Report on the Radio Testing

For

Sound Devices LLC

on

A20-TX

Report no. TRA-061998-47-20B

21st February 2024

RF993 1.0

0026

Report Number: TRA-061998-47-20B
Issue: A

REPORT ON THE RADIO TESTING OF A
Sound Devices LLC
A20-TX
WITH RESPECT TO SPECIFICATION
FCC 47CFR Part 90

TEST DATE: 12th February - 16th February 2024

Tested by: D Winstanley, S Garwell

Written by: Digitally signed by D Winstanley
DN: cn=D Winstanley, o=Element, ou=Radio, email=daniel.winstanley@element.com, c=US
Date: 2024.02.21 10:22:18 Z
D Winstanley
Radio Senior Test Engineer

Approved by: Digitally signed by John Charters
Date: 2024.02.21 12:41:26 Z
J Charters
Lab Manager

Date: 21st February 2024

Disclaimers:

[1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
[2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	20th December 2023	Original
B	21st February 2024	Report updates to reflect testing performed on lowest and highest frequencies specified in 90.265(b)(1)

2 Summary

TEST REPORT NUMBER:	TRA-061998-47-20B
WORKS ORDER NUMBER:	TRA-061998-00
PURPOSE OF TEST:	Certification
TEST SPECIFICATION:	47CFR Part 90.265
EQUIPMENT UNDER TEST (EUT):	A20-TX
FCC IDENTIFIER:	2AKLX-9808
EUT SERIAL NUMBER:	SP0223137019
MANUFACTURER/AGENT:	Sound Devices LLC
ADDRESS:	E7556 State Road 23 and 33 Reedsburg WI 53959
CLIENT CONTACT:	Lee Stone ✉ lee.stone@audioltd.com
ORDER NUMBER:	73795
TEST DATE:	12th February - 16th February 2024
TESTED BY:	D Winstanley, S Garwell Element

2.1 Test Summary

Test Method and Description	*Requirement Clause 47CFR*	*Applicable to this equipment*	*Result / Note*
Conducted Power Output	2.1046 90.265(b)(2)	☒	*Pass*
Spurious Emissions Emission Mask	2.1051 90.265(b)(3)	☒	*Pass*
Field Strength of Spurious Emissions	2.1051 90.265(b)(3)	☒	*Pass*
Bandwidth Limitations	2.1049 90.265(b)(1)	☒	*Pass*
Frequency Stability	2.1055 90.265(b)(3)	☒	*Note 1*

Specific Note:
Note 1: No specific frequency stability limits within the part 90.265 rule parts, compliance demonstrated by the Emissions Mask and 99% Occupied bandwidth measurements
(Part 2.1051 / ETSI EN 300 422 Digital Mask and 2.1049).

General Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

The decision rule for compliance is not inherent within this test specification and compliance is based on the customer requesting a simple acceptance rule based on understanding and acceptance of Elements Measurement Uncertainty values.

3 Contents

4 Introduction

This report TRA-061998-47-20B presents the results of the Radio testing on a Sound Devices LLC, A20-TX to specification 47CFR90 Land Mobile Radio Service.

The testing was carried out for Sound Devices LLC by Element, at the address detailed below.

☐ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ Element Skelmersdale
Unit 1
Pendle Place
Skelmersdale
West Lancashire
WN8 9PN
UK

☐ Element Surrey Hills
Unit 15 B
Henley Business Park
Pirbright Road
Normandy
Guildford
GU3 2DX
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
The test laboratory is accredited for the above sites under the following US-UK MRA, Designation numbers.

Element Skelmersdale UK2020

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 2 - Code of Federal Regulations, Title 47, Part 2, “Frequency allocations and Radio Telemetry Matters; General Rules and Regulations”
- FCC 47 CFR Ch. I – Part 90 - Code of Federal Regulations, Title 47, Part 90, “Land Mobile Radio Service”
- TIA EIA-603-D Land Mobile FM or PM Communications Equipment Measurement and Performance StandardsANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- ANSI C63.26-2015 - American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- KDB 206256 D01 Wireless Microphone Certification v02r01,
- KDB 971168 D01 Power Meas License Digital Systems v03r01

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment under Test

7.1 EUT Identification

- Name: A20-TX
- Serial Number: SP0223137019
- Model Number: 9808
- Software Revision: 7.50.8469
- Build Level / Revision Number: 02

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Hp Spectre Laptop

7.3 EUT Mode of Operation

The channels were selected using the client supplied test scripts.

7.4 EUT Radio Parameters

7.4.1 General

Band of operation:	169.0 MHz - 172.0 MHz
Frequencies of operation:	169.575 MHz, 170.025 MHz, 171.075 MHz, 171.875 MHz
Modulation type(s):	COFDM
Occupied channel bandwidth(s):	192 kHz
Channel spacing:	200 kHz
ITU emission designator(s):	200KG2E
Declared output power(s):	2.0 mW
Nominal Supply Voltage:	4.5 Vdc
Duty cycle:	100%

7.4.2 Antennas

Type:	¼ Wave Whip Antenna
Frequency range:	2.15 dBi

7.5 EUT Description

The EUT is a professional (Body-worn) Wireless Microphone Transmitter, Which incorporates the following radio's, BTLE, proprietary LoRa and various frequency bands for the digital wireless audio, this test report is reporting on the Digital Wireless Audio radio.

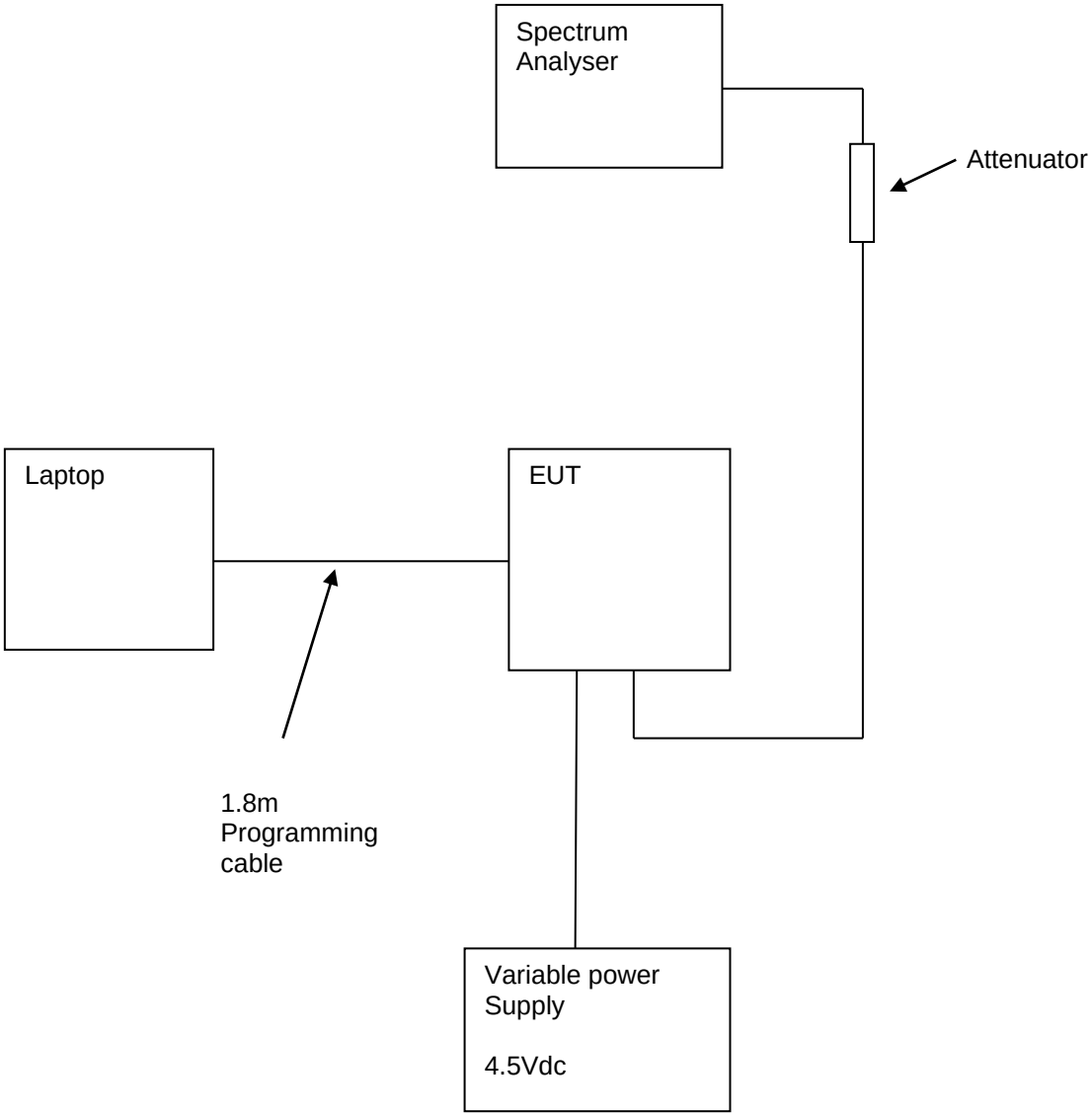
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT interconnections:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:

9.3 Measurement software

Where applicable, the following software was used to perform measurements contained within this report.

Element Emissions R5
Element Transmitter Bench Test
ETS Lindgren EMPower V1.0.4.2

10 General Technical Parameters

10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 4.5 Vdc from batteries

10.2 Extreme Test Conditions

Extreme temperatures and voltages are required to be tested, the following extremes were used:

Voltage	***Temperature***
Nominal	-30ºC to +50ºC in 10ºC steps
85% Nominal	20ºC
100% Nominal	20ºC

Extreme voltage range as Per TIA-603-E 1.4.4.5, specified by the manufacturer.

11 Conducted output power

11.1 Definition

The conducted carrier power output rating for a transmitter is the power available at the output terminals of the transmitter when the output terminals are connected to the standard transmitter load.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	Part 90.265(b)(2), Part 2.1046 ETSI EN 300 422–1 V1.4.2 (2011–08), Clause 14.3.2.1
Frequencies Measured:	169.575 MHz / 171.875 MHz
EUT Channel Bandwidths:	200 kHz
Deviations from Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW:	3 MHz
Measurement Detector:	RMS Average

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 46 % RH	20 % RH to 75 % RH (as declared)

11.3 Test Limit

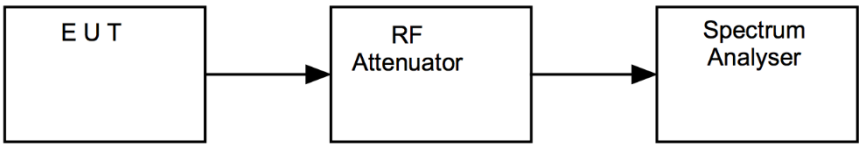
Part 15.265(b)(2) The output power shall not exceed 50 milliwatts.

11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure i Test Setup

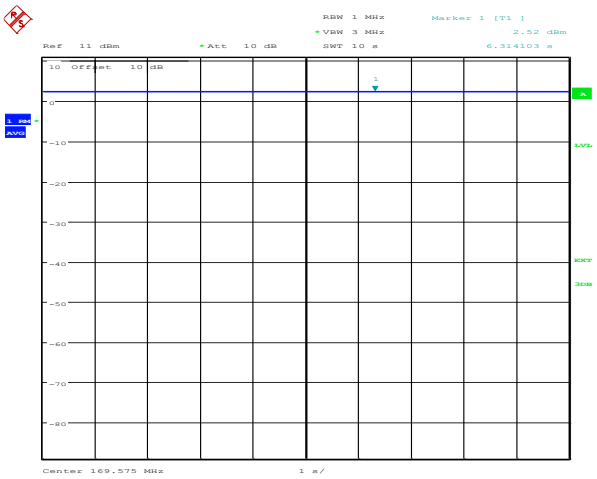


11.5 Test Equipment

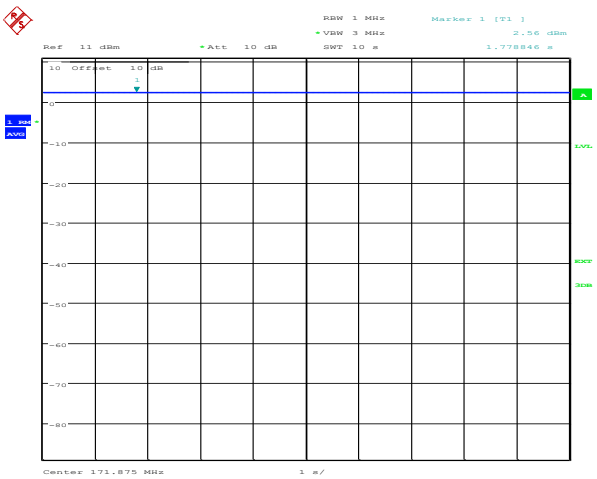
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	FSU26	REF909	2024-08-30
20dB SMA	AtlanTech	Attenuator	U631	Cal in use
Signal Generator	R&S	SMBV100A	U674	2024-05-02
Power Supply	ISO-Tech	IPS 303A	U748	Use U674
33XR-A	Amprobe	Multimeter	U674	2024-07-28

11.6 Test Results

Tx RF Output power setting: 3.0 dBm: 2.0 mW							
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***System loss (dB)***	***Conducted Carrier Output Power (dBm)***	***Conducted Carrier Output Power (mW)***	***Rated Output Power (mW)***	***Limit (mW)***	***Result***
169.575	-7.48	10	2.52	1.79	2.0	50.0	Pass
171.875	-7.44	10	2.56	1.80	2.0	50.0	Pass



169.575 MHz



171.875 MHz

12 Emissions Mask

12.1 Definition

Necessary bandwidth. For a given class of emission, the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed, under specified conditions. Emissions useful for the good functioning of the receiving equipment, as for example, the emission corresponding to the carrier of reduced carrier systems, shall be included in the necessary bandwidth.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	Part 90.265(b)(3) Part 2.1051 KDB 206256 D01 v02r01 ETSI EN 300 422–1 v1.4.2 (2011–08) Clause 8.3.
Frequencies Measured:	169.575 MHz / 171.875 MHz
EUT Channel Bandwidths:	200 kHz
Deviations from Standard:	None
Measurement BW:	1 MHz / 1 kHz
Measurement Detector:	RMS Average / RMS Peak Hold
Measurement Range:	± 1 MHz from Fc

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 46 % RH	20 % RH to 75 % RH (as declared)
Supply: 4.5 Vdc	

12.3 Test Limit

Part 90.265(b)(3)

(3) For emissions with a bandwidth not exceeding 54 kHz, the frequency stability of wireless microphones shall limit the total emission to within ±32.5 kHz of the assigned frequency. Emissions with a bandwidth exceeding 54 kHz shall comply with the emission mask in Section 8.3 of ETSI EN 300 422–1 v1.4.2 (2011–08)

12.4 Test Method

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:
a) At 10 °C intervals of temperatures between −30 °C and +50 °C at the manufacturer's rated supply voltage, and
b) At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the −15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

