www.nemko.com
Nemko Italy S.p.A., Via del Carroccio 4, 20853, Biassono, Italy.

Report number: 165681TRFWL

Apparatus: RA-450

Applicant: Radio Activity S.r.l.

FCC ID: Y9MRA-450

Test specification:

Title 47-Telecommunication
Chapter I - Federal Communications Commission
Subchapter D – Safety and special radio services
Part 90 – Private land mobile services

- **Subpart I – General technical standards**

Reviewed by: _____ 2011-10-19
Signature Date
G. Curioni, Wireless/EMC Specialist

Tested by: _____ 2011-10-19
Signature Date
D. Guarnone, Wireless/EMC Specialist

# Table of contents

# Section 1: Report summary

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Italy SpA.

## Test specification:
FCC Part 90 Private land mobile services
Subpart I – General technical standards

| | |
|---|---|
| Compliance status: | Complies |
| Exclusions: | None |
| Non-compliances: | None |
| Report release history: | Original release |
| Test location: | Nemko Italy S.p.A.<br>Via del Carroccio 4, 20853, Biassono, Italy. |
| Registration number: | 481407 (10 m Semi anechoic chamber) |

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90. Conducted measurements were performed in accordance with ANSI TIA-603-B-2002. Radiated tests were conducted is accordance with ANSI C63.4-2003.

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 Italy's ISO/IEC 17025 accreditation.

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# Section 2: Equipment under test

## 2.1 Identification of equipment under test (EUT)

The following information identifies the EUT under test:

| | |
|---|---|
| Type of equipment: | DMR REPEATER - UHF BASE STATION |
| Product marketing name: | RA-450 |
| Serial number: | 450RA1562 |
| FCC ID: | Y9MRA-450 |
| Date of receipt: | 2011-09-22 |

## 2.2 Accessories and support equipment

The following information identifies accessories used to exercise the EUT during testing:

| Item # 1 | |
|---|---|
| Type of equipment: | DC power supply |
| Brand name: | Rodhe Schwarz |
| Model name or number: | NSGM 32/10 |
| Serial number: | 192.0810.31 |
| Nemko sample number: | 00406 |
| Connection port: | DC |
| Cable length and type: | DC power 2 m two wires cable |
| Connection port: | 25x AF I/O + 1x Ethernet 10/100 Base-T |
| Cable length and type: | 26x UTP CAT. 5E Patch Ethernet 2 m cable |

Section 2: Equipment under test, continued

## 2.3 EUT description

The EUT is DMR REPEATER - UHF BASE STATION
-

## 2.4 Technical specifications of the EUT

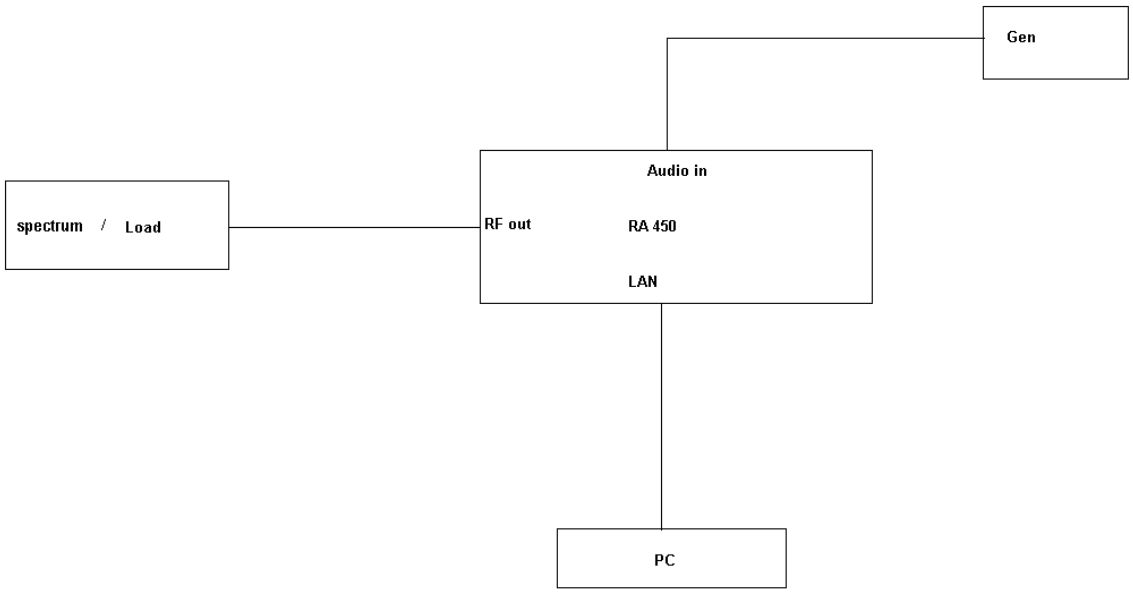
| | |
|---|---|
| Operating frequency: | 407 ÷ 470 MHz |
| Modulation type: | FM/PM |
| Occupied bandwidth: | 16 kHz |
| Power at antenna connector | Max. 25 W |
| Channel spacing | 12.5 kHz |
| Emission designator: | 11K0F3E/11K0G3E 7K60FXE/7K60FXD |
| Synchronization: | OCXO synchronized by GPS |
| Working modality: | Simplex/Duplex |
| 1st Local oscillator: | 45 MHz lower |
| Antenna type: | External Antenna (not provided) |
| Temperature range: | -30 to 60°C |
| Power source | External 12 VDC, |

Emission Designators:

According to e-CFR 2.202 bandwidths and using the following formula for digital modulations:
Multilevel Frequency Shift Keying: $Bn=(R/\log_2 S) + 2DK$
Where for 4FSK modulation: R=9600 bps, S=4, D=1400Hz, K=1 --> we get Bn= 7600 Hz
Emission designators: 7K60FXD and 7K60FXE -
12.5 kHz channel spacing F3E/G3E BWn = 2M+2DK=2x3+2x2.5x1=11 kHz
Emission designators: 11K0F3E and 11K0G3E

Section 2: Equipment under test, continued

## 2.5 EUT setup diagram




## 2.6 Operation of the EUT during testing

The EUT has been tested in TX mode, with the antenna connector closed on a 50 Ω dummy load

## 2.7 Modifications incorporated in the EUT

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

# Section 3: Test conditions

## 3.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

## 3.2 Test conditions, power source and ambient temperatures

| | |
|---|---|
| Normal temperature, humidity and air pressure test conditions | Temperature: 15–30 °C<br>Relative humidity: 20–75 %<br>Air pressure: 860–1060 hPa<br><br>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. |
| Power supply range: | The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed. |

Section 3: Test conditions, continued

## 3.3 Measurement uncertainty

Nemko S.p.A. measurement uncertainty has been calculated using the standard CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements“. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko S.p.A. document WML1002.

## 3.4 Test equipment

| Equipment | Manufacturer | Model No. | Asset/Serial No. | Next cal. |
|---|---|---|---|---|
| Trilog Broad Band Antenna | Schwarzbeck | VULB 9168 | VULB 9168-242 | 2012/08 |
| EMI receiver 20 Hz ÷ 8 GHz | R&S | ESU8 | 100202 | 2012/09 |
| EMI receiver 20 Hz ÷ 3 GHz | R&S | ESCI | 100888 | 2012/09 |
| Hydraulic revolving platform | Nemko | RTPL 01 | 4.233 | NCR |
| Turning-table | R&S | HCT | 835 803/03 | NCR |
| Antenna mast | R&S | HCM | 836 529/05 | NCR |
| Controller | R&S | HCC | 836 620/7 | NCR |
| Spectrum Analyzer 9kHz ÷ 40GHz | R&S | FSEK | 848255/005 | 2012/09 |
| Semi-anechoic chamber | Nemko | 10m semi-anechoic chamber | 530 | 2012/08 |
| Shielded room | Siemens | 10m control room | 1947 | NCR |
| Attenuator | Aeroflex/Weinschel | 24-20-34 | CA0248 | 2012/08 |
| Attenuator | Aeroflex/Weinschel | 24-10-34 | 0124BZ2456 | 2012/08 |
| Attenuator | BIRD Electronic Corpo. | 1500-WA-FFN-30 | 1032019 | 2012/09 |
| Dummy load | Celwave | ALO30A | -- | NCR |
| Notch Filter | Nemko | 400-500 | 2.437 | NCR |
| High Pass Filter | Wainwright | WHK0.8/13G-10EF | SN1 | 2012/08 |
| Radiocommunication Tester | R&S | CMT | 883152/001 | 2012/09 |
| Climatic chamber | Espec | ARS 1100 | 4100000067 | 2012/09 |
| Frequencymeter | Anritzu | MF2414A | MT07571 | 2012/05 |

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

# Section 4: Result summary

## 4.1 FCC Part 90: Test results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

| | |
|---|---|
| N | No : not applicable / not relevant. |
| Y | Yes : Mandatory i.e. the apparatus shall conform to these tests. |
| N/T | Not Tested, mandatory but not assessed. (See report summary) |

| Part | Test method | Test description | Required | Result |
|---|---|---|---|---|
| §90.205 | §2.1046 | Output power | Y | Pass |
| §90.207 | §2.1047 | Modulation Characteristics | Y | Pass |
| §90.209 | §2.1049 | Occupied bandwidth | Y | Pass |
| §90.210 | §2.1051 | Spurious Emissions at the antenna terminal | Y | Pass |
| §90.210 | §2.1053 | Field strength of spurious radiation | Y | Pass |
| §90.213 | §2.1055 | Frequency stability | Y | Pass |
| §90.214 | --- | Transient Behaviour | Y | Pass |
| §90.219 | --- | Use of boosters | N | --- |

Notes: None

# Appendix A: Test results

## Clause 90.205 Output power

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized to applicants whose license applications for new stations are filed after August 18, 1995 is as follows in FCC Part 90.205 (a) through (r).

For measurements conducted pursuant to paragraphs (a) and (b) of § 2.1046, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

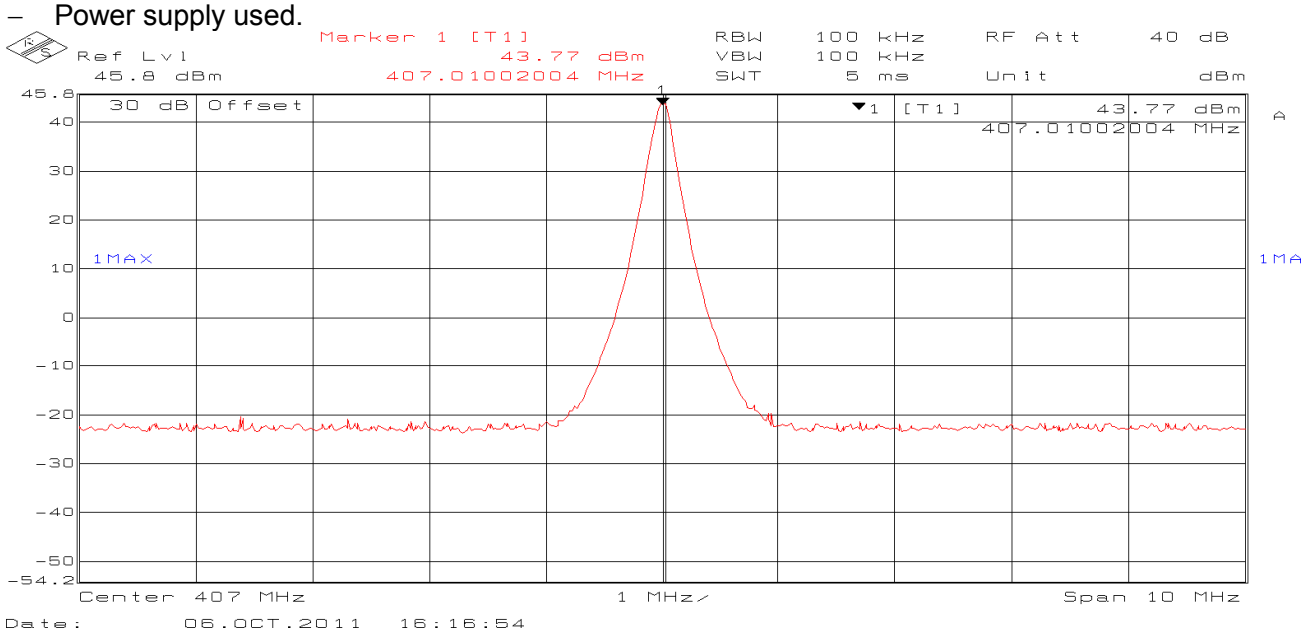
Test date: 2011/10/06

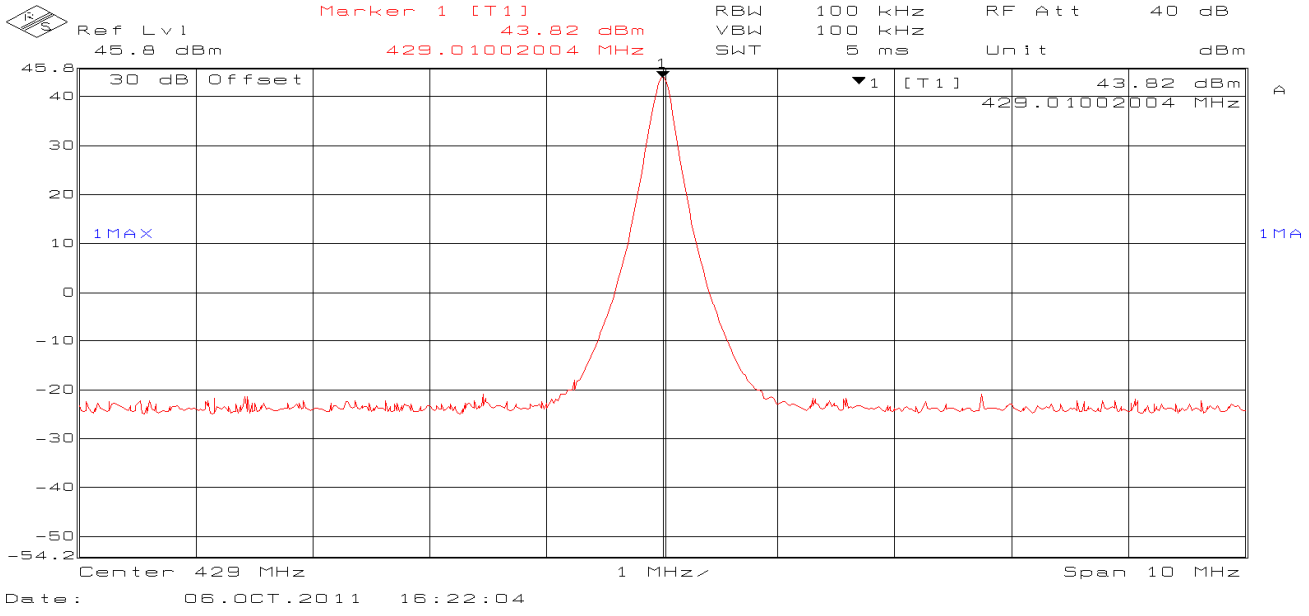
Test results: Pass

p

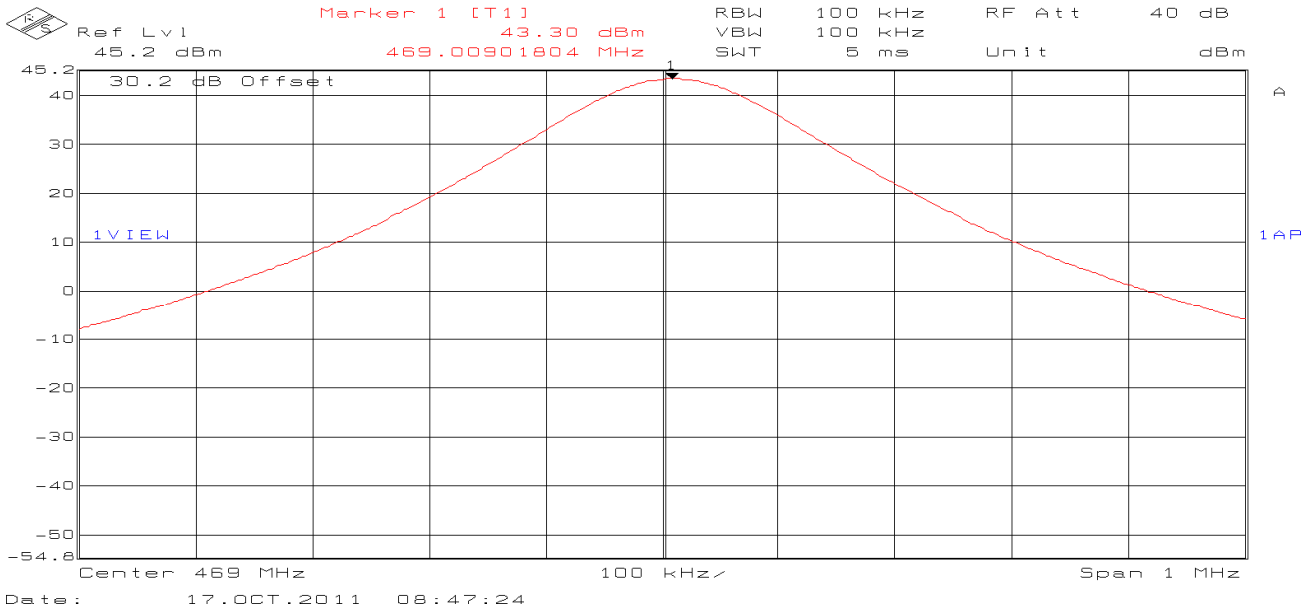
## Test data

– Power supply used.



