

Test report

349778-1TRFWL

Date of issue: June 29, 2018

Applicant:

Thrane & Thrane A/S

Product:

SAILOR 3965 UHF Fire Fighter / McMurdo SmartFind R8F UHF Fire Fighter

Model:

TT-3965A

FCC ID:

ROJTT-3965A

IC Registration number:

6200B-3965

Specifications:

◆ **FCC 47 CFR Part 80 Subpart E**

Stations in the maritime services

◆ **RSS-119, Issue 12, May 2015**

Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: CA2040; IC: 2040A-4 (3 m SAC)

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Russell Grant, Senior Technical Assessor
Date	June 29, 2018
Signature of the reviewer	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

© Nemko Canada Inc.

Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Test methods	4
1.4 Statement of compliance	4
1.5 Exclusions	4
1.6 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Part 80 test results	5
2.2 RSS-119, Issue 12 test results	5
Section 3. Equipment under test (EUT) details	6
3.1 Sample information	6
3.2 EUT information	6
3.3 Technical information	6
3.4 Product description and theory of operation	6
3.5 EUT exercise details	6
3.6 EUT setup diagram	7
Section 4. Engineering considerations	8
4.1 Modifications incorporated in the EUT	8
4.2 Technical judgment	8
4.3 Deviations from laboratory tests procedures	8
Section 5. Test conditions	9
5.1 Atmospheric conditions	9
5.2 Power supply range	9
Section 6. Measurement uncertainty	10
6.1 Uncertainty of measurement	10
Section 7. Test equipment	11
7.1 Test equipment list	11
Section 8. Testing data	12
8.1 FCC 2.1046, 80.215(e)(3) and RSS-119 Section 5.4 Power Output	12
8.2 FCC 2.1047, 80.213(b) Modulation Characteristics	14
8.3 FCC 2.1049, 80.205 and RSS-119 Section 5.5 Occupied Bandwidth	17
8.4 FCC 2.1051, 80.211(f) and RSS-119 Section 5.8 Spurious Emissions at Antenna Terminals	19
8.5 FCC 2.1053, 80.211(f) and RSS-119 Section 5.8 Field Strength of Spurious Radiation	24
8.6 FCC 2.1055, 80.209(7)(ii) and RSS Section 5.3 Frequency Stability	26
8.7 RSS-119 Section 5.9 Transient Frequency Behavior	28
Section 9. Block diagrams of test set-ups	31
9.1 Power Output	31
9.2 Modulation Characteristics	31
9.3 Occupied Bandwidth	31
9.4 Spurious Emissions at Antenna Terminals	32
9.5 Field Strength of Spurious Radiation	33
9.6 Frequency stability	34
9.7 Transient frequency behavior	34

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Thrane & Thrane A/S
Address	Lundtoftegaardsvej 93D
City	Kgs. Lyngby
Province/State	
Postal/Zip code	DK-2800
Country	Denmark

1.2 Test specifications

FCC 47 CFR Part 80 Subpart E	Stations in the maritime services
FCC 47 CFR Part 2 Subpart J	Equipment Authorization Procedures

1.3 Test methods

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
------------------	---

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 80 test results

Part 2	Part 80	Test description	Verdict
§2.1046	§80.215 (e)(3)	RF power output	Pass
§2.1047	§80.215 (b)	Modulation Characteristics	Pass
§2.1049	§80.205	Occupied bandwidth	Pass
§2.1051	§80.211 (f)	Spurious Emissions at Antenna Terminals	Pass
§2.1053	§80.211 (f)	Field Strength of Spurious Radiation	Pass
§2.1055	§80.209(7)(ii)	Frequency stability	Pass

Notes: None

2.2 RSS-119, Issue 12 test results

Part	Test description	Verdict
5.3	Frequency stability	Pass
5.4	Power Output	Pass
5.5	Occupied Bandwidth	Pass
5.8	Spurious Emissions at Antenna Terminals and Field Strength of Spurious Radiation	Pass
5.9	Transient Frequency Behavior	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 27, 2018
Nemko sample ID number	1

3.2 EUT information

Product name	SAILOR 3965 UHF Fire Fighter / McMurdo SmartFind R8F UHF Fire Fighter
Model	TT-3965A
Serial number	1899130138

3.3 Technical information

Frequency band	450-470 MHz
Frequency Min (MHz)	457.525 MHz, 467.525 MHz
Frequency Max (MHz)	457.575 MHz, 467.575 MHz
RF power Max (W)	1 W
Field strength, Units @ distance	N/A
Type of modulation	PM
Emission classification (F1D, G1D, D1D)	8K50G3E (12.5 kHz channels) 16K0G3E (25 kHz channels)
Transmitter spurious emission	-27.20 dBm
Power requirements	3.6 Vdc battery
Antenna information	The EUT uses a unique antenna coupling (50 Ohm SMA connector)

3.4 Product description and theory of operation

The EUT is a UHF radio

3.5 EUT exercise details

The EUT was programmed to transmit on the selectable channels

3.6 EUT setup diagram

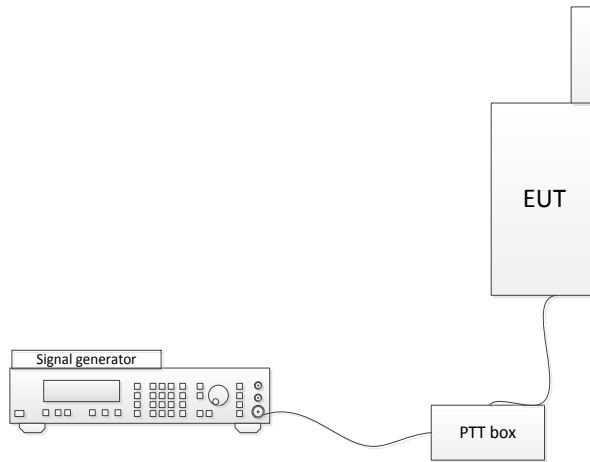


Figure 3.6-1: Setup diagram

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Dec. 09/18
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESW 8	SN: 101009	1 year	May 10 /18
Horn with Preamp (1–18 GHz)	ETS-Lindgren	3117	FA002840	1 year	Dec. 07/18
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	June 27/18
50 Ω coax cable	Huber + Suhner	None	FA002074	1 year	May 12/18
50 Ω coax cable	Huber + Suhner	None	FA002830	1 year	May 12/18
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	Aug. 08/18
PTT box	Thrane & Thrane A/S	None	None	None	None
Audio generator	GW	GAG-808G	FA001034	—	VOU
Arbitrary waveform generator	HP	33120A	FA001082	—	VOU

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

Section 8. Testing data

8.1 FCC 2.1046, 80.215(e)(3) and RSS-119 Section 5.4 Power Output

8.1.1 Definitions and limits

FCC:

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below: If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

FCC 80.215(n)(3):

(e) Ship stations frequencies above 27500 kHz. The maximum power must not exceed the values listed below.