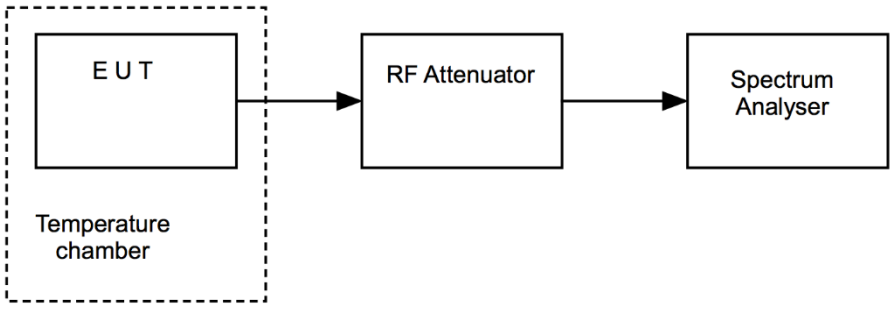
During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

$V_{nominal}$ 4.5 Vdc

$V_{minimum}$ 3.2 Vdc

$V_{maximum}$ 4.5 Vdc

Figure v Test Setup



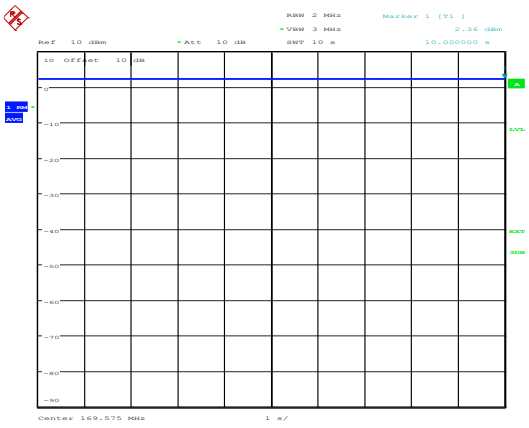
12.5 Test Equipment

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU26	REF909	2024-08-30
Signal Generator	R&S	SMBV100A	U674	2024-05-02
Power Supply	ISO-Tech	IPS 303A	U748	Use U674
33XR-A	Amprobe	Multimeter	U674	2024-07-28
Temperature Chamber	Votsch	VT 4002	U521	Use L426
Temperature Indicator	Fluke	52 Series II	L426	2024-07-19

12.6 Test Results

169.575 MHz

REF Step 1



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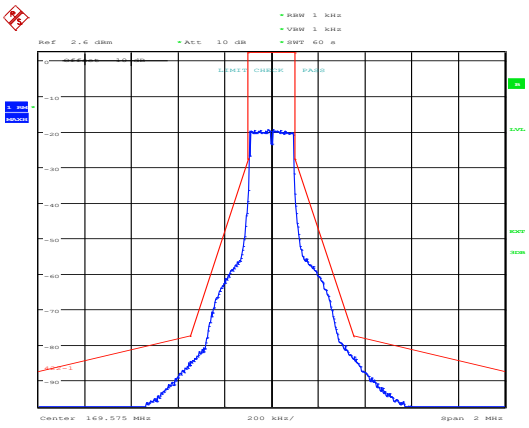

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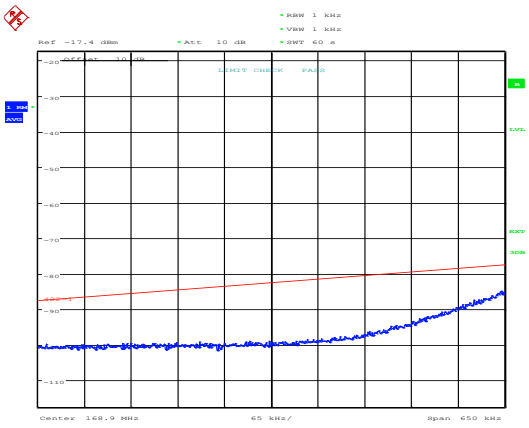

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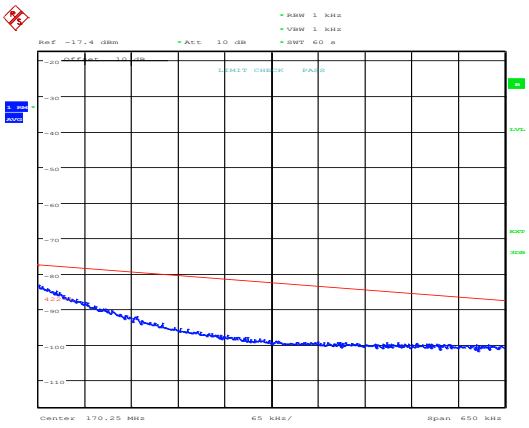

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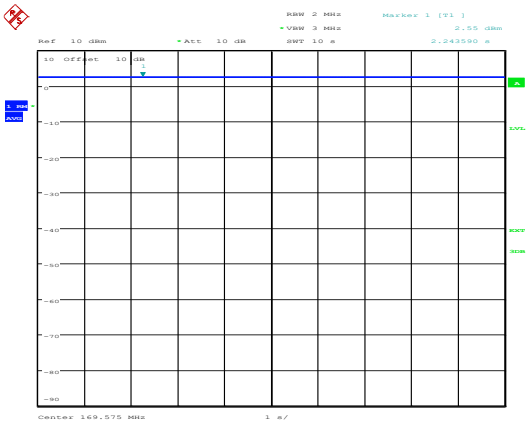

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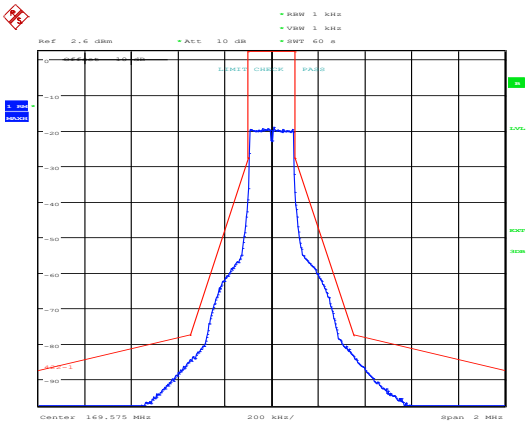

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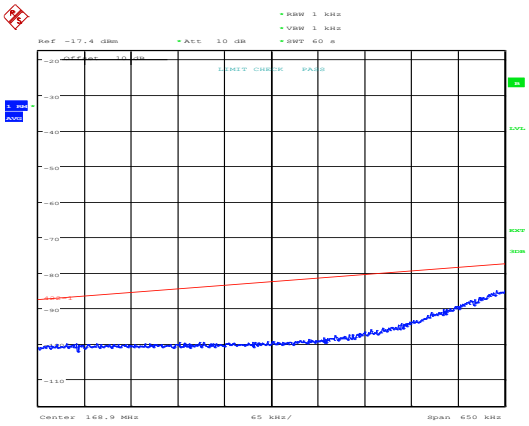

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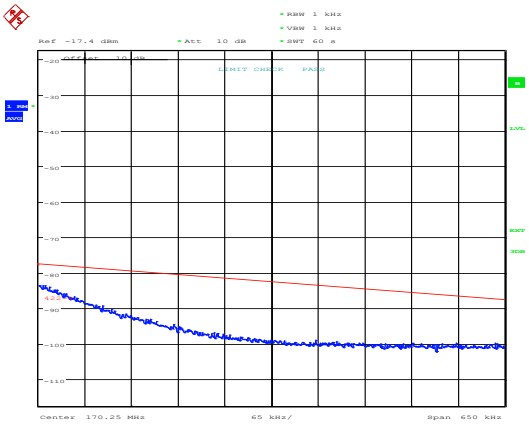

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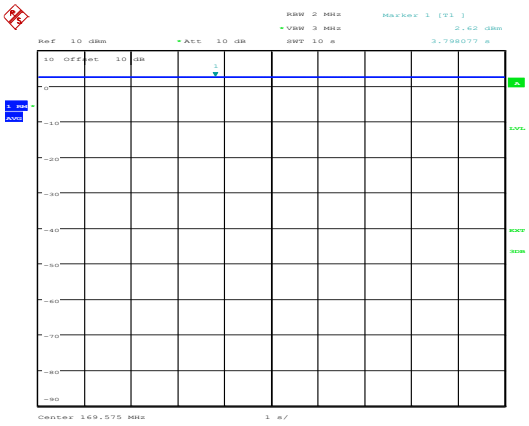

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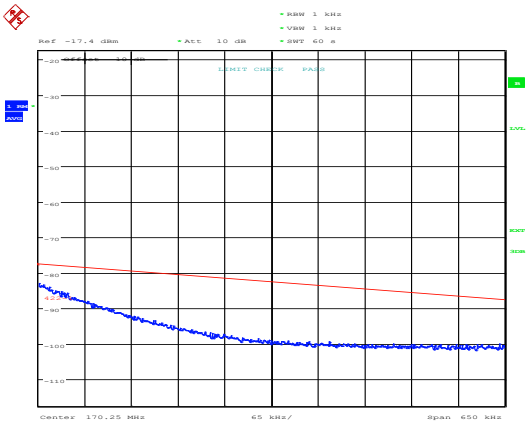

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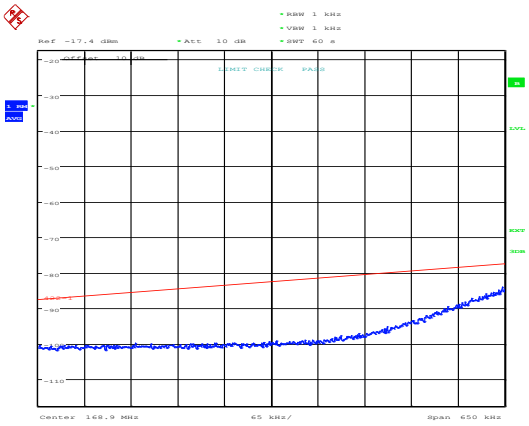

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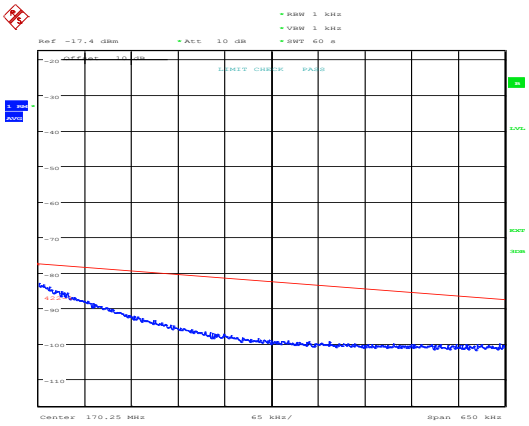

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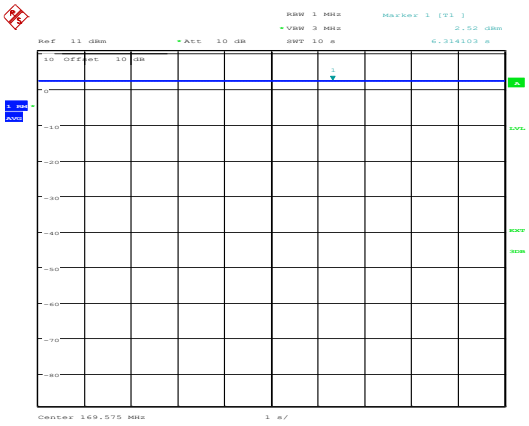

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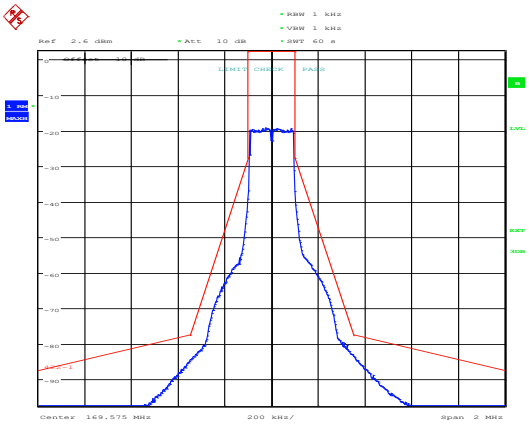

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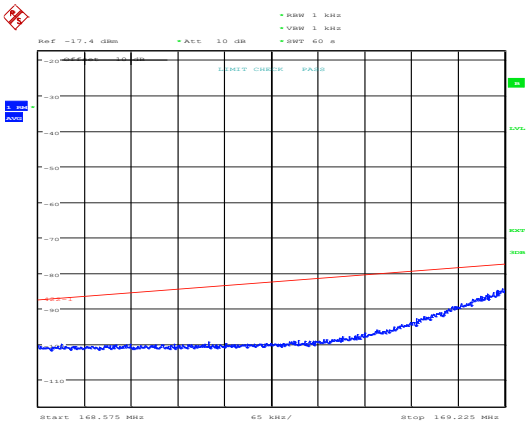

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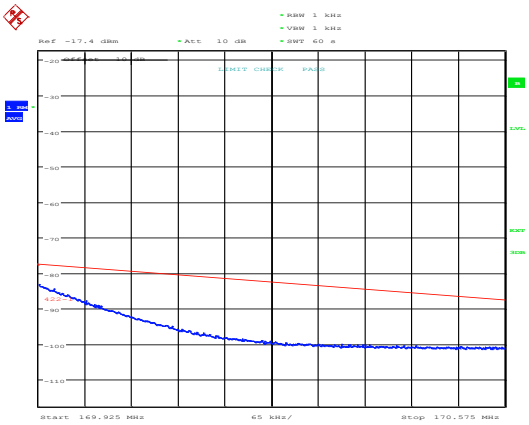

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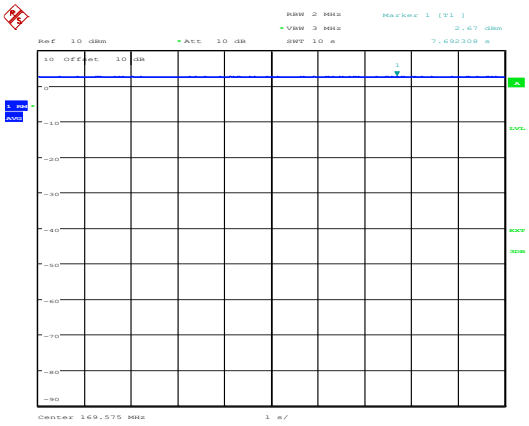

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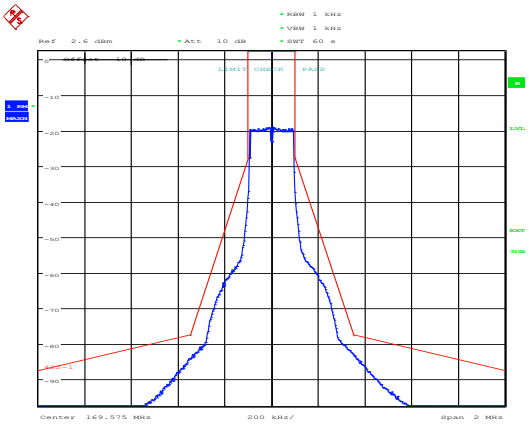