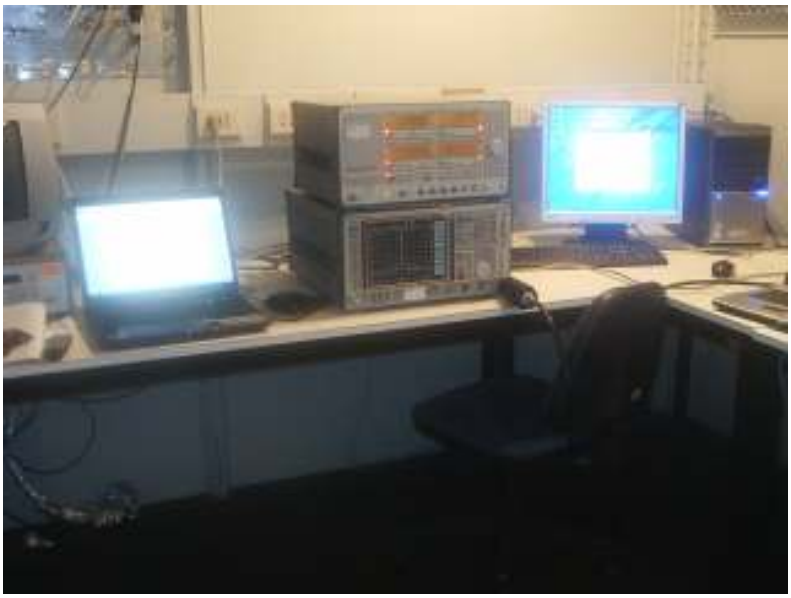



## Test data




| Frequency [MHz] | Measured Output power [dBm] | Measured Output power [W] | Manufacturer's Rated Power [W] | LIMIT [W] (Manufacturer's rated Power + 20%) |
|---|---|---|---|---|
| 407 | 43.77 | 23.82 | 25 | 30 |
| 429 | 43.82 | 24.09 | 25 | 30 |
| 469 | 43.30 | 21.40 | 25 | 30 |

## Set up photo



## Clause 90.207 Modulation characteristics

Unless specified elsewhere in this part, stations will be authorized emissions as provided for in paragraphs (b) through (n) of this section.

**§ 2.1047 Measurements required: Modulation characteristics.**

(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.

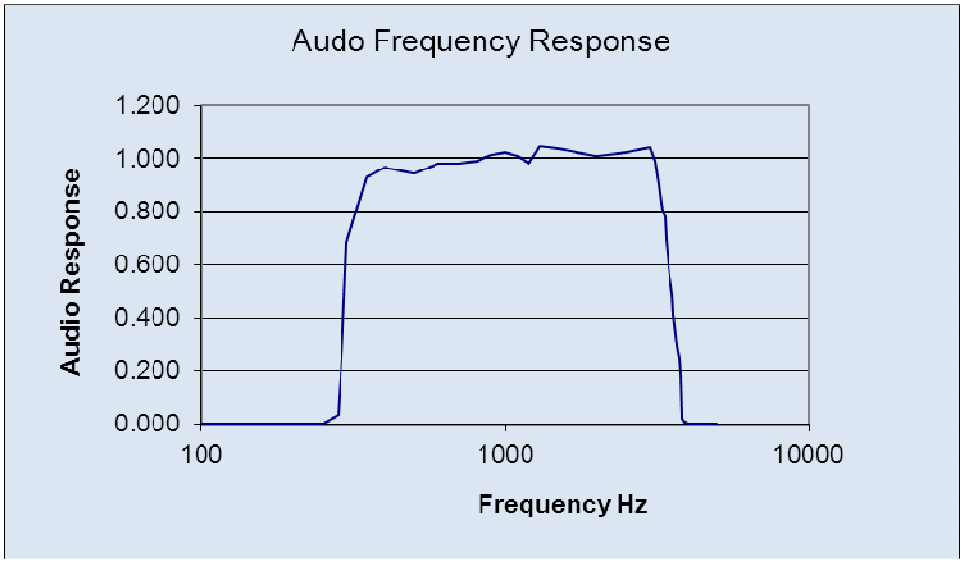
(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test date: 2011/10/19

Test results: Pass

## Test data

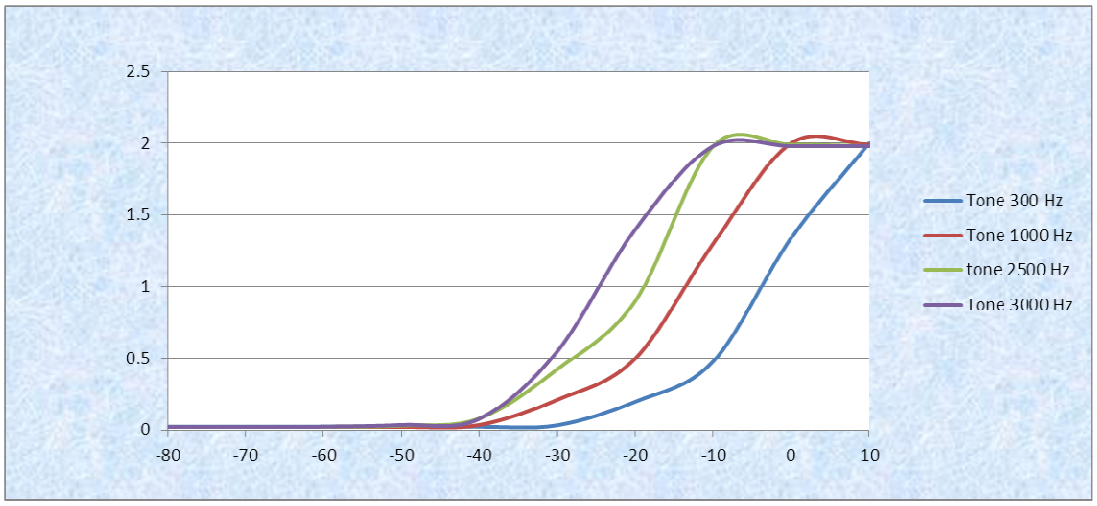
**12.5 kHz channel spacing**



## Test data

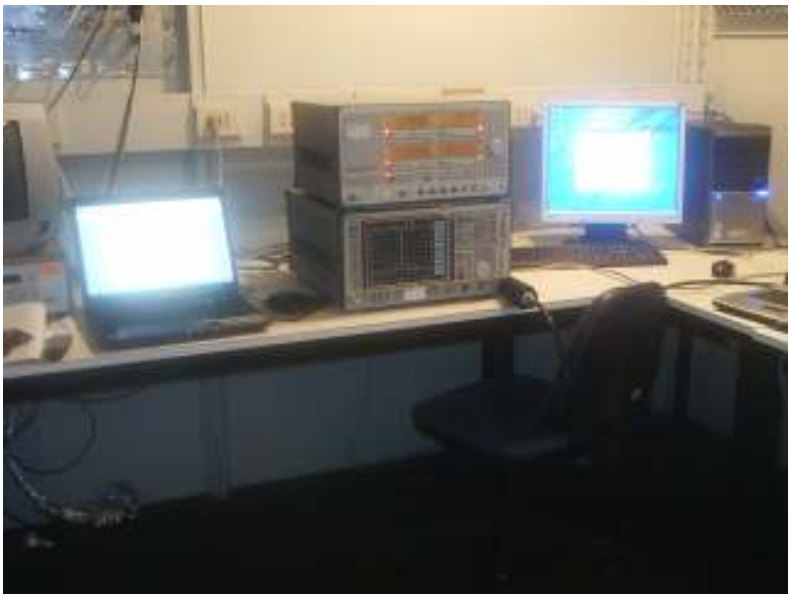
| 12.5 kHz channel spacing | | |
|---|---|---|
| Modulation | Deviation | Audio |
| Hz | dB | response |
| 100 | -46.97 | 0.004 |
| 150 | -46.65 | 0.005 |
| 200 | -46.65 | 0.005 |
| 250 | -46.76 | 0.005 |
| 280 | -29.57 | 0.033 |
| 290 | -11.85 | 0.256 |
| 300 | -3.28 | 0.685 |
| 350 | -0.64 | 0.929 |
| 400 | -0.30 | 0.966 |
| 500 | -0.51 | 0.943 |
| 600 | -0.15 | 0.983 |
| 700 | -0.17 | 0.981 |
| 800 | -0.09 | 0.990 |
| 900 | 0.11 | 1.013 |
| 1000 | 0.19 | 1.023 |
| 1100 | 0.06 | 1.007 |
| 1200 | -0.15 | 0.983 |
| 1300 | 0.38 | 1.044 |
| 1500 | 0.32 | 1.037 |
| 2000 | 0.08 | 1.009 |
| 2500 | 0.21 | 1.024 |
| 3000 | 0.37 | 1.043 |
| 3100 | -0.09 | 0.990 |
| 3200 | -0.90 | 0.901 |
| 3250 | -1.59 | 0.832 |
| 3300 | -1.88 | 0.805 |
| 3350 | -2.14 | 0.781 |
| 3400 | -3.15 | 0.696 |
| 3450 | -4.53 | 0.594 |
| 3500 | -5.14 | 0.553 |
| 3550 | -6.18 | 0.491 |
| 3600 | -7.77 | 0.409 |
| 3650 | -9.55 | 0.333 |
| 3700 | -10.72 | 0.291 |
| 3750 | -12.23 | 0.245 |
| 3800 | -14.62 | 0.186 |
| 3850 | -33.61 | 0.021 |
| 3900 | -44.81 | 0.006 |
| 3950 | -45.71 | 0.005 |
| 4000 | -46.96 | 0.004 |
| 5000 | -46.66 | 0.005 |

## Test data




| 12.5 kHz channel spacing | | | | |
|---|---|---|---|---|
| Audio Level | Deviation (kHz) | | | |
| dBm | TONE 300 Hz | TONE 1000 Hz | TONE 2500 Hz | TONE 3000 Hz |
| -80 | 0.026 | 0.025 | 0.024 | 0.025 |
| -70 | 0.026 | 0.025 | 0.024 | 0.025 |
| -65 | 0.026 | 0.025 | 0.024 | 0.025 |
| -60 | 0.026 | 0.025 | 0.025 | 0.026 |
| -50 | 0.026 | 0.025 | 0.034 | 0.038 |
| -40 | 0.026 | 0.038 | 0.082 | 0.08 |
| -30 | 0.036 | 0.212 | 0.425 | 0.55 |
| -20 | 0.199 | 0.5 | 0.9 | 1.4 |
| -10 | 0.48 | 1.3 | 1.98 | 1.98 |
| 0 | 1.34 | 2 | 1.99 | 1.98 |
| 10 | 2 | 1.99 | 1.98 | 1.98 |

## Set up photo



## Clause 90.209 Occupied bandwidth

Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table:

Standard Channel Spacing/Bandwidth

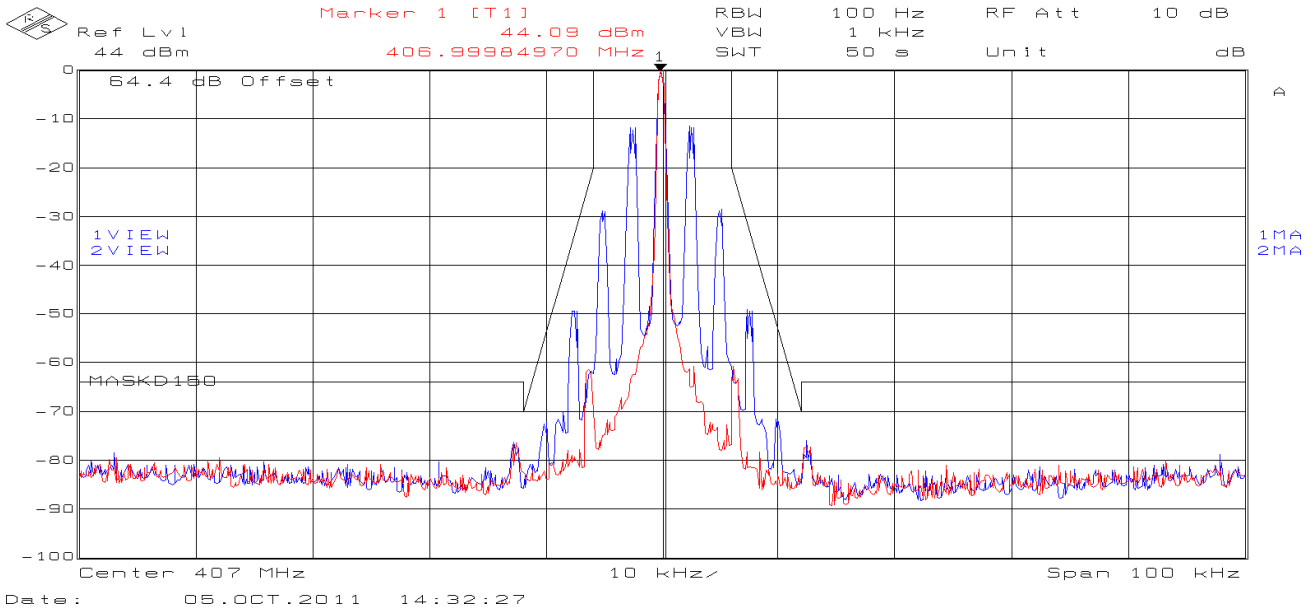
| Frequency Band (MHz) | Channel Spacing (kHz) | Authorized Bandwidth (kHz) |
|---|---|---|
| Below 25 | – | – |
| 25–50 | 20 | 20 |
| 72–76 | 20 | 20 |
| 150–174 | 7.5 | 20/11.25/6 |
| 216–220 | 6.25 | 20/11.25/6 |
| 220–222 | 5 | 4 |
| 406–512 | 6.25 | 20/11.25/6 |
| 806–809/851–854 | 12.5 | 20 |
| 809–824/854–869 | 25 | 20 |
| 896–901/935–940 | 12.5 | 13.6 |
| 902–928 | – | – |
| 929–930 | 25 | 20 |
| 1427–1432 | 12.5 | 12.5 |
| 2450–2483.5 | – | – |
| Above 2500 | – | – |