(3) On board stations 456-468 MHz—4W

Certification based on a carrier power of 4 watts with transmitter connected to a dummy load of matching impedance. The effective radiated power must not exceed 2 watts.

ISED:

The output power shall be within ± 1 dB of the manufacturer's rated power listed in the equipment specifications
 RSS-119 Section 5.4 Table 2 Limit for Mobile Equipment: 60 W

8.1.2 Test summary

Test date	February 28, 2018	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	31 %

8.1.3 Observations, settings and special notes

The test was performed with the spectrum analyzer:

Resolution bandwidth	\geq OBW
Video bandwidth	$\geq 3 \times$ RBW
Detector	Peak
Trace mode	Max hold

8.1.4 Test data

Table 8.1-1: Output power measurement result

Frequency, MHz	Measured power, dBm	Measured power, mW	Measured power, W	Rated Power, W	Limit, W	Limit, dBm Margin, dB	measured/rated power, dB
457.5250	30.05	1012	1.01	1	60	17.78	0.05
467.5375	30.28	1067	1.07	1	60	17.78	0.28
457.5250	24.94	312	0.31	0.3	60	23.01	0.17
467.5375	25.42	348	0.35	0.3	60	23.01	0.65

8.2 FCC 2.1047, 80.213(b) Modulation Characteristics

8.2.1 Definitions and limits

8.2.2 Definitions and limits

FCC:

5 kHz Maximum Frequency Deviation (§80.205(a) note 8)

80.213(b) Radiotelephone transmitters using A3E, F3E and G3E emission must have a modulation limiter to prevent any modulation over 100 percent. This requirement does not apply to survival craft transmitters, to transmitters that do not require a license or to transmitters whose output power does not exceed 3 watts.

8.2.3 Test summary

Test date:	February 27, 2018	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1005 mbar
Verdict:	Pass	Relative humidity:	36 %

8.2.4 Observations, settings and special notes

Spectrum analyser settings:

Detector mode	Peak
Resolution bandwidth	20 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.2.5 Test data

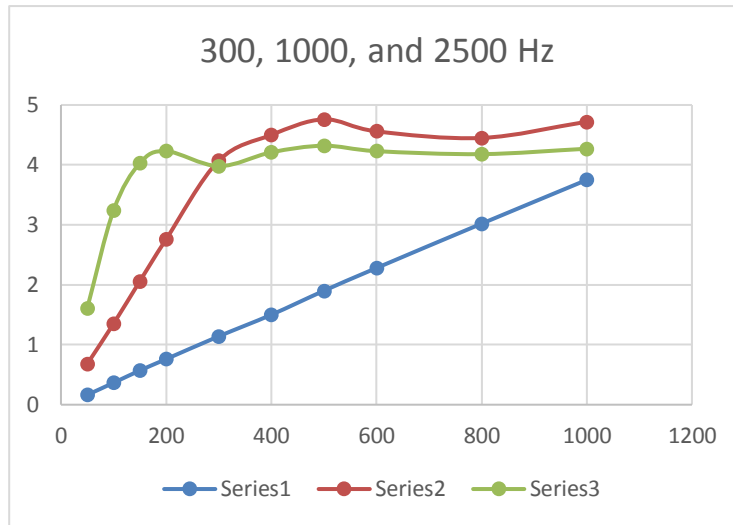


Figure 8.2-1: Modulation limiting 25 kHz
Series 1 300 Hz, Series 2 1000 Hz, and Series 3 2500 Hz

