relative to Carrier
More than 250% of channel BW	3 kHz	At least 43 + 10 $\log_{10}$P dB

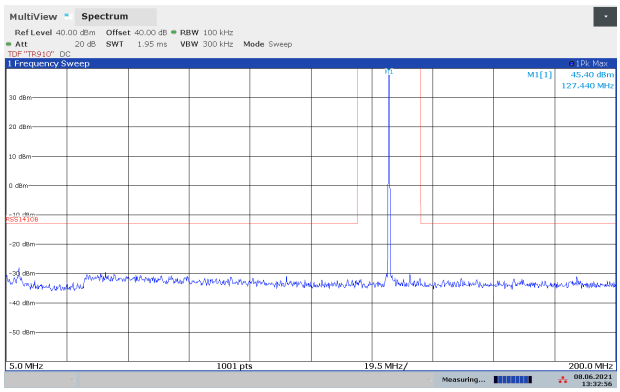
P is Average Conducted Power in Watts



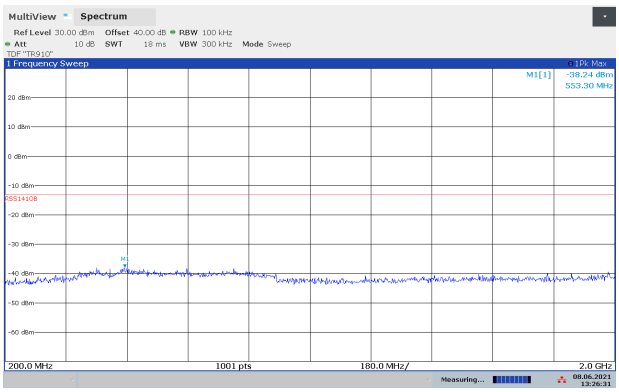
Emission 5-200 MHz, 2500kHz, 85% Mod, 118.000 MHz



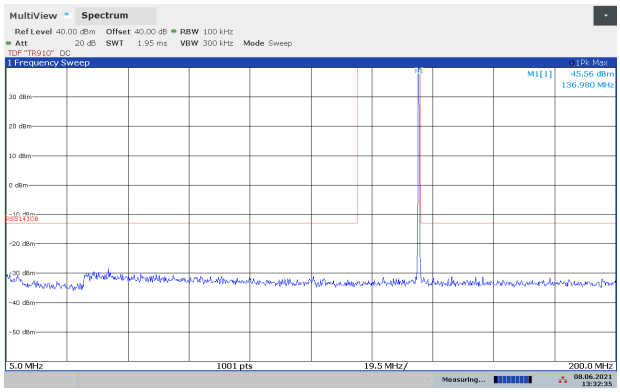
Emission 200-2000 MHz, 2500kHz, 85% Mod, 118.000 MHz



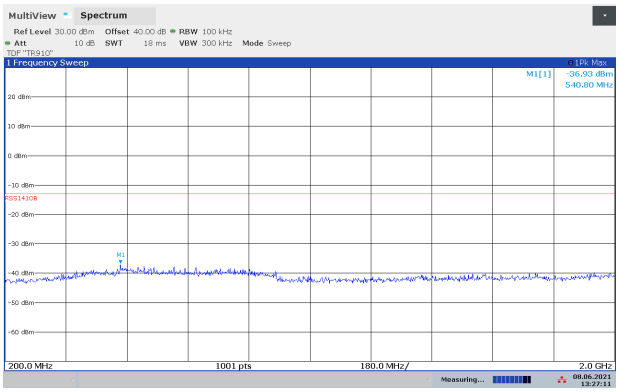
Emission 5-200 MHz, 2500kHz, 85% Mod, 127.500 MHz



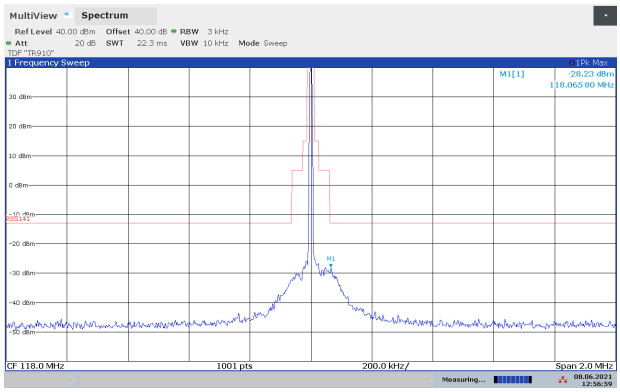
Emission 200-2000 MHz, 2500kHz, 85% Mod, 127.500 MHz



