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Nemko Italy S.p.A., Via del Carroccio 4, 20046, Biassono, Italy.

Report number:	165591 TRF WL
Apparatus:	RA-160
Applicant:	Radio Activity S.p.A. Via Ponte Nuovo, 8 I – 20128 MILANO
FCC ID:	Y9MRA-160

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: _____ 2011/02/17
Signature Date
P. Barbieri, Wireless/EMC Specialist

Tested by: _____ 2011/02/17
Signature Date
G. Curioni, 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. Via del Carroccio 4, 20046, 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.

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 – VHF base station
Product marketing name:	RA-160
Part number:	--
Serial number:	160RA1561
FCC ID:	Y9MRA-160
Date of receipt:	2011-02-03

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:	R&S NGSM 32/10
Model name or number:	192.0810.31
Serial number:	290
Nemko sample number:	2.62
E.U.T. Connection port:	TX in REPEATER Configuration
Connection port:	DC
DC Cable length and type:	DC power 3 m two wires cable + Axial Ferrite Bead Axial Ferrite Bead: code 742700790 Würth Elektronik.
Connection port:	Ethernet 10/100 Base-T
Ethernet Cable length and type:	1x UTP CAT. 5E Patch Ethernet 3 m cable
Connection port:	Antenna connector type N.

Section 2: Equipment under test, continued

2.3 EUT description

The EUT is VHF fixed Repeater provided of:
- A Transmitter module (TX) including 25 W power amplifier;
- A power supply module (PSM);
- A Vectorial Receiver module (RX);
- A Controller module (DSP);
- A Interface module (I/O);

2.4 Technical specifications of the EUT

Operating frequency:	150÷174 MHz for US market
Modulation type:	FM/PH
Occupied bandwidth:	11 kHz/7.60 kHz
Power at antenna connector	Max. 25 W
Channel spacing	12.5 kHz
Emission designator:	11K0F3E/11K0G3E 7K60FXE/7K60FXD
Synchronization:	VCTCXO not synchronized by GPS
Working modality:	Duplex
1st RX Local oscillator:	45 MHz higher
Antenna type:	External Antenna (not provided)
Temperature range:	-25 to 55℃
Frequency stability:	0.5 ppm
Power source	External 13.8 Vdc, (10.8 ÷ 15.8 Vdc)

Emission Designators:

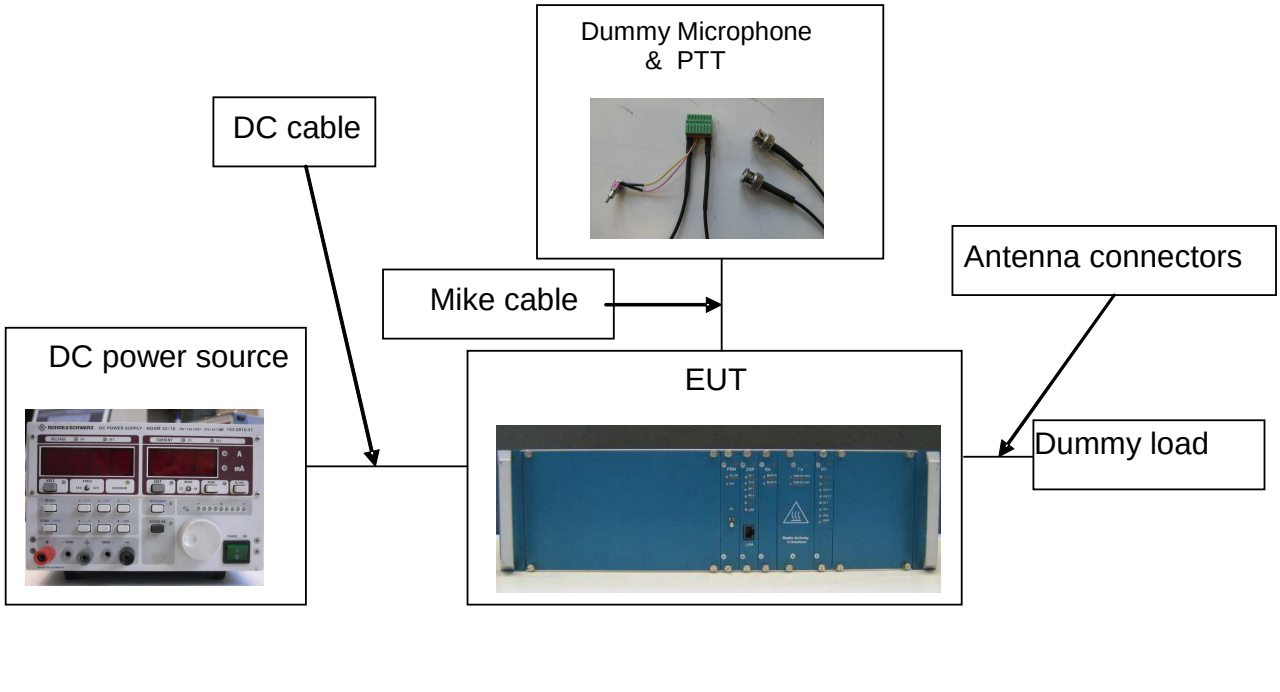
According to e-CFR 2.202 bandwidths and using the following formula for digital modulations:
Multilevel Frequency Shift Keying: $Bn=(R/\log_2 S) + 2DK$

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 ℃ Relative humidity: 20–75 % Air pressure: 860–1060 hPa 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	2011/08
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202	2011/08
EMI receiver 20 Hz ÷ 3 GHz	R&S	ESCI	100888	2011/08
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	2011/08
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	2011/08
Shielded room	Siemens	10m control room	1947	NCR
Attenuator	Aeroflex/Weinschel	24-20-34	CA0248	2011/03
Attenuator	Aeroflex/Weinschel	24-10-34	0124BZ2456	2011/03
Attenuator	BIRD Electronic Corpo.	1500-WA-FFN-30	1032019	2011/03
Attenuator	Weinschel	83-30-11	450	2011/05
Attenuator	Weinschel	33-10-34	AP8906	2011/05
Dummy load	Celwave	ALO30A	--	NCR
Notch Filter	Nemko	400-500	2.437	NCR
Power meter	R&S	NRVD	833 697/027	2011/03
Thermal Power Sensor	R&S	NRV-Z55	100301	2011/11
Radiocommunication Tester	R&S	CMT	883152/001	2011/08
Thermic chamber	ESPEC	ARS 1100	4100000067	2011/11
Frequencymeter	Anritzu	MF2414A	MT07571	2011/05
Frequencymeter Rubidium osc. + GPS system	Fluke	910R	985602	2011/12
DC Power supply	R&S	NGSM 32/10	192.0810.31	NCR

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: 2011/02/08

Test results: Pass

Test data

– Power supply used. 13 Vdc (20℃)

Frequency [MHz]	Measured Output power [W]	Manufacturer's Rated Power [W]	LIMIT [W] (Manufacturer's rated Power + 20%)
150	24.0	25	30
162	24.5	25	30
174	24.5	25	30

Test data

– Power supply used. 15 Vdc (20℃)

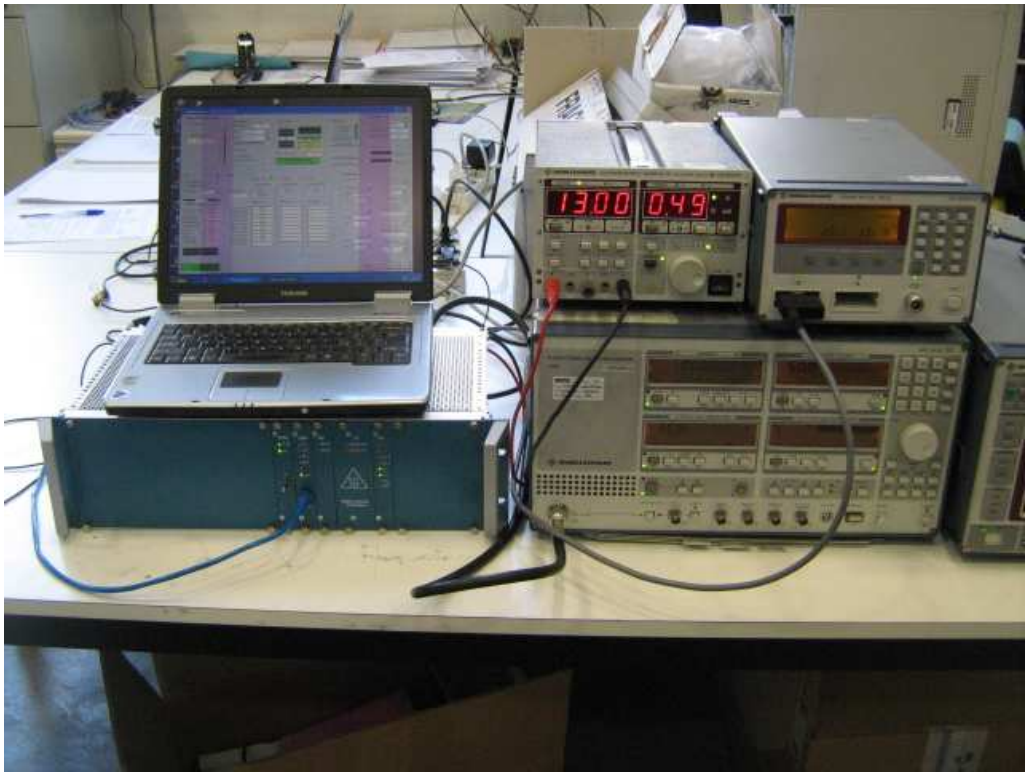
Frequency [MHz]	Measured Output power [W]	Manufacturer's Rated Power [W]	LIMIT [W] (Manufacturer's rated Power + 20%)
150	24.5	25	30
162	24.5	25	30
174	24.5	25	30

Test data

– Power supply used. 11 Vdc (20℃)

Frequency [MHz]	Measured Output power [W]	Manufacturer's Rated Power [W]	LIMIT [W] (Manufacturer's rated Power + 20%)
150	14.8	25	30
162	17.4	25	30
174	21.4	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.