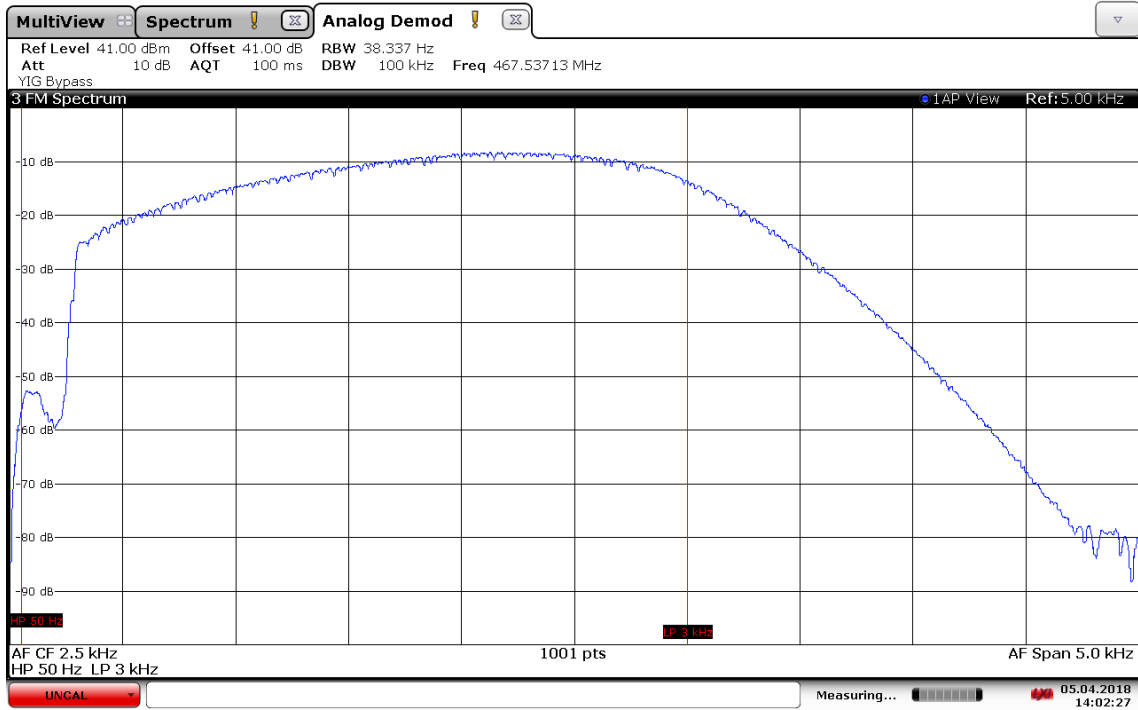


Figure 8.2-2: Audio Frequency response 12.5 kHz

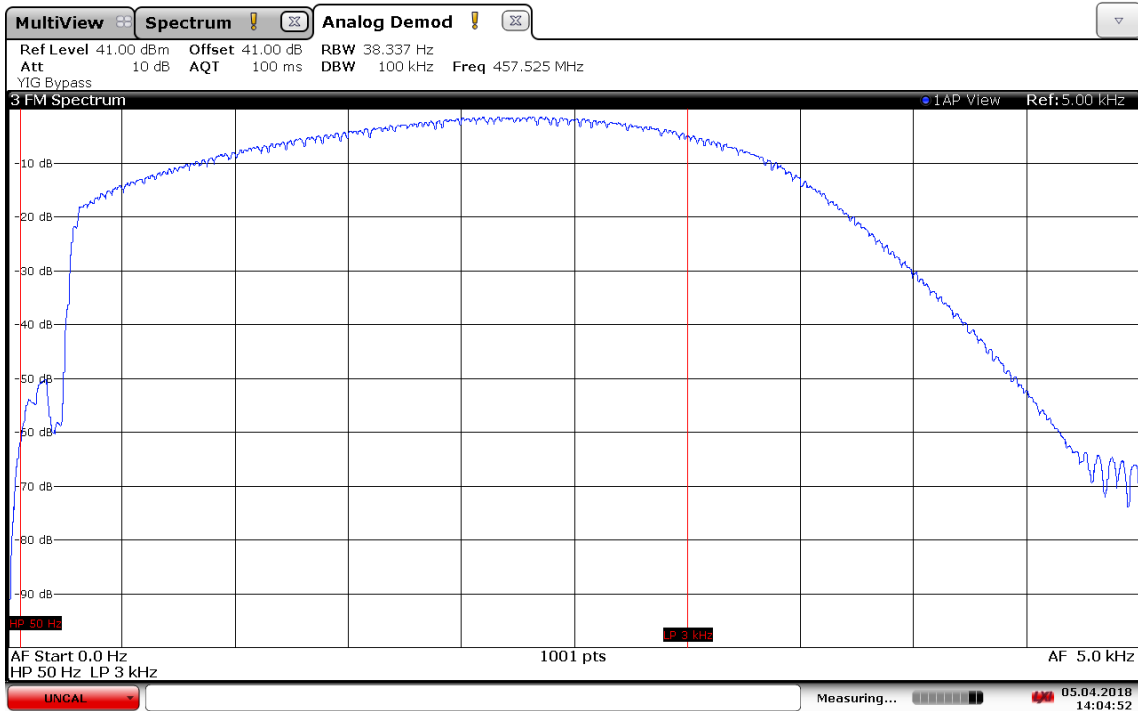


Figure 8.2-3: Audio Frequency response 25 kHz

8.3 FCC 2.1049, 80.205 and RSS-119 Section 5.5 Occupied Bandwidth

8.3.1 Definitions and limits

FCC:
80.205: 20 kHz

ISED:
25 kHz Channel Bandwidth Authorized Bandwidth: 20 kHz
12.5 kHz Channel Bandwidth Authorized Bandwidth: 11.25 kHz

8.3.2 Test summary

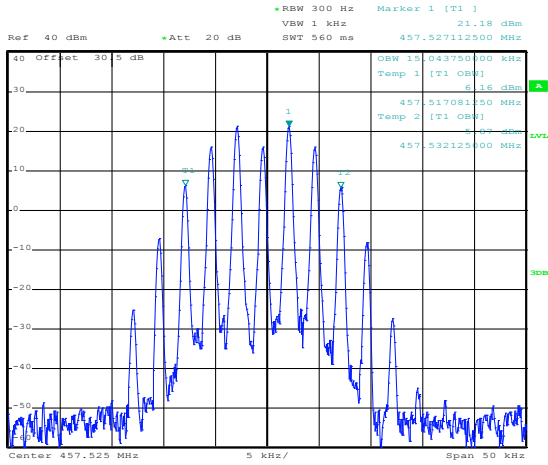
Test date	February 28, 2018	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	36 %

8.3.3 Observations, settings and special notes

Spectrum analyser settings:

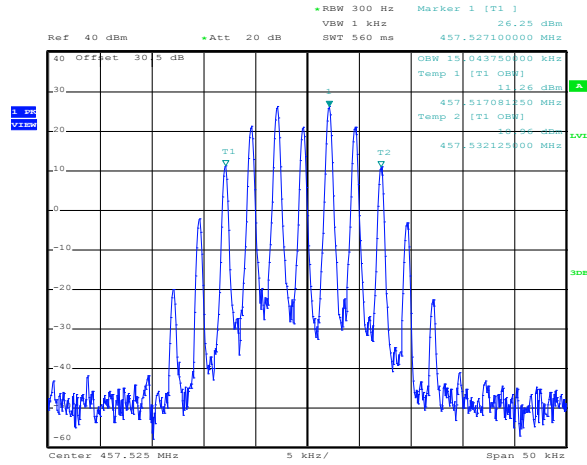
Resolution bandwidth	300 Hz
Video bandwidth	$\geq 3 \times \text{RBW}$
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test data



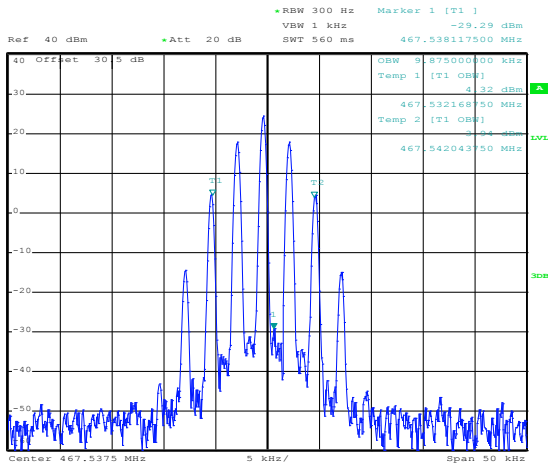
Date: 20.JUN.2018 16:08:55

Figure 8.3-1: 457.525 MHz 25 kHz low power 99%



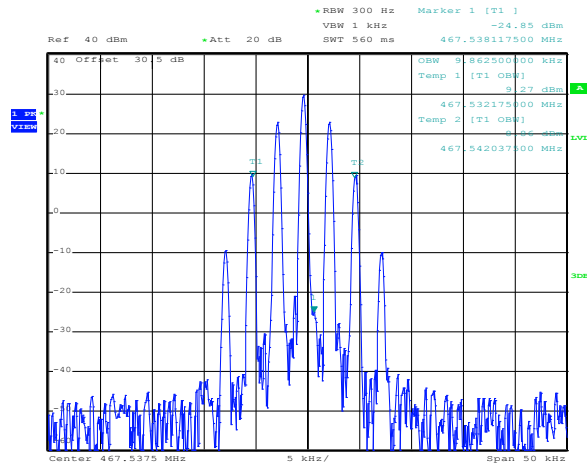
Date: 20.JUN.2018 16:09:43

Figure 8.3-2: 457.525 MHz 25 kHz high power 99%



Date: 20.JUN.2018 16:04:14

Figure 8.3-3: 467.5375 MHz 12.5 kHz low power 99%



Date: 20.JUN.2018 16:03:44

Figure 8.3-4: 467.5375 MHz 12.5 kHz high power 99%

8.4 FCC 2.1051, 80.211(f) and RSS-119 Section 5.8 Spurious Emissions at Antenna Terminals

8.4.1 Definitions and limits

FCC:

80.211(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

- (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
- (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

ISED:

5.8 Table 5 – Emission Mask B, Table 7 – Emission Mask D

8.4.2 Test summary

Test date	February 28, 2018	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	36 %

8.4.3 Observations, settings and special notes

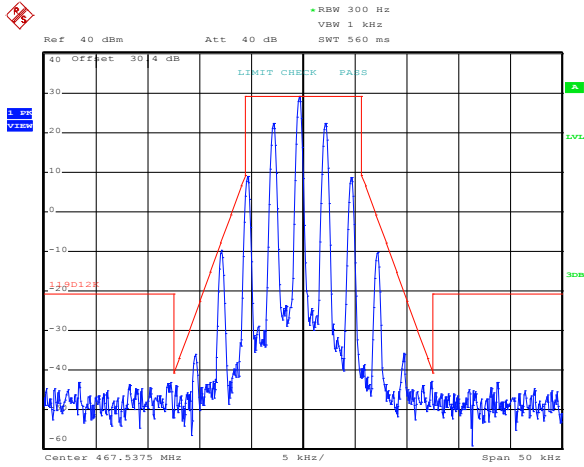
The spectrum was searched from 30 MHz to 5GHz.
Spectrum analyser settings for measurements below 1 GHz:

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

Spectrum analyser settings for measurements above 1 GHz:

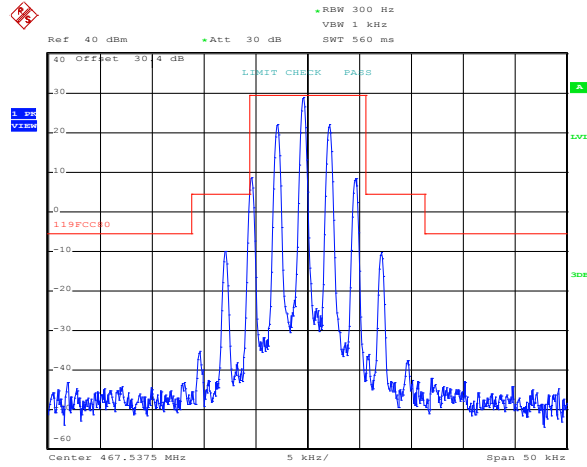
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.4.4 Test data



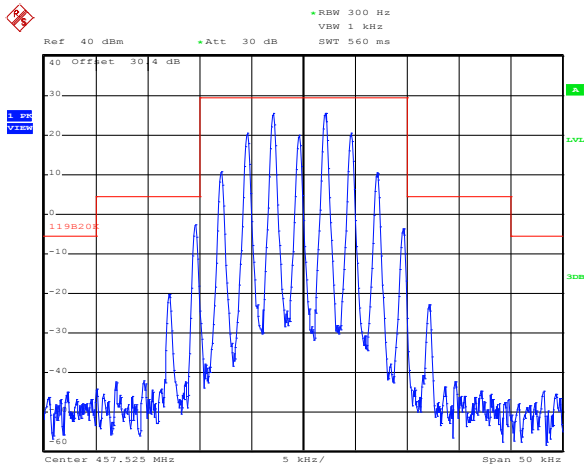
Date: 7.MAR.2018 13:42:09

Figure 8.4-1: 467.5375 MHz 12.5 kHz Channel RSS 119 Mask D high power



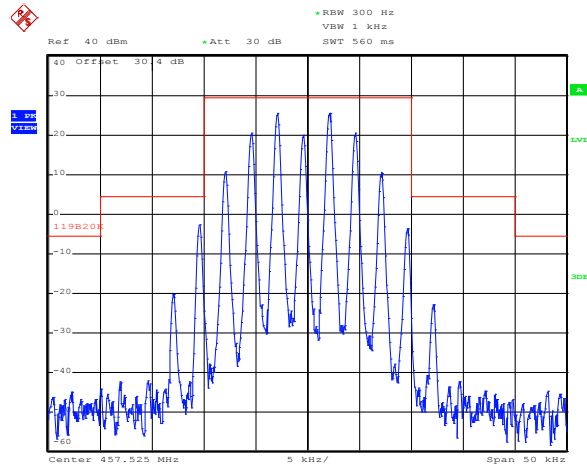
Date: 6.MAR.2018 14:32:44

Figure 8.4-2: 467.5375 MHz 12.5 kHz Channel Part 80 Mask F high power



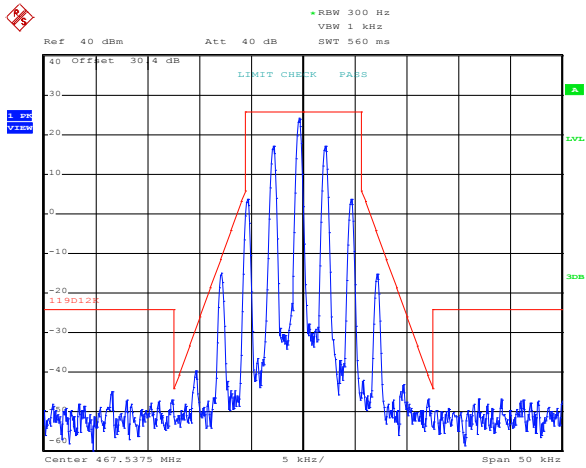
Date: 6.MAR.2018 14:43:06

Figure 8.4-3: 457.525 MHz 25 kHz Channel RSS 119 Mask B high power



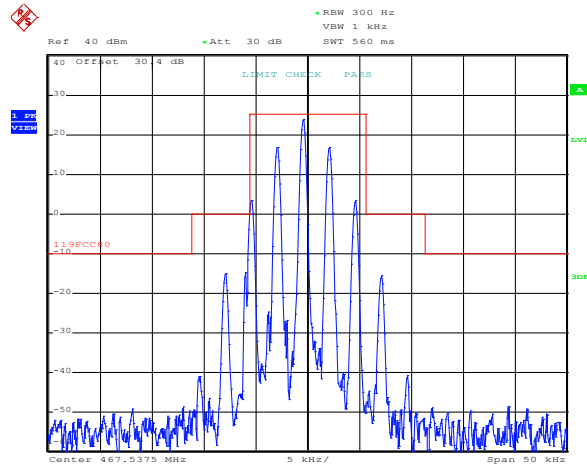
Date: 6.MAR.2018 14:43:06

Figure 8.4-4: 457.525 MHz 25 kHz Channel Part 80 Mask F high power



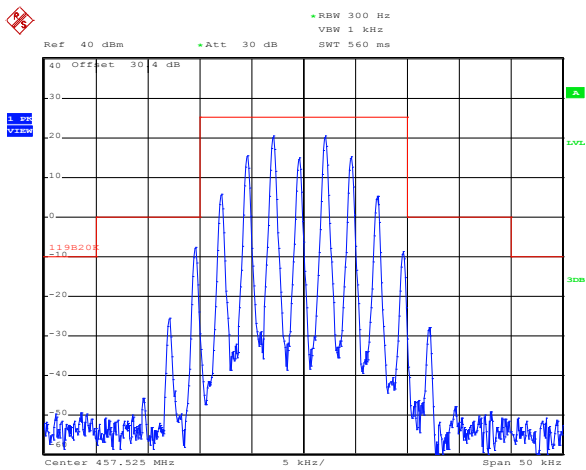
Date: 7.MAR.2018 13:46:04

Figure 8.4-5: 467.5375 MHz 12.5 kHz Channel RSS 119 Mask D low power



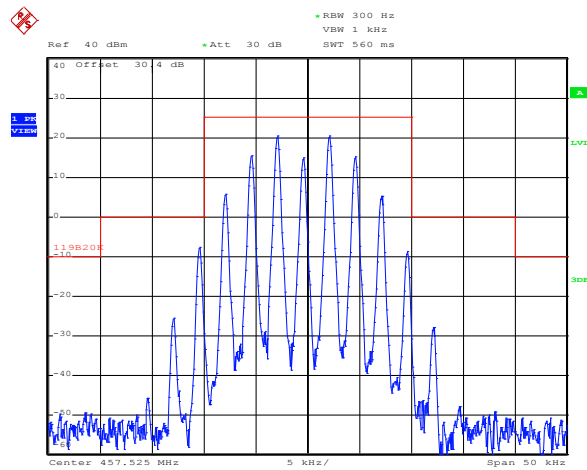
Date: 6.MAR.2018 14:48:43

Figure 8.4-6: 467.5375 MHz 12.5 kHz Channel Part 80 Mask F low power



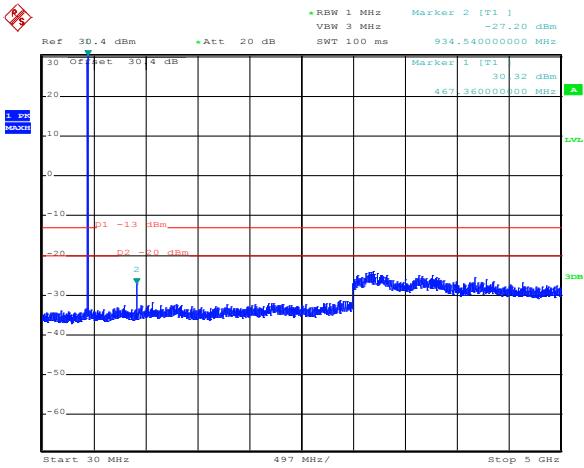
Date: 6.MAR.2018 14:46:48

Figure 8.4-7: 457.525 MHz 25 kHz Channel RSS 119 Mask B low power



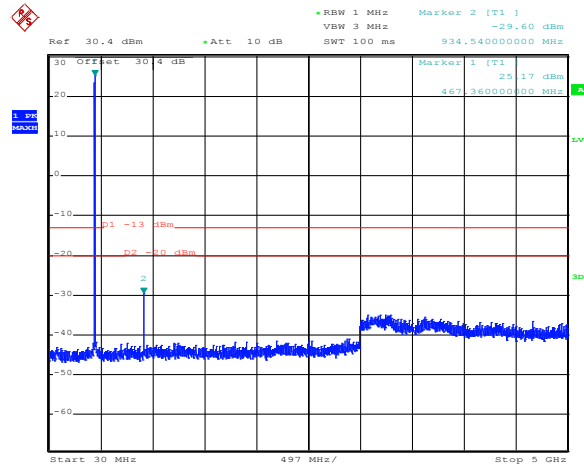
Date: 6.MAR.2018 14:46:48

Figure 8.4-8: 457.525 MHz 25 kHz Channel Part 80 Mask F low power



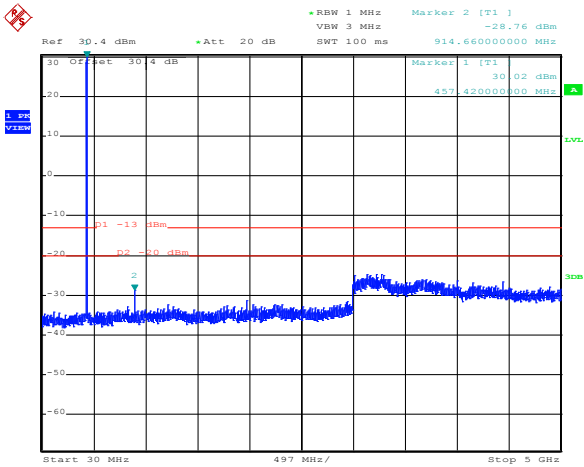
Date: 6.MAR.2018 15:02:38

Figure 8.4-9: 467.5375 MHz Spurious High power



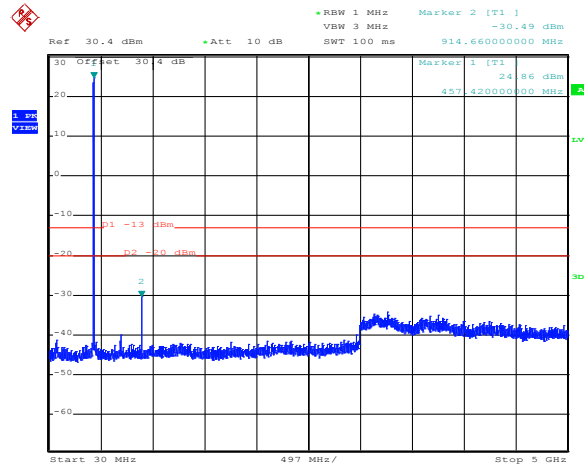
Date: 6.MAR.2018 15:03:19

Figure 8.4-10: 467.5375 MHz Spurious Low power



Date: 6.MAR.2018 15:01:41

Figure 8.4-11: 457.525 MHz Spurious High power



Date: 6.MAR.2018 15:00:45

Figure 8.4-12: 457.525 MHz Spurious Low power

8.5 FCC 2.1053, 80.211(f) and RSS-119 Section 5.8 Field Strength of Spurious Radiation

8.5.1 Definitions and limits

FCC:

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB (-13 dBm).

ISED:

On any frequency outside of the ranges specified in the ACP tables 13 to 16, the power of any emission shall be attenuated below the mean output power P(dBW) by at least $43 + 10 \log_{10}(p)$, measured in a 100 kHz bandwidth for frequencies less than or equal to 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz

Table 8.5-1: Spurious emissions limit

Frequency range, MHz	Attenuation below carrier, dBc	Spurious emissions, dBm	Field strength of spurious radiation* at 3 m, dBμV/m
30-5000	$43 + 10 \log_{10}(P)$	-13	82.23

Note: theoretical conversion is for the preliminary results only.

8.5.2 Test summary

Test date	February 28, 2018	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	36 %

8.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 5GHz.
 Spectrum analyser settings for measurements below 1 GHz:

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

Spectrum analyser settings for measurements above 1 GHz:

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

8.5.4 Test data

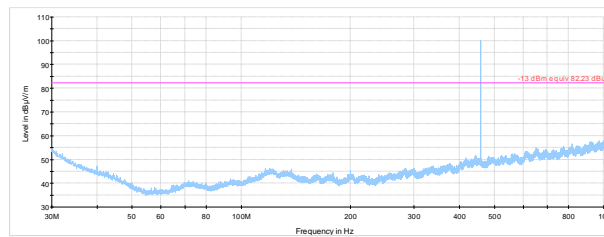


Figure 8.5-1: Spurious emissions within 30-1000 MHz

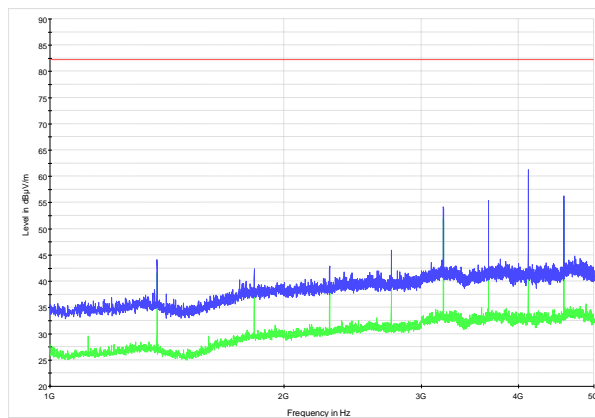


Figure 8.5-2: Spurious emissions within 1–5 GHz

8.6 FCC 2.1055, 80.209(7)(ii) and RSS Section 5.3 Frequency Stability

8.6.1 Definitions and limits

FCC:
5 ppm

ISED:
2.5 ppm

8.6.2 Test summary

Test date:	February 27, 2018	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1005 mbar
Verdict:	Pass	Relative humidity:	36 %

8.6.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	≥ 1 % of emission bandwidth
Video bandwidth	≥ 3 × RBW
Frequency span	Wider than emission bandwidth
Detector mode	Peak

8.6.4 Test data

Table 8.6-1: Frequency drift measurement results

Test conditions	Frequency, Hz	Drift, Hz	ppm
+50 °C, Nominal	457524304	-305	-0.67
+40 °C, Nominal	457524453	-156	-0.34
+30 °C, Nominal	457524594	-15	-0.03
+20 °C, +15 %	457524614	5	0.01
+20 °C, Nominal	457524609	Ref	
+20 °C, -15 %	457524706	97	0.21
+10 °C, Nominal	457524772	163	0.36
0 °C, Nominal	457524283	-326	-0.71
-10 °C, Nominal	457524478	-131	-0.29
-20 °C, Nominal	457524304	-305	-0.67
-30 °C, Nominal	457524453	-156	-0.34

Note: Offset was calculated as per the following formula:

$$\frac{F_{\text{Measured}} - F_{\text{reference}}}{F_{\text{reference}}} \times 1 \cdot 10^6$$

8.7 RSS-119 Section 5.9 Transient Frequency Behavior

8.7.1 Definitions and limits

ISED:

Channel Bandwidth (kHz)	Time Intervals (Notes 1, 2)	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138-174 MHz	406.1-512 MHz
25	t ₁	±25	5	10
	t ₂	±12.5	20	25
	t ₃	±25	5	10
12.5	t ₁	±12.5	5	10
	t ₂	±6.25	20	25
	t ₃	±12.5	5	10
6.25	t ₁	±6.25	5	10
	t ₂	±3.125	20	25
	t ₃	±6.25	5	10

Note: 1

ton: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t1: the time period immediately following ton.

t2: the time period immediately following t1.

t3: the time period from the instant when the transmitter is turned off until toff.

toff: the instant when the 1 kHz test signal starts to rise.

Note: 2

If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t1 and t3 shall be recorded in the test report.

8.7.2 Test summary

Test date	February 27, 2018	Temperature:	23 °C
Test engineer	Kevin Rose	Air pressure:	1005 mbar
Verdict	Pass	Relative humidity:	36 %

8.7.3 Observations, settings and special notes

Assessed to remain within assigned band. Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	20 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.7.4 Test data