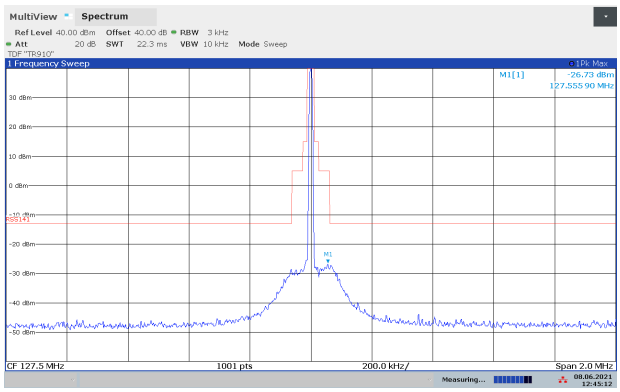
Emission 5-200 MHz, 2500kHz, 85% Mod, 136.975 MHz



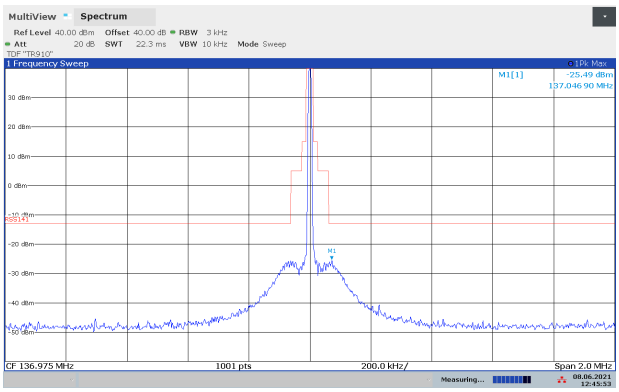
Emission 200-2000 MHz, 2500kHz, 85% Mod, 136.975 MHz



Emission Mask, 2500kHz, 85% Mod, 118.000 MHz



Emission Mask, 2500kHz, 85% Mod, 127.500 MHz



Emission Mask, 2500kHz, 85% Mod, 136.975 MHz

3.7 Field Strength of Spurious Radiations

Measurement Procedure:

FCC Parts: 2.1053, 87.139

ANSI C63.26-2015, Clause 5.6

Test Results: Complies

Measurement Data:

Spurious Frequency MHz	Carrier Frequency MHz	Measured Value dBµV/m @3m	Calculated Value dBm	Limit dBm	Margin dB
255.000	127.500	34.9	-60.3	-13	47.3
273.950	136.975	43.5	-51.7	-13	38.7
354.000	118.000	43.9	-51.3	-13	38.3
382.500	127.500	52.3	-42.9	-13	29.9
410.900	136.975	44.0	-51.2	-13	38.2
547.900	136.975	47.8	-47.4	-13	34.4
590.000	118.000	47.6	-47.6	-13	34.6
1095.800	136.975	45.8	-49.4	-13	36.4
All other	all	< 50	< -45	-13	> 30

All measurements were performed at 3m with the antenna connector terminated into a 50 Ohm load.

The turntable was rotated 360 degrees and the antenna was adjusted between 1m and 4m for all measurements.

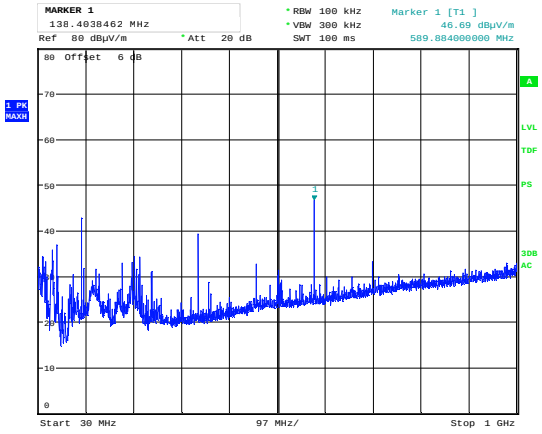
All measurements were field strength measurements, equivalent power values were calculated using the free field formula as described in ANSI C63.26-2015 clause 5.2.7 (d).