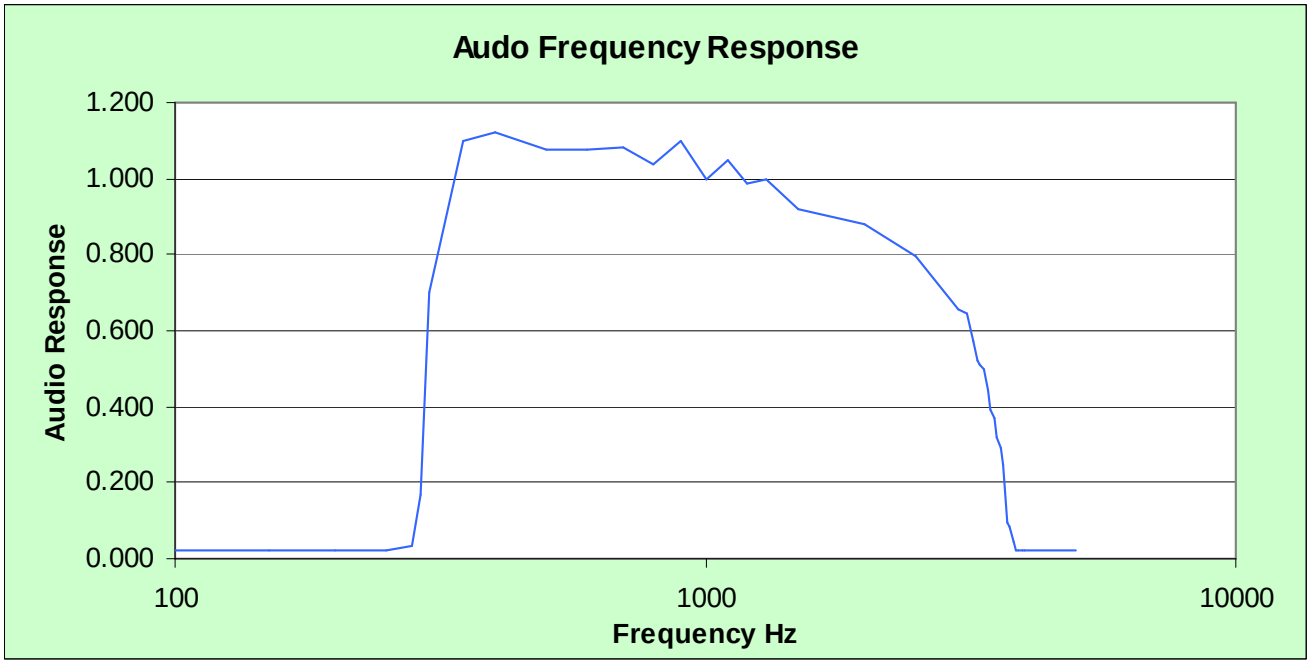
(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified 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: 2011/02/08

Test results: Pass

Test data

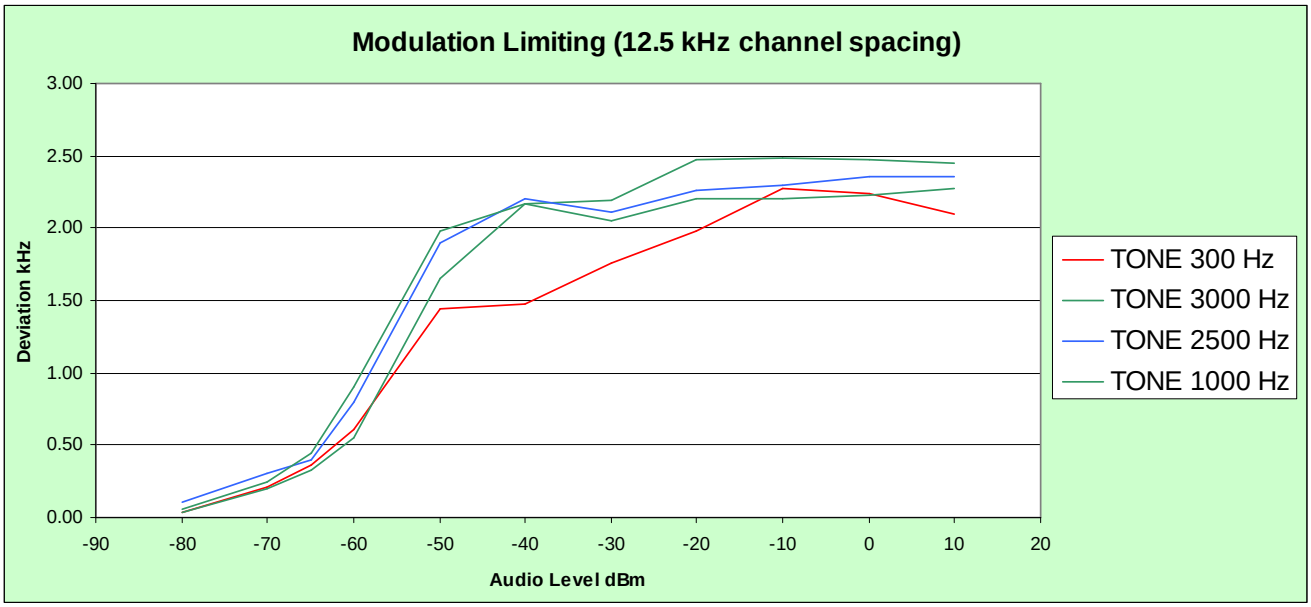


12.5 kHz channel spacing

Test data

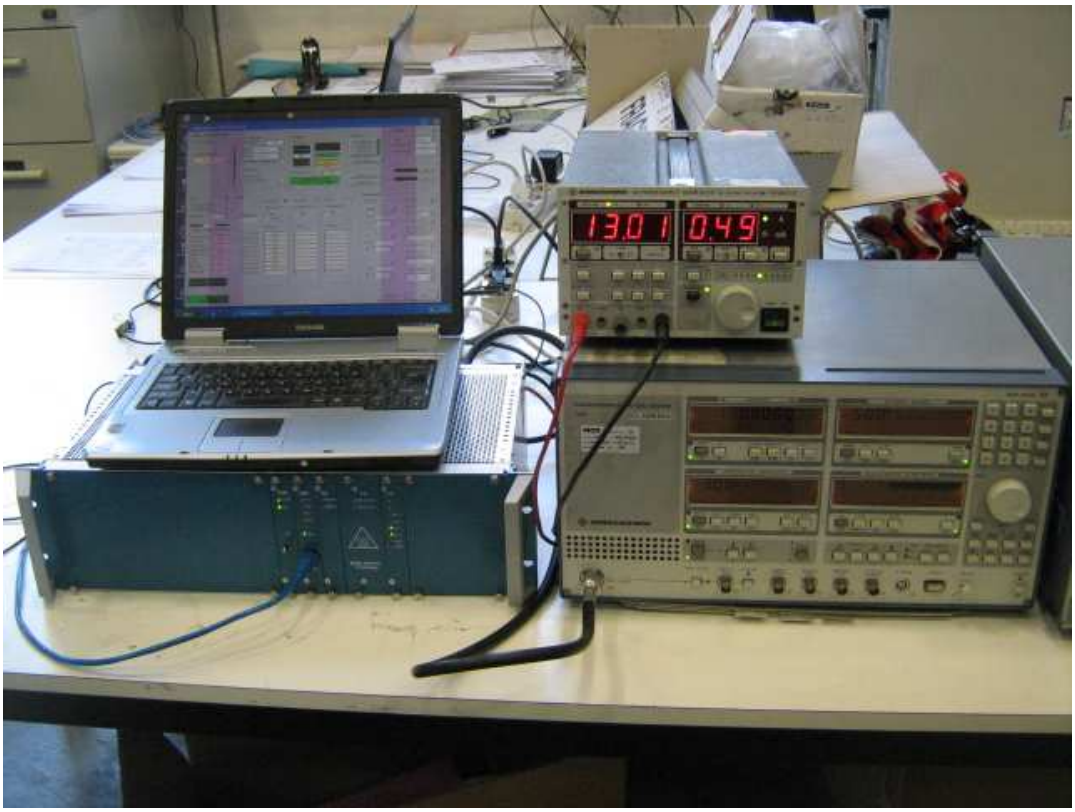
12.5 kHz channel spacing		
Modulation	**Deviation**	**Audio**
Hz	**dB**	**response**
100	-33.2	0.022
150	-34.0	0.020
200	-33.2	0.022
250	-34.0	0.020
280	-28.9	0.036
290	-15.6	0.166
300	-3.1	0.700
350	0.8	1.100
400	1.0	1.119
500	0.7	1.079
600	0.6	1.074
700	0.7	1.080
800	0.3	1.040
900	0.8	1.100
1000	0.0	1.000
1100	0.4	1.046
1200	-0.1	0.989
1300	0.0	0.997
1500	-0.7	0.918
2000	-1.1	0.878
2500	-2.0	0.794
3000	-3.6	0.658
3100	-3.8	0.646
3200	-4.8	0.574
3250	-5.6	0.524
3300	-5.9	0.510
3350	-6.1	0.498
3400	-7.1	0.444
3450	-8.2	0.390
3500	-8.6	0.372
3550	-9.9	0.320
3600	-10.8	0.290
3650	-12.3	0.244
3700	-20.4	0.096
3750	-21.5	0.084
3800	-27.1	0.044
3850	-32.3	0.024
3900	-33.2	0.022
3950	-33.2	0.022
4000	-34.0	0.020
5000	-34.0	0.020

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	0.04	0.06	0.10	0.04
-70	0.21	0.25	0.30	0.20
-65	0.36	0.44	0.40	0.33
-60	0.61	0.90	0.80	0.55
-50	1.44	1.98	1.90	1.65
-40	1.48	2.17	2.20	2.17
-30	1.76	2.05	2.11	2.19
-20	1.98	2.20	2.26	2.47
-10	2.27	2.20	2.30	2.48
0	2.24	2.23	2.36	2.47
10	2.10	2.27	2.35	2.45

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

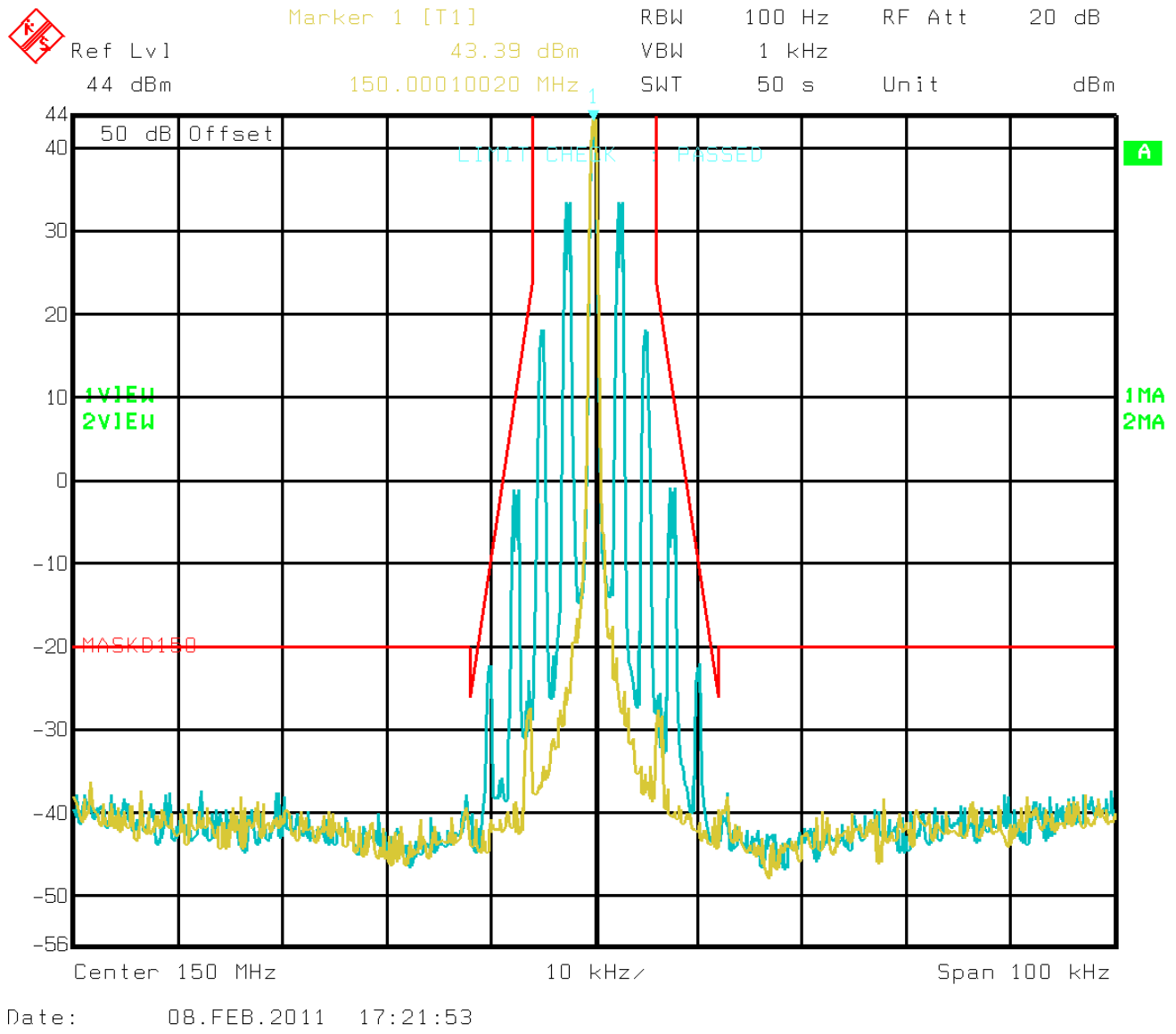
Frequency Band (MHz)	Channel Spacing (kHz)	Authorized Bandwidth (kHz)
Below 25	–	–
25–50	20	20
72–76	20	20
150–174	7.5	20/11.25/6
216–220	6.25	20/11.25/6
220–222	5	4
406–512	6.25	20/11.25/6
806–809/851–854	12.5	20
809–824/854–869	25	20
896–901/935–940	12.5	13.6
902–928	–	–
929–930	25	20
1427–1432	12.5	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: 2011/02/08- 09