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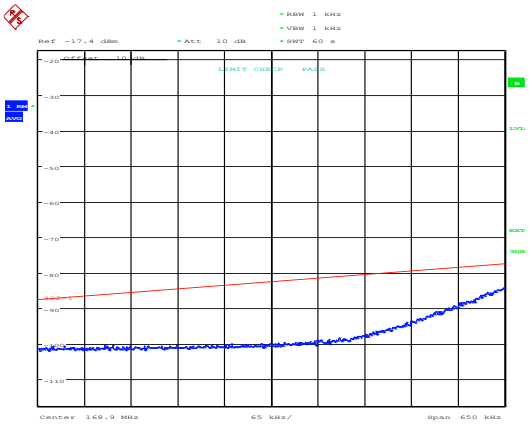

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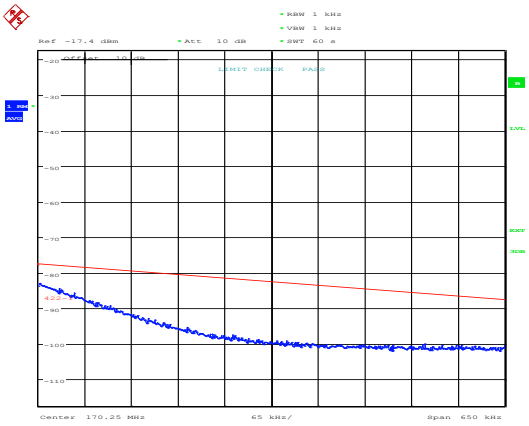

Date: 2.JAN.2003 05:44:16

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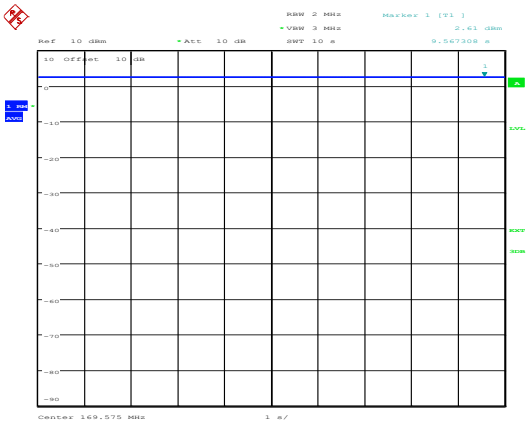
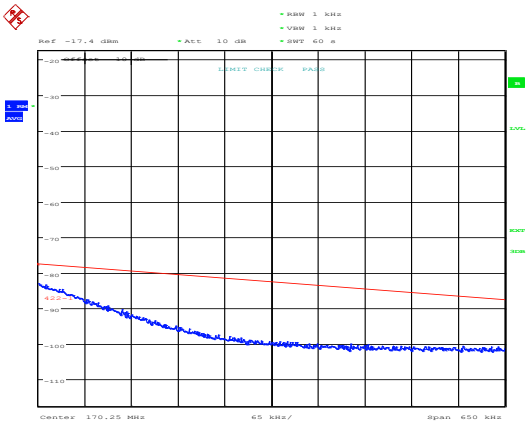


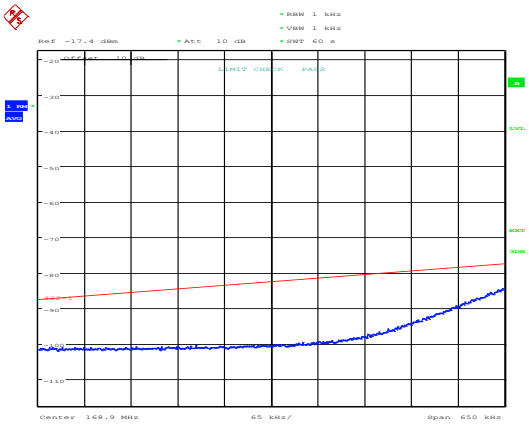
Date: 2.JAN.2003 07:04:11

Step 2 Vnom 0°C



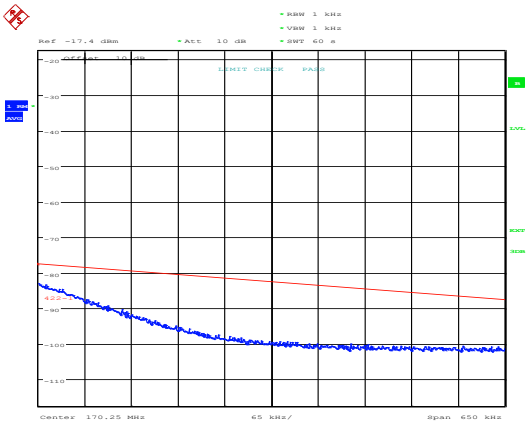
Date: 2.JAN.2003 07:00:59

Step 3 Lower Vnom 0°C



Date: 2.JAN.2003 06:59:41

Step 3 Upper Vnom 0°C



Date: 2.JAN.2003 07:00:59

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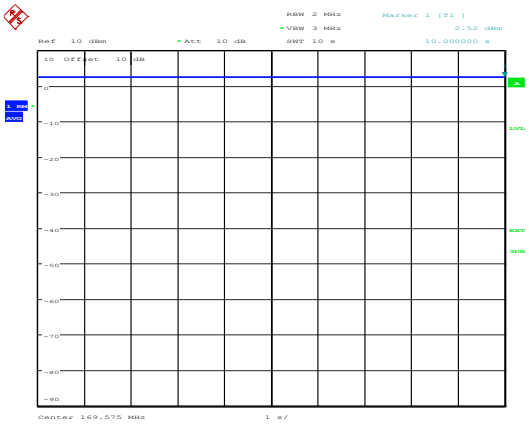
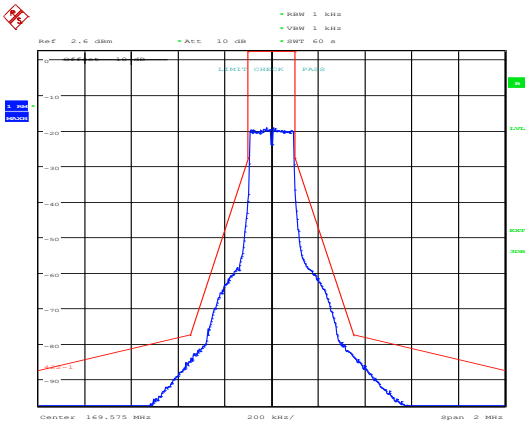


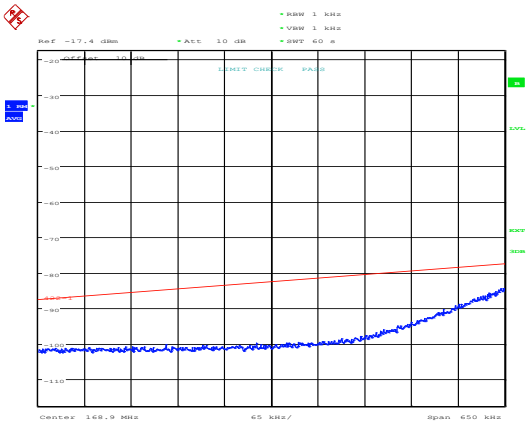
Date: 3.JAN.2003 02:36:42

Step 2 Vnom -10°C



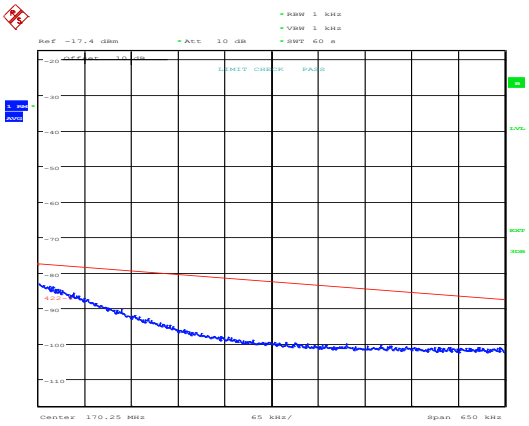
Date: 3.JAN.2003 02:32:54

Step 3 Lower Vnom -10°C



Date: 3.JAN.2003 02:35:58

Step 3 Upper Vnom -10°C



Date: 3.JAN.2003 02:34:42

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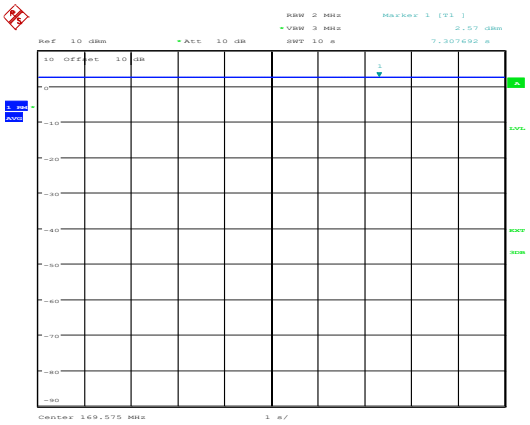
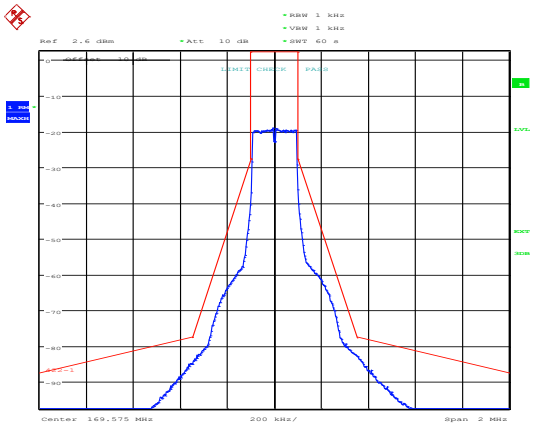


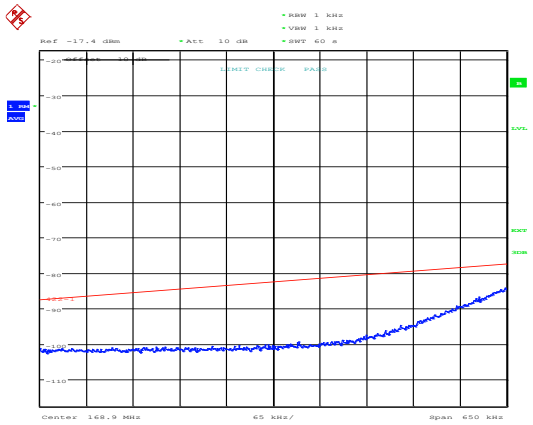
Date: 3.JAN.2003 00:57:00

Step 2 Vnom -10°C



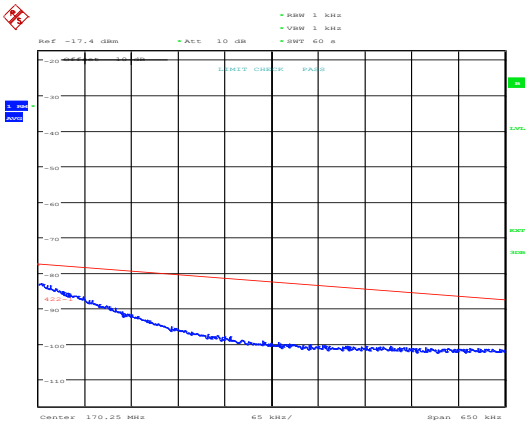
Date: 3.JAN.2003 00:59:25

Step 3 Lower Vnom -10°C



Date: 3.JAN.2003 01:05:47

Step 3 Upper Vnom -10°C



Date: 3.JAN.2003 01:03:13

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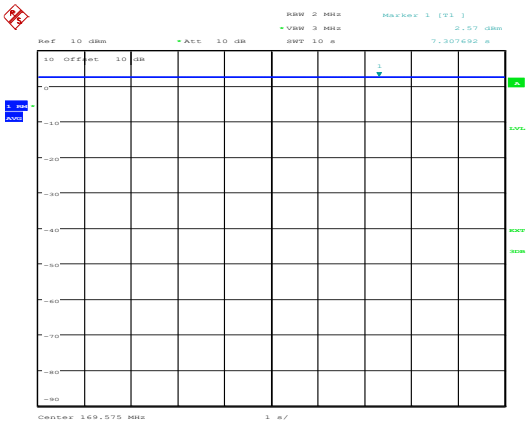
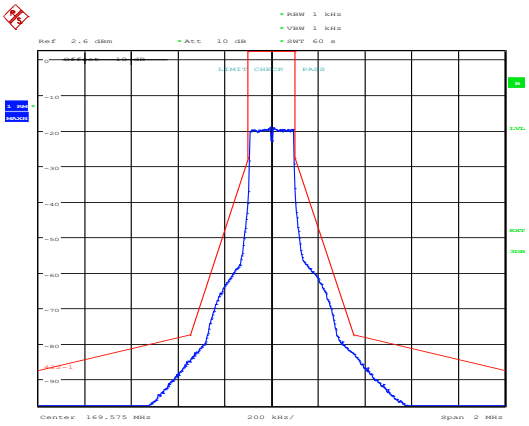


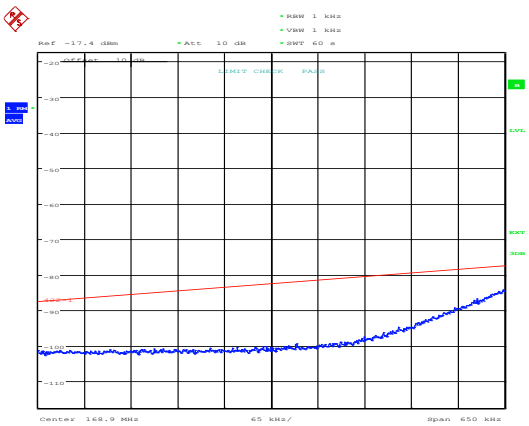
Date: 3.JAN.2003 00:57:00

Step 2 Vnom -20°C



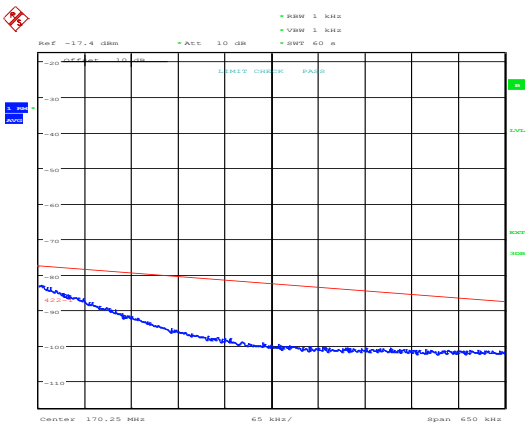
Date: 3.JAN.2003 00:59:25

Step 3 Lower Vnom -20°C



Date: 3.JAN.2003 01:05:47

Step 3 Upper Vnom -20°C



Date: 3.JAN.2003 01:03:13

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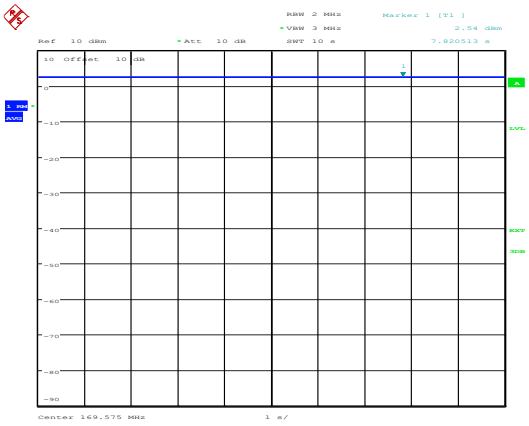
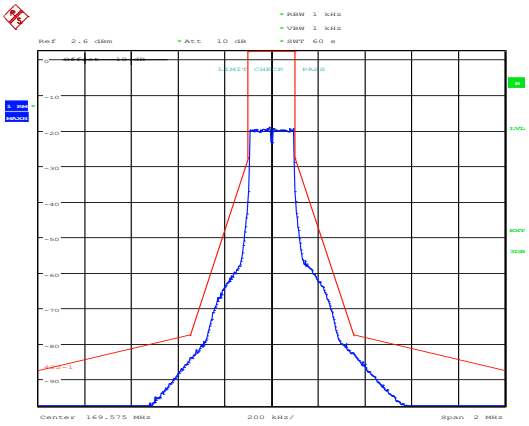