Requirements:

Transmitters with A3E Modulation

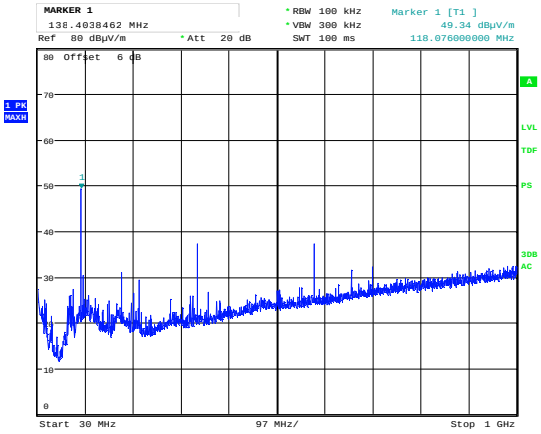
Frequency relative to Channel Centre Frequency	Attenuation Relative to Carrier
More than 250% of channel BW	At least 43 + 10 $\log_{10}$P dB

P is Average Conducted Power in Watts



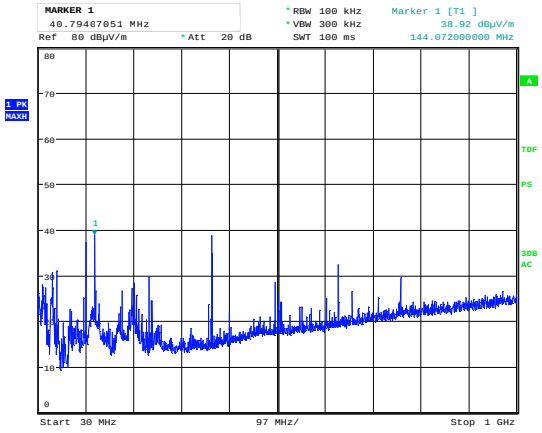
Date: 4.JUN.2021 13:38:40

Radiated Emissions 30-1000MHz, 118.000MHz, VP



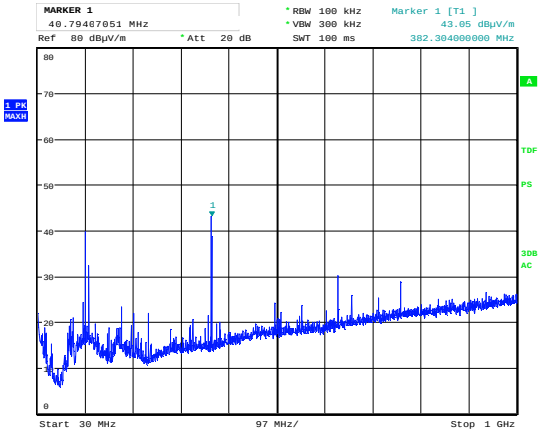
Date: 4.JUN.2021 13:44:33

Radiated Emissions 30-1000MHz, 118.000MHz, HP