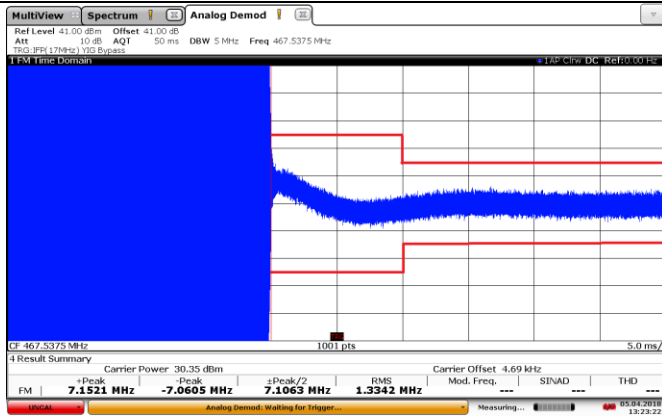


Figure 8.7-1: Transient frequency behavior 12.5 kHz On

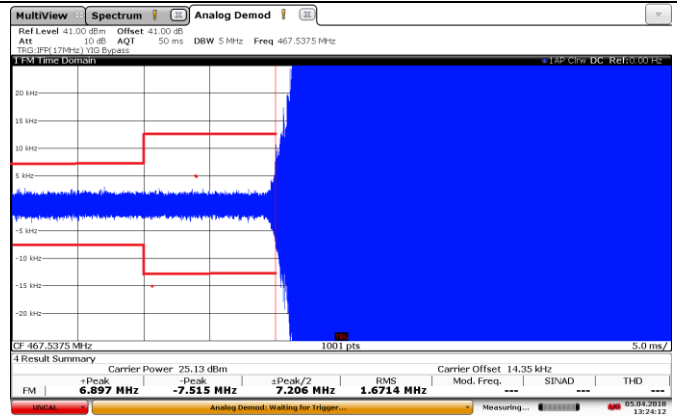


Figure 8.7-2: Transient frequency behavior 12.5 kHz Off

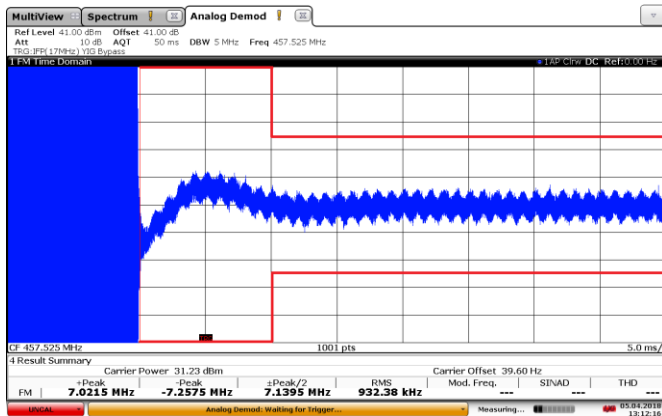


Figure 8.7-3: Transient frequency behavior 25 kHz On

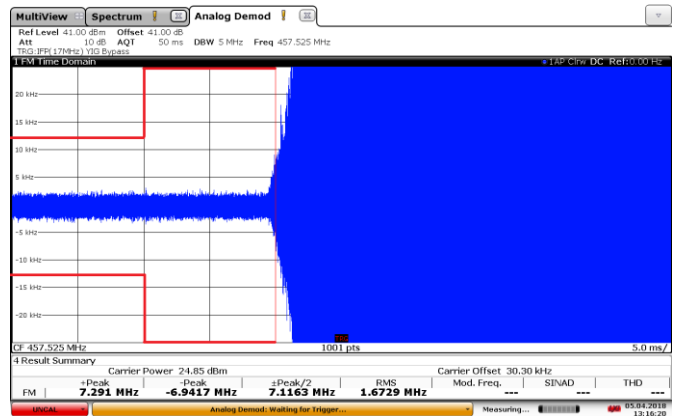
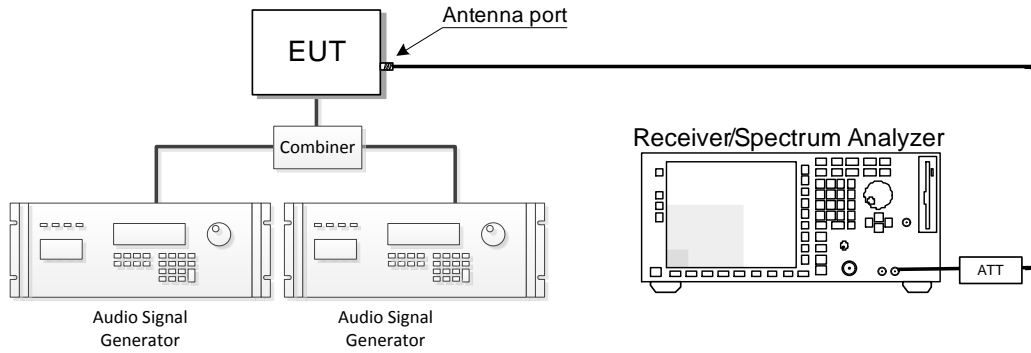


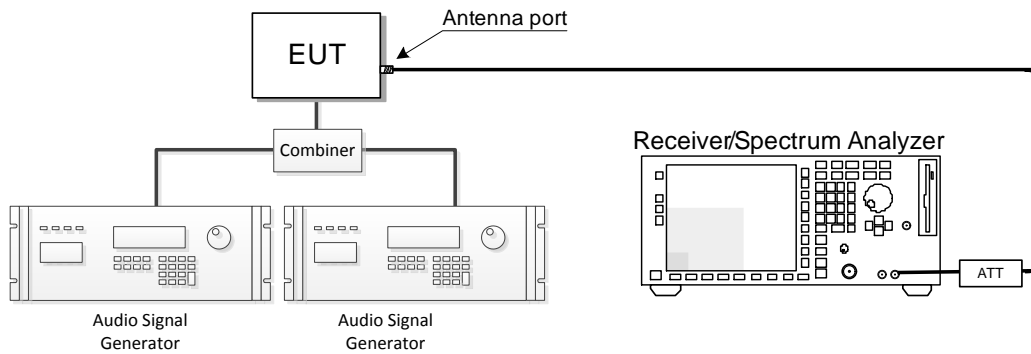
Figure 8.7-4: Transient frequency behavior 25 kHz Off