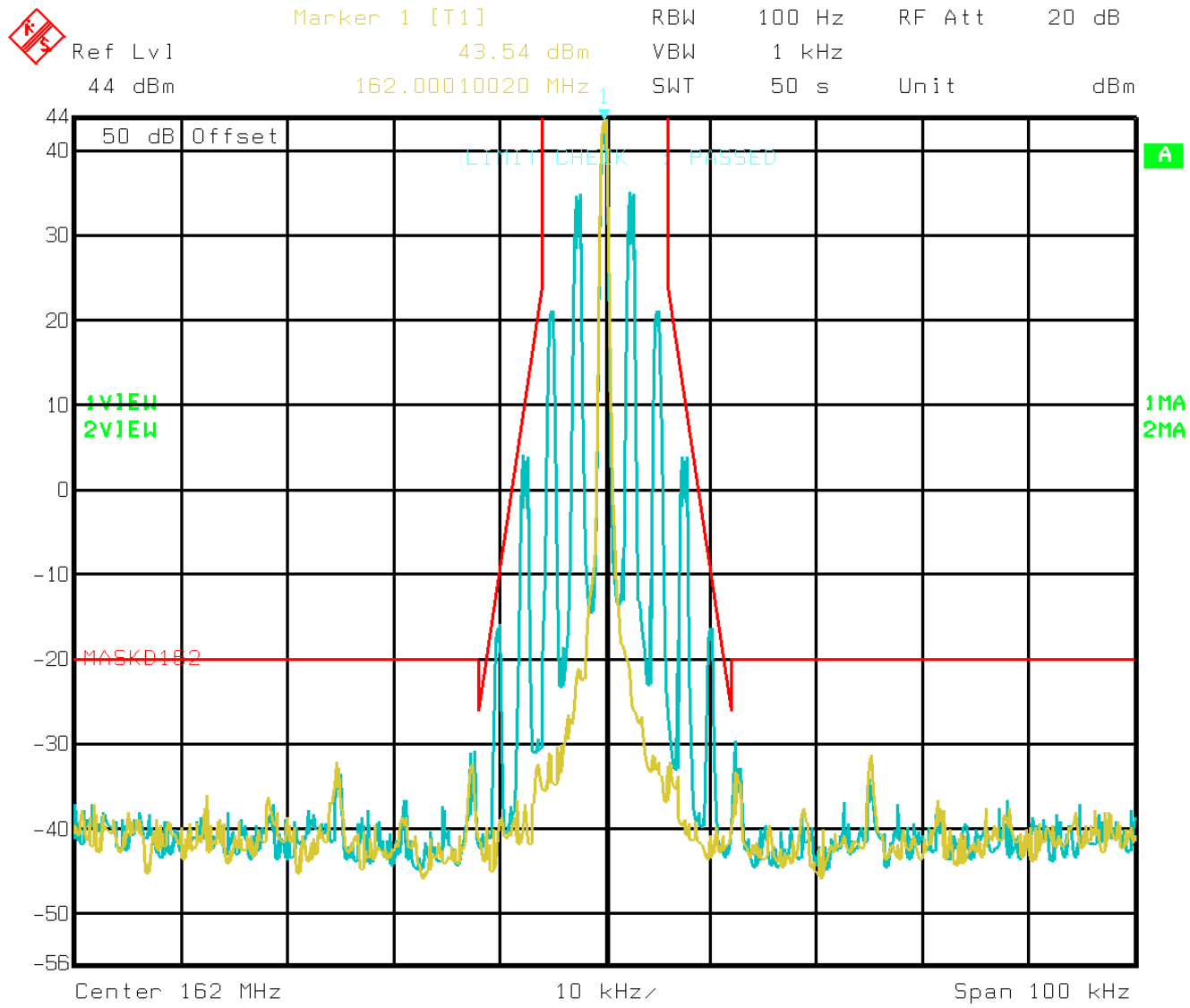
Test results: Pass

Test data



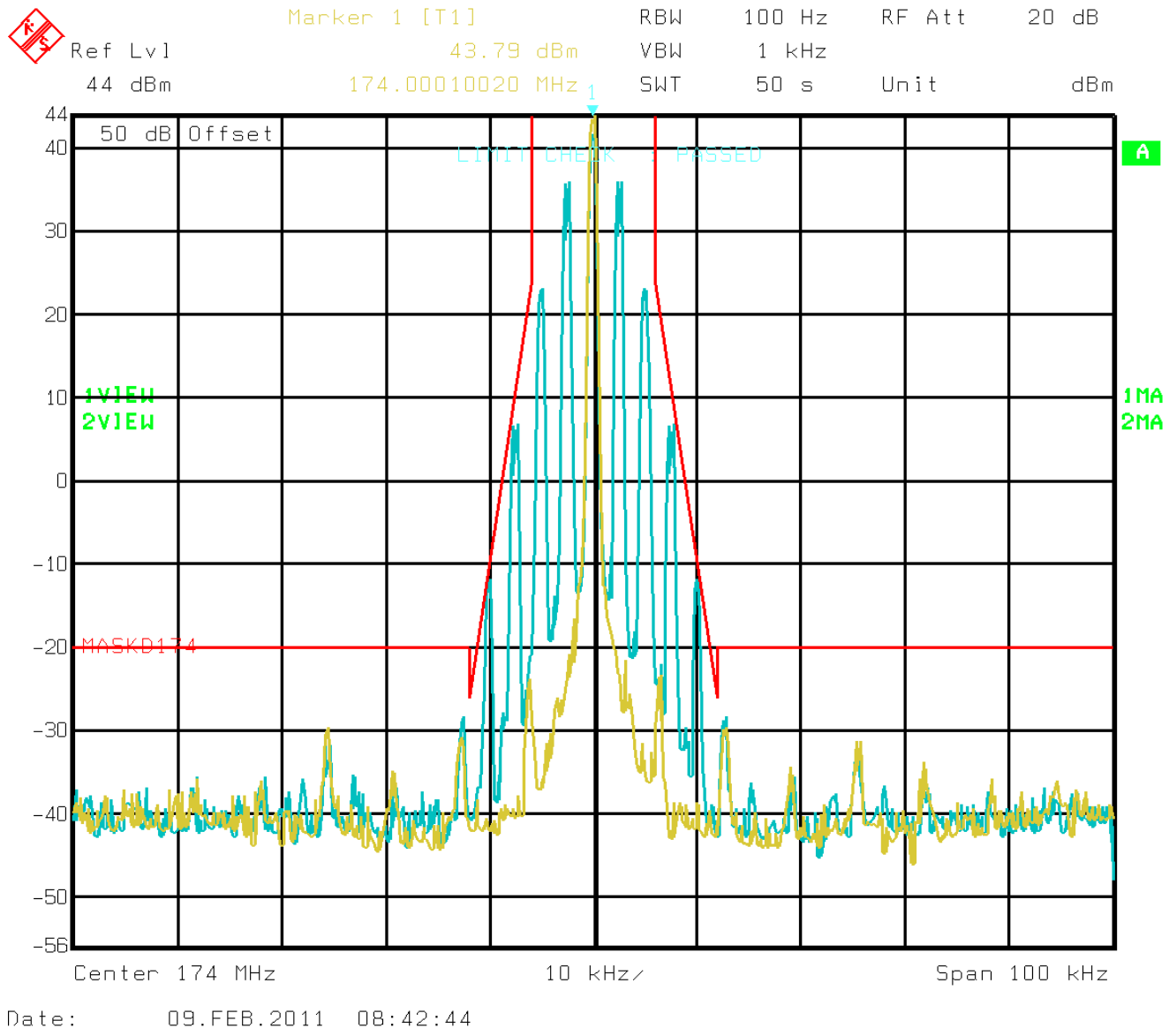
150 MHz, 25 W, 12.5 kHz, 2500 Hz Tone 16 dB above 50% Deviation