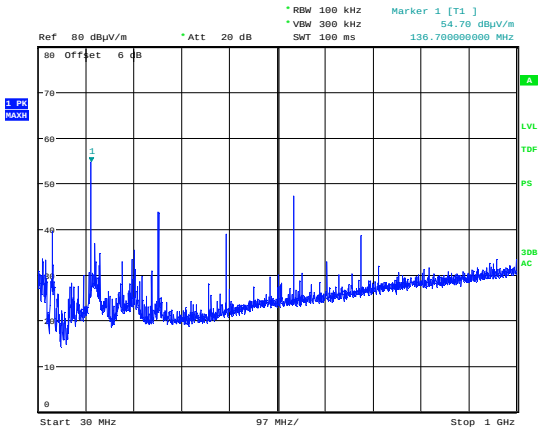
Date: 4.JUN.2021 13:29:09

Radiated Emissions 30-1000MHz, 127.500MHz, VP



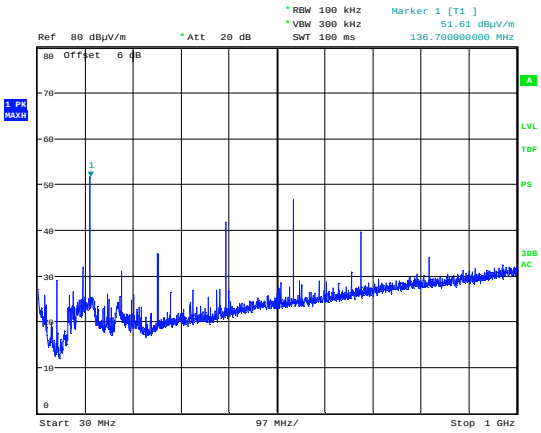
Date: 4.JUN.2021 13:35:04

Radiated Emissions 30-1000MHz, 127.500MHz, HP



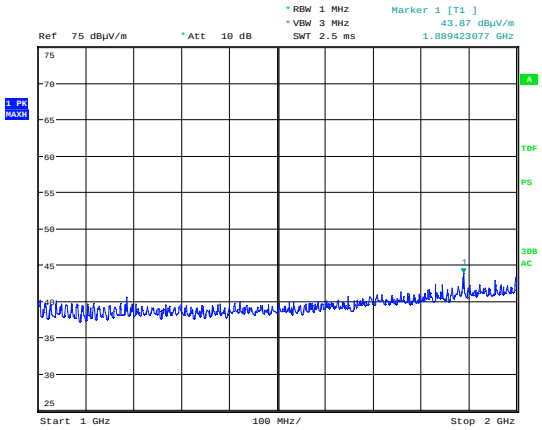
Date: 4.JUN.2021 12:27:13

Radiated Emissions 30-1000MHz, 136.975MHz, VP



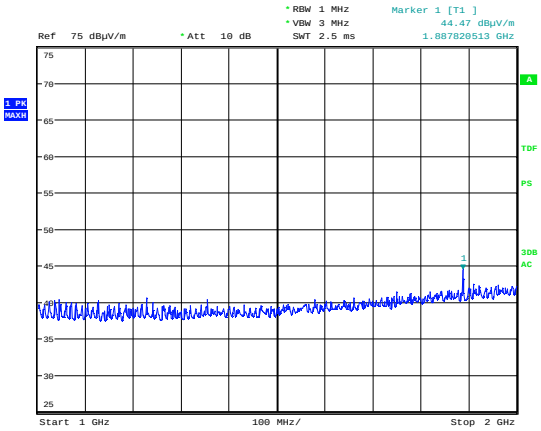
Date: 4.JUN.2021 12:33:09

Radiated Emissions 30-1000MHz, 136.975MHz, HP



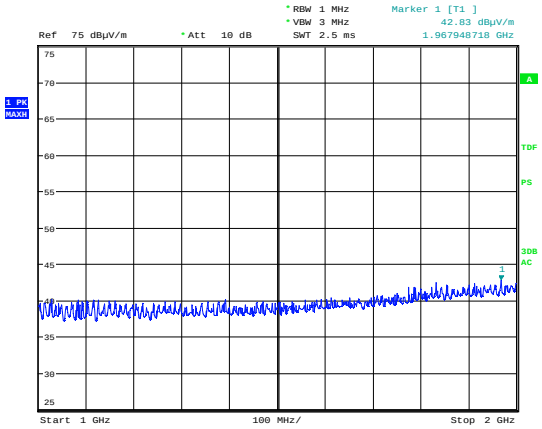
Date: 4.JUN.2021 14:19:26