Section 9. Block diagrams of test set-ups

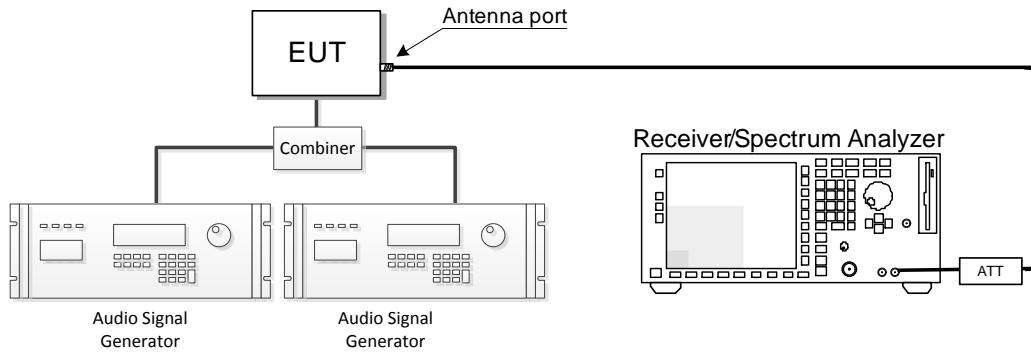
9.1 Power Output



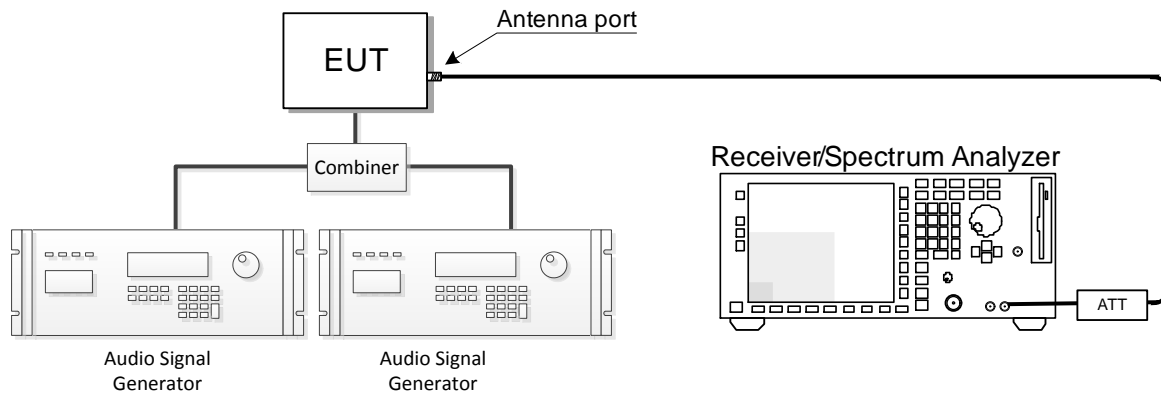
9.2 Modulation Characteristics



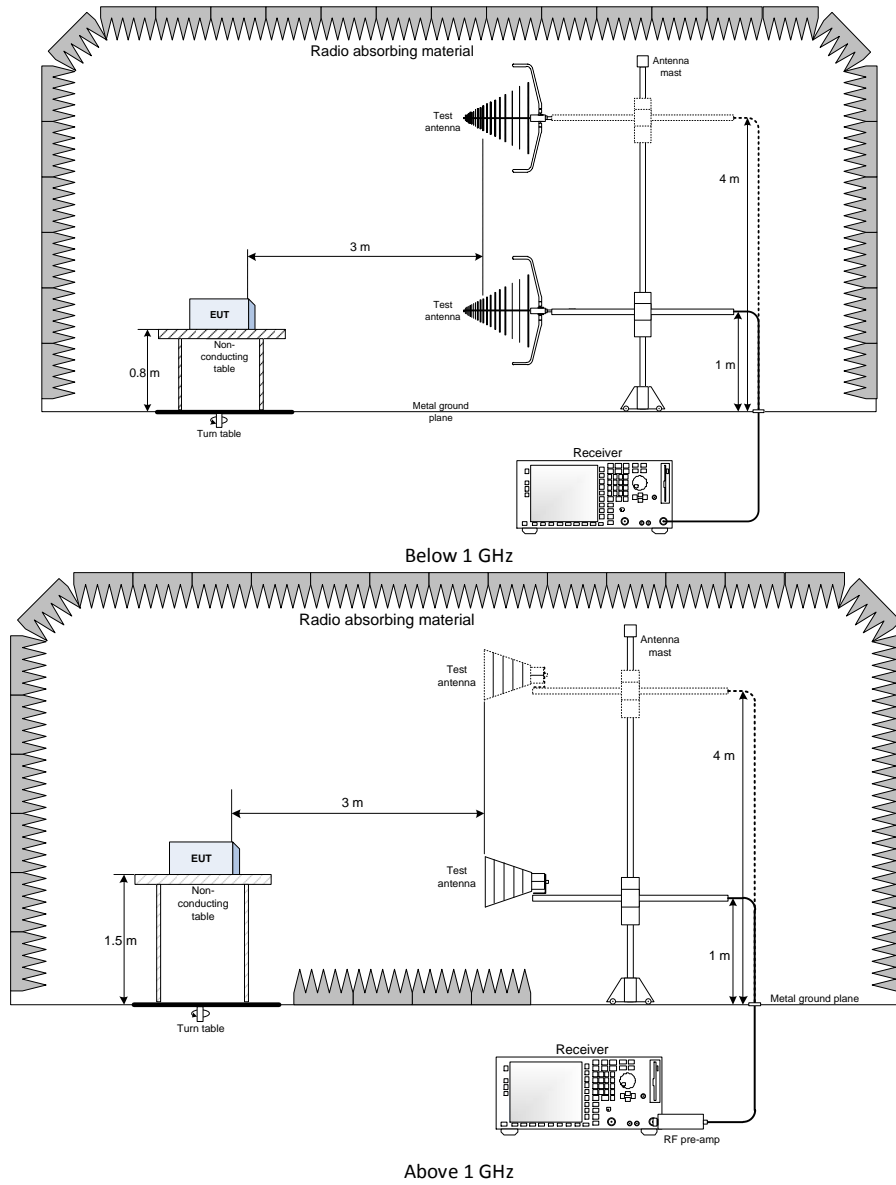
9.3 Occupied Bandwidth



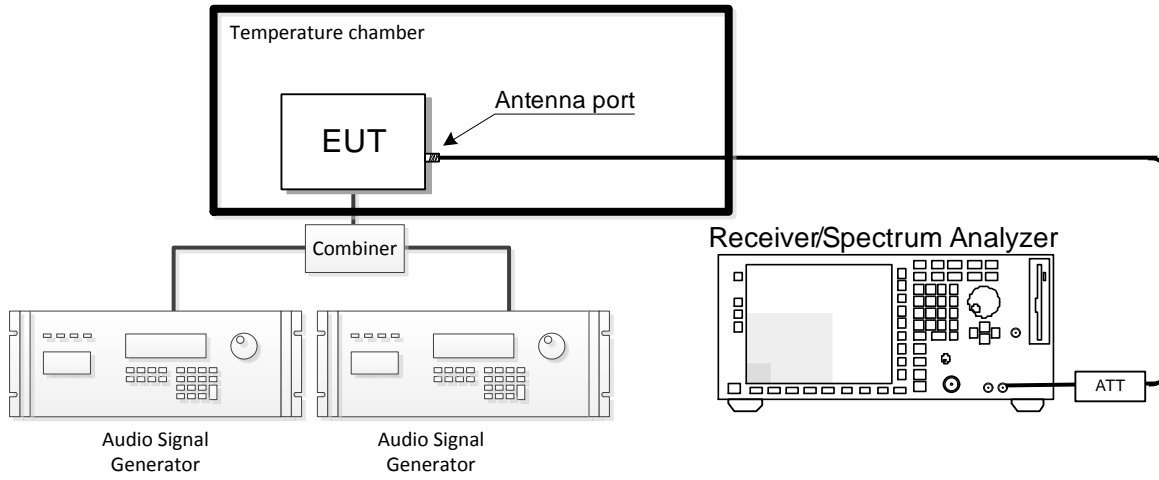
9.4 Spurious Emissions at Antenna Terminals



9.5 Field Strength of Spurious Radiation



9.6 Frequency stability



9.7 Transient frequency behavior