Test data

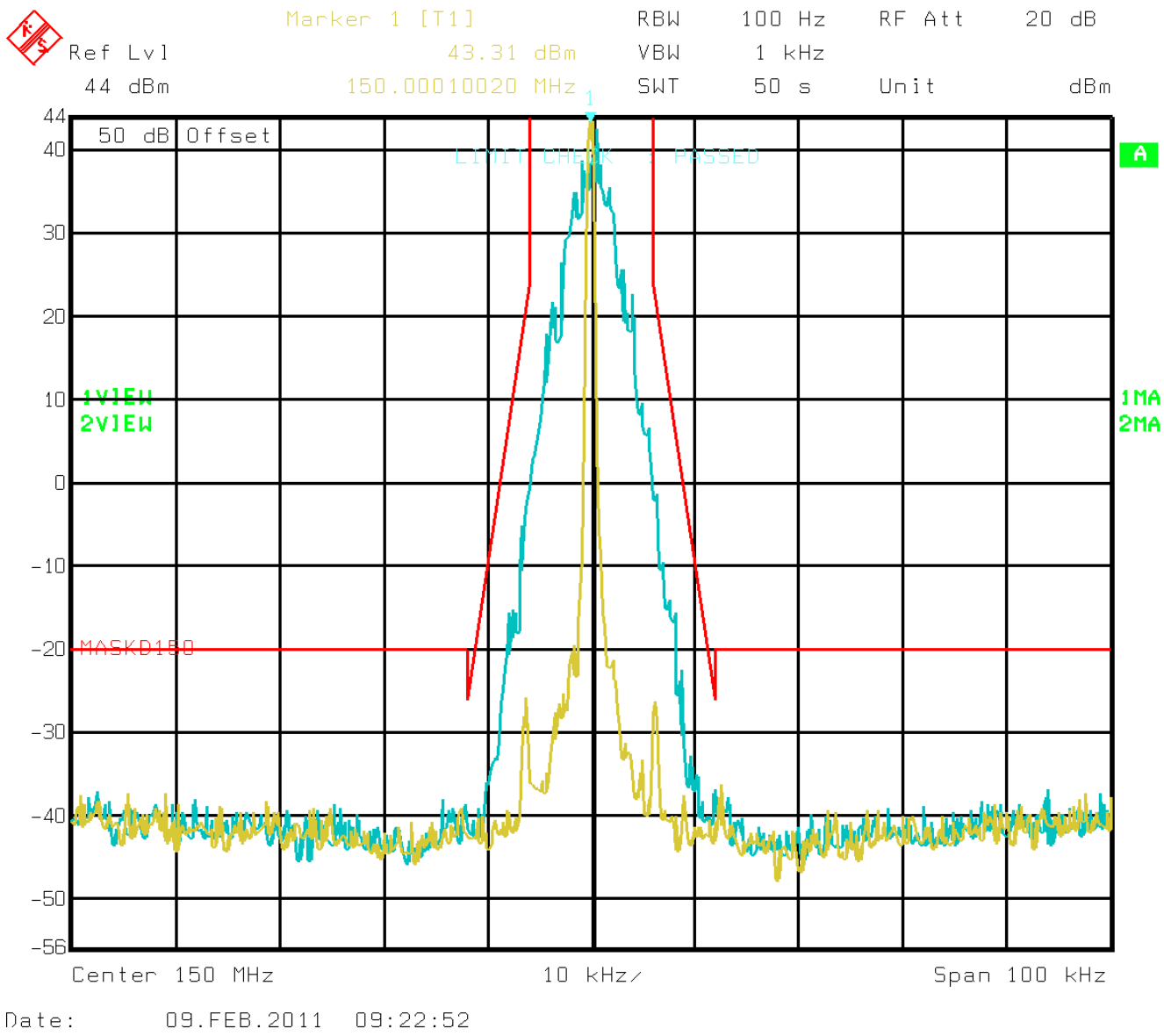


162 MHz, 25 W, 12.5 kHz, 2500 Hz Tone 16 dB above 50% Deviation

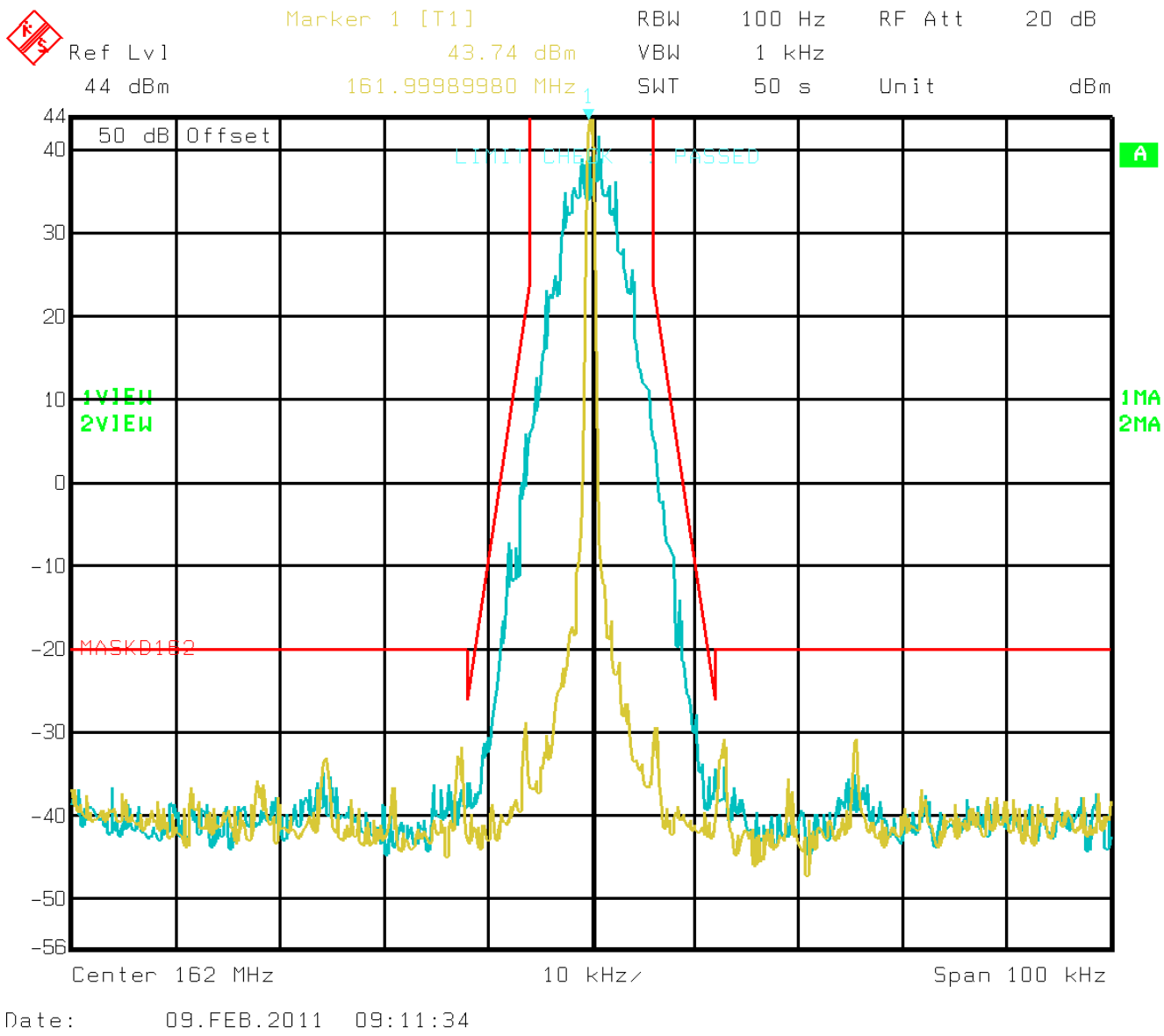
Test data



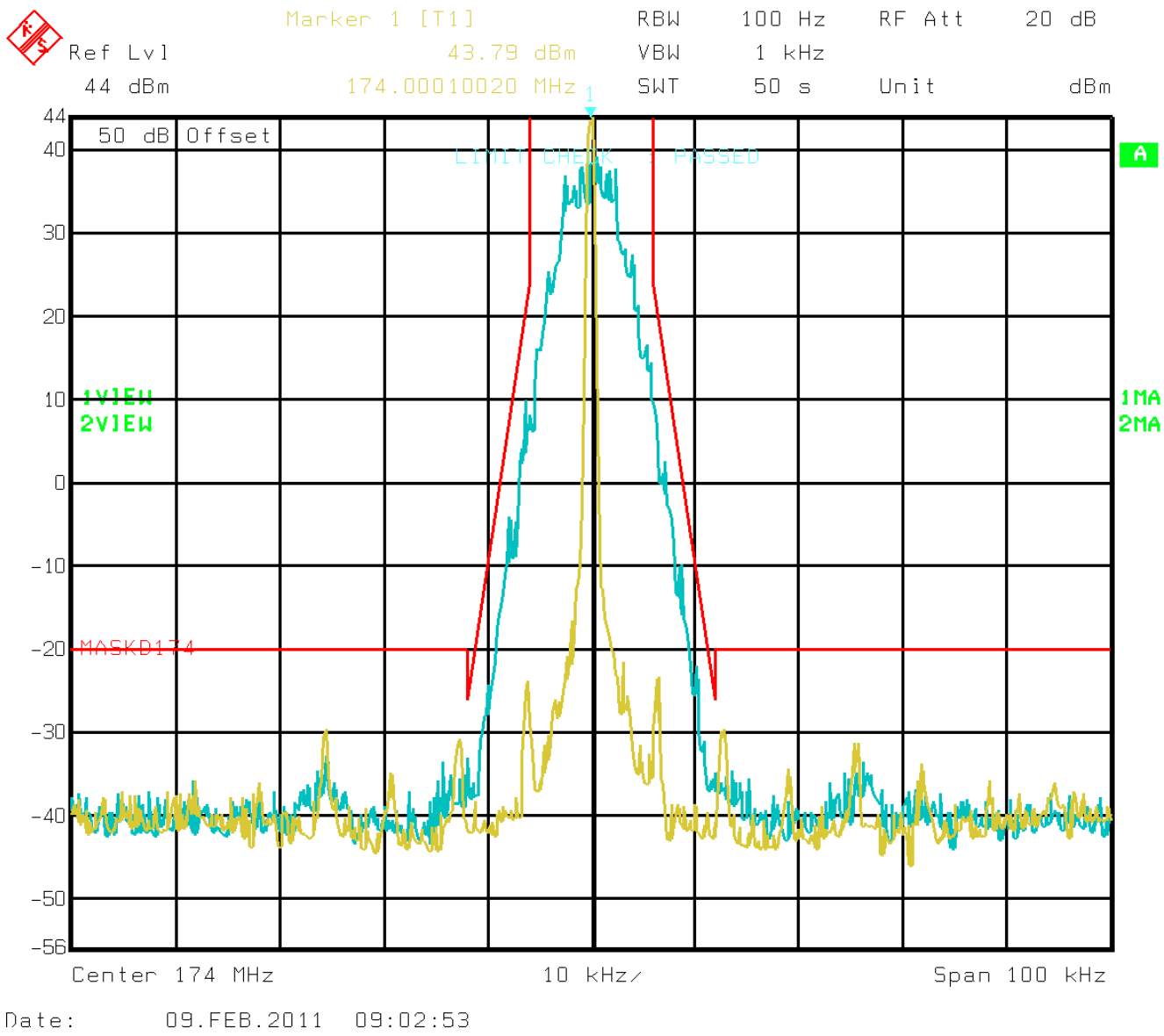
174 MHz, 25 W, 12.5 kHz, 2500 Hz Tone 16 dB above 50% Deviation