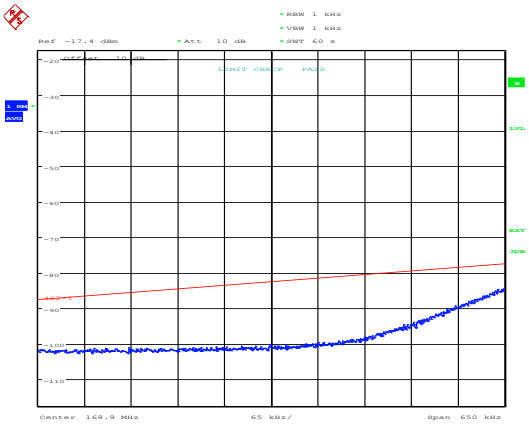
Date: 2.JAN.2003 23:33:26

Step 2 Vnom -30°C



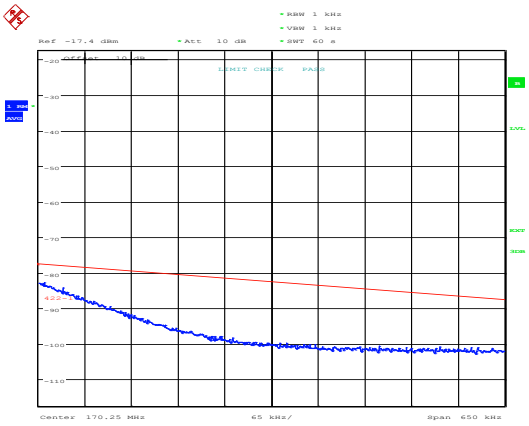
Date: 2.JAN.2003 23:27:29

Step 3 Lower Vnom -30°C



Date: 2.JAN.2003 23:32:52

Step 3 Upper Vnom -30°C



Date: 2.JAN.2003 23:30:08

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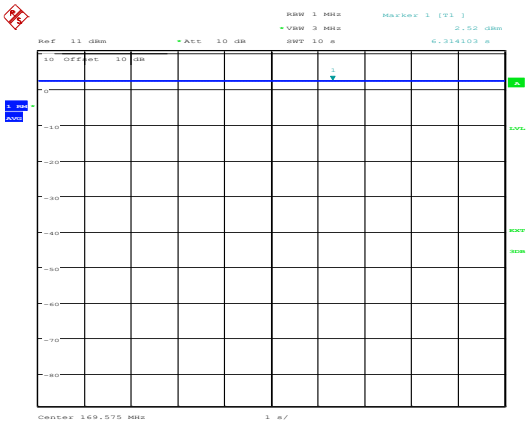
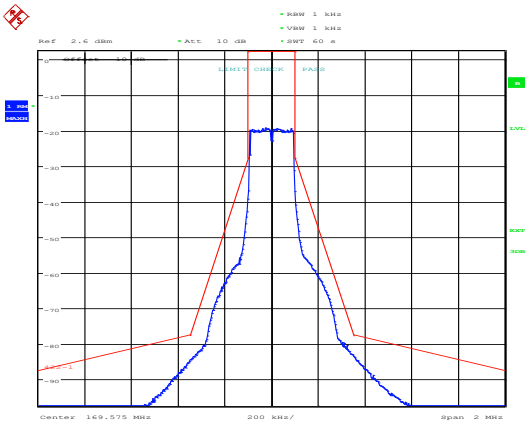


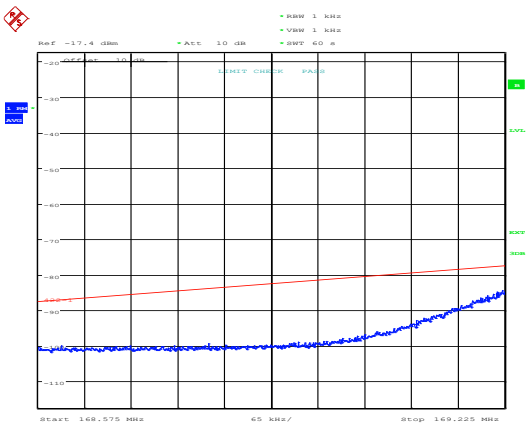
Date: 1.JAN.2003 02:26:27

Step 2 Vmax +20°C



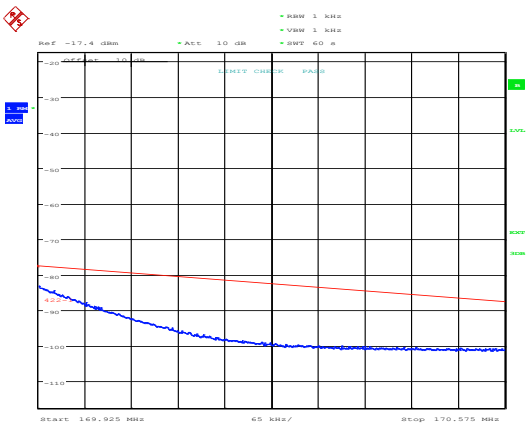
Date: 1.JAN.2003 01:39:16

Step 3 Lower Vmax +20°C



Date: 1.JAN.2003 02:20:42

Step 3 Upper Vmax +20°C



Date: 1.JAN.2003 02:18:24

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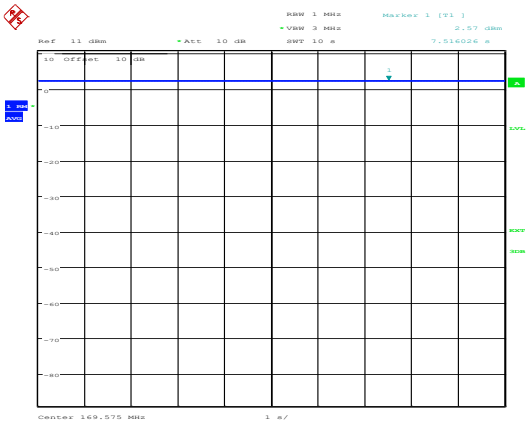
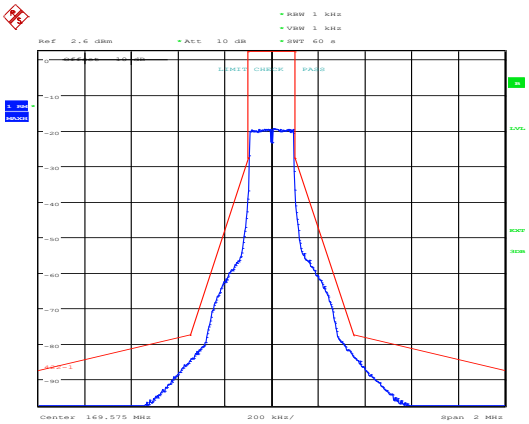


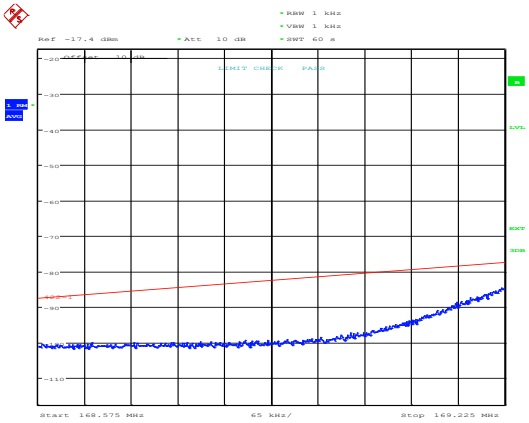
Date: 1.JAN.2003 03:13:03

Step 2 Vmin +20°C



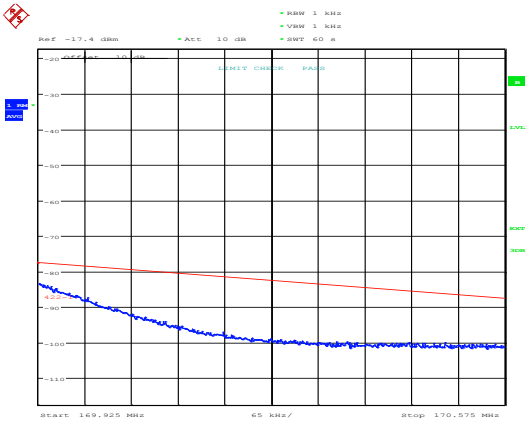
Date: 1.JAN.2003 03:04:43

Step 3 Lower Vmin +20°C



Date: 1.JAN.2003 03:07:08

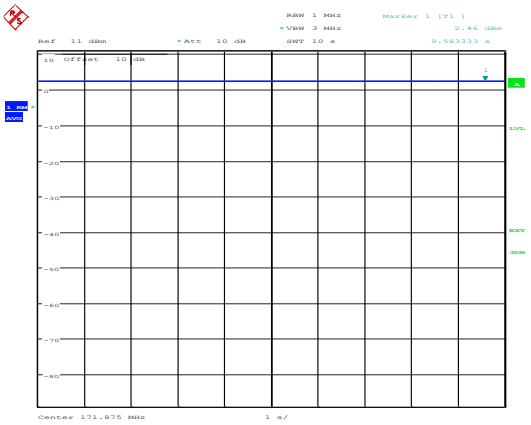
Step 3 Upper Vmin +20°C



Date: 1.JAN.2003 03:10:57

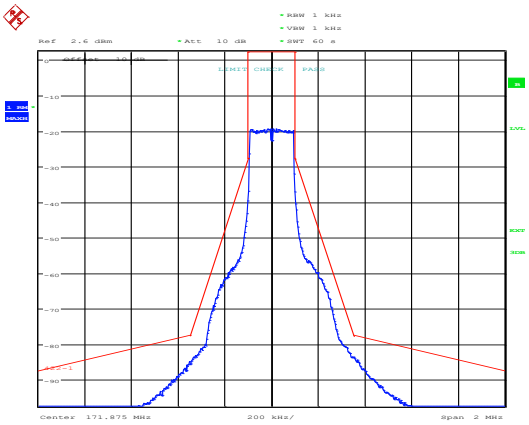
171.875 MHz

REF Step 1



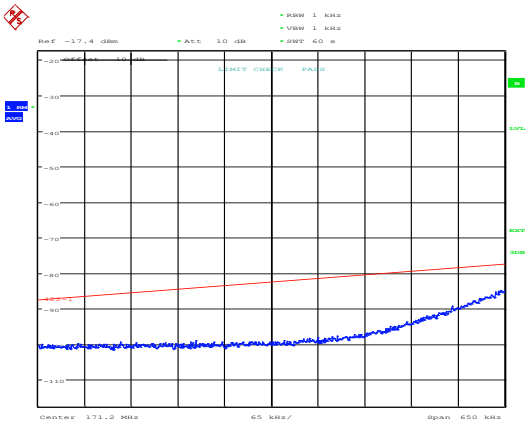
Date: 2.JAN.2003 00:23:16

Step 2 Vnom +50°C



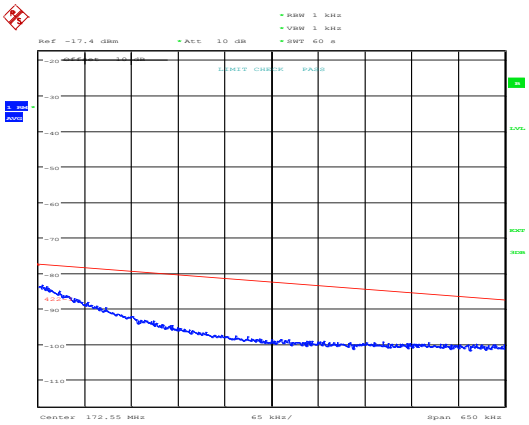
Date: 2.JAN.2003 00:24:50

Step 3 Lower Vnom +50°C



Date: 2.JAN.2003 00:54:40

Step 3 Upper Vnom +50°C



Date: 2.JAN.2003 00:53:30

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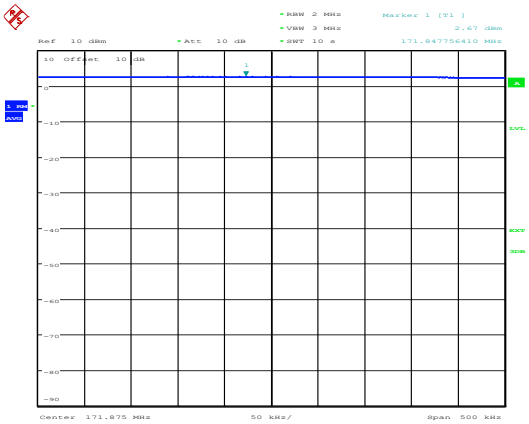
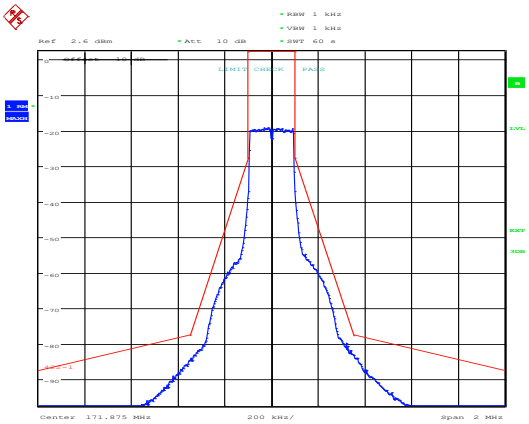