Radiated Emissions 1000-2000MHz, 118.000MHz, VP



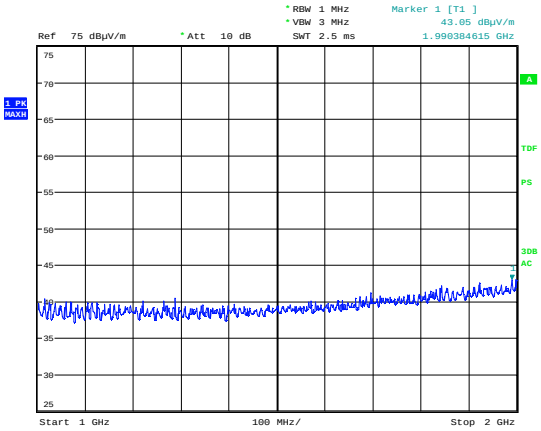
Date: 4.JUN.2021 14:21:40

Radiated Emissions 1000-2000MHz, 118.000MHz, HP



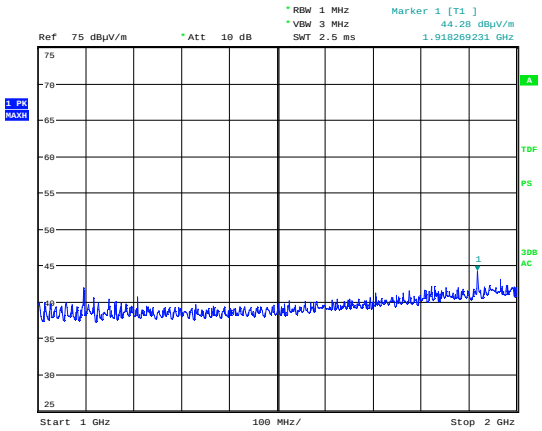
Date: 4.JUN.2021 14:08:31

Radiated Emissions 1000-2000MHz, 127.500MHz, VP



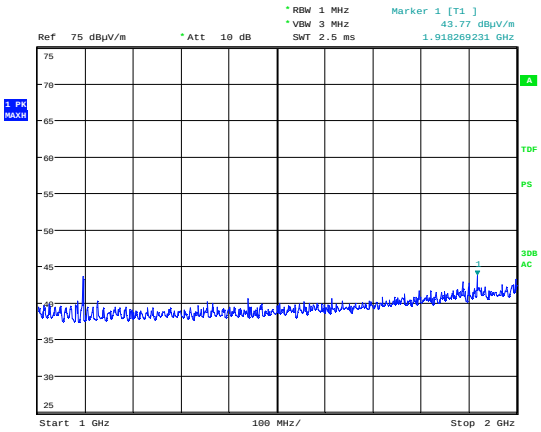
Date: 4.JUN.2021 14:14:23

Radiated Emissions 1000-2000MHz, 127.500MHz, HP



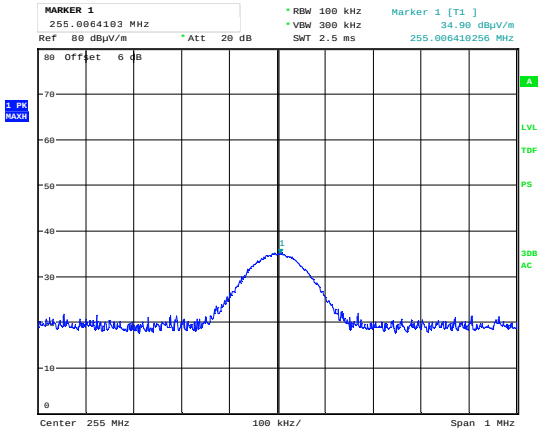
Date: 4.JUN.2021 14:25:28

Radiated Emissions 1000-2000MHz, 136.975MHz, VP