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

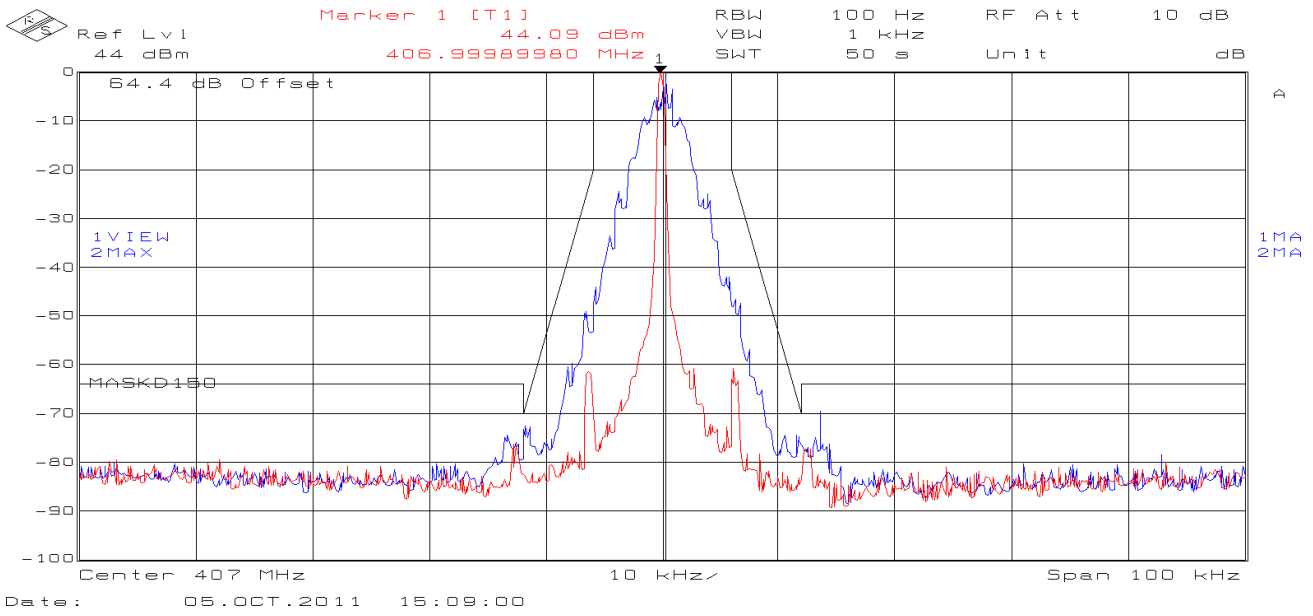
Test date: 2011/10/05

Test results: Pass

## Test data

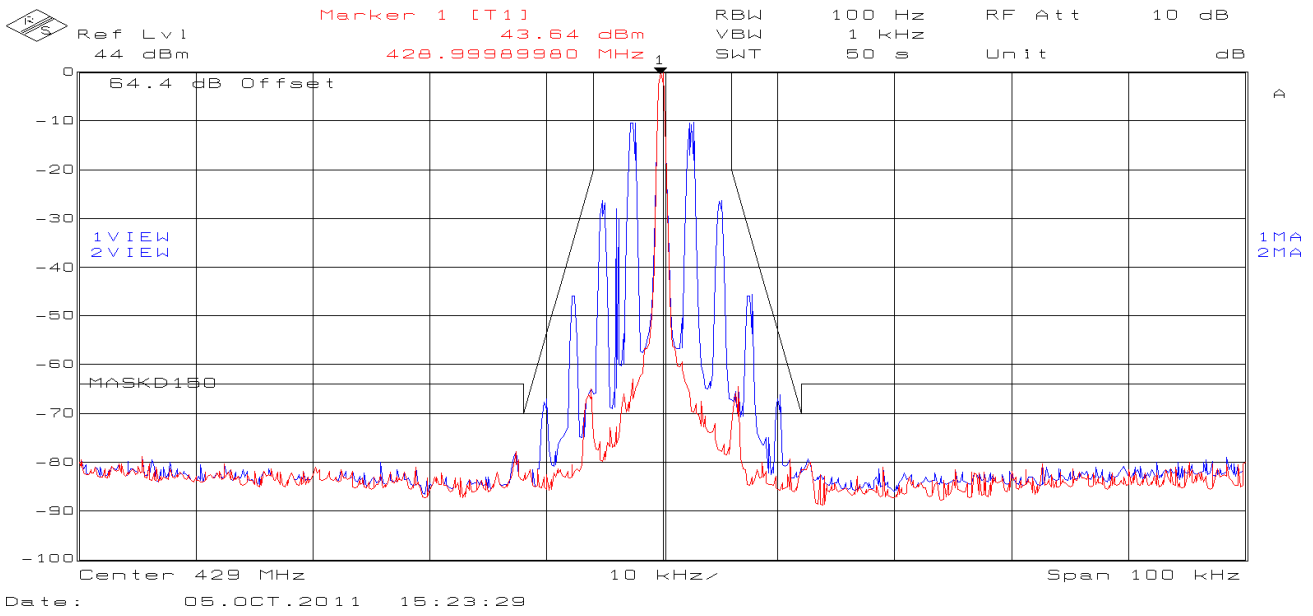



407 MHz, 25 W, 12.5 kHz, 2500 Hz Tone 16 dB above 50% Deviation

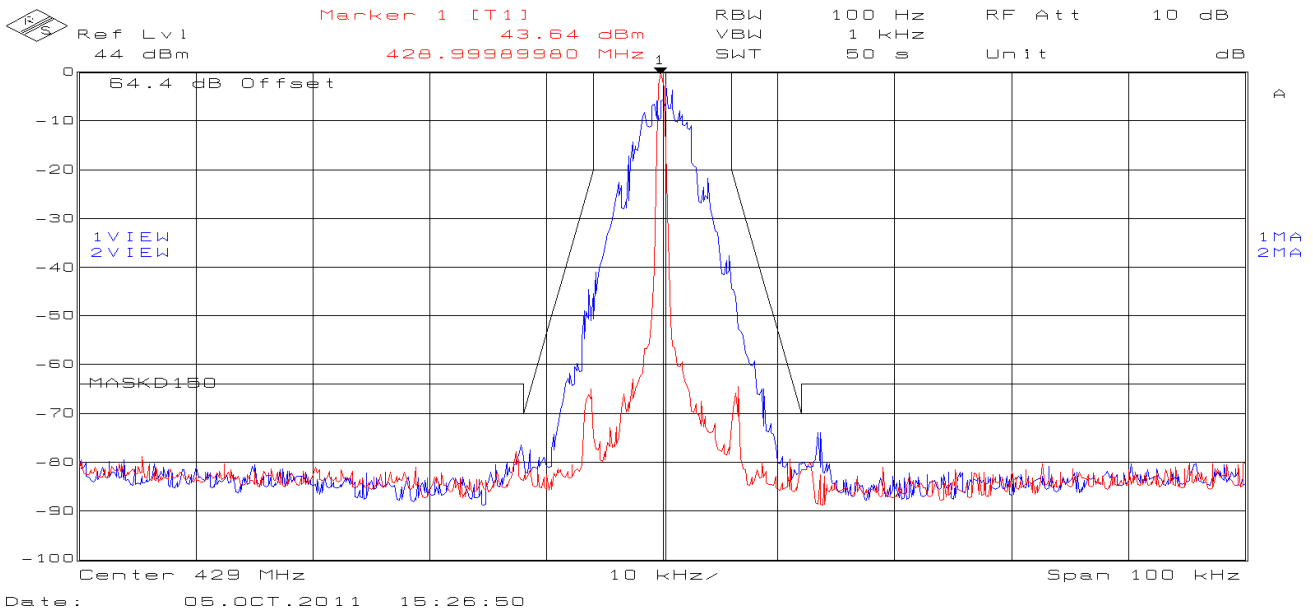



407 MHz, 25 W, 12.5 kHz, 4FSK

## Test data

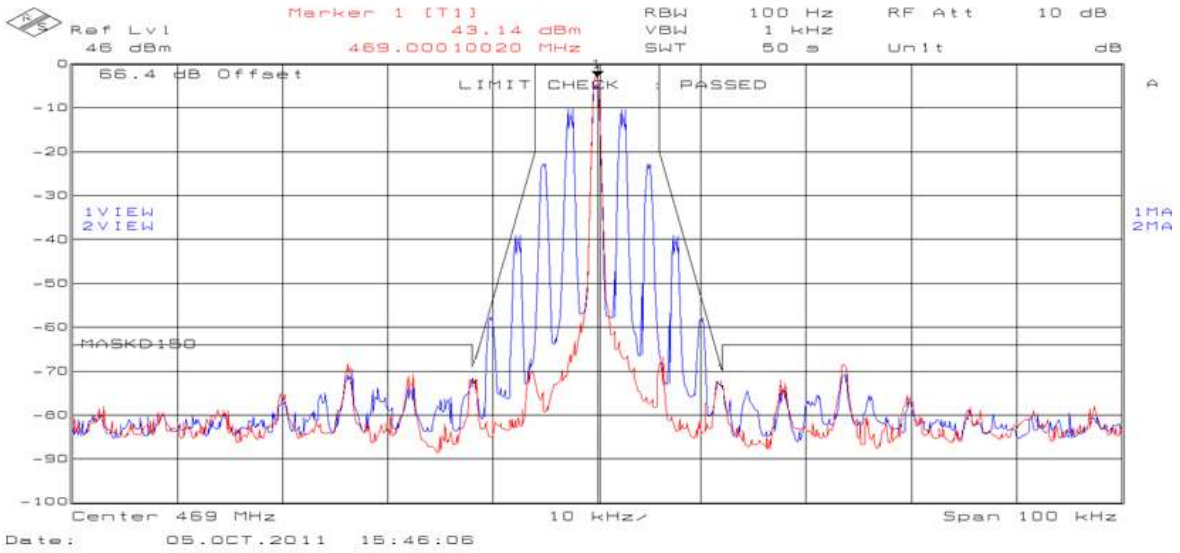



429 MHz, 25 W, 12.5 kHz, 2500 Hz Tone 16 dB above 50% Deviation

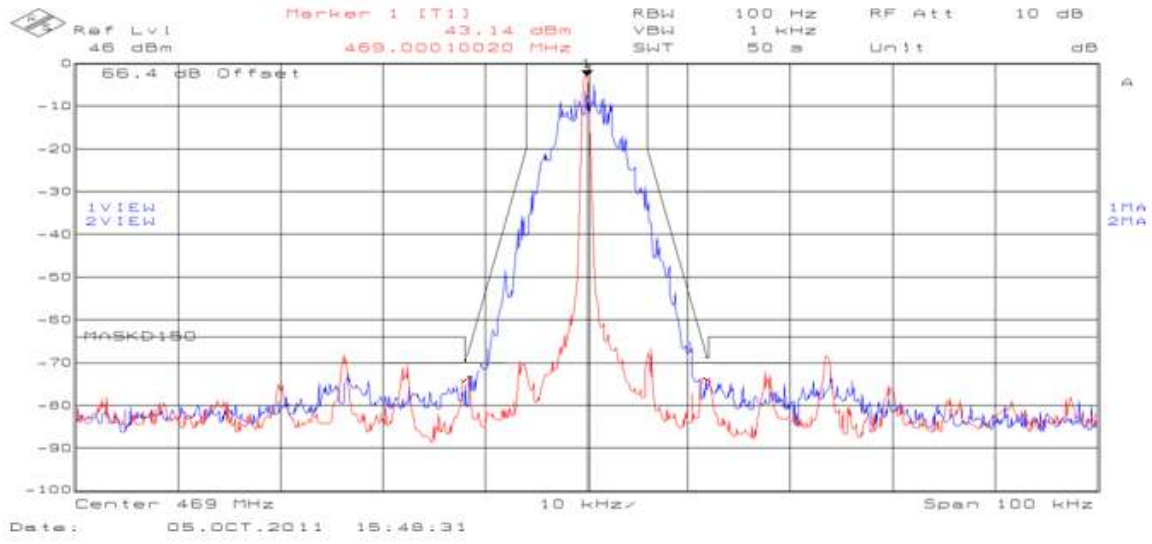



429 MHz, 25 W, 12.5 kHz, 4FSK

## Test data




469 MHz, 25 W, 12.5 kHz, 2500 Hz Tone 16 dB above 50% Deviation




469 MHz, 25 W, 12.5 kHz, 4FSK

## Clause 90.210 Spurious emissions at the antenna terminal

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks:

| Frequency band (MHz) | Mask for equipment with Audio low pass filter | Mask for equipment without audio low pass filter |
|---|---|---|
| Below 25 | A or B | A or C |
| 25–50 | B | C |
| 72–76 | B | C |
| 150–174 | B, D, or E | C, D, or E |
| 150 Paging-only | B | C |
| 220–222 | F | F |
| 421–512 | B, D, or E | C, D, or E |
| 450 Paging-only | B | G |
| 806–809/851–854 | B | H |
| 809–824/854–869 | B | G |
| 896–901/935–940 | I | J |
| 902–928 | K | K |
| 929–930 | B | G |
| 4940–4990 | L or M | L or M. |
| 5850–5925 | – | – |
| All other bands | B | C |

**§ 2.1051 Measurements required: Spurious emissions at antenna terminals.**
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Test date: 2011/10/07

Test results: Pass

### Special notes

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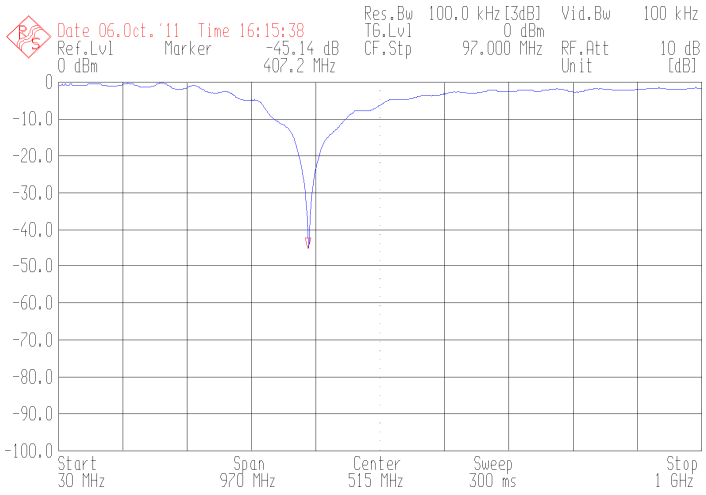
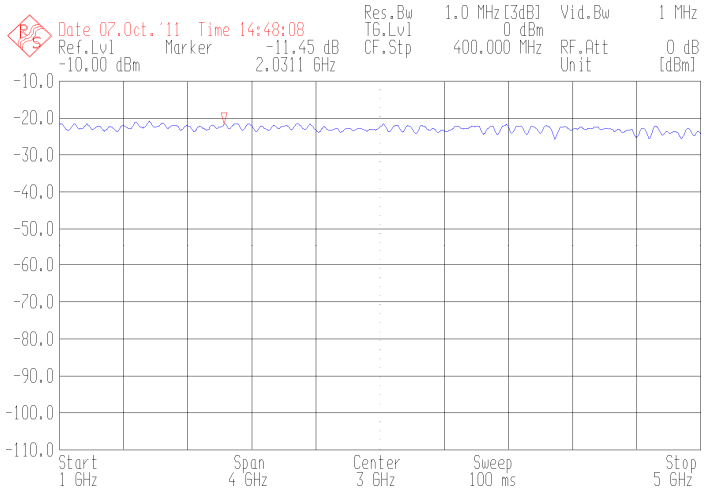
## Test data

Notch 407 MHz



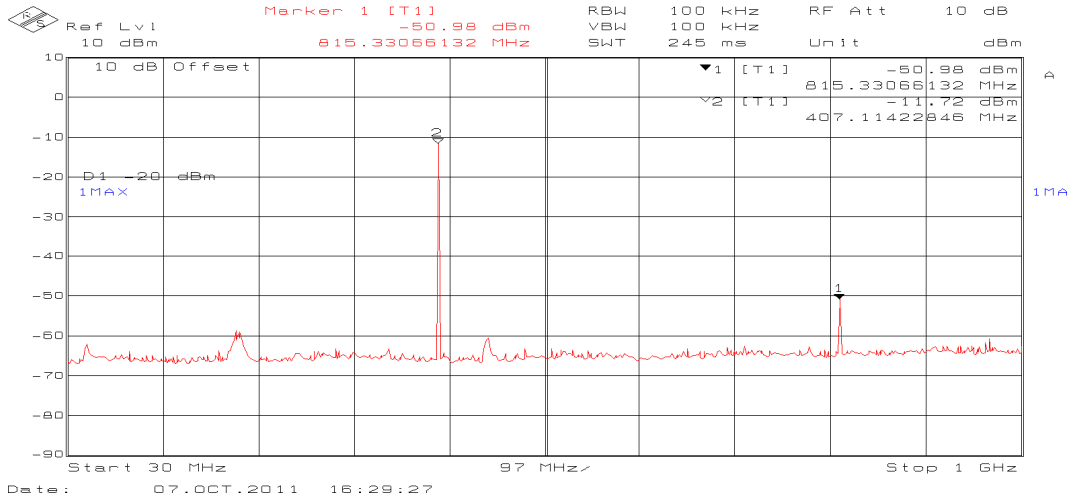

Notch 407 MHz + 50 W 10 Db Attenuator

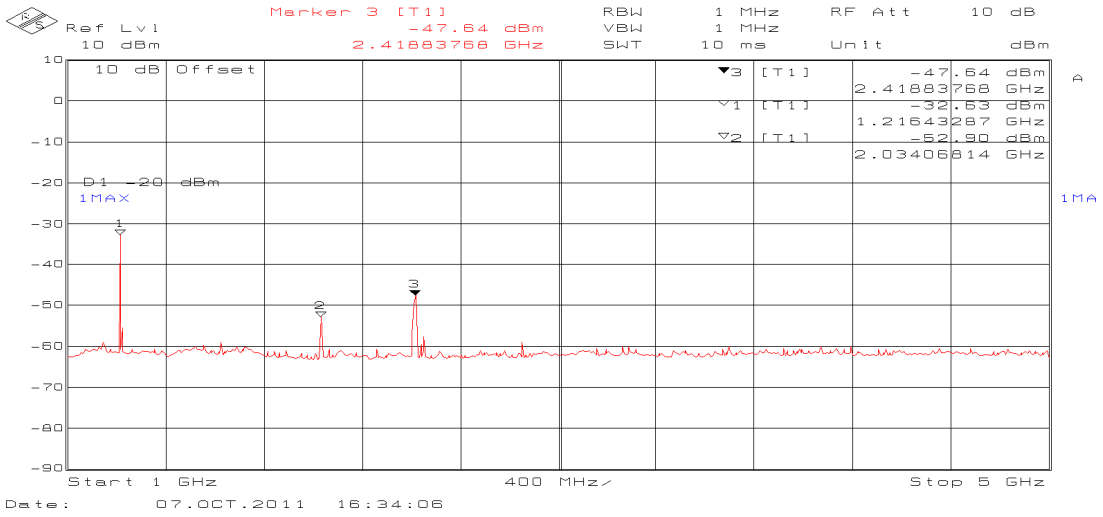



| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm | dB | dBm | | |
| 407.02 | -45.1 | 0 | -- | -- | -- |