150 MHz, 25 W, 12.5 kHz, 4FSK

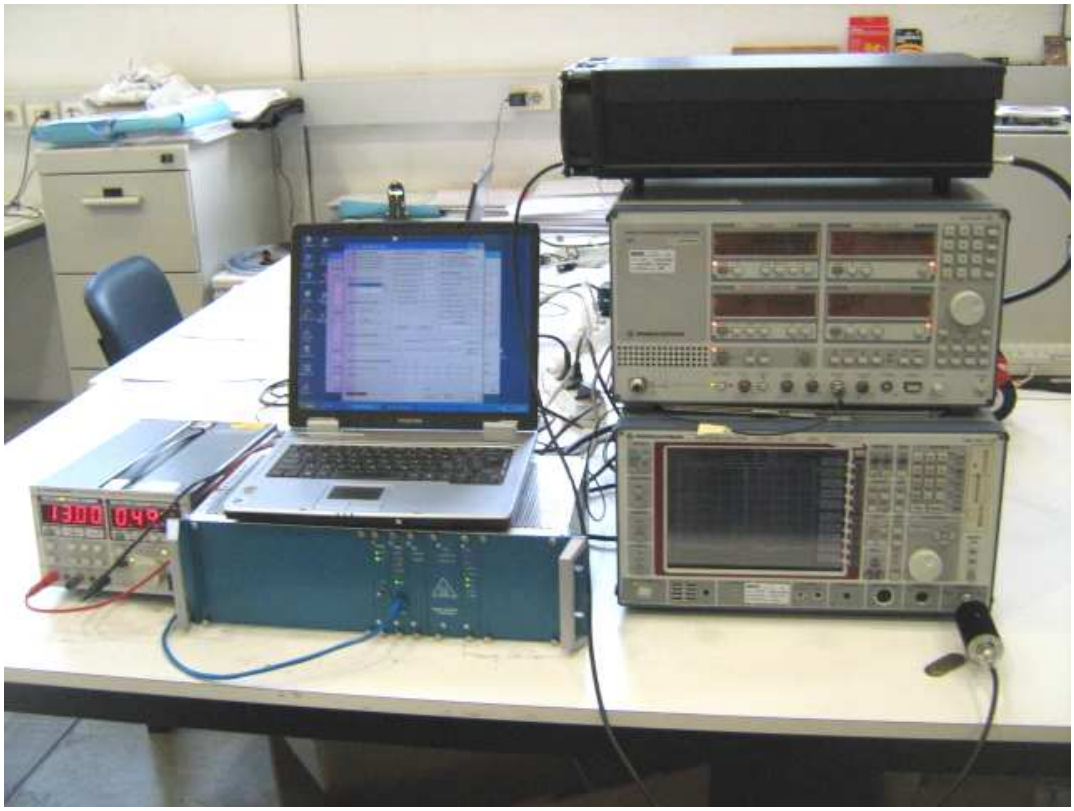


162 MHz, 25 W, 12.5 kHz, 4FSK



174 MHz, 25 W, 12.5 kHz, 4FSK

Set up photo



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: 2011/02/09

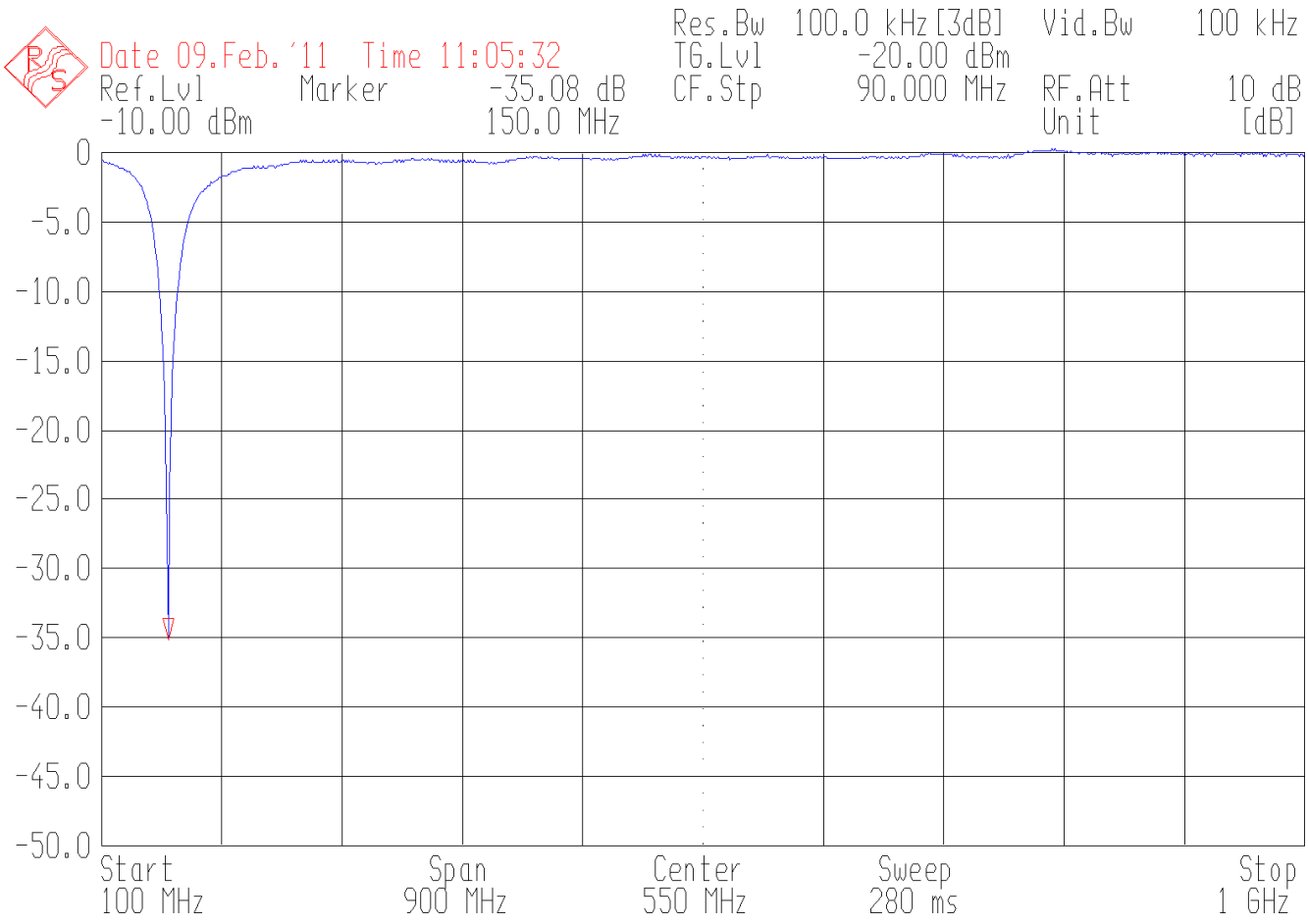
Test results: Pass

Special notes

Tunable RF NOTCH FILTER Was USED from 30 to 1000 MHz.

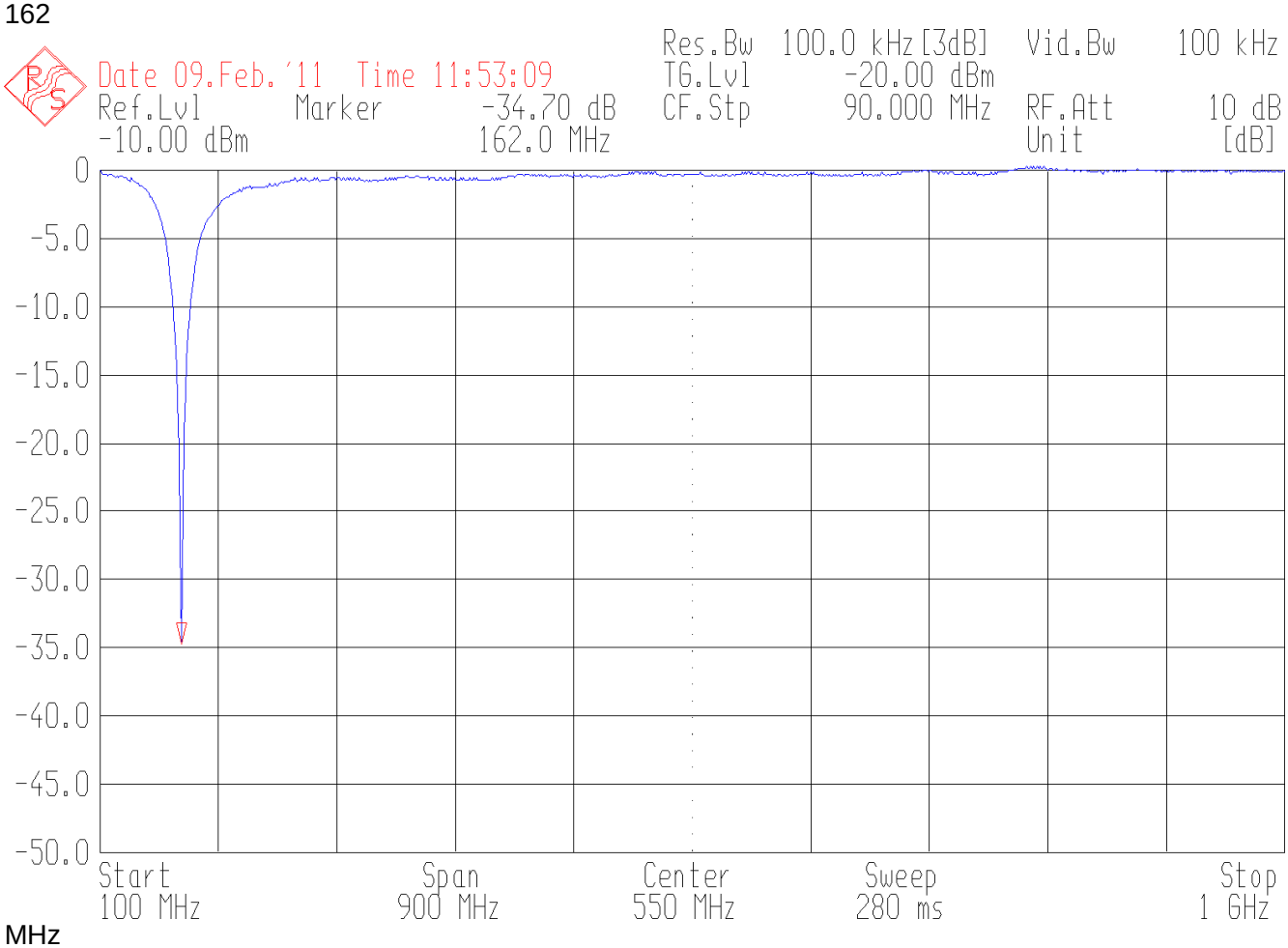
The following set-up was prepared getting a cascade connection from TX antenna connector to spectrum analyzer, in this way:

TX antenna connector, 30 dB through attenuator, tuned RF notch filter, spectrum analyzer