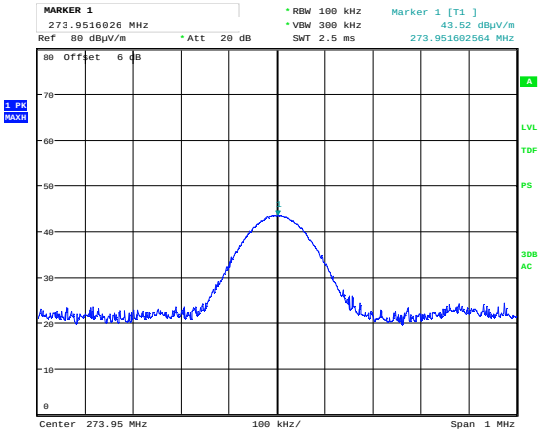


Date: 4.JUN.2021 14:27:42

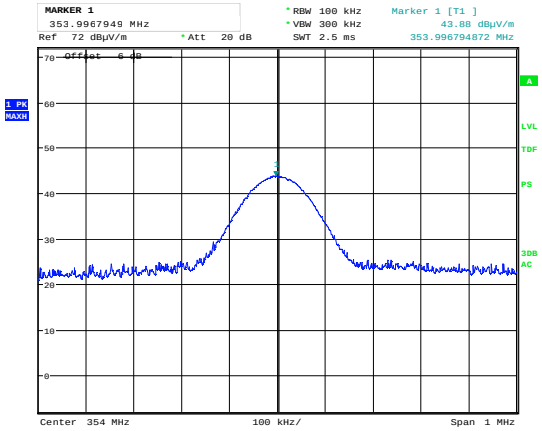
Radiated Emissions 1000-2000MHz, 136.975MHz, HP



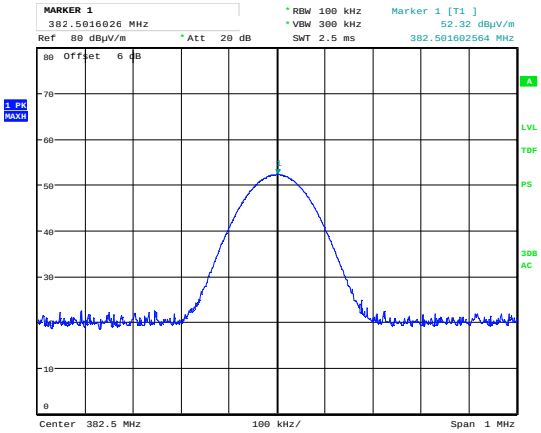
Radiated Emissions 255.000MHz, 127.500MHz, VP



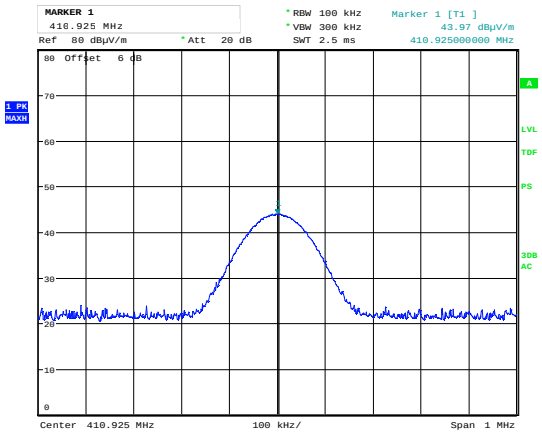
Radiated Emissions 273.95MHz, 136.975MHz, VP



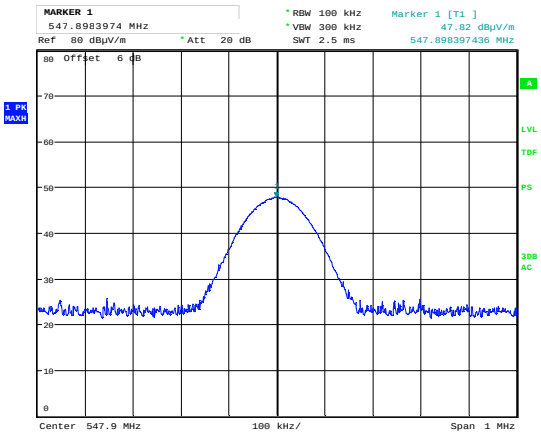
Radiated Emissions 354.000MHz, 118.000MHz, HP



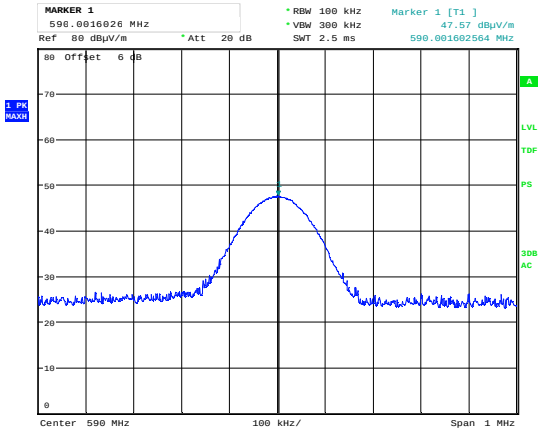
Radiated Emissions 382.500MHz, 127.500MHz, HP