## Test data

Carrier 407 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm

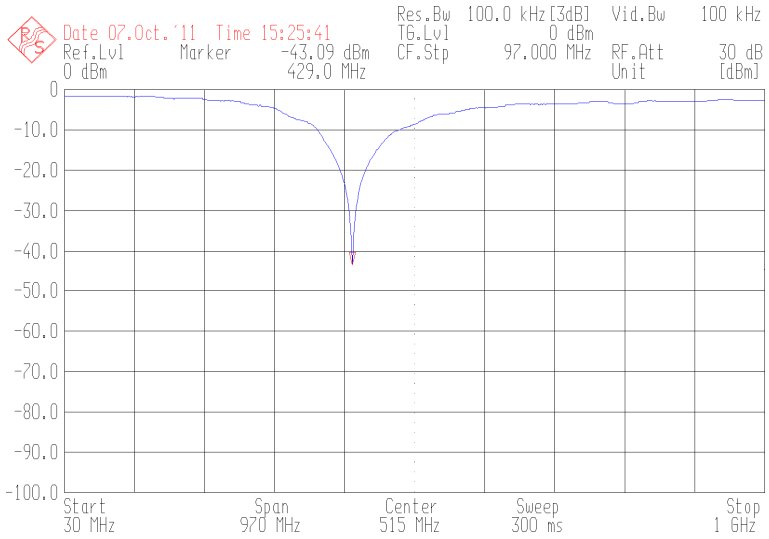


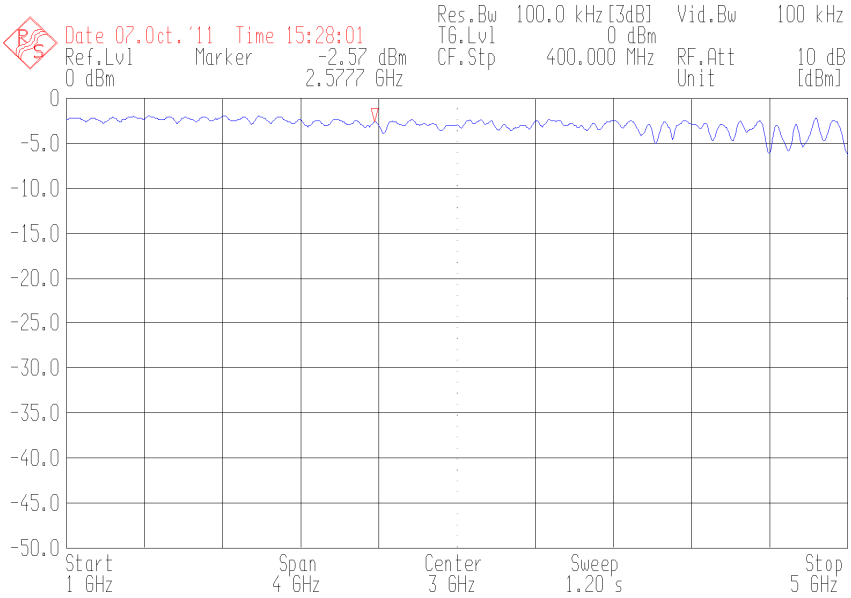

| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm | dB | dBm | | |
| 407.114 | -11.7 | 55.1 | -- | PK | Carrier |
| 815.330 | -50.9 | 0 | -20 | PK | -- |
| 1216.432 | -32.6 | 0 | -20 | PK | -- |
| 2418.837 | -47.6 | 0 | -20 | PK | -- |

## Test data

Notch 429 MHz



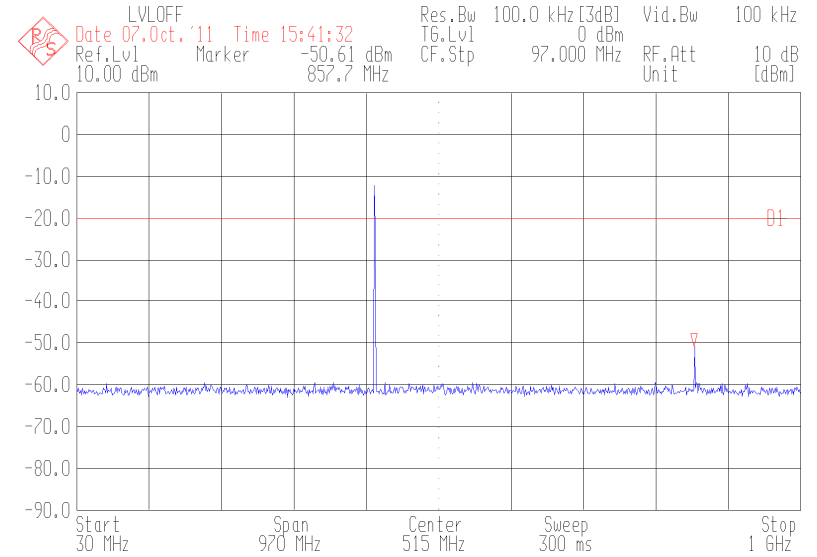

Notch 429 MHz

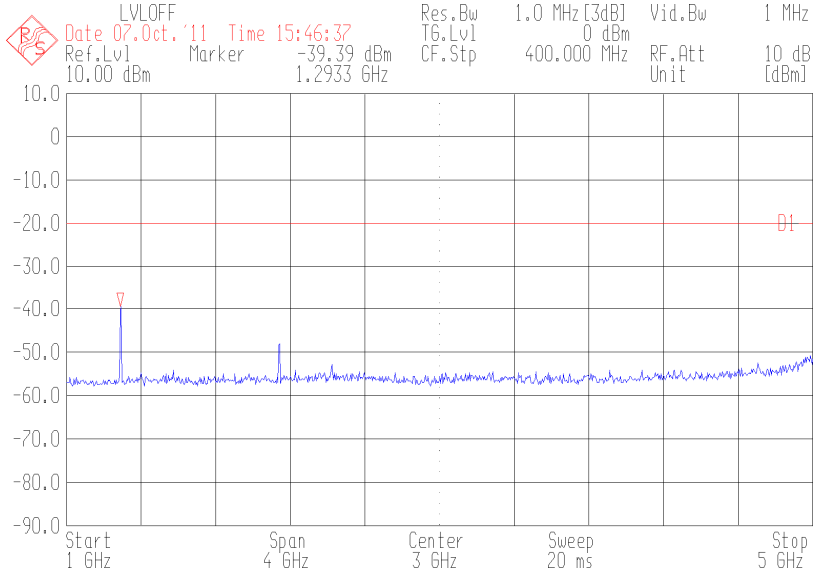



| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm | dB | dBm | | |
| 429.0 | -43.1 | 0 | -- | -- | -- |

## Test data

Carrier 429 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm

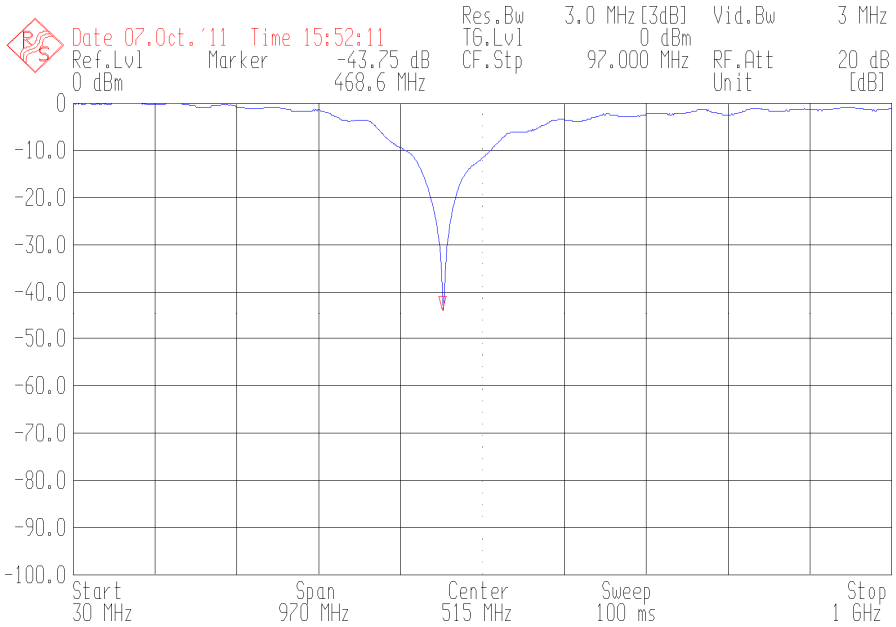


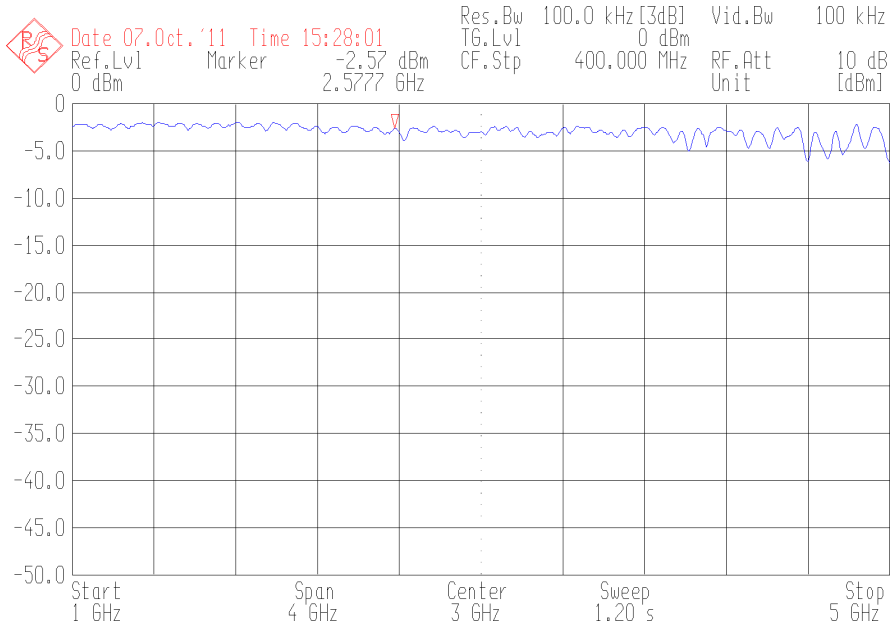

| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm | dB | dBm | | |
| 429 | -9.2 | 53.1 | -- | PK | Carrier |
| 857.7 | -50.6 | 0 | -20 | PK | -- |
| 1293.3 | -39.3 | 0 | -20 | PK | -- |
| 2142.2 | -47.9 | 0 | -20 | PK | -- |

## Test data

Notch 469 MHz



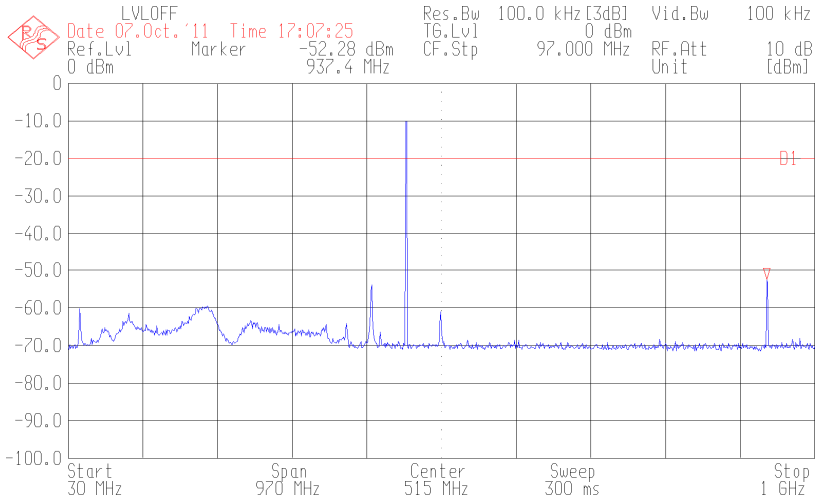

Notch 469 MHz

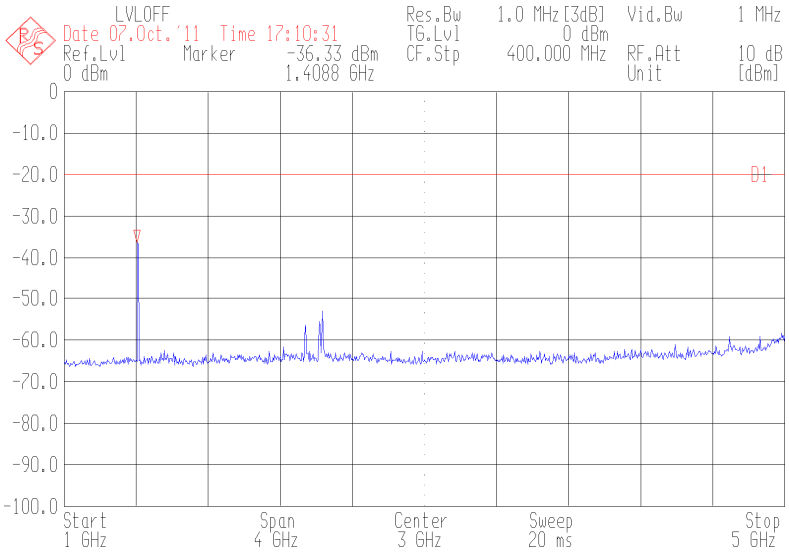



| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm | dB | dBm | | |
| 469.0 | -43.8 | 0 | -- | -- | -- |

## Test data

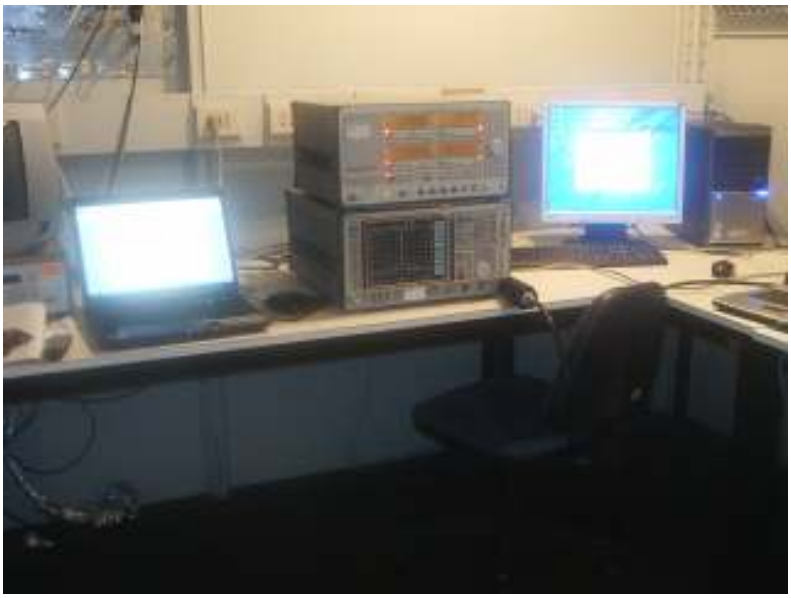
Carrier 469 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm | dB | dBm | | |
| 469 | -10.5 | 53.8 | -- | PK | Carrier |
| 937.4 | -52.8 | 0 | -20 | PK | -- |
| 1408.8 | -36.3 | 0 | -20 | PK | -- |
| 2435.5 | -52.9 | 0 | -20 | PK | -- |

## Set up photo



## Clause 90.210 Field strength of spurious radiation

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

**§ 2.1053 Measurements required: Field strength of spurious radiation.**
(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

Test date: 2011/10/06

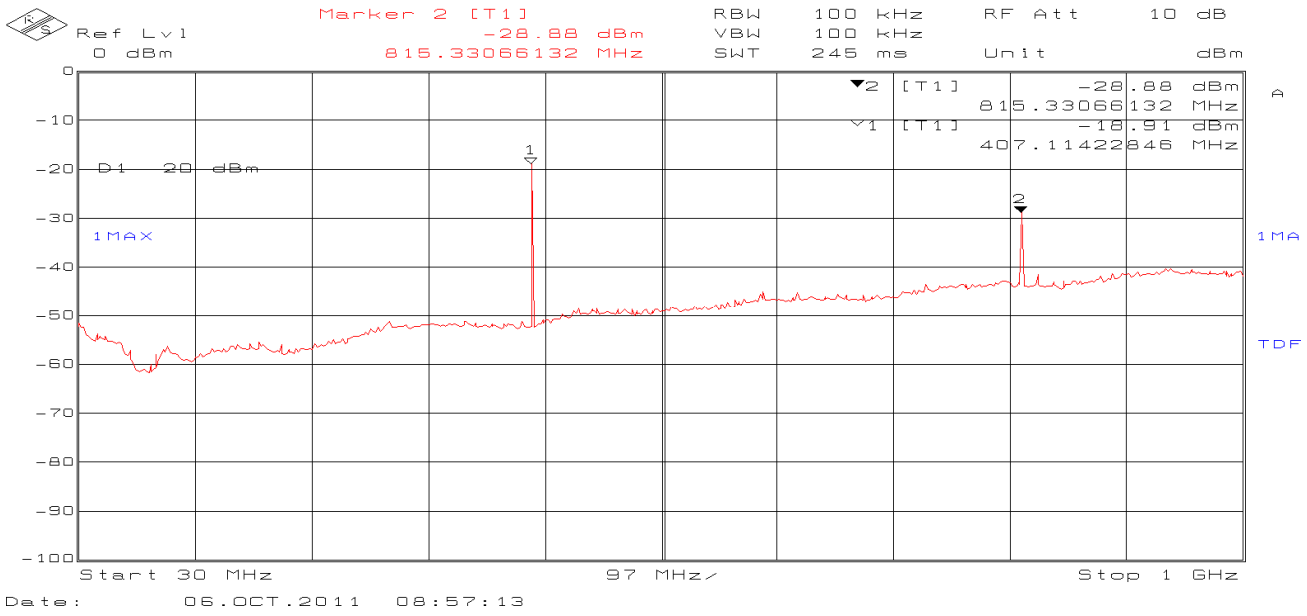
Test results: Pass

### Special notes

- The spectrum was searched from 30 MHz to the 10$^{th}$ harmonic.
- All measurements were performed at a distance of 3 m.
- Only the worst data presented in the test report.