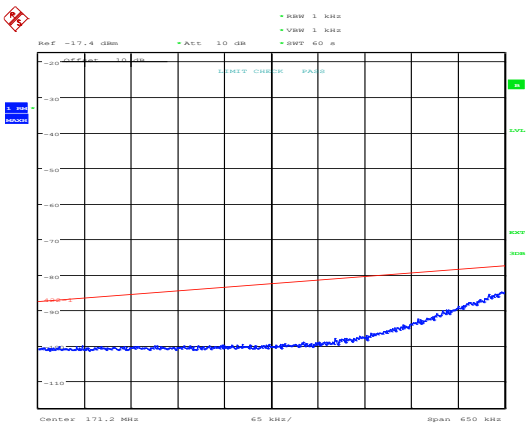
Date: 2.JAN.2003 02:19:53

Step 2 Vnom +40°C



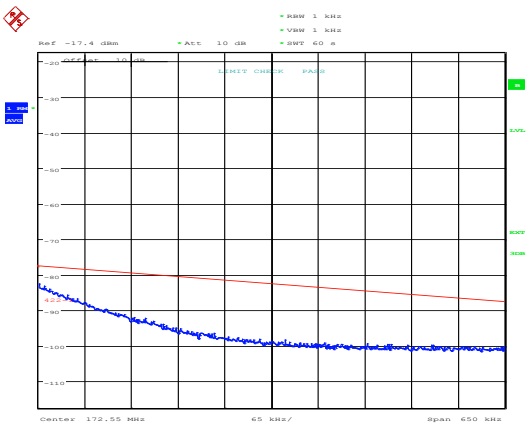
Date: 2.JAN.2003 02:26:57

Step 3 Lower Vnom +40°C



Date: 2.JAN.2003 04:13:00

Step 3 Upper Vnom +40°C



Date: 2.JAN.2003 02:24:53

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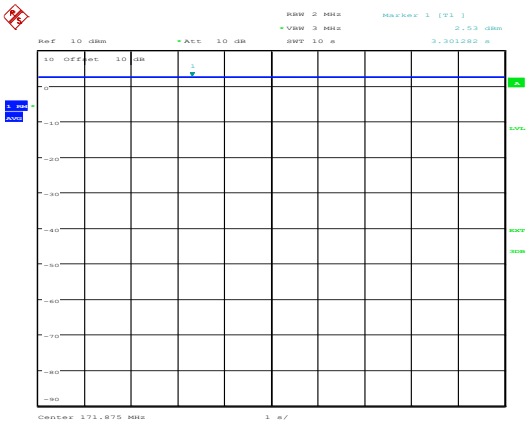
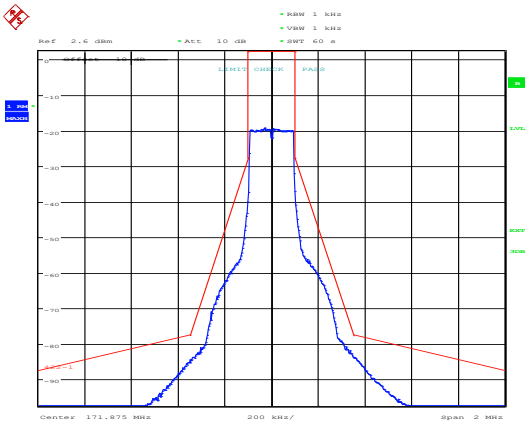


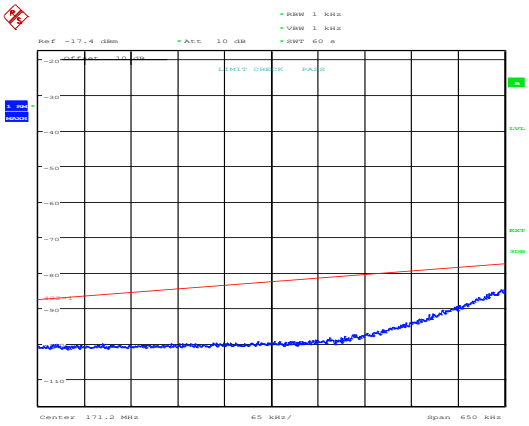
Date: 2.JAN.2003 03:57:36

Step 2 Vnom +30°C



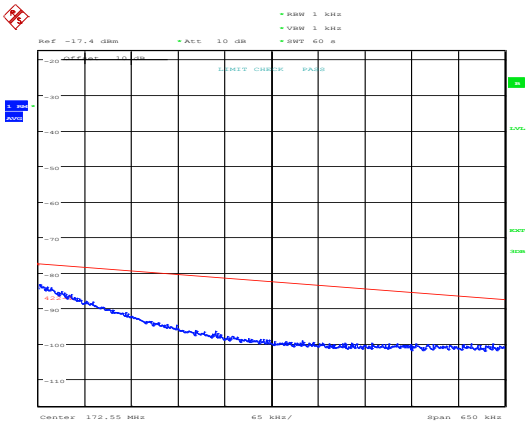
Date: 2.JAN.2003 04:04:51

Step 3 Lower Vnom +30°C



Date: 2.JAN.2003 04:01:17

Step 3 Upper Vnom +30°C



Date: 2.JAN.2003 04:02:44

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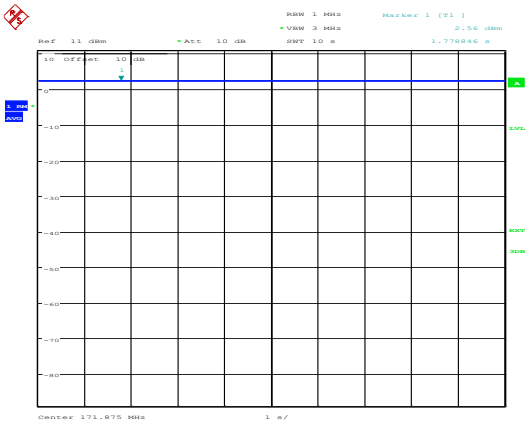
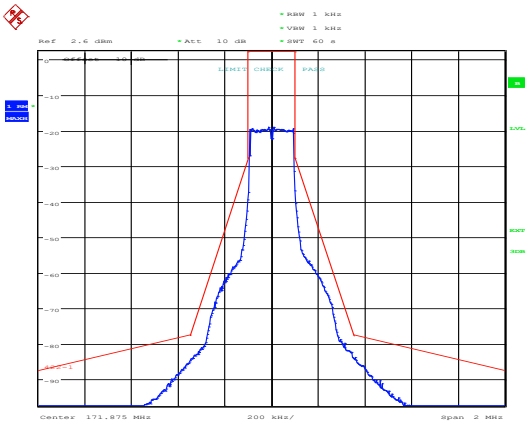


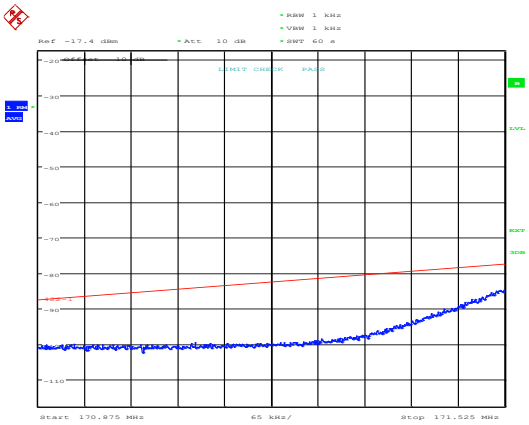
Date: 1.JAN.2003 03:29:28

Step 2 Vnom +20°C



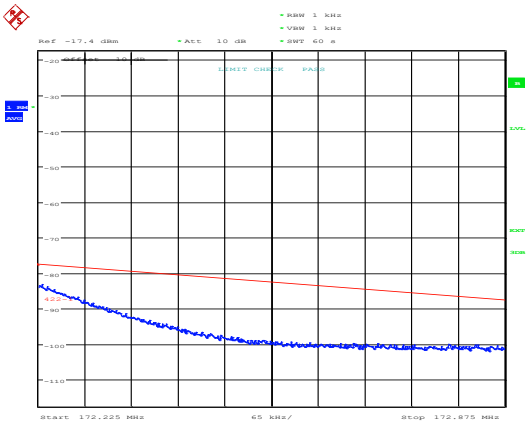
Date: 1.JAN.2003 03:38:32

Step 3 Lower Vnom +20°C



Date: 1.JAN.2003 03:43:52

Step 3 Upper Vnom +20°C



Date: 1.JAN.2003 04:34:34

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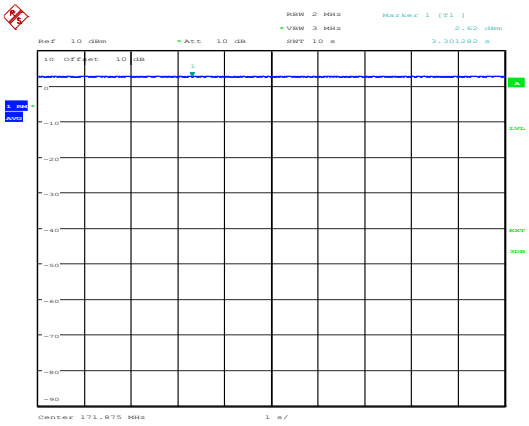
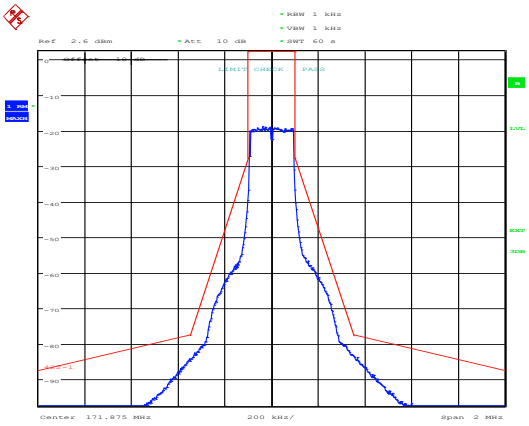


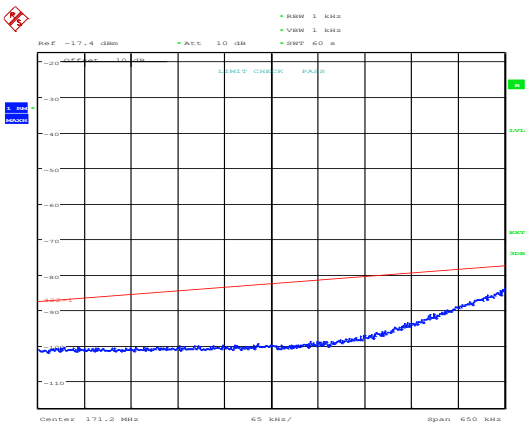
Date: 2.JAN.2003 05:32:59

Step 2 Vnom +10°C



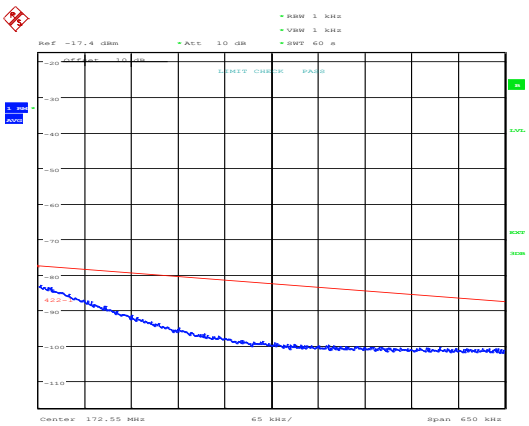
Date: 2.JAN.2003 05:31:46

Step 3 Lower Vnom +10°C



Date: 2.JAN.2003 05:26:05

Step 3 Upper Vnom +10°C



Date: 2.JAN.2003 05:29:42

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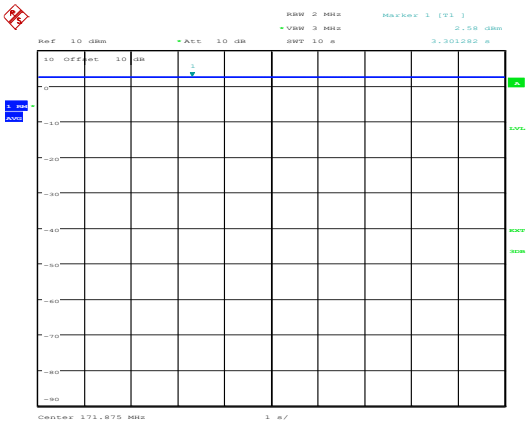
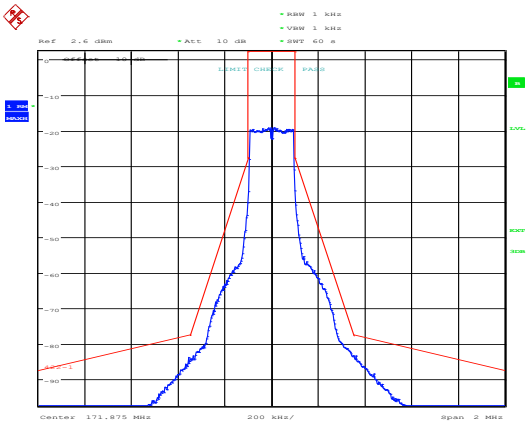


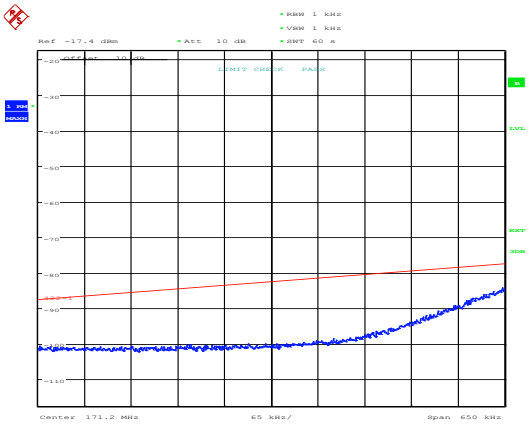
Date: 2.JAN.2003 07:07:30

Step 2 Vnom 0°C



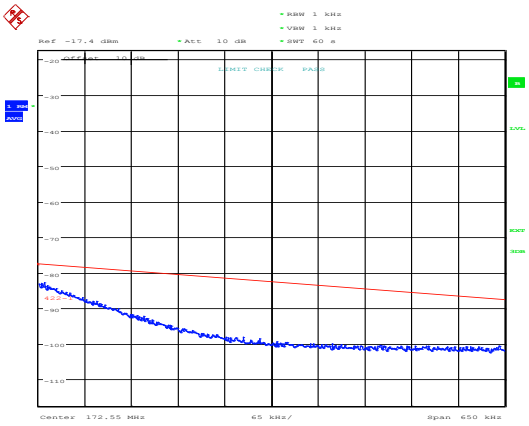
Date: 2.JAN.2003 07:09:01

Step 3 Lower Vnom 0°C



Date: 2.JAN.2003 07:11:33

Step 3 Upper Vnom 0°C



Date: 2.JAN.2003 07:10:18

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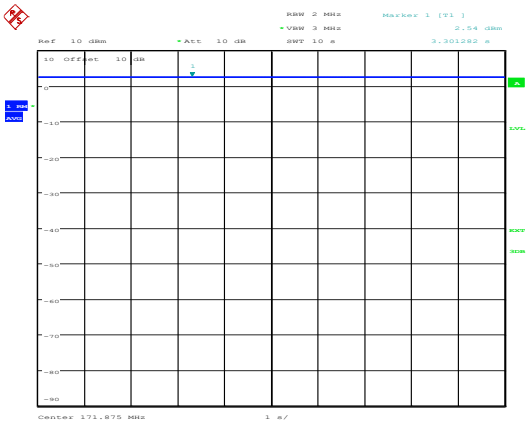
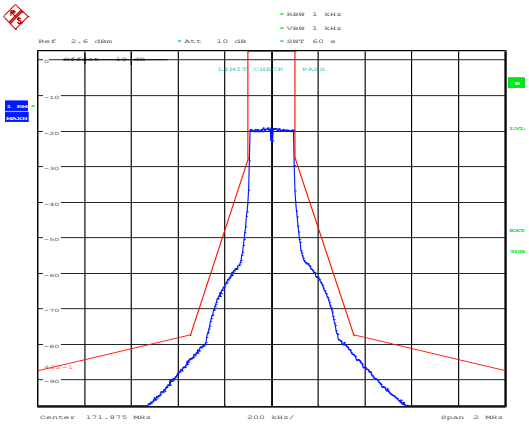