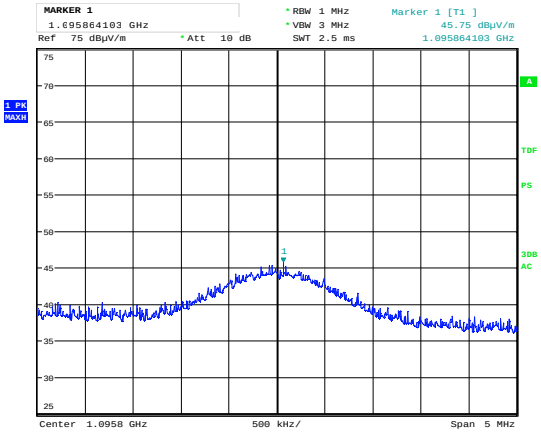
Radiated Emissions 410.9MHz, 136.975MHz, HP



Radiated Emissions 547.9MHz, 136.975MHz, VP



Radiated Emissions 590.0MHz, 118.000MHz, VP



Radiated Emissions 1095.8MHz, 136.975MHz, VP

3.8 Frequency Stability

Measurement Procedure:

FCC Parts: 2.1055, 87.133

ANSI C63.26-2015, Clause 5.6

Test Results: Complies

Measurement Data:

Temperature	Measured Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
+50 °C	127.4999899	-10.1	-0.079
+40 °C	127.4999915	-8.5	-0.067
+30 °C	127.4999964	-3.6	-0.028
+20 °C	127.4999968	-3.2	-0.025
+10 °C	127.5000360	36.0	0.282
0 °C	127.5000446	44.6	0.350
-10 °C	127.5000531	53.1	0.416
-20 °C	127.5001021	102.1	0.801
-30 °C	127.5001281	128.1	1.005

Voltage	Measured Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
10.8 V DC	127.4999968	-3.2	-0.025
15.0 V DC	127.4999968	-3.2	-0.025
30.8 V DC	127.4999966	-3.4	-0.027

Deviation is referenced to the Nominal Carrier Frequency (127.500 MHz).

The measurement was performed with the counter function of the Spectrum Analyzer.

Requirements:

	Frequency Stability (ppm) A3E and A9W emissions
Ground Equipment / Stations	±20 ppm
Airborne / Aircraft Equipment	±30 ppm

4 Measurement Uncertainties

Measurement Uncertainty Values		
Test Item		**Uncertainty U_{95}**
Output Power		**±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 %**
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

5 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	Rohde & Schwarz	LR 1690	2020-10	2021-10
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2021-02	2022-02
3	CMA180	Radiocomm Tester	Rohde & Schwarz	LR 1776	2021-01	2023-01
4	Model 768-20	Attenuator (20dB)	Narda	LR 1201	2019-07	2021-07
5	6820.20A	Attenuator (20dB)	Suhner	LR 1127	2019-07	2021-07
6	Model 562	Noise Suppressor	Narda	LR 1522	COU	
7	WHK-S200-10SS	HighPass Filter (200MHz)	Wainwright Inst.	LR 1620	COU	
8	JB3	BiLog Antenna	Sunol Sciences	N-4525	2020-03	2023-03
9	Model 317	Pre-Amplifier	Sonoma Inst.	LR 1687	2020-08	2021-08
10	5906_N-50-010	Attenuator (6dB)	Suhner	N-4904	2019-10	2022-10
11	3115	Horn Antenna	EMCO	LR 1330	2016-10	2026-10
12	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2020-08	2021-08
14	HP 6032A	Power Supply	Hewlett Packard	LR 1062	COU	
15	CPX400S	Power Supply	AimTTi	LR 1711	COU	
16	Model 87V	Multimeter	Fluke	LR 1599	2021-01	2023-01
17	ST18/Nm/Nm/36	Cable	HuberSuhner	LR 1634	COU	

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	Power Line Conducted test software
2	Rohde & Schwarz	EMC32	10.50.10	Radiated Emission test software
3	Nemko AS	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

Revision history

Revision	Date	Comment	Sign
00	2021-06-29	First edition	FS
01	2021-09-06	Corrected some typos	FS

6 BLOCK DIAGRAM

6.1 Test Site Radiated Emission