## Test data

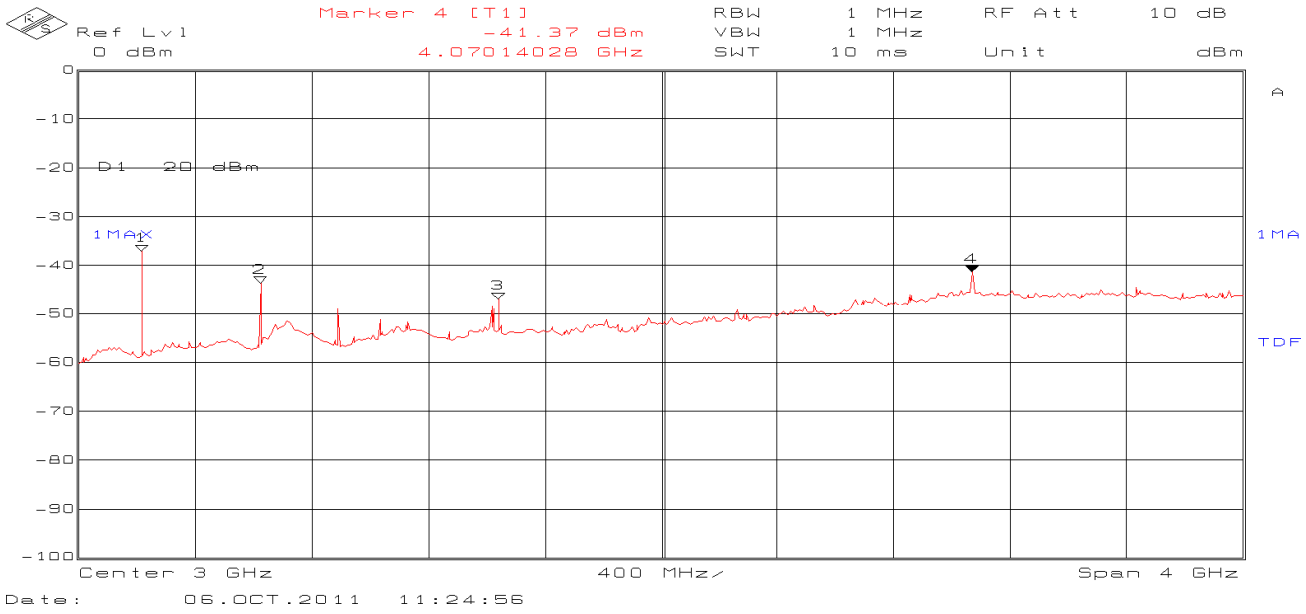
Vertical polarization, 30-1000 MHz, Carrier 407 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp,




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 407.11422846 | -18.9 | 28.0 | -20 | PK | Carrier |
| 815.33066132 | -28.9 | 36.1 | -20 | PK | -- |

## Test data

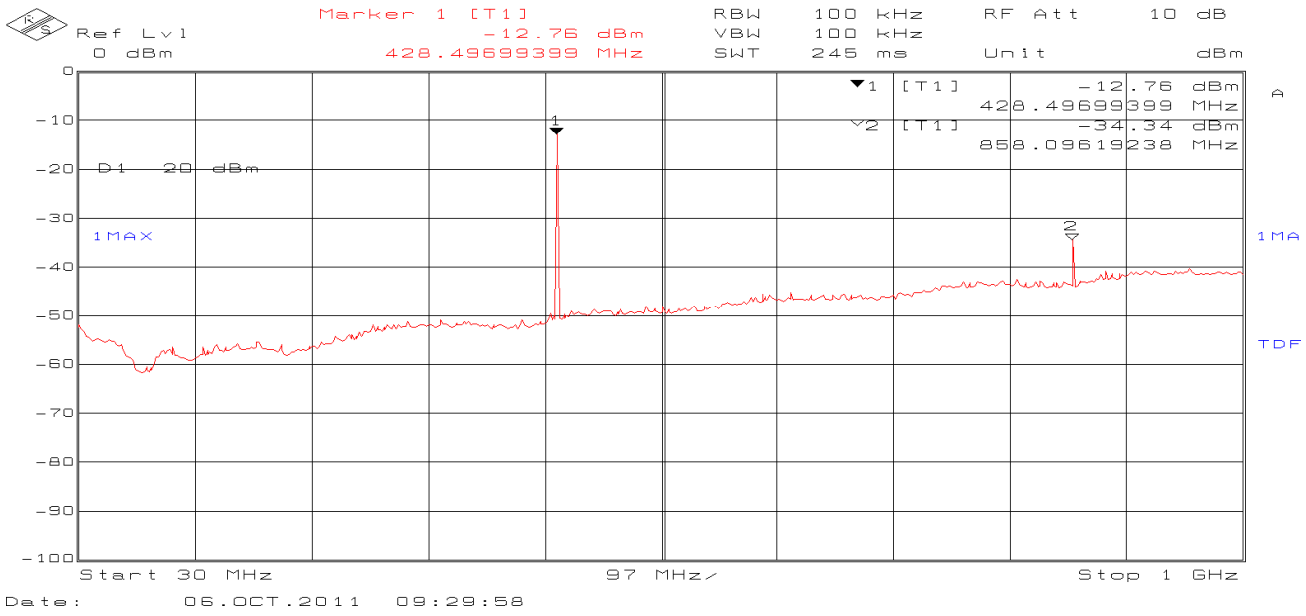
Vertical polarization, 1000-5000 MHz, Carrier 407 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1000 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 1216.43287 | -37.2 | 10.6 | -20 | PK | -- |
| 1625.25050 | -43.5 | 12.4 | -20 | PK | -- |
| 2034.06814 | -51.5 | 15.5 | -20 | PK | -- |
| 2442.88577 | -46.9 | 17.2 | -20 | PK | -- |
| 2955.91182 | -51.1 | 17.1 | -20 | PK | -- |
| 3260.52104 | -49.4 | 18.9 | -20 | PK | -- |
| 3733.46693 | -46.8 | 22.5 | -20 | PK | -- |
| 4070.14028 | -41.4 | 24.1 | -20 | PK | -- |
| 4511.02204 | -45.2 | 24.1 | -20 | PK | -- |
| 4631.26253 | -44.7 | 24.1 | -20 | PK | -- |
| 4951.90381 | -45.5 | 24.1 | -20 | PK | -- |

## Test data

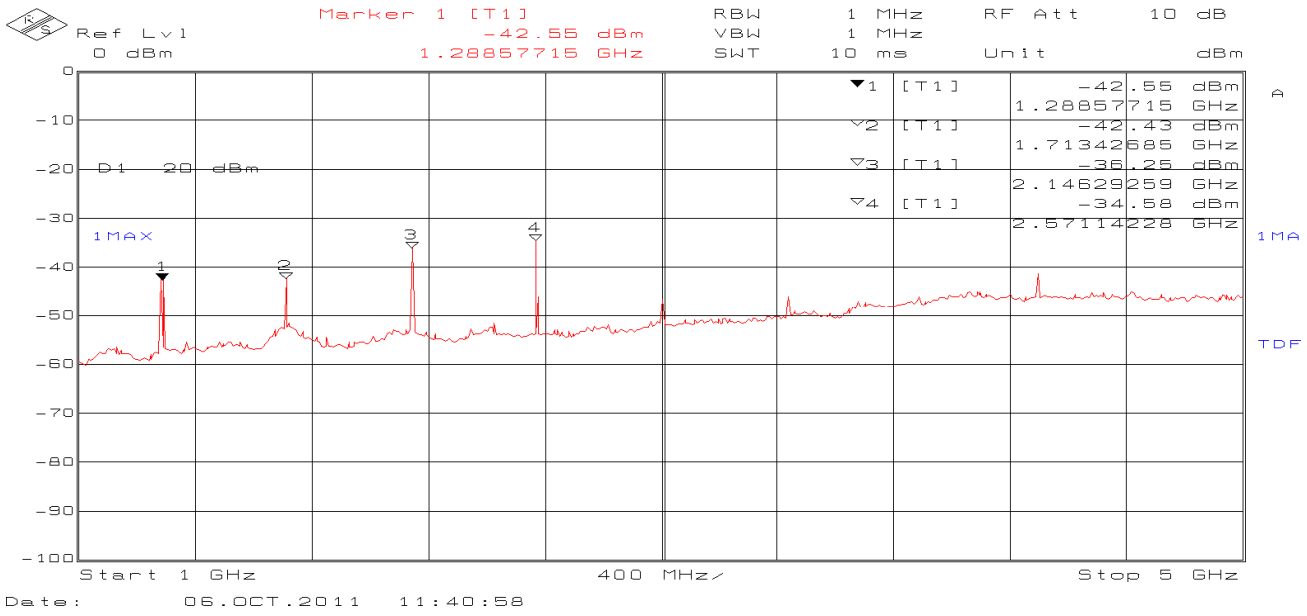
Vertical polarization, 30-1000 MHz, Carrier 429 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 428.49699399 | -12.8 | 28.0 | -20 | PK | Carrier |
| 858.09619238 | -34.3 | 35.4 | -20 | PK | -- |

## Test data

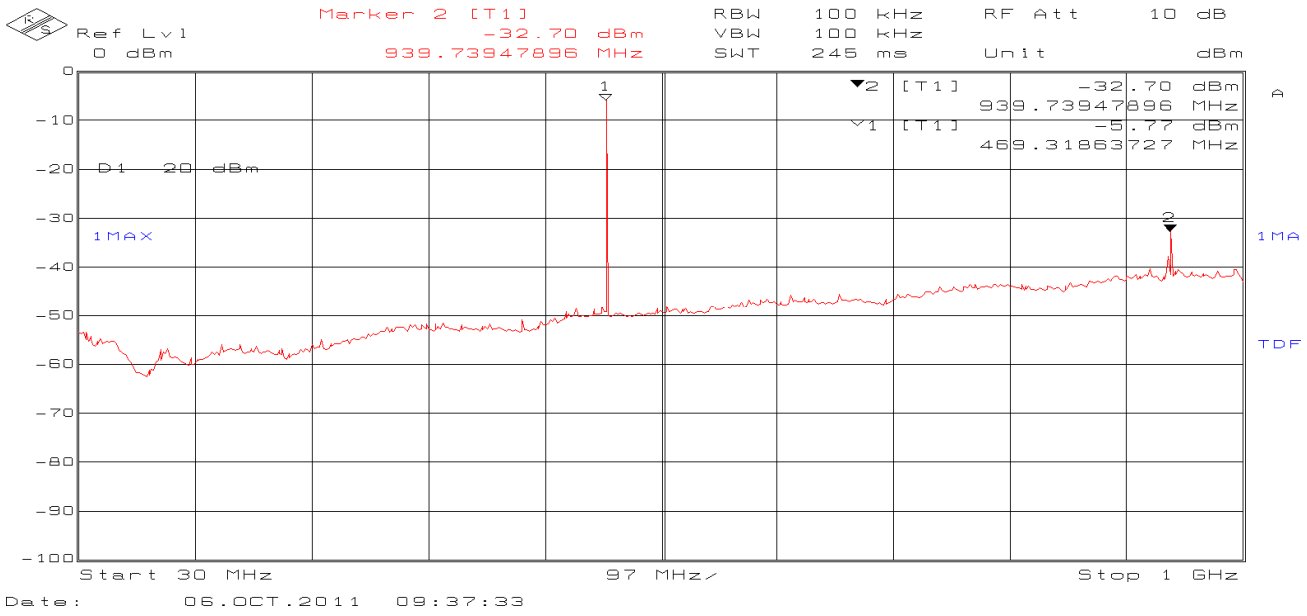
Vertical polarization, 1000-5000 MHz, Carrier 429 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1000 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 1288.57715 | -42.6 | 10.6 | -20 | PK | Carrier |
| 1713.42685 | -42.4 | 16.8 | -20 | PK | -- |
| 2146.29259 | -36.2 | 17.0 | -20 | PK | Carrier |
| 2571.14228 | -34.7 | 16.9 | -20 | PK | -- |
| 3004.00802 | -46.7 | 18.6 | -20 | PK | Carrier |
| 3436.87375 | -46.1 | 20.1 | -20 | PK | -- |
| 3861.72345 | -47.1 | 22.3 | -20 | PK | Carrier |
| 4030.06012 | -45.5 | 24.1 | -20 | PK | -- |
| 4294.58918 | -41.7 | 24.1 | -20 | PK | Carrier |
| 4719.43888 | -45.8 | 24.1 | -20 | PK | -- |
| 4991.98397 | -46.3 | 24.1 | -20 | PK | -- |

## Test data

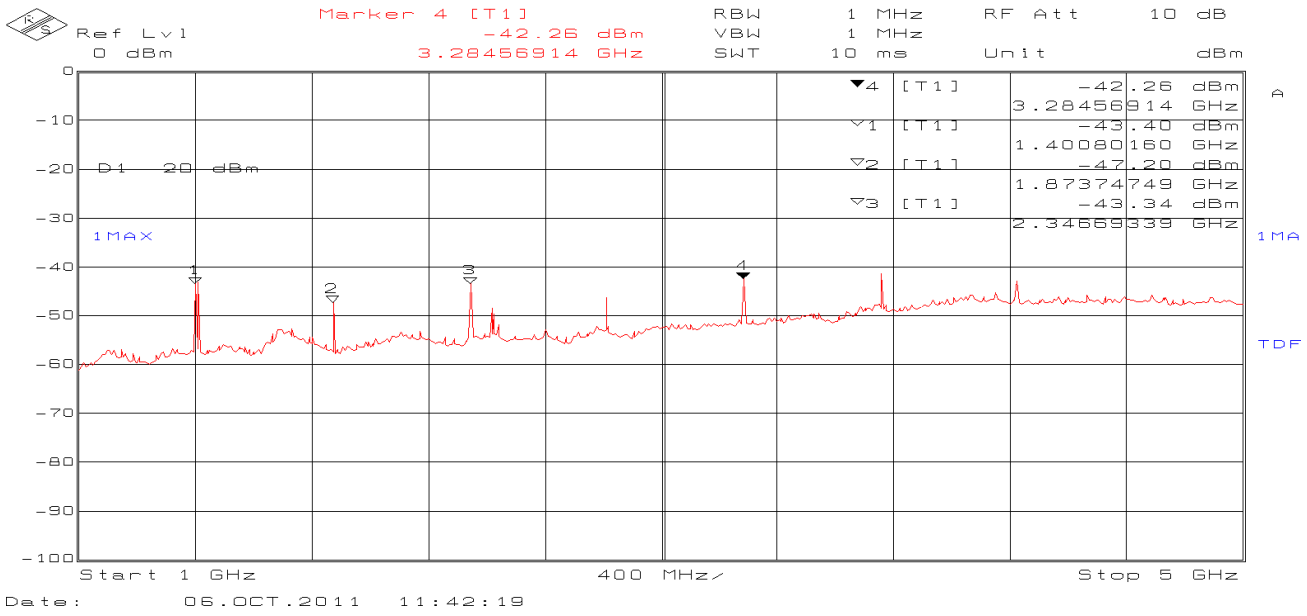
Vertical polarization, 30-1000 MHz, Carrier 469 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 469.31863727 | -5.8 | 30.9 | -20 | PK | Carrier |
| 939.73947896 | -32.7 | 36.9 | -20 | PK | -- |

## Test data

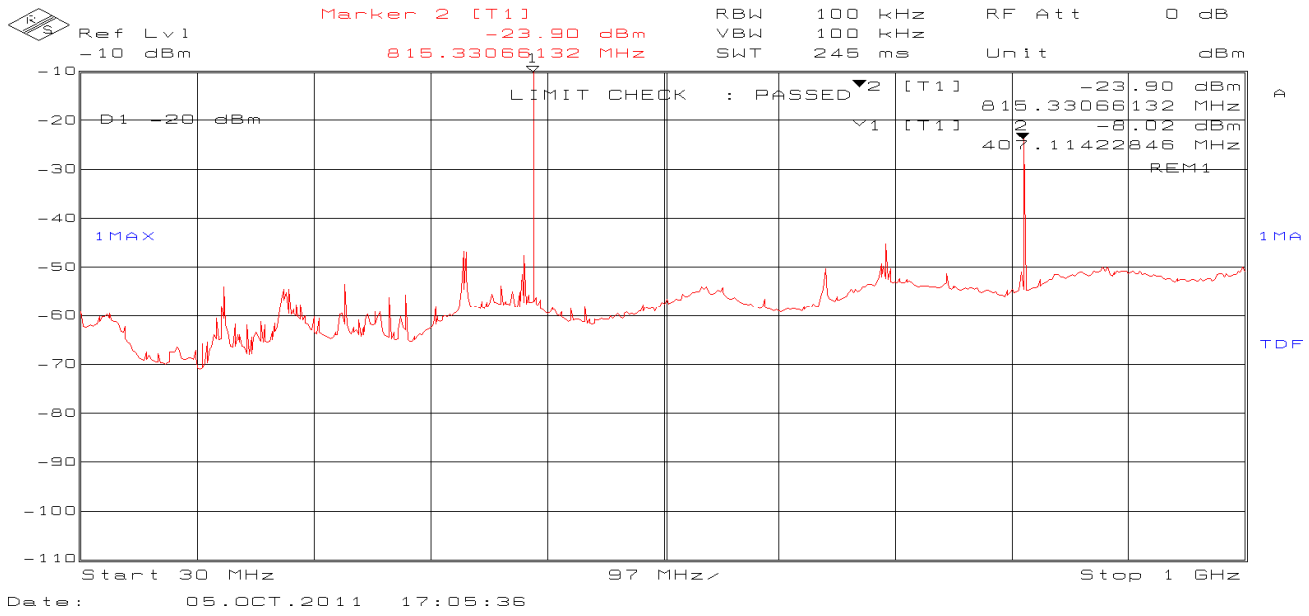
Vertical polarization, 1000-5000 MHz, Carrier 469 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1000 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 1408.81764 | -43.0 | 13.0 | -20 | PK | -- |
| 1873.74749 | -47.2 | 15.3 | -20 | PK | -- |
| 2346.69339 | -43.3 | 15.5 | -20 | PK | -- |
| 2779.55912 | -52.3 | 16.3 | -20 | PK | -- |
| 2811.62325 | -46.4 | 17.9 | -20 | PK | -- |
| 3284.56914 | -42.3 | 18.9 | -20 | PK | -- |
| 3757.51503 | -41.4 | 22.5 | -20 | PK | -- |
| 4150.30060 | -45.3 | 24.1 | -20 | PK | -- |
| 4222.44489 | -42.1 | 24.1 | -20 | PK | -- |
| 4687.37475 | -45.8 | 24.1 | -20 | PK | -- |