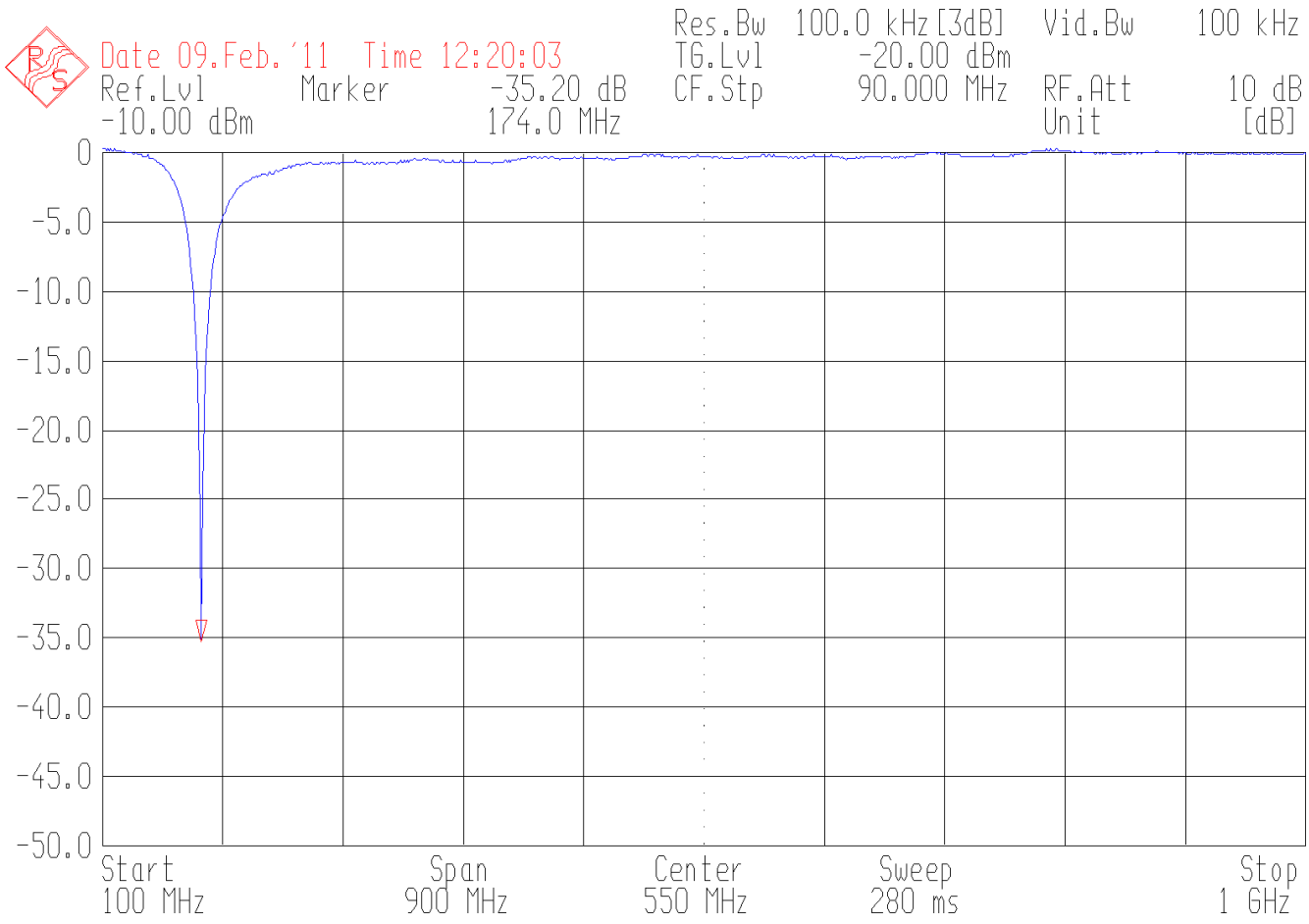


Notch Filter tuned on 150 MHz

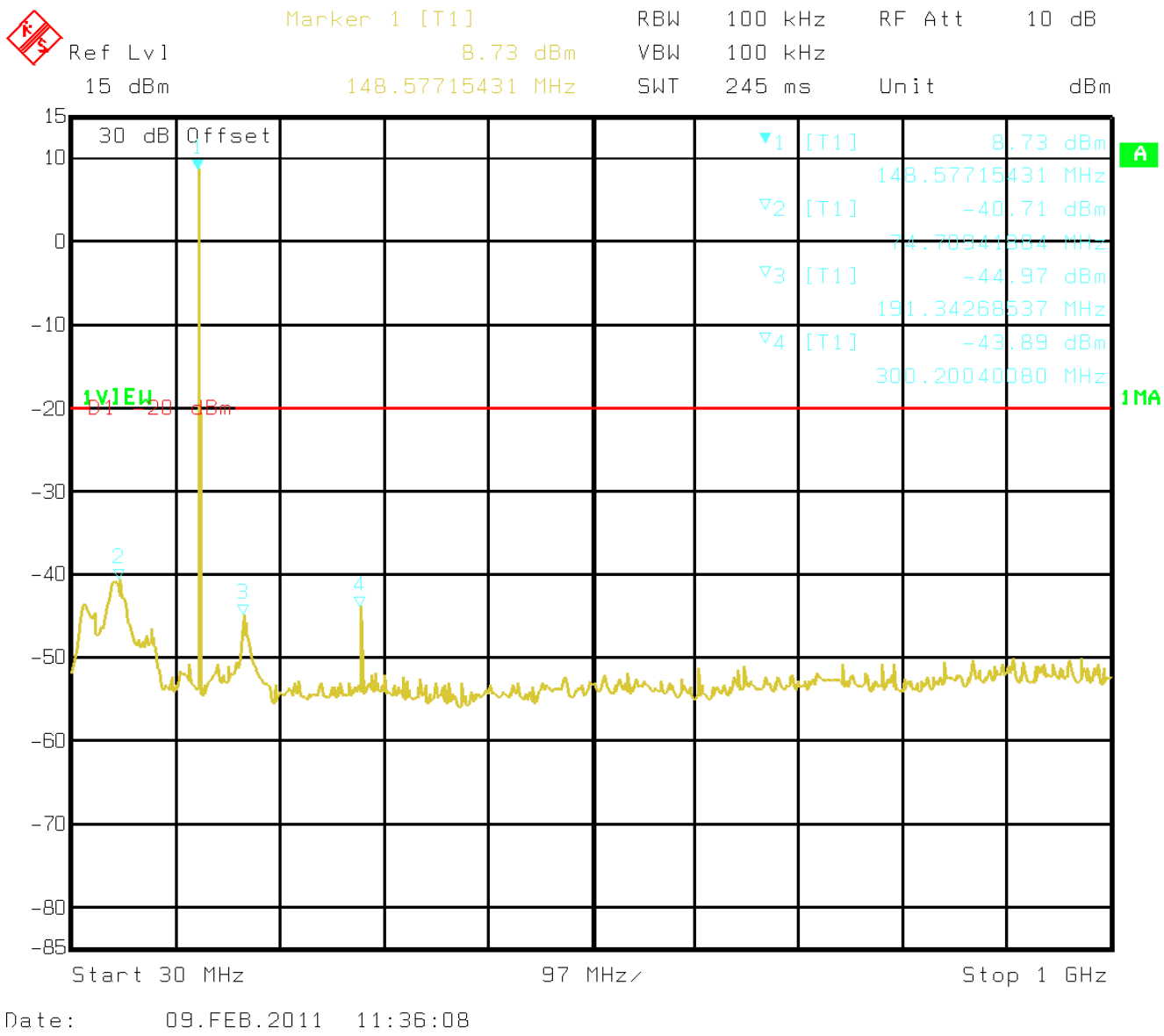
Notch Filter tuned on
162



MHz

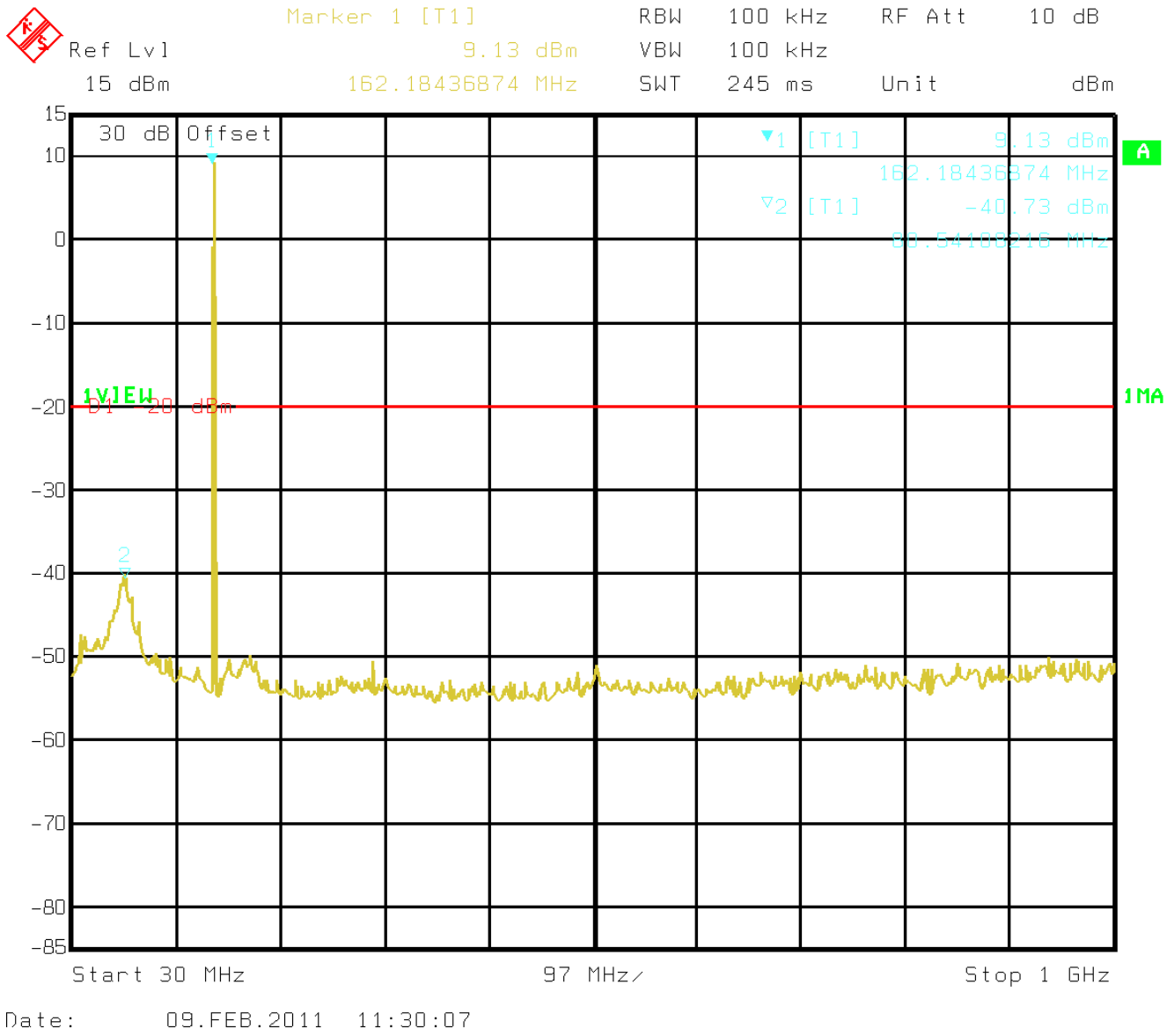


Notch Filter tuned on 174 MHz



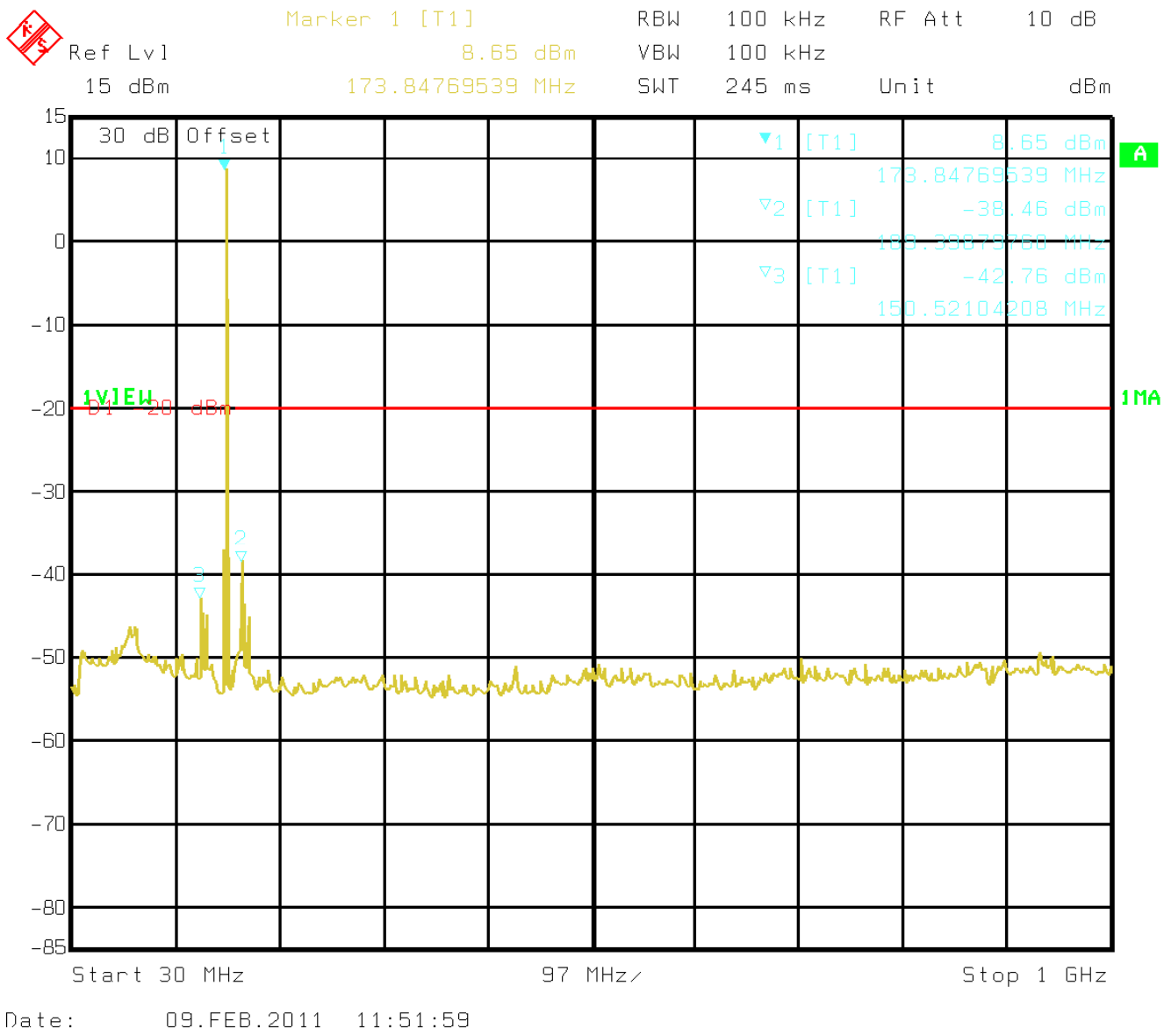
150 MHz, 25 W, 12.5 kHz,

Carrier level (marker 1) 8.73 dBm (30 dB through attenuator included)+ (tuned notch attenuation) 35.08 dB = 43.81 dBm (true carrier)



162 MHz, 25 W, 12.5 kHz

Carrier level (marker 1) 9.13 dBm (30 dB through attenuator included)+ (tuned notch attenuation) 34.70 dB = 43.83 dBm (true carrier)



174 MHz, 25 W, 12.5 kHz,

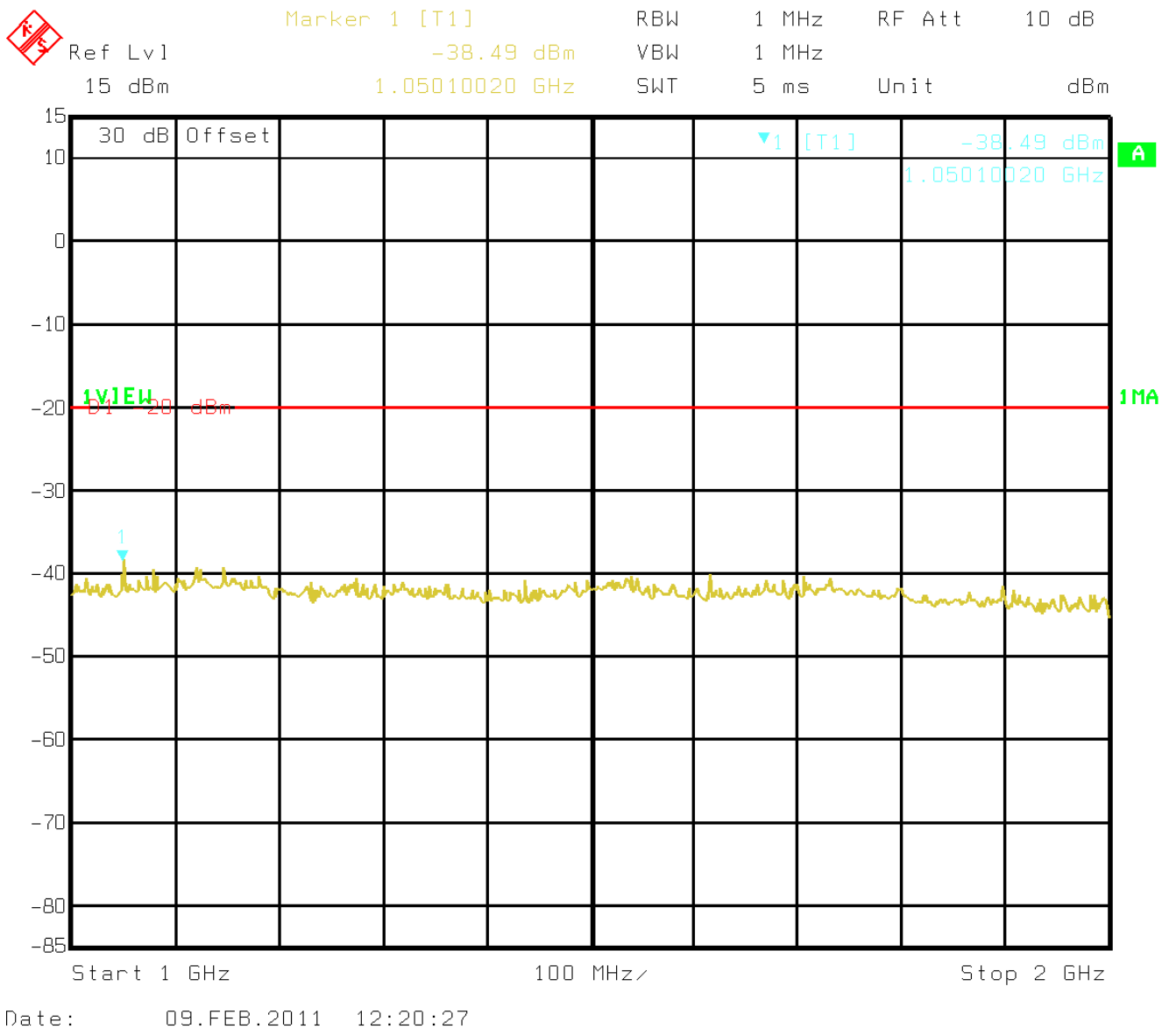
Carrier level (marker 1) 8.65 dBm (30 dB through attenuator included)+ (tuned notch attenuation) 35.20 dB = 43.85 dBm (true carrier)

Special notes

NO Tunable RF NOTCH FILTER Was USED to scan 1000 to 2000 MHz

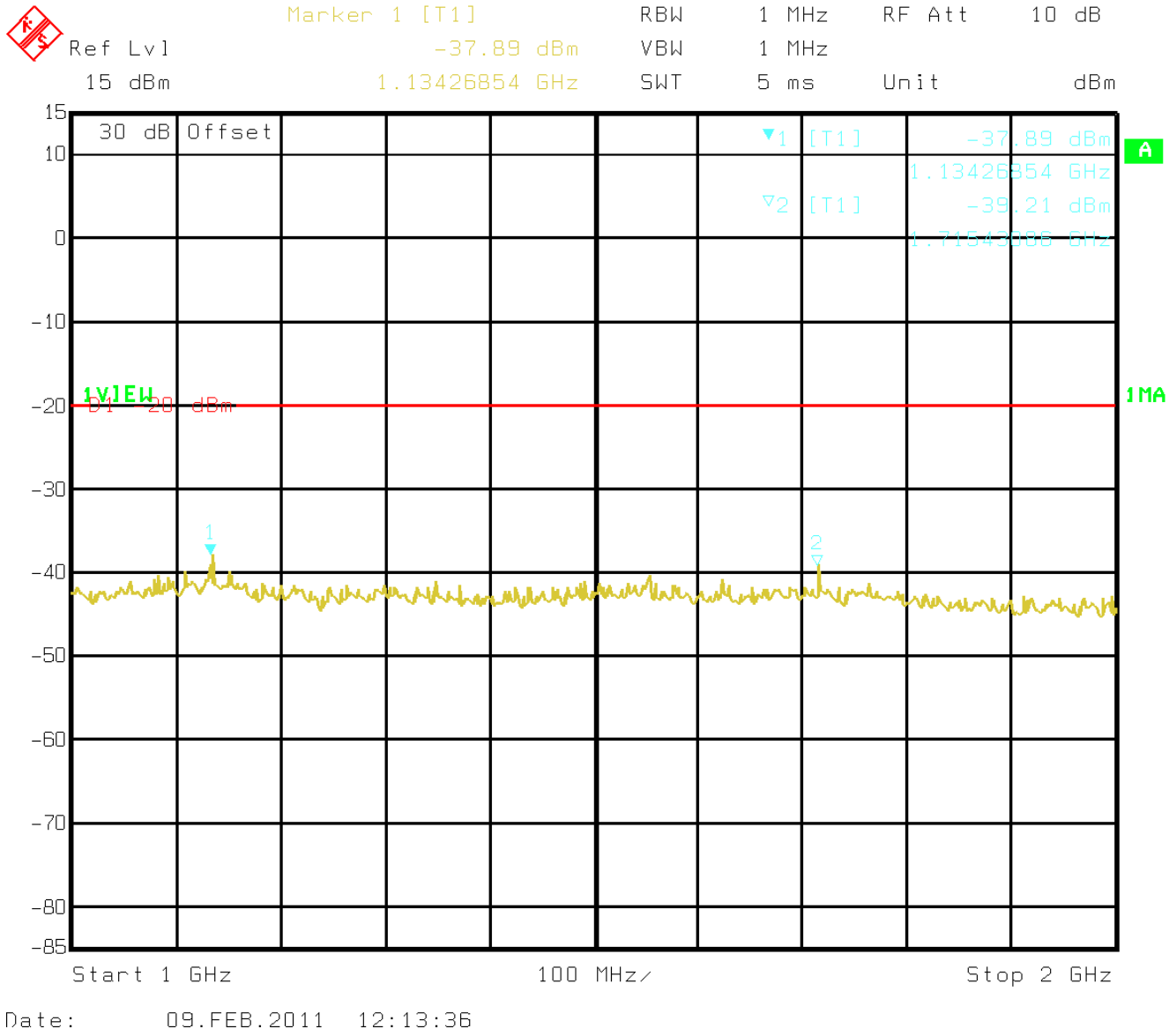
The following set-up was prepared getting a cascade connection from TX antenna connector to spectrum analyzer, in this way:

TX antenna connector, 30 dB through attenuator, spectrum analyzer



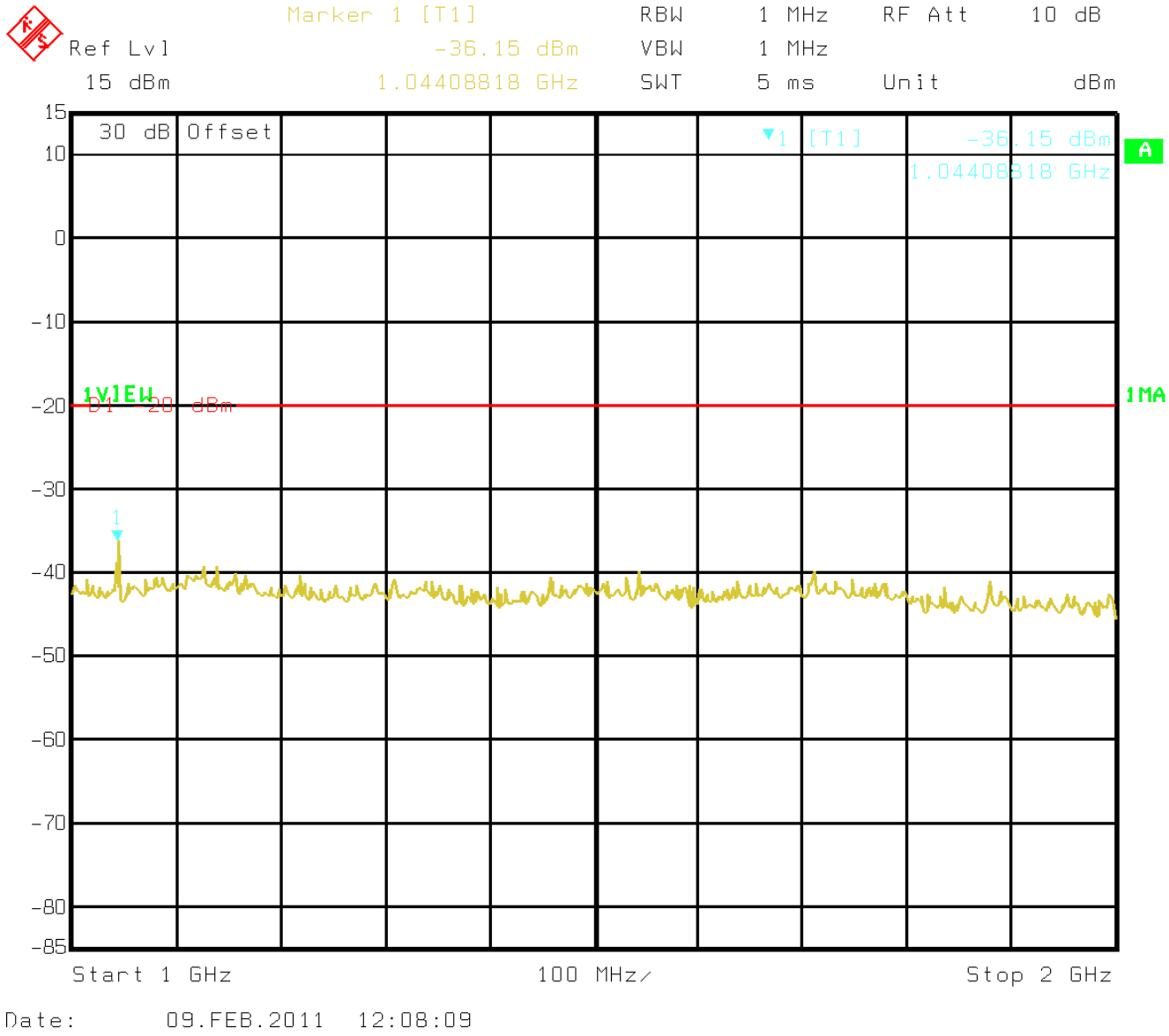
Carrier 150 MHz, 25 W, 12.5 kHz,

Spurious through 30 dB attenuator.



Carrier 162 MHz, 25 W, 12.5 kHz,

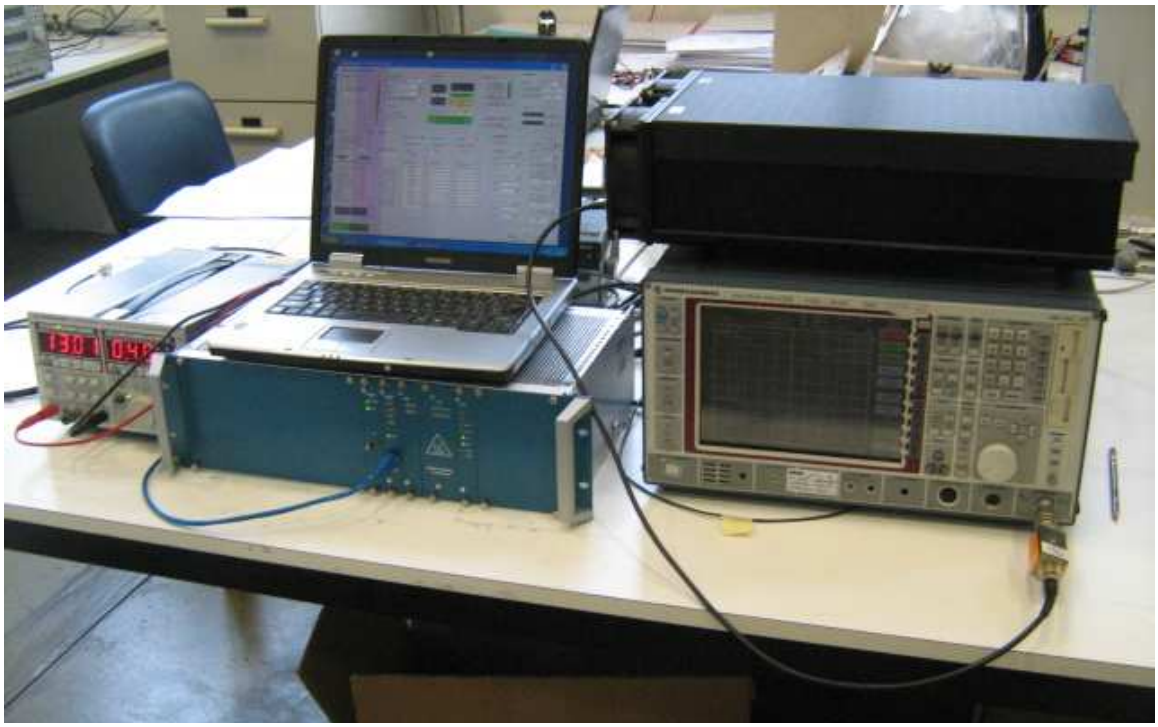
Spurious through 30 dB attenuator.



Carrier 174 MHz, 25 W, 12.5 kHz,

Spurious through 30 dB attenuator.

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: 2011/02/09

Test results: Pass

Special notes

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

Test data
V Pol, 30-1000 MHz, Carrier 150 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz

Frequency	Level measured	Correction factor	Spurious radiation	Limit	Detector
MHz	dBm erp	dB	dBm erp	dBm erp	
148.34	-68.38	-23.4	-44.98	-20	PK
299.66	-67.76	-27.6	-40.16	-20	PK
450.98	-62.9	-28.1	-34.98	-20	PK
749.74	-69.19	-32.0	-37.19	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
H Pol, 30-1000 MHz, Carrier 150 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz

Frequency	Level measured	Correction factor	Spurious radiation	Limit	Detector
MHz	dBm erp	dB	dBm erp	dBm erp	
148.34	-61.61	-18.0	-43.61	-20	PK
299.66	-68.58	-24.5	-44.08	-20	PK
450.98	-63.28	-27.9	-35.38	-20	PK
600.36	-62.26	-31.0	-31.26	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
V Pol, 30-1000 MHz, Carrier 162 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz

Frequency	Level measured	Correction factor	Spurious radiation	Limit	Detector
MHz	dBm erp	dB	dBm erp	dBm erp	
150.28	-69.83	-23.4	-46.43	-20	PK
161.92	-56.31	-24.1	-32.21	-20	PK
322.94	-67.95	-28.0	-39.95	-20	PK
485.90	-64.47	-28.7	-35.77	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
H Pol, 30-1000 MHz, Carrier 162 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz

Frequency	Level measured	Correction factor	Spurious radiation	Limit	Detector
MHz	dBm erp	dB	dBm erp	dBm erp	
162.92	-51.70	-18.9	-32.80	-20	PK
249.22	-71.08	-24.1	-46.98	-20	PK
322.94	-63.07	-26.4	-36.67	-20	PK
485.90	-73.85	-29.3	-44.55	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
V Pol, 30-1000 MHz, Carrier 174 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz

Frequency	Level measured	Correction factor	Spurious radiation	Limit	Detector
MHz	dBm erp	dB	dBm erp	dBm erp	
173.56	-54.00	-23.4	-30.60	-20	PK
318.16	-63.25	-28.1	-35.15	-20	PK
522.76	-62.04	-27.5	-34.54	-20	PK
697.36	-64.85	-32.9	-31.95	-20	PK
870.40	-73.20	-34.7	-38.30	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
H Pol, 30-1000 MHz, Carrier 174 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 100 kHz

Frequency	Level measured	Correction factor	Spurious radiation	Limit	Detector
MHz	dBm erp	dB	dBm erp	dBm erp	
173.56	-49.73	-20.9	-28.83	-20	PK
249.22	-71.36	-24.1	-47.26	-20	PK
348.16	-68.15	-31.6	-36.55	-20	PK
522.76	-68.32	-33.0	-35.32	-20	PK
870.40	-72.65	-38.6	-34.05	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
V Pol, 1-2 GHz, Carrier 150 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1 MHz

Frequenza	Level measured	Correction factor	Spurious radiation	Limit	Detector
GHz	dBm erp	dB	dBm erp	dBm erp	
1.050	-63.11	-3.37	-59.74	-20	PK
1.152	-67.40	-4.32	-63.08	-20	PK
1.500	-65.68	-4.63	-61.05	-20	PK
1.650	-65.22	-4.48	-60.74	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
H Pol, 1-2 GHz, Carrier 150 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1MHz

Frequenza	Level measured	Correction factor	Spurious radiation	Limit	Detector
GHz	dBm erp	dB	dBm erp	dBm erp	
1.050	-62.38	-2.42	-59.96	-20	PK
1.200	-60.08	-0.97	-59.11	-20	PK
1.350	-63.19	-4.26	-58.93	-20	PK
1.650	-65.78	-2.93	-62.85	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
V Pol, 1-2 GHz, Carrier 162 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1 MHz

Frequenza	Level measured	Correction factor	Spurious radiation	Limit	Detector
GHz	dBm erp	dB	dBm erp	dBm erp	
1.134	-45.11	-4.32	-40.79	-20	PK
1.296	-66.52	-3.24	-63.28	-20	PK
1.458	-67.90	-4.85	-63.05	-20	PK
1.620	-69.51	-3.70	-65.81	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
H Pol, 1-2 GHz, Carrier 162 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1 MHz

Frequenza	Level measured	Correction factor	Spurious radiation	Limit	Detector
GHz	dBm erp	dB	dBm erp	dBm erp	
1.134	-41.74	-3.16	-38.58	-20	PK
1.296	-62.21	-1.69	-60.52	-20	PK
1.458	-66.15	-2.21	-63.94	-20	PK
1944	-66.05	-2.59	-63.46	-20	PK

All other spurious were lower than -40 dBm erp.

Test data
V Pol, 1-2 GHz, Carrier 174 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1 MHz

Frequenza	Level measured	Correction factor	Spurious radiation	Limit	Detector
GHz	dBm erp	dB	dBm erp	dBm erp	
1.044	-61.73	-3.37	-58.36	-20	PK
1.200	-65.31	-1.80	-63.51	-20	PK
1.218	-66.44	-2.00	-64.44	-20	PK
1.566	-65.31	-5.42	-59.89	-20	PK

All other spurious were lower than -40 dBm erp.