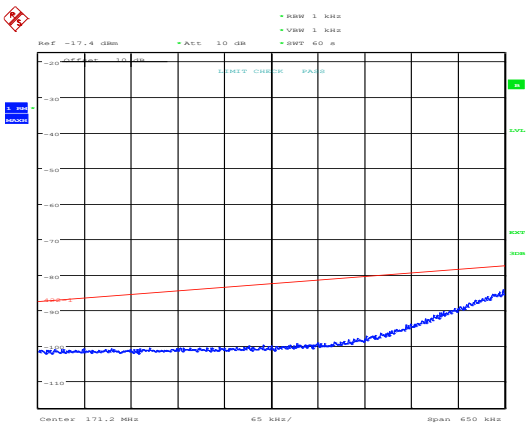
Date: 3.JAN.2003 02:17:48

Step 2 Vnom -10°C



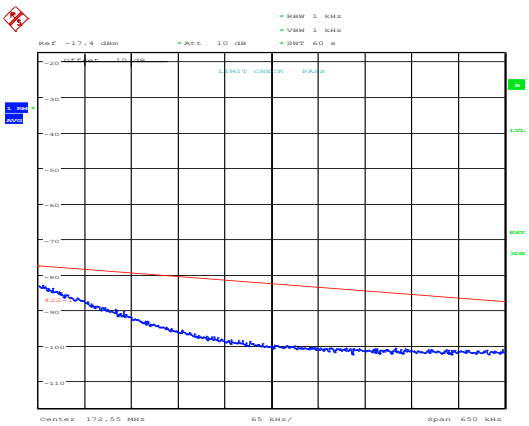
Date: 3.JAN.2003 02:29:46

Step 3 Lower Vnom -10°C



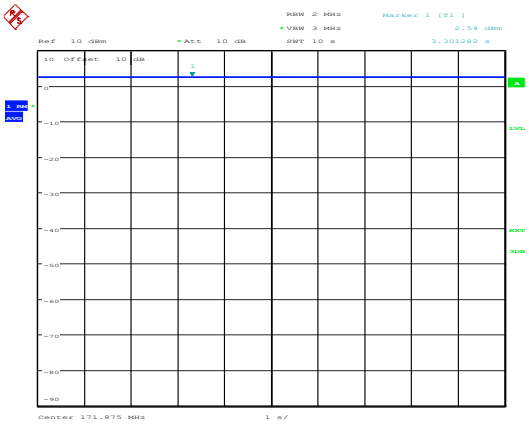
Date: 3.JAN.2003 02:48:13

Step 3 Upper Vnom -10°C



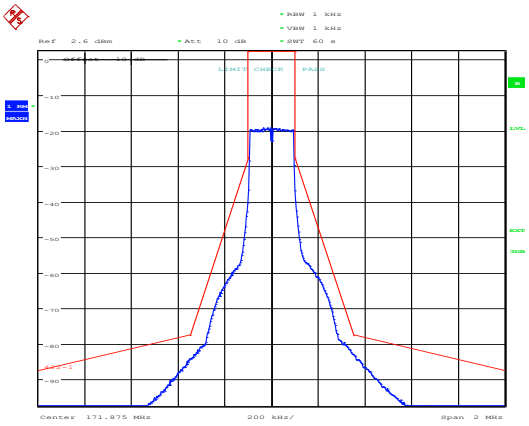
Date: 3.JAN.2003 02:25:49

REF Step 1



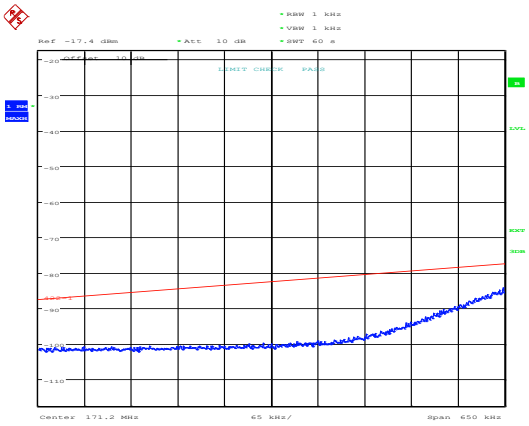
Date: 3.JAN.2003 02:17:48

Step 2 Vnom -10°C



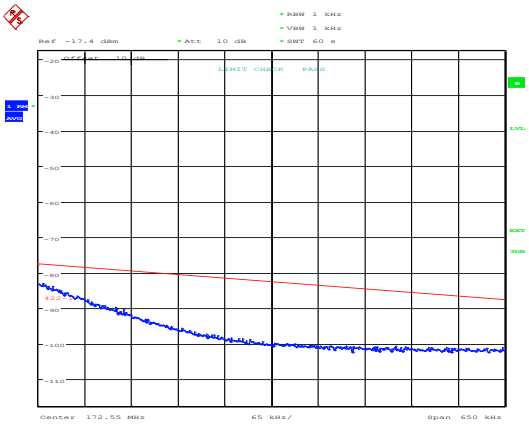
Date: 3.JAN.2003 02:29:46

Step 3 Lower Vnom -10°C



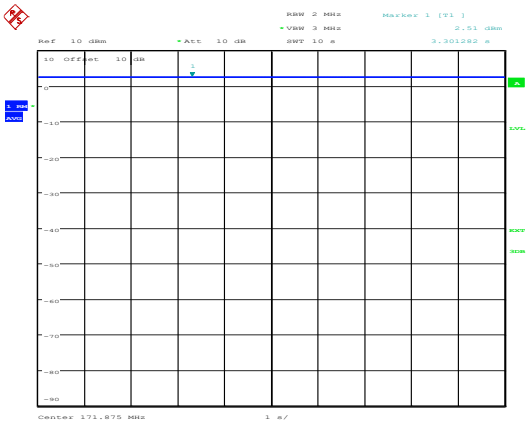
Date: 3.JAN.2003 02:48:13

Step 3 Upper Vnom -10°C



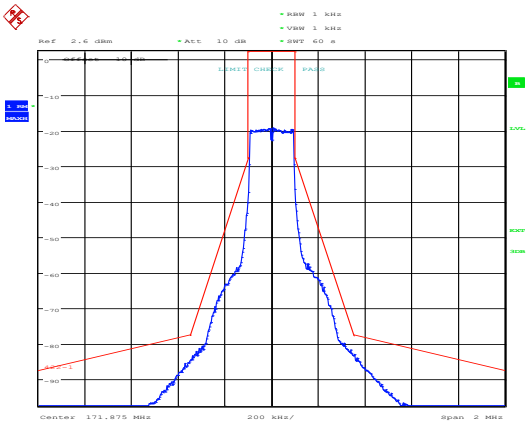
Date: 3.JAN.2003 02:25:49

REF Step 1



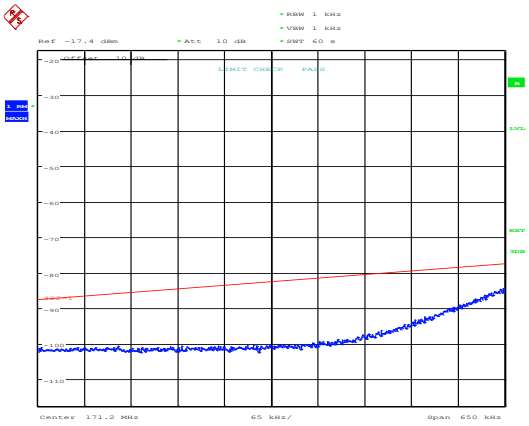
Date: 3.JAN.2003 01:13:30

Step 2 Vnom -20°C



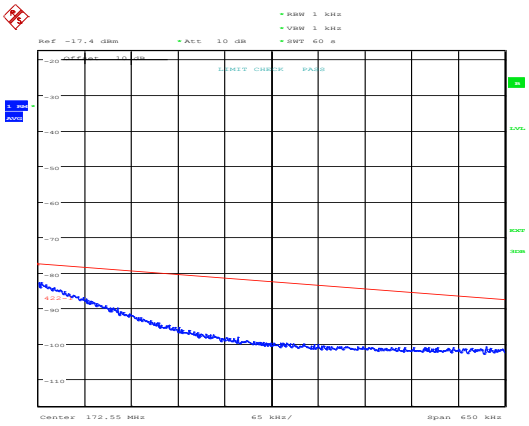
Date: 3.JAN.2003 01:07:44

Step 3 Lower Vnom -20°C



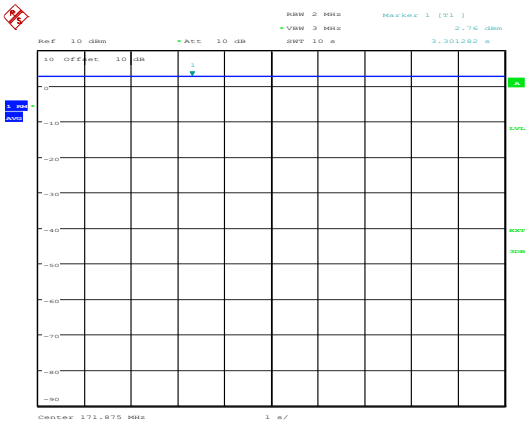
Date: 3.JAN.2003 01:10:59

Step 3 Upper Vnom -20°C



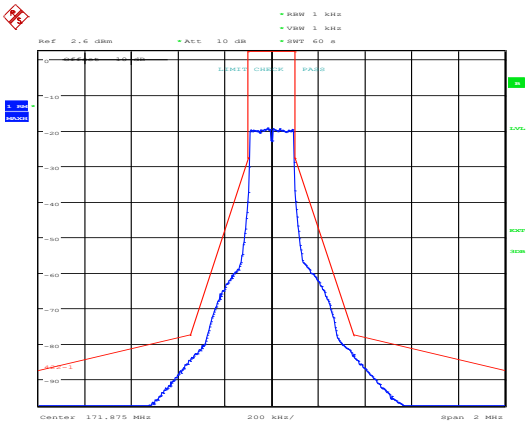
Date: 3.JAN.2003 01:09:45

REF Step 1



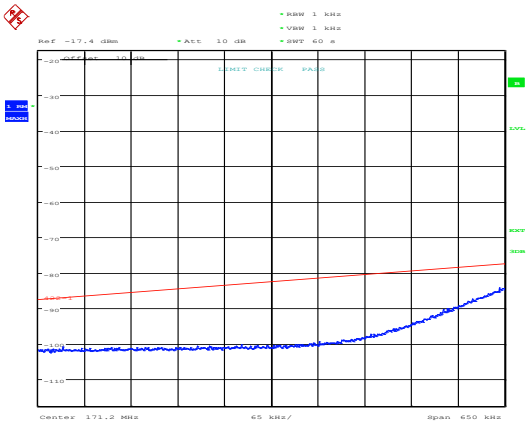
Date: 2.JAN.2003 23:08:18

Step 2 Vnom -30°C



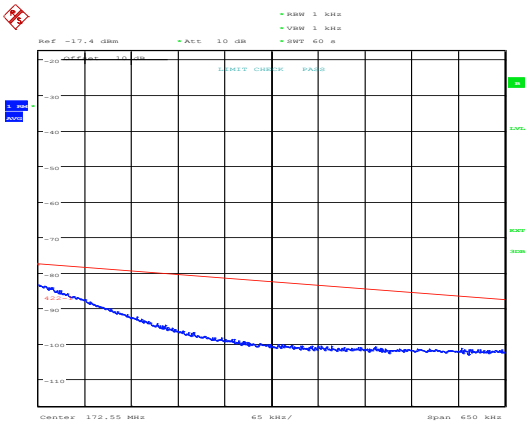
Date: 2.JAN.2003 23:24:27

Step 3 Lower Vnom -30°C



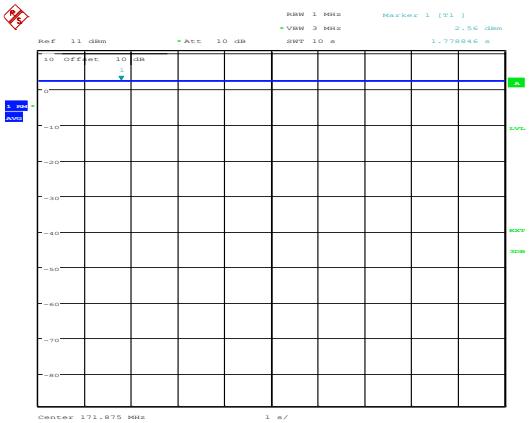
Date: 2.JAN.2003 23:18:00

Step 3 Upper Vnom -30°C



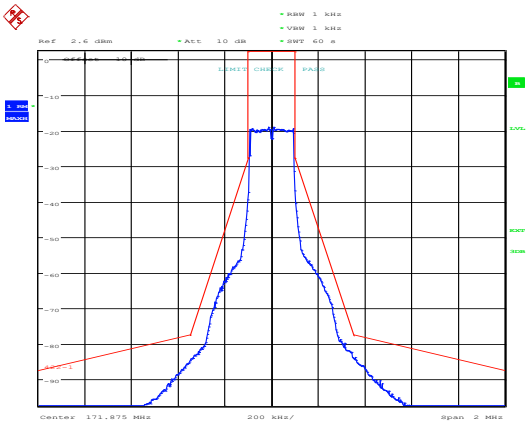
Date: 2.JAN.2003 23:21:38

REF Step 1



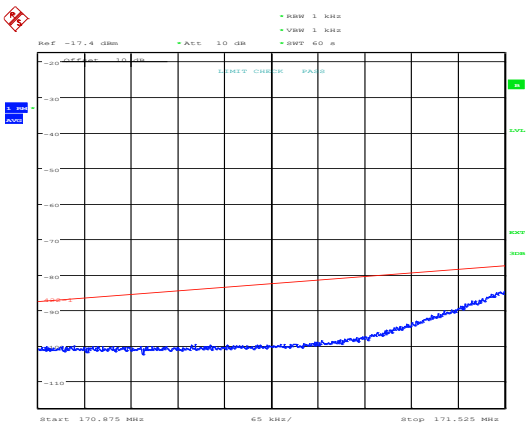
Date: 1.JAN.2003 03:29:28

Step 2 Vmax +20°C



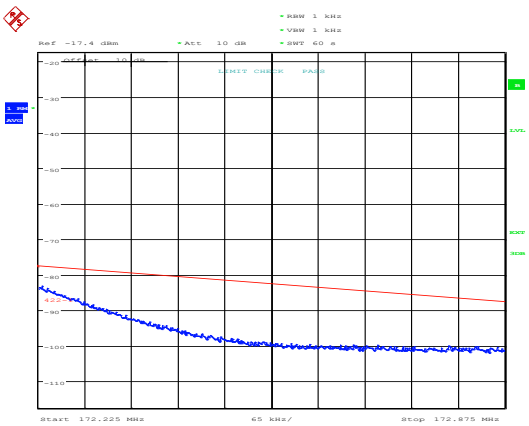
Date: 1.JAN.2003 03:38:32

Step 3 Lower Vmax +20°C



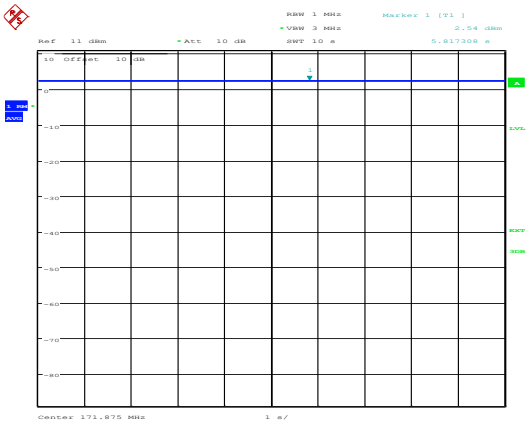
Date: 1.JAN.2003 03:43:52

Step 3 Upper Vmax +20°C



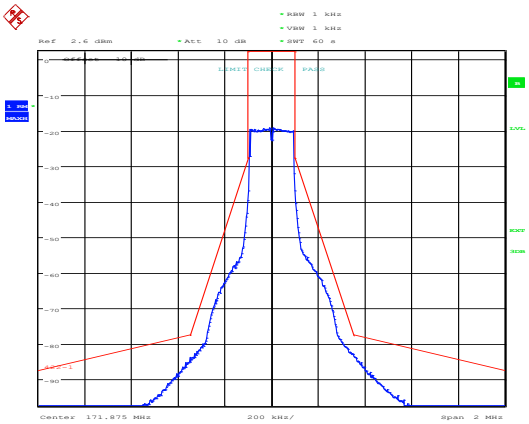
Date: 1.JAN.2003 04:34:34

REF Step 1



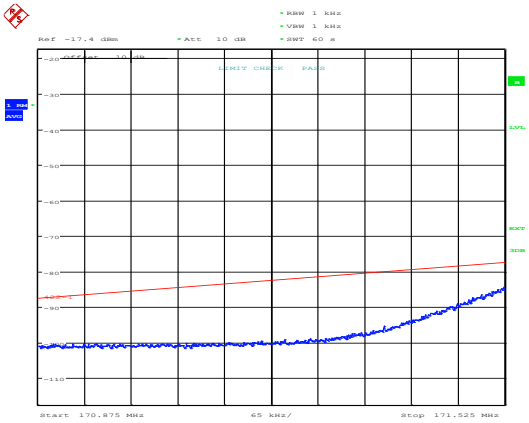
Date: 1.JAN.2003 03:32:47

Step 2 Vmin +20°C



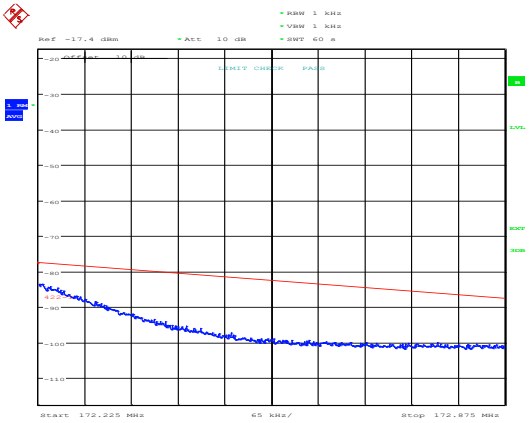
Date: 1.JAN.2003 03:36:08

Step 3 Lower Vmin +20°C



Date: 1.JAN.2003 03:47:26

Step 3 Upper Vmin +20°C



Date: 1.JAN.2003 04:29:07

13 Field strength of Spurious Emissions

13.1 Definitions

Spurious emissions
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	SK03 Radio Chamber
Test Standards and Clauses:	Part 90.265 Part 2.1053 KDB 206256 D01 Referencing ETSI EN 300 422–1 V1.4.2 (2011–08) Clause 8.4
EUT Frequencies Measured:	169.575 MHz / 171.875 MHz
Deviations from Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: Peak; Above 1 GHz: Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 49 % RH	20 % RH to 75 % RH (as declared)
Supply: 4.5 Vdc	4.5 Vdc (as declared)

13.3 Test Limits

For emissions with a bandwidth not exceeding 54 kHz, the frequency stability of wireless microphones shall limit the total emission to within ±32.5 kHz of the assigned frequency. Emissions with a bandwidth exceeding 54 kHz shall comply with the emission mask in Section 8.3 of ETSI EN 300 422–1 v1.4.2 (2011–08).

Limits for spurious emissions EN 300 422-1 V1.4.2 (2011-08)

State	***Frequency***		
	47 MHz to 74 MHz 87,5 MHz to 137 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	***Other Frequencies below 1 000 MHz***	***Frequencies above 1 000 MHz***
Operation	4 nW	250 nW	1 µW
Standby	2 nW	2 nW	20 nW

13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

$$FS = PR + CL + AF - PA + DC - CF$$

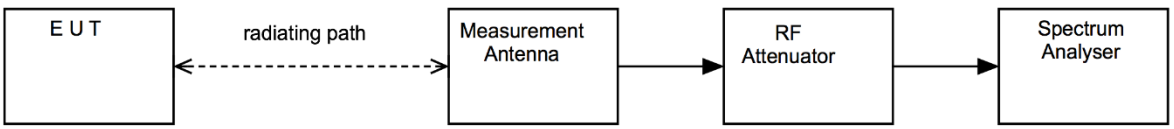
$$Factor = CL + AF - PA$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

Figure iii Test Setup

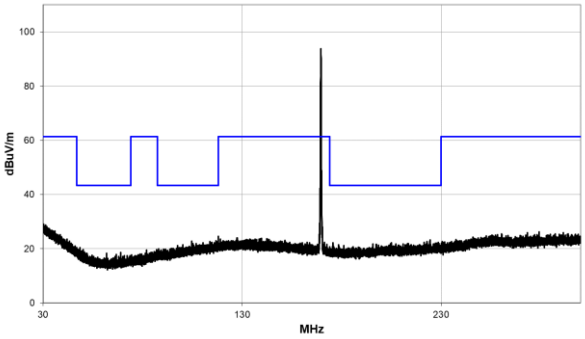


13.5 Test Equipment

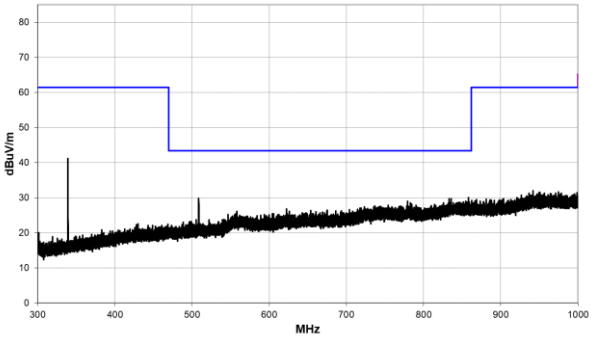
Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU26	U405	2024-05-22
Signal Generator	R&S	SMB100A	U677	2025-02-01
Bilog	Chase	CBL611/B	U573	2024-10-14
Log Periodic Ant	Chase	UPA6108	L203	2024-06-15
PreAmp	Watkins Johnson	6201-69	U372	2024-03-07
1-18GHz Horn	EMCO	3115	L139	2024-07-01
Horn 18-26GHz (&U330)	Flann	20240-20	L300	2024-06-30
Horn Antenna	EMCO	3115	L138	2024-05-23
Pre Amp	Agilent	8449B	U457	2025-01-26
High Pass Filter	Mini-Circuits	VHF-1500+	U519	2025-02-15
High Pass Filter	Atlantic Microwave	AFH-07000	U558	2025-02-15
High Pass Filter 1.1-4 GHz	Atlantic Microwave	F-HPC5-730008-S5S5	U719	2024-02-09
High Pass Filter 300-1 GHz	Mini-Circuits	NHP-300	RFG 351-8	Cal In Use
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required
Radio Chamber - PP	Rainford EMC	ATS	REF940	2026-01-29

13.6 Test Results

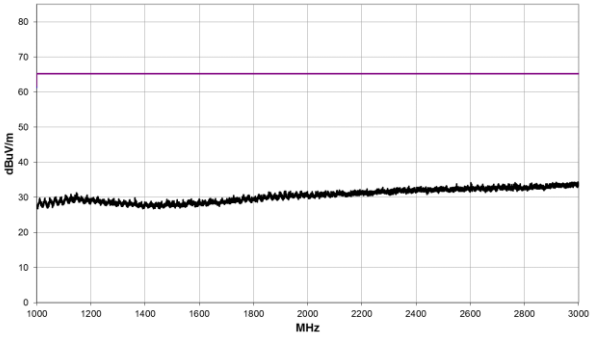
169.575 MHz 30 MHz -300 MHz



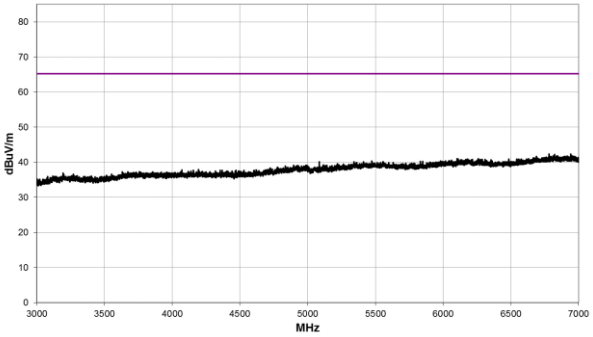
169.1 300 MHz -1 GHz



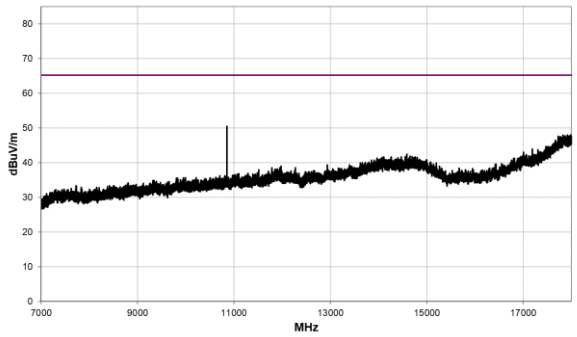
169.575 MHz 1 GHz-3 GHz



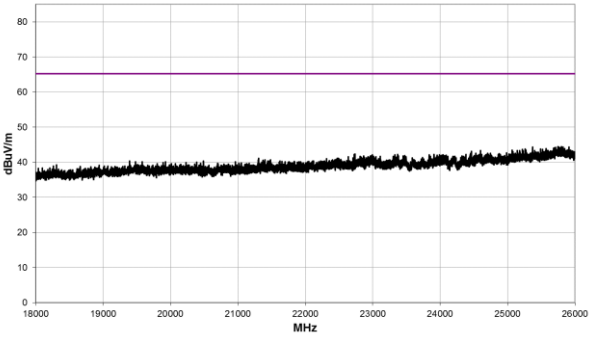
169.575 MHz 3 GHz-7 GHz



169.575 MHz 7 GHz-18 GHz

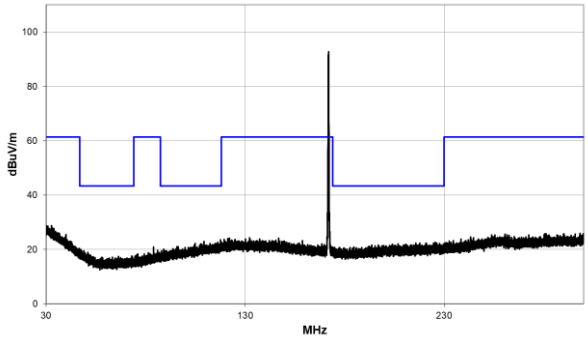


169.575 MHz 18 GHz-26 GHz

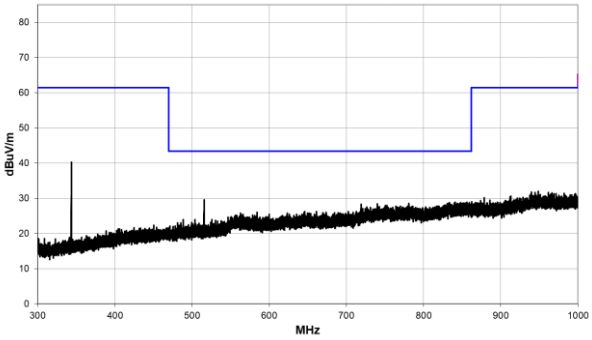


Freq (MHz)	*Amplitude (dBuV)*	*Factor (dB/m)*	*Test Distance (meters)*	*Polarity/ Transducer Type*	*Detector*	*Distance Adjustment (dB)*	*Adjusted (dBuV/m)*	*Spec. Limit (dBuV/m)*	*Compared to Spec. (dB)*
508.715	26.0	-1.4	3.0	Vert	AV	0.0	24.6	43.4	-18.8
339.150	37.9	-6.4	3.0	Vert	AV	0.0	31.5	61.4	-29.9
10852.790	50.5	10.0	1.0	Vert	AV	-9.5	51.0	65.2	-14.2

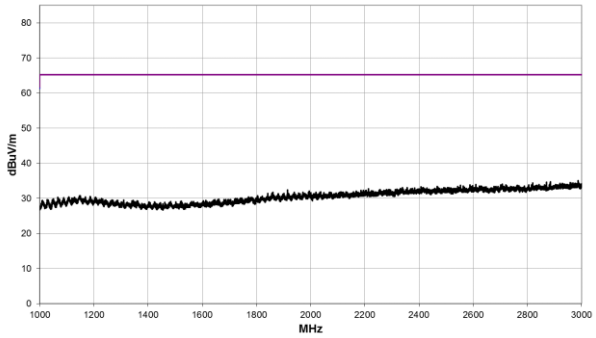
171.875 MHz 30 MHz -300 MHz



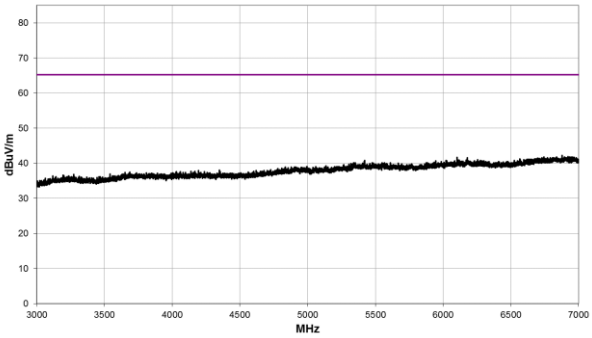
171.875 MHz 300 MHz -1 GHz



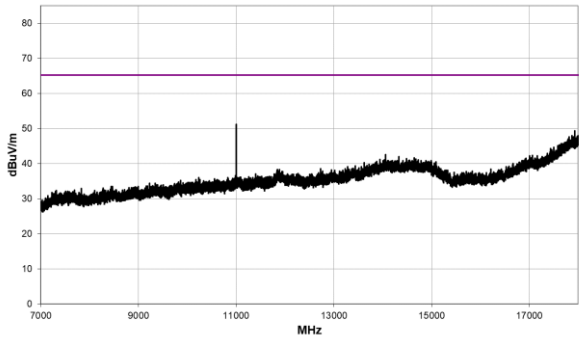
171.875 MHz 1 GHz – 3 GHz



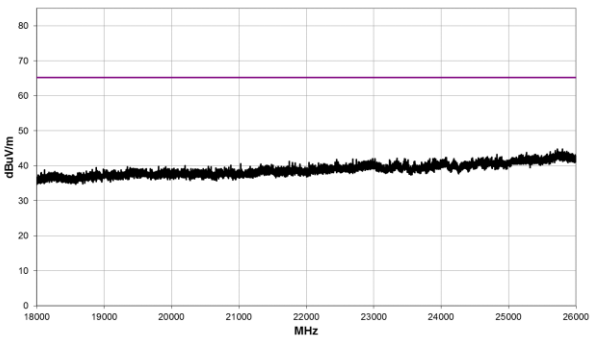
171.875 MHz 3 GHz - 7 GHz



171.875 MHz 7 GHz - 18 GHz



171.875 MHz 18 GHz - 26 GHz



Freq (MHz)	*Amplitude (dBuV)*	*Factor (dB/m)*	*Test Distance (meters)*	*Polarity/ Transducer Type*	*Detector*	*Distance Adjustment (dB)*	*Adjusted (dBuV/m)*	*Spec. Limit (dBuV/m)*	*Compared to Spec. (dB)*
515.64	23.7	-1.4	3.0	Vert	AV	0.0	22.3	43.4	-21.1
343.77	35.1	-6.1	3.0	Vert	AV	0.0	29.0	61.4	-32.4
11000.00	51.6	10.4	1.0	Vert	AV	-9.5	52.5	65.2	-12.7

14 Bandwidth Limitations

14.1 Definition

The 99% emission bandwidth is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	99% Bandwidth: Part 2.1049 ANSI C63.26-2015, Clause 5.4
Frequencies Measured:	169.575 MHz / 171.875 MHz
EUT Channel Bandwidths:	200 kHz
EUT Test Modulations:	1 kHz
Deviations from Standard:	None
Measurement BW:	2 kHz
Spectrum Analyzer Video BW:	10 kHz
Measurement Span:	500 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 56 % RH	20 % RH to 75 % RH (as declared)
Supply: 4.5 Vdc	

14.3 Test Limit

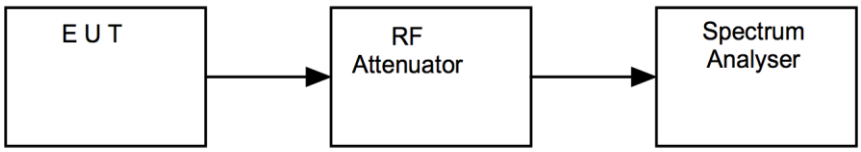
90.265 (b)(1)

On centre frequencies 169.575 MHz, 170.025 MHz, 171.075 MHz, and 171.875 MHz, the emission bandwidth shall not exceed 200 kHz. On the other centre frequencies listed in this paragraph (b), the emission bandwidth shall not exceed 54 kHz.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the bandwidth of the EUT was measured on a spectrum analyser.

Figure iv Test Setup

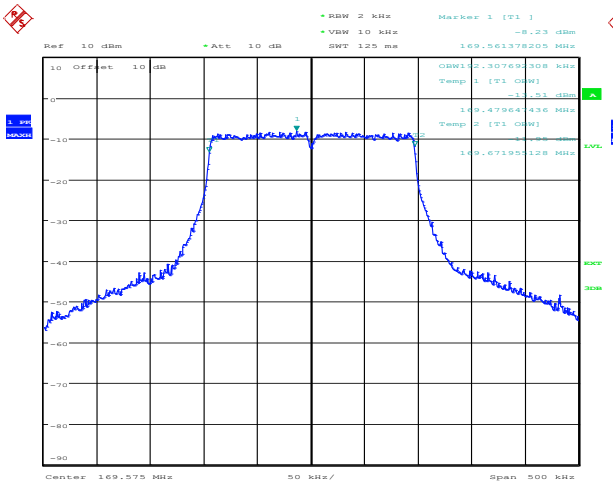


14.5 Test Equipment

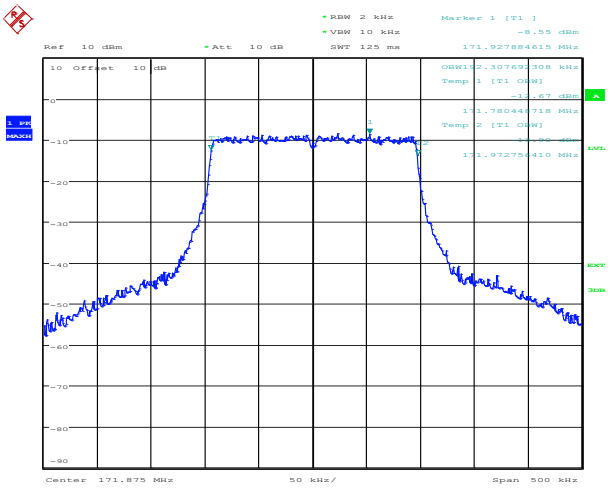
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	2024-01-10
20dB SMA	AtlanTech	Attenuator	U631	Cal in use
SMBV100A	R&S	Signal Generator	U674	2024-05-02
IPS 303A	ISO-Tech	Power Supply	U748	Use REF976
34405a	Agilent	Multimeter	REF976	2024-01-24

14.6 Test Results

Channel Frequency (MHz)	*F_L (MHz)*	*F_H (MHz)*	*99% Bandwidth (kHz)*	*Result*
169.575	169.479647	169.672756	193.1	PASS
171.875	171.780449	171.972756	192.3	PASS



169.575 MHz



171.875 MHz

15 Frequency stability

15.1 Definition

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	90.265(b)(1) ETSI EN 300 422–1 V1.4.2 (2011–08), Clause 14.3.2.1
Frequencies Measured:	169.575 MHz / 171.875 MHz
EUT Channel Bandwidths:	200 kHz
Deviations from Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW:	3 MHz
Measurement Detector:	RMS Average

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 56 % RH	20 % RH to 75 % RH (as declared)
Voltage: 4.5 Vdc Via batteries	(as Declared)

15.3 Test Limit

Part 90.265(b)(3)

(3) For emissions with a bandwidth not exceeding 54 kHz, the frequency stability of wireless microphones shall limit the total emission to within ±32.5 kHz of the assigned frequency. Emissions with a bandwidth exceeding 54 kHz shall comply with the emission mask in Section 8.3 of ETSI EN 300 422–1 v1.4.2 (2011–08).

Note: No frequency stability limit stated for this part 90 rule.

Part 2.1055
Frequency stability (ppm/ frequency tolerance %)

15.4 Test Method

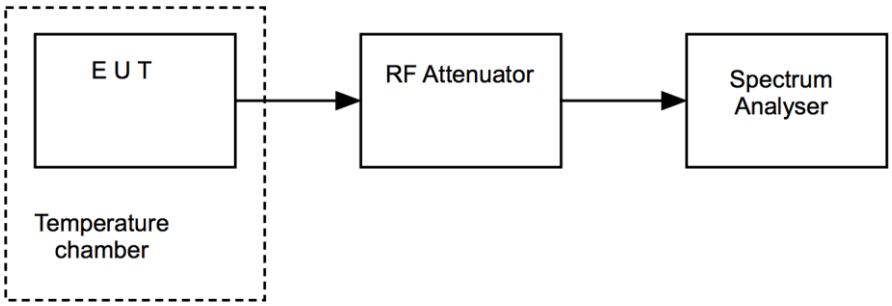
The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:
a) At 10 °C intervals of temperatures between −30 °C and +50 °C at the manufacturer's rated supply voltage, and
b) At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the −15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

$V_{nominal}$ 4.5 Vdc
$V_{minimum}$ 3.2 Vdc
$V_{maximum}$ 4.5 Vdc

The measurements were performed with a modulated signal,
The 99% occupied bandwidth was used to determine fc using the formula fc=fl+fh/2
Measurements were made once temperature stability was achieved at each temperature.

Figure v Test Setup



15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	2024-01-10
20dB SMA	AtlanTech	Attenuator	U631	Cal in use
SMBV100A	R&S	Signal Generator	U674	2024-05-02
IPS 303A	ISO-Tech	Power Supply	U748	Use REF976
34405a	Agilent	Multimeter	REF976	2024-01-24
52 Series II	Fluke	Temperature Indicator	L426	2024-07-19
VT 4002	Votsch	Temperature Chamber	U521	Use L426 or U720

15.6 Test Results

EUT Frequency: 169.575 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Frequency error (ppm)***	***Frequency Tolerance (%)***
+50 °C	$V_{nominal}$	169.575801	0.80	4.73	0.00047
+40 °C	$V_{nominal}$	169.575801	0.80	4.73	0.00047
+30 °C	$V_{nominal}$	169.576202	1.20	7.09	0.00071
+20 °C	$V_{nominal}$	169.575801	0.80	4.73	0.00047
+10 °C	$V_{nominal}$	169.576202	1.20	7.09	0.00071
+0 °C	$V_{nominal}$	169.576603	1.60	9.45	0.00095
-10 °C	$V_{nominal}$	169.576513	1.51	8.92	0.00089
-20 °C	$V_{nominal}$	169.576603	1.60	9.45	0.00095
-30 °C	$V_{nominal}$	169.576603	1.60	9.45	0.00095

Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Frequency error (ppm)***	***Frequency Tolerance (%)***
+20 °C	$V_{maximum}$	169.575801	0.80	4.73	0.00047
+20 °C	$V_{Minimal}$	169.575801	0.80	4.73	0.00047

EUT Frequency: 171.875 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Frequency error (ppm)***	***Frequency Tolerance (%)***
+50 °C	$V_{nominal}$	171.876202	1.20	6.99	0.00070
+40 °C	$V_{nominal}$	171.875801	0.80	4.66	0.00047
+30 °C	$V_{nominal}$	171.876202	1.20	6.99	0.00070
+20 °C	$V_{nominal}$	171.876603	1.60	9.32	0.00093
+10 °C	$V_{nominal}$	171.876202	1.20	6.99	0.00070
+0 °C	$V_{nominal}$	171.876603	1.60	9.32	0.00093
-10 °C	$V_{nominal}$	171.876603	1.60	9.32	0.00093
-20 °C	$V_{nominal}$	171.876603	1.60	9.32	0.00093
-30 °C	$V_{nominal}$	171.876602	1.60	9.32	0.00093

Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Frequency error (ppm)***	***Frequency Tolerance (%)***
+20 °C	$V_{maximum}$	171.876603	1.60	9.32	0.00093
+20 °C	$V_{Minimal}$	171.875801	0.80	4.66	0.00047

Note: The 99% occupied bandwidth, and Mask measurements show that the emission is contained within the allocated frequency band. 169 MHz to 172 MHz , and the 200 kHz Emission Mask.

16 Measurement Uncertainty

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence where no required test level exists.

Test/Measurement	Budget Number	MU
Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions		
Absolute RF power (via antenna connecter) Dare RPR3006W Power Head	MU4001	**0.9 dB**
Carrier Power and PSD - Spectrum Analysers	MU4004	**0.9 dB**
Adjacent Channel Power	MU4002	**1.9 dB**
Transmitter conducted spurious emissions	MU4041	**0.9 dB**
Conducted power and spurious emissions 40 GHz to 50 GHz	MU4042	**2.4 dB**
Conducted power and spurious emissions 50 GHz to 75 GHz	MU4043	**2.5 dB**
Conducted power and spurious emissions 75 GHz to 110 GHz	MU4044	**2.4 dB**
Radiated RF Power and Spurious emissions ERP and EIRP		
Effective Radiated Power Reverb Chamber	MU4020	**3.7 dB**
Effective Radiated Power	MU4021	**4.7 dB**
TRP Emissions 30 MHz to 1 GHz using CBL6111 or CBL6112 Bilog Antenna	MU4046	**5.3 dB**
TRP Emissions 1 GHz to 18 GHz using HL050 Log Periodic Antenna	MU4047	**5.1 dB**
TRP Emissions 18 GHz to 26.5 GHz using Standard Gain Horn	MU4048	**2.7 dB**
TRP Emissions 26.5 GHz to 40 GHz using Standard Gain Horn	MU4049	**2.7 dB**
Spurious Emissions Electric and Magnetic Field		
Radiated Spurious Emissions 30 MHz to 1 GHz	MU4037	**4.7 dB**
Radiated Spurious Emissions 1-18 GHz	MU4032	**4.5 dB**
E Field Emissions 18GHz to 26 GHz	MU4024	**3.2 dB**
E Field Emissions 26GHz to 40 GHz	MU4025	**3.3 dB**
E Field Emissions 40GHz to 50 GHz	MU4026	**3.5 dB**
E Field Emissions 50GHz to 75 GHz	MU4027	**3.6 dB**
E Field Emissions 75GHz to 110 GHz	MU4028	**3.6 dB**
Radiated Magnetic Field Emissions	MU4031	**2.3 dB**
Frequency Measurements		
Frequency Deviation	MU4022	**0.316 kHz**
Frequency error using CMTA test set	MU4023	**113.441 Hz**
Frequency error using GPS locked frequency source	MU4045	**0.0413 ppm**
Bandwidth/Spectral Mask Measurements		
Channel Bandwidth	MU4005	**3.87 %**
Transmitter Mask Amplitude	MU4039	**1.3 dB**
Transmitter Mask Frequency	MU4040	**2.59 %**
Time Domain Measurements		
Transmission Time	MU4038	**4.40 %**
Dynamic Frequency Selection (DFS) Parameters)		
DFS Analyser - Measurement Time	MU4006	**679 µs**
DFS Generator - Frequency Error	MU4007	**92 Hz**
DFS Threshold Conducted	MU4008	**1.3 dB**
DFS Threshold Radiated	MU4009	**3.2 dB**

Test/Measurement	Budget Number	MU
Receiver Parameters		
EN300328 Receiver Blocking	MU4010	**1.1 dB**
EN301893 Receiver Blocking	MU4011	**1.1 dB**
EN303340 Adjacent Channel Selectivity	MU4012	**1.1 dB**
EN303340 Overloading	MU4013	**1.1 dB**
EN303340 Receiver Blocking	MU4014	**1.1 dB**
EN303340 Receiver Sensitivity	MU4015	**0.9 dB**
EN303372-1 Image Rejection	MU4016	**1.4 dB**
EN303372-1 Receiver Blocking	MU4017	**1.1 dB**
EN303372-2 Adjacent Channel Selectivity	MU4018	**1.1 dB**
EN303372-2 Dynamic Range	MU4019	**0.9 dB**
Receiver Blocking Talk Mode Conducted	MU4033	**1.2 dB**
Receiver Blocking Talk Mode- radiated	MU4034	**3.4 dB**
Rx Blocking, listen mode, blocking level	MU4035	**3.2 dB**
Rx Blocking, listen mode, radiated Threshold Measurement	MU4036	**3.4 dB**
Adjacent Sub Band Selectivity	MU4003	**4.2 dB**