## Test data

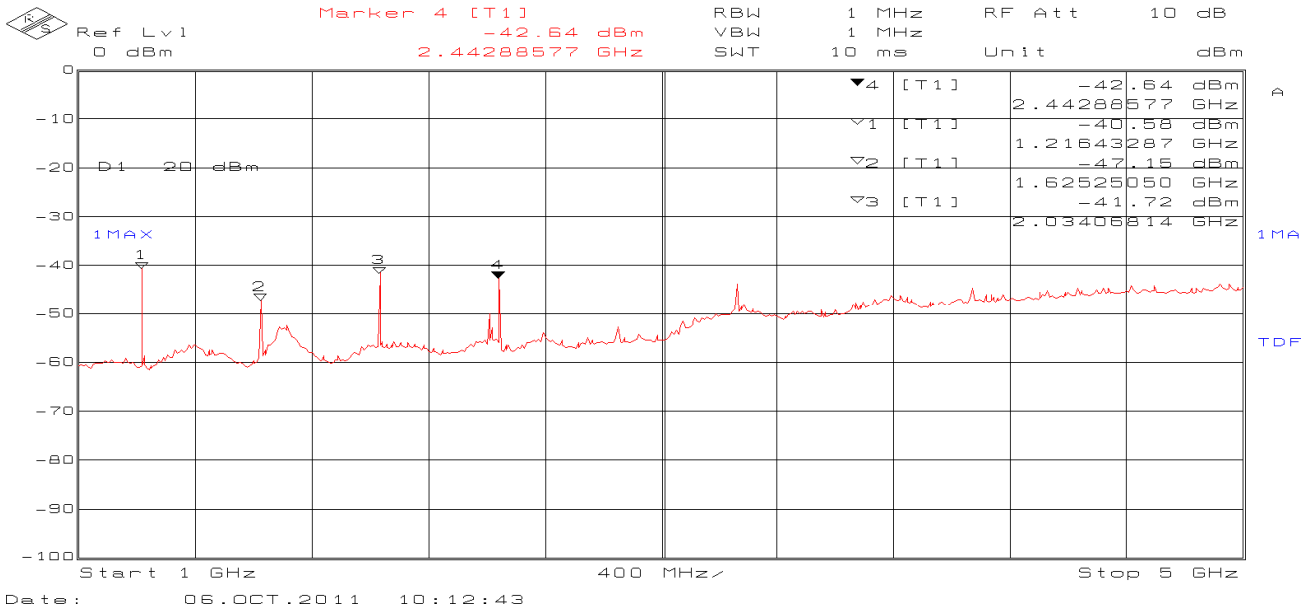
Horizontal polarization, 30-1000 MHz, Carrier 407 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 148.57715 | -54.0 | 20.4 | -20 | PK | |
| 249.65932 | -53.7 | 28.6 | -20 | PK | |
| 348.79760 | -46.9 | 23.8 | -20 | PK | |
| 407.11423 | -8.0 | 31.3 | -20 | PK | Carrier |
| 547.07415 | -54.0 | 30.6 | -20 | PK | |
| 650.10020 | -50.5 | 31.9 | -20 | PK | |
| 700.64128 | -45.3 | 35.9 | -20 | PK | |
| 815.33066 | -23.9 | 33.6 | -20 | PK | |
| 885.31062 | -50.1 | 36.9 | -20 | PK | |
| 998.05611 | -50.2 | 35.5 | -20 | PK | |

## Test data

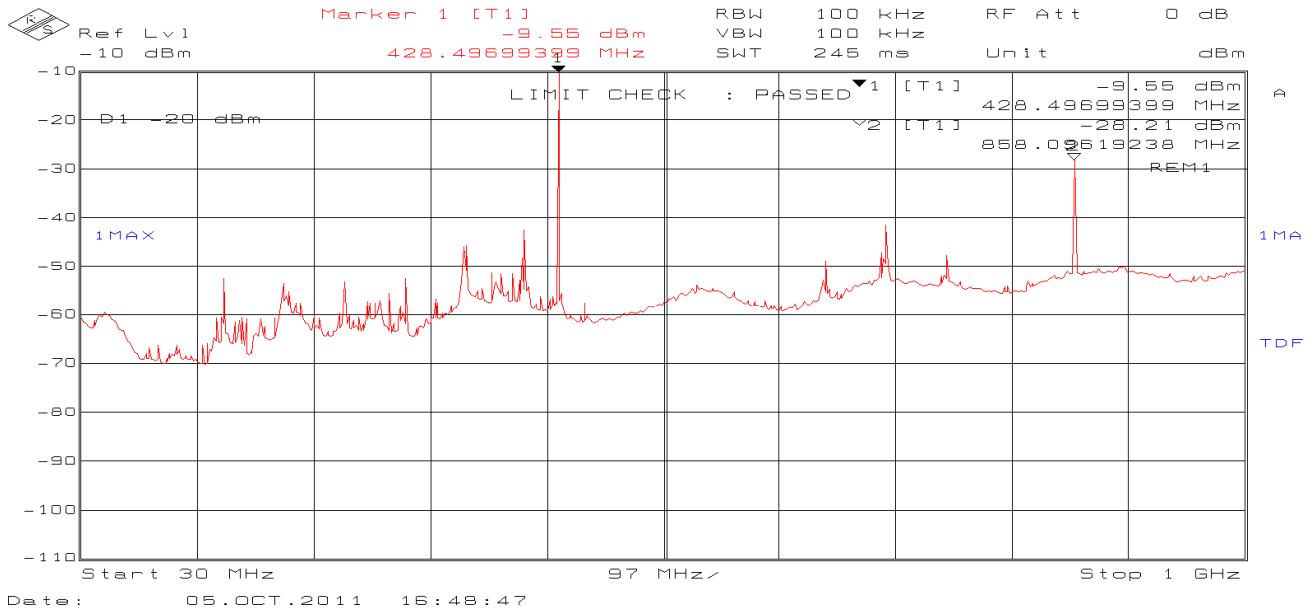
Horizontal polarization, 1000-5000 MHz, Carrier 407 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1000 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 1216.43287 | -40.6 | 9.7 | -20 | PK | -- |
| 1625.25050 | -47.2 | 9.4 | -20 | PK | -- |
| 2034.06814 | -41.7 | 14.6 | -20 | PK | -- |
| 2442.88577 | -42.6 | 15.3 | -20 | PK | -- |
| 2851.70341 | -52.4 | 15.2 | -20 | PK | -- |
| 3260.52104 | -43.8 | 20.2 | -20 | PK | -- |
| 3797.59519 | -45.0 | 22.5 | -20 | PK | -- |
| 4174.34870 | -44.7 | 23.2 | -20 | PK | -- |
| 4951.90381 | -42.8 | 23.2 | -20 | PK | -- |
| 4983.96794 | -42.4 | 23.2 | -20 | PK | -- |

## Test data

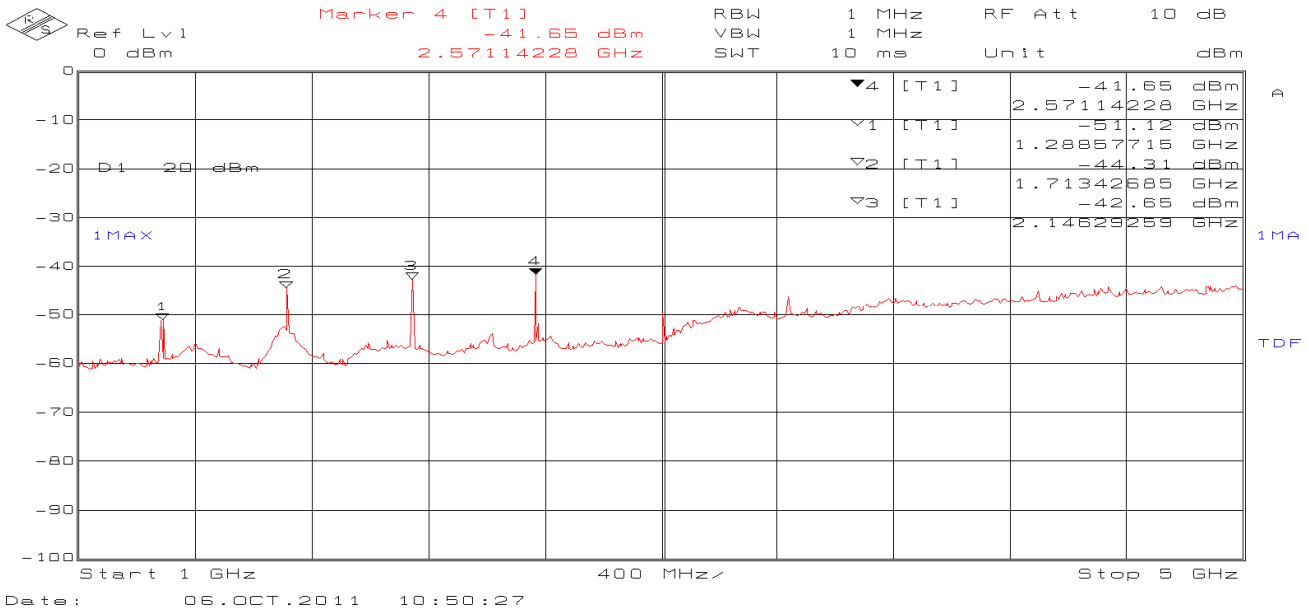
Horizontal polarization,, 30-1000 MHz, Carrier 429 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 148.57715 | -52.6 | 20.4 | -20 | PK | |
| 300.20040 | -52.6 | 23.8 | -20 | PK | |
| 399.33868 | -42.7 | 31.0 | -20 | PK | |
| 428.49699 | -9.5 | 31.3 | -20 | PK | Carrier |
| 543.18637 | -53.8 | 30.6 | -20 | PK | |
| 650.10020 | -49.3 | 31.9 | -20 | PK | |
| 700.64128 | -43.1 | 35.9 | -20 | PK | |
| 751.18236 | -48.7 | 35.0 | -20 | PK | |
| 858.09619 | -29.8 | 36.9 | -20 | PK | |
| 994.16834 | -51.0 | 35.5 | -20 | PK | |

## Test data

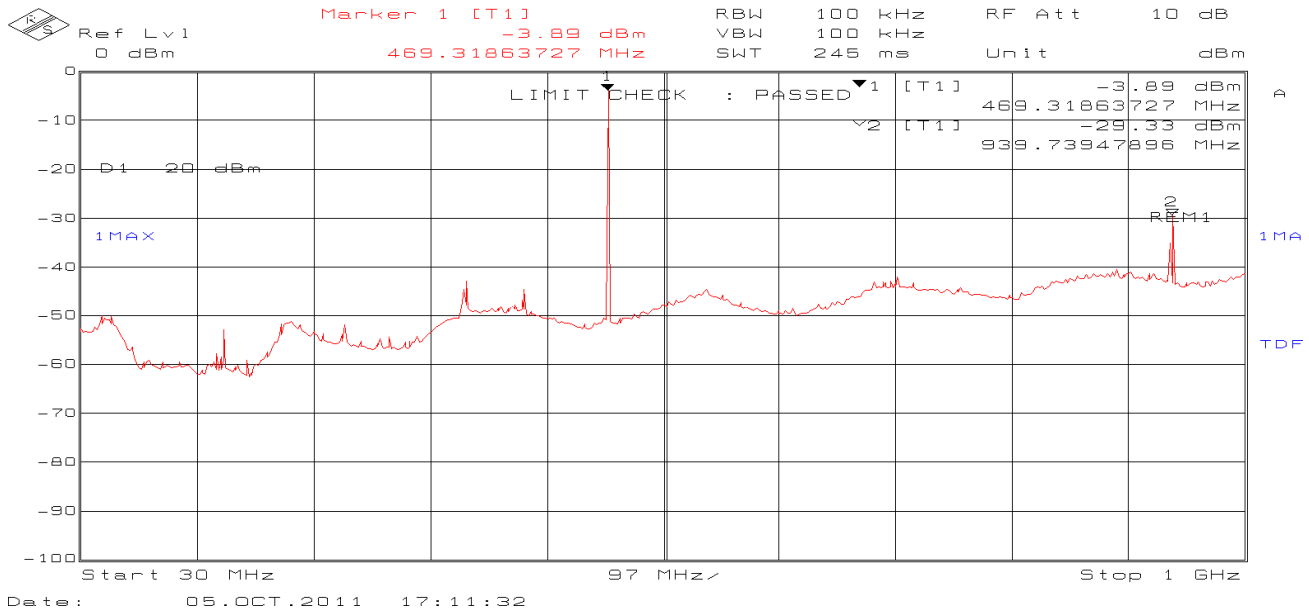
Horizontal polarization, 1000- 5000 MHz, Carrier 429 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1000 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 1288.57715 | -51.1 | 9.7 | -20 | PK | |
| 1713.42685 | -44.3 | 16.6 | -20 | PK | |
| 2146.29259 | -42.6 | 14.3 | -20 | PK | |
| 2571.14228 | -41.6 | 14.3 | -20 | PK | Carrier |
| 3004.00802 | -49.8 | 15.7 | -20 | PK | |
| 3436.87375 | -46.4 | 20.7 | -20 | PK | |
| 3781.56313 | -46.5 | 22.5 | -20 | PK | |
| 4126.25251 | -45.9 | 23.2 | -20 | PK | |
| 4478.95792 | -44.0 | 23.2 | -20 | PK | |
| 4831.66333 | -44.4 | 23.2 | -20 | PK | |
| 4991.98397 | -44.1 | 23.2 | -20 | PK | |

## Test data

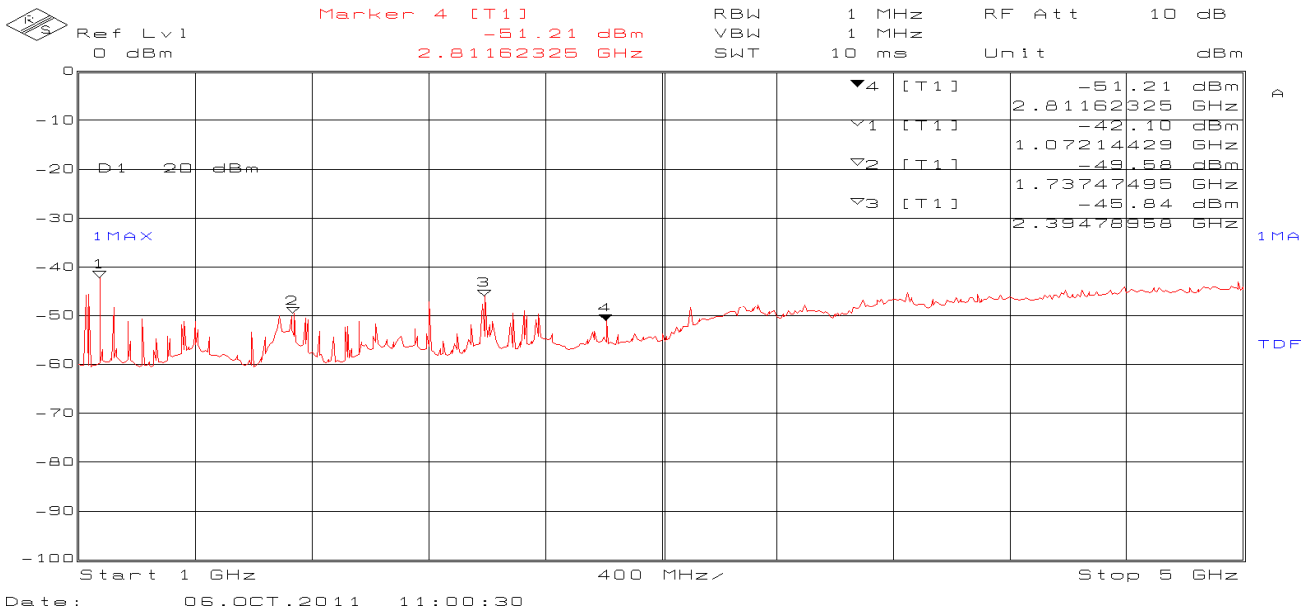
Horizontal polarization, 30-1000 MHz, Carrier 469 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz




| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 47.49499 | -50.2 | 28.3 | -20 | PK | |
| 199.11824 | -50.0 | 23.8 | -20 | PK | |
| 249.65932 | -51.5 | 28.6 | -20 | PK | |
| 350.74148 | -42.8 | 31.0 | -20 | PK | |
| 469.31864 | -3.9 | 28.4 | -20 | PK | Carrier |
| 550.96192 | -44.7 | 34.7 | -20 | PK | |
| 700.64128 | -41.7 | 35.9 | -20 | PK | |
| 733.68737 | -43.1 | 35.9 | -20 | PK | |
| 893.08617 | -40.6 | 36.9 | -20 | PK | |
| 939.73948 | -29.3 | 37.4 | -20 | PK | |

## Test data

Horizontal polarization, 1000-5000 MHz, Carrier 469 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1000 kHz

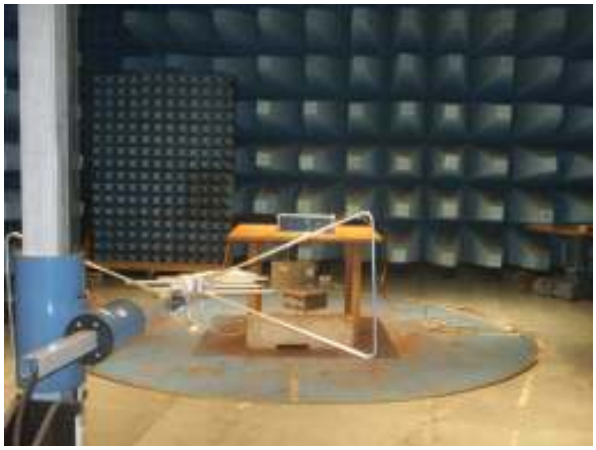


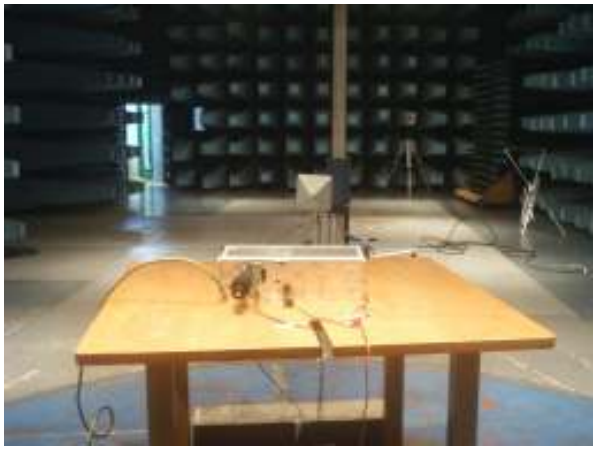

| Frequency | Level measured | Correction factor | Limit | Detector | Remarks |
|---|---|---|---|---|---|
| MHz | dBm erp | dB | dBm erp | | |
| 1072.14429 | -42.1 | 10.2 | -20 | PK | |
| 1737.47495 | -49.6 | 16.6 | -20 | PK | |
| 2202.40481 | -47.1 | 13.7 | -20 | PK | |
| 2394.78958 | -45.8 | 13.3 | -20 | PK | |
| 2811.62325 | -51.2 | 15.2 | -20 | PK | |
| 3332.66533 | -47.9 | 21.6 | -20 | PK | |
| 3693.38677 | -46.9 | 21.2 | -20 | PK | |
| 4126.25251 | -45.4 | 23.2 | -20 | PK | |
| 4390.78156 | -45.0 | 23.2 | -20 | PK | |
| 4927.85571 | -43.7 | 23.2 | -20 | PK | |
| 4983.96794 | -43.1 | 23.2 | -20 | PK | |

## Test method

Measurements were made using the signal substitution method of paragraph 2.2.12 TIA-603-C – December 2004 (Revision of TIA-603-B-2002).

## Set up photo



## Clause 90.213 Frequency stability

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

| Frequency range (MHz) | Fixed and base stations | Mobile stations | |
|---|---|---|---|
| | | Over 2 W output power | 2 W or less output power |
| Below 25 | 100 | 100 | 200 |
| 25–50 | 20 | 20 | 50 |
| 72–76 | (5) 2.5 | – | 50 |
| 150–174 | 5 | 5 | 50 |
| 216–220 | 1.0 | – | 1.0 |
| 220–222 | 0.1 | 1.5 | 1.5 |
| 421–512 | 2.5 | 5 | 5 |
| 806–809 | 1.0 | 1.5 | 1.5 |
| 809–824 | 1.5 | 2.5 | 2.5 |
| 851–854 | 1.0 | 1.5 | 1.5 |
| 854–869 | 1.5 | 2.5 | 2.5 |
| 896–901 | 0.1 | 1.5 | 1.5 |
| 902–928 | 2.5 | 2.5 | 2.5 |
| 929–930 | 1.5 | – | – |
| 935–940 | 0.1 | 1.5 | 1.5 |
| 1427–1435 | 300 | 300 | 300 |
| Above 2450 | – | – | – |

The units are in ppm

Test date: 2011/10/17

Test results: Pass

### Special notes

None

## Clause 90.213 Frequency stability, continued

### Test data, continued

| Conditions | Frequency (MHz) | Offset (ppm) |
|---|---|---|
| +60 °C*, Nominal power | 428.99992986 | -0.16349650 |
| +50 °C, Nominal power | 428.99996994 | -0.07006993 |
| +40 °C, No inal power | 429.00009018 | 0.21020979 |
| +30 ° , ominal pow r | 428.99996994 | -0.07006993 |
| +20 °C, +15 % power | 428.99990982 | -0.21020979 |
| 20 °C, Nominal power 13.5Vdc | 428.99990982 | -0.21020979 |
| +20 °C, -15 % power | 428.99990982 | -0.21020979 |
| +10 °C, Nominal power | 428.99990982 | -0.21020979 |
| 0 °C, Nominal powe | 29.0000250 | 0.05839161 |
| −10 °C, Nominal power | 429.00002505 | 0.05839161 |
| −20 °C, Nominal power | 428.99990982 | -0.21020979 |
| −30 °C*, Nominal power | 428.99996994 | -0.07006993 |

Offset calculation: $\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^6$

* Manufacturer's larger declarations.

OCXO synchronized by GPS.

## Set up photo

## Clause 90.214 Transient frequency behaviour

Transmitters designed to operate in the 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

| Time Intervals | Maximum frequency difference | All equipment | |
|---|---|---|---|
| | | 150 to 174 MHz | 421 to 512 MHz |
| Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels | | | |
| t1 | ±25.0 kHz | 5.0 ms | 10.0 ms |
| t2 | ±12.5 kHz | 20.0 ms | 25.0 ms |
| t3 | ±25.0 kHz | 5.0 ms | 10.0 ms |
| Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels | | | |
| t1 | ±12.5 kHz | 5.0 ms | 10.0 ms |
| t2 | ±6.25 kHz | 20.0 ms | 25.0 ms |
| t3 | ±12.5 kHz | 5.0 ms | 10.0 ms |
| Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels | | | |
| t1 | ±6.25 kHz | 5.0 ms | 10.0 ms |
| t2 | ±3.125 kHz | 20.0 ms | 25.0 ms |
| t3 | ±6.25 kHz | 5.0 ms | 10.0 ms |

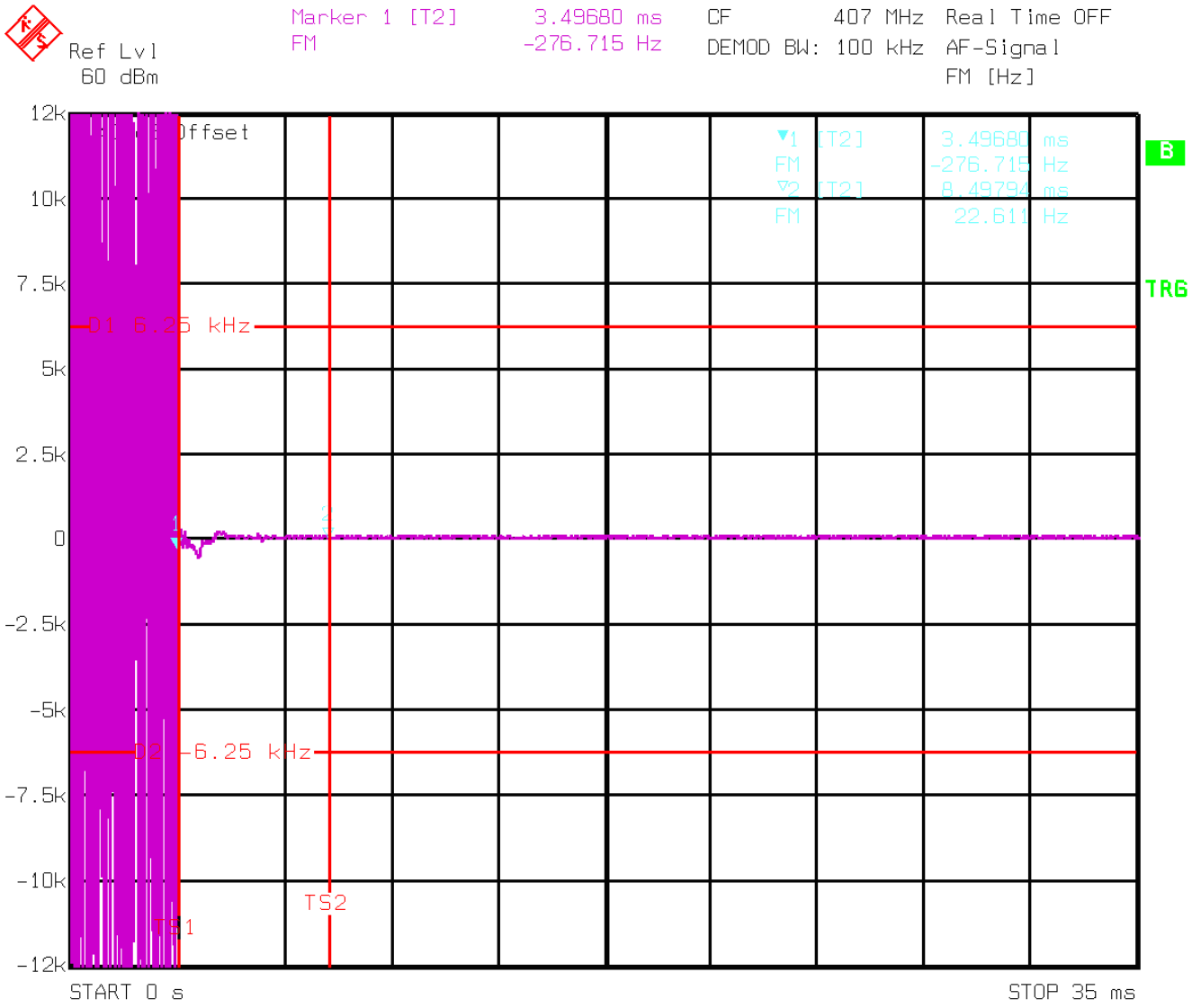
Test date: 2011/10/19

Test results: Pass

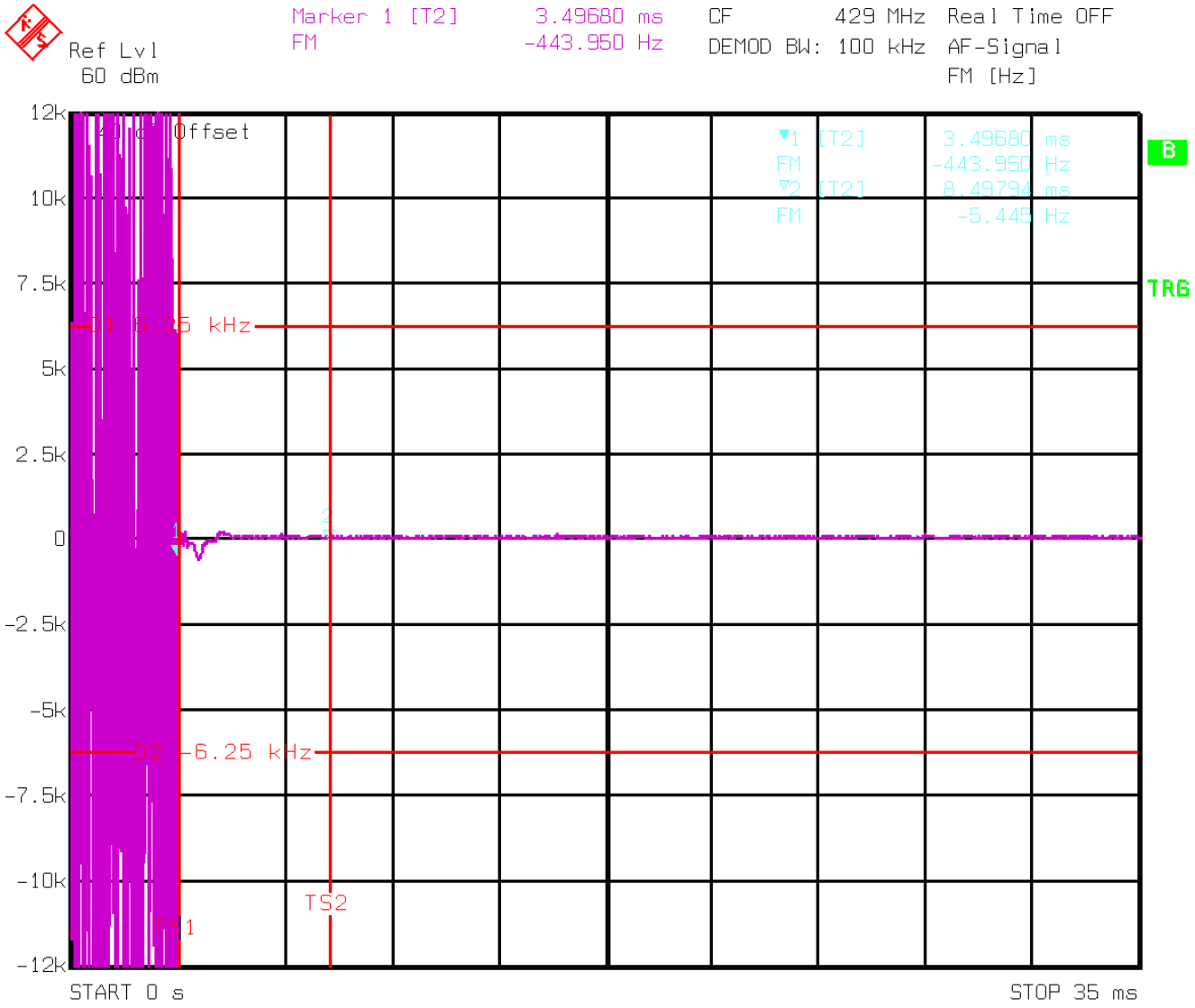
### Special notes

None

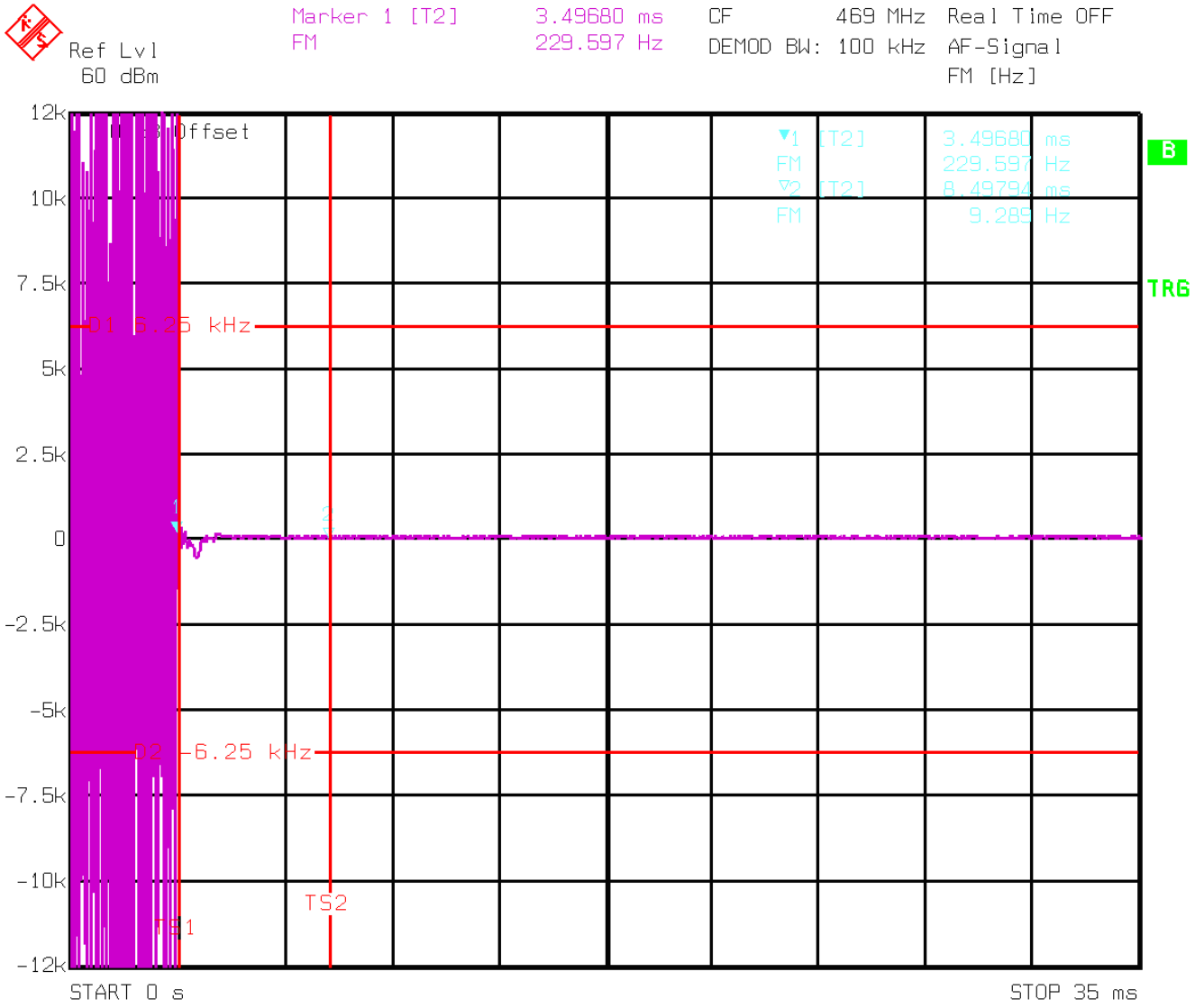
Switch on condition, $t_1$=10 ms, $t_2$=25 ms, 407 MHz, channel separation ± 12.5 kHz



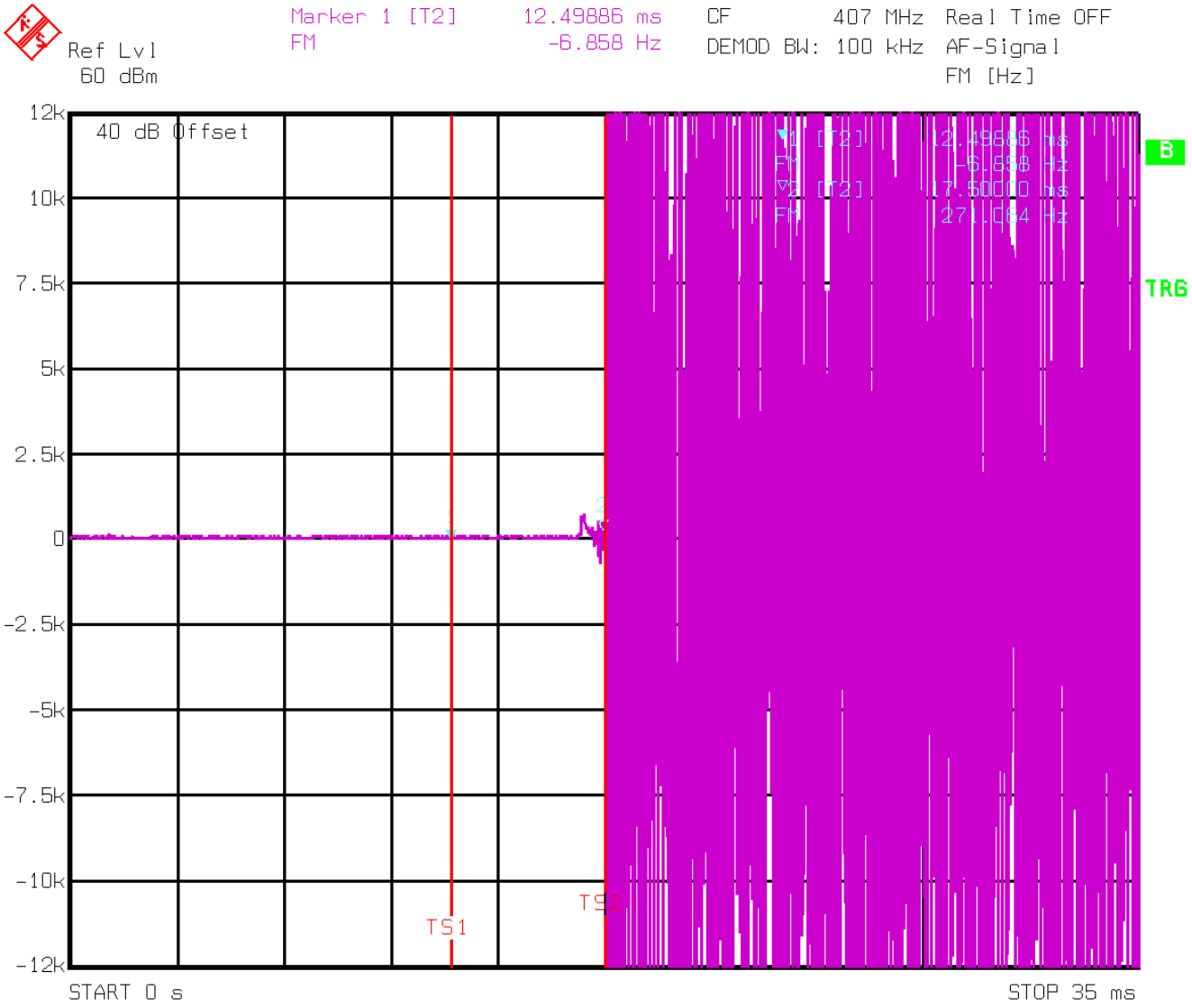
Switch on condition, $t_1$=10 ms, $t_2$=25 ms, 429 MHz, channel separation ± 12.5 kHz



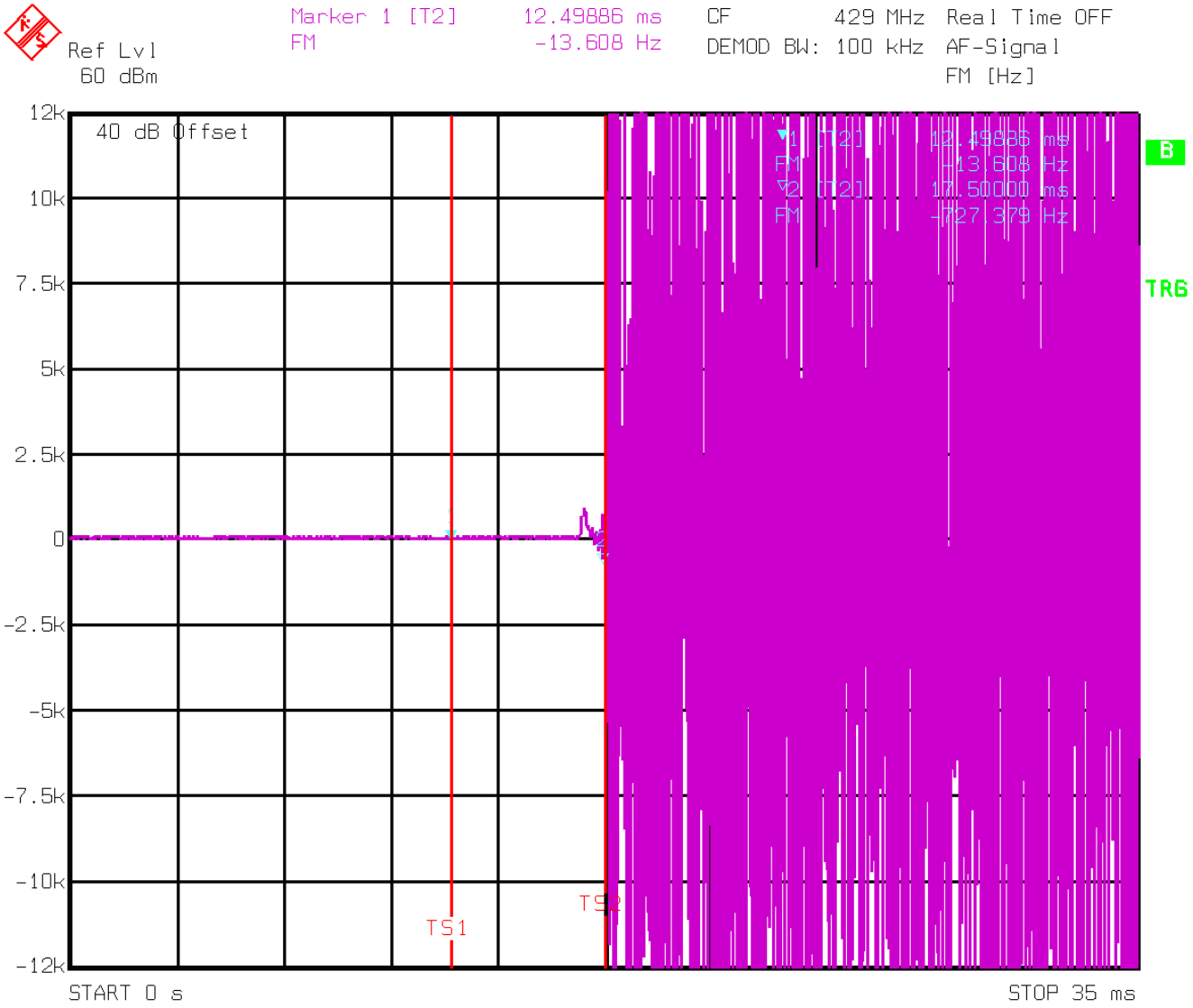
Switch on condition, $t_1$=10 ms, $t_2$=25 ms, 469 MHz, channel separation ± 12.5 kHz



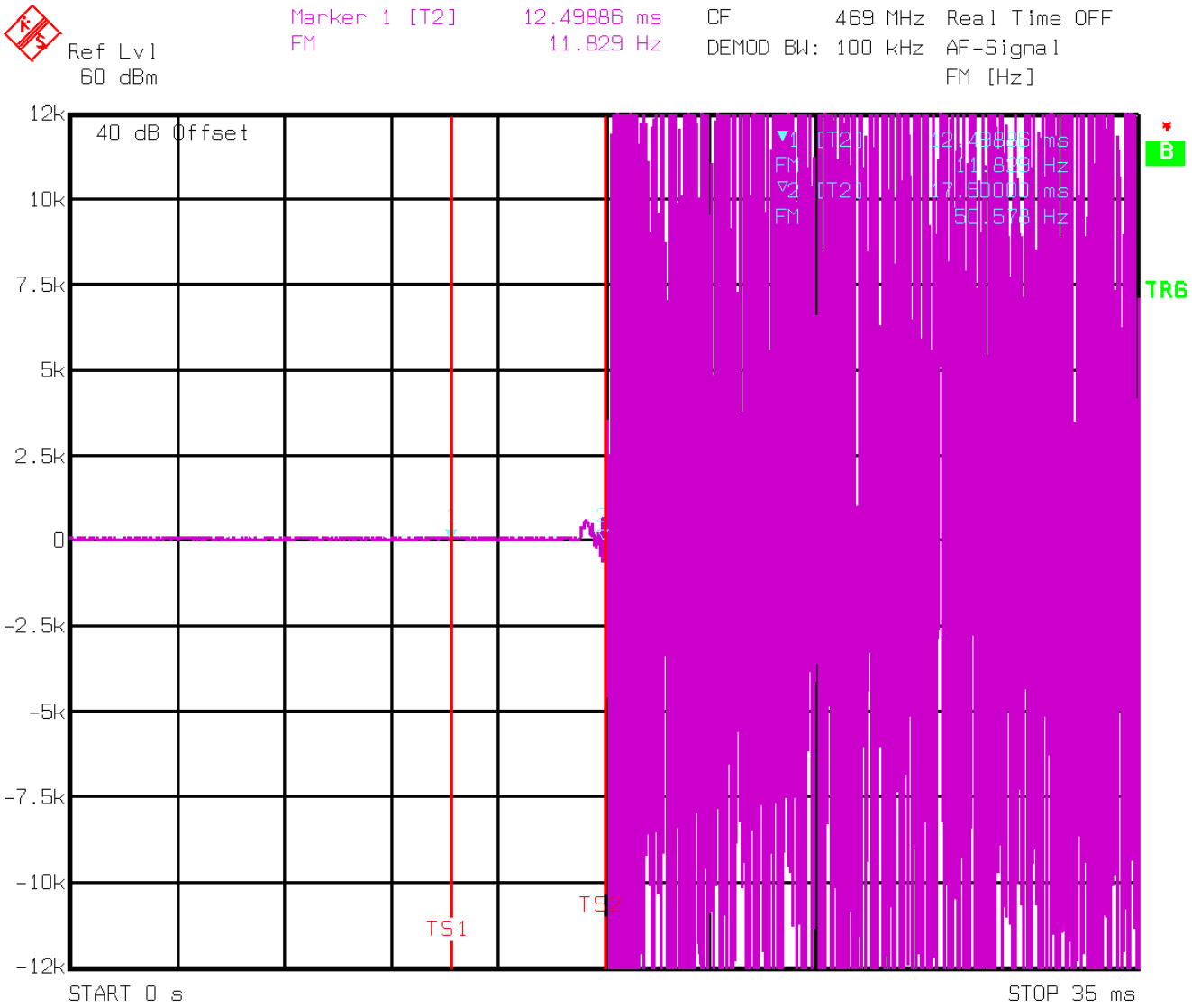
Switch off condition, $t_3$=10 ms, 407 MHz, channel separation ± 12.5 kHz



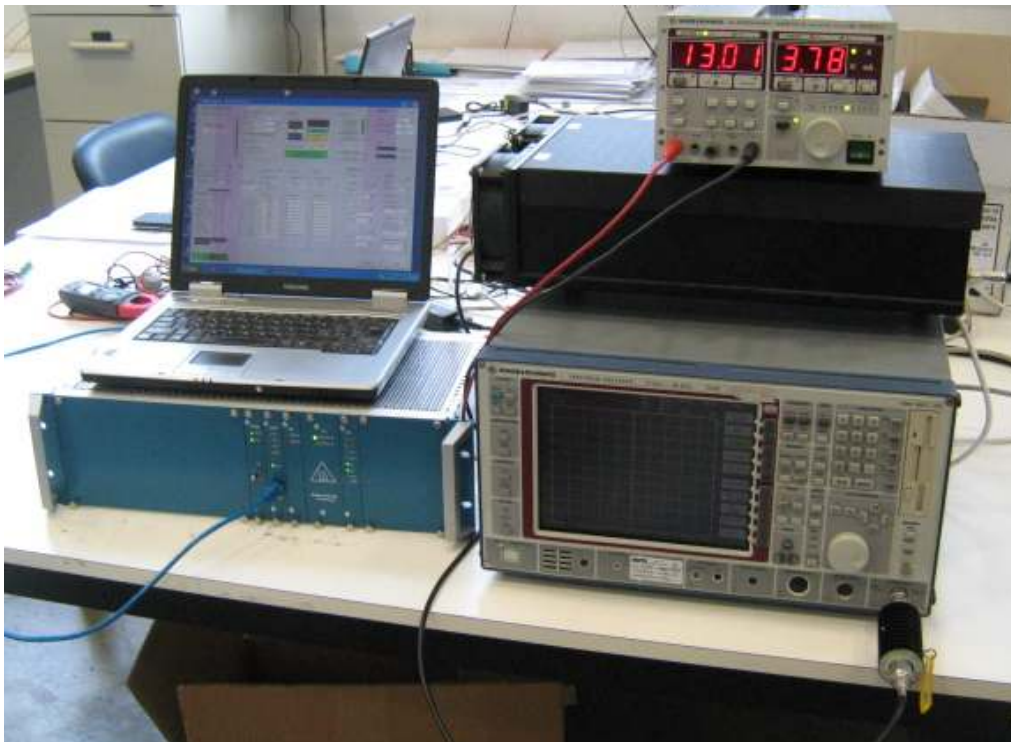
Switch off condition, $t_3$=10 ms, 429 MHz, channel separation ± 12.5 kHz



Switch off condition, $t_3$=10 ms, 469 MHz, channel separation ± 12.5 kHz



## Set up photo



## Clause 90.219 Use of boosters

Licensees authorized to operate radio systems in the frequency bands above 150 MHz may employ signal boosters at fixed locations in accordance with the following criteria:
(a) The amplified signal is retransmitted only on the exact frequency(ies) of the originating base, fixed, mobile, or portable station(s). The booster will fill in only weak signal areas and cannot extend the system's normal signal coverage area.
(b) Class A narrowband signal boosters must be equipped with automatic gain control circuitry which will limit the total effective radiated power (ERP) of the unit to a maximum of 5 W under all conditions. Class B broadband signal boosters are limited to 5 W ERP for each authorized frequency that the booster is designed to amplify.
(c) Class A narrowband boosters must meet the out-of-band emission limits of §90.210 for each narrowband channel that the booster is designed to amplify. Class B broadband signal boosters must meet the emission limits of §90.210 for frequencies outside of the booster's designed passband.
(d) Class B broadband signal boosters are permitted to be used only in confined or indoor areas such as buildings, tunnels, underground areas, etc., or in remote areas, i.e., areas where there is little or no risk of interference to other users.
(e) The licensee is given authority to operate signal boosters without separate authorization from the Commission. Certificated equipment must be employed and the licensee must ensure that all applicable rule requirements are met.
(f) Licensees employing either Class A narrowband or Class B broadband signal boosters as defined in §90.7 are responsible for correcting any harmful interference that the equipment may cause to other systems. Normal co-channel transmissions will not be considered as harmful interference. Licensees will be required to resolve interference problems pursuant to §90.173(b).

Test date: ---

Test results: N

**Special notes**

None

# Appendix B: Block diagrams of test set-ups

## Radiated emissions set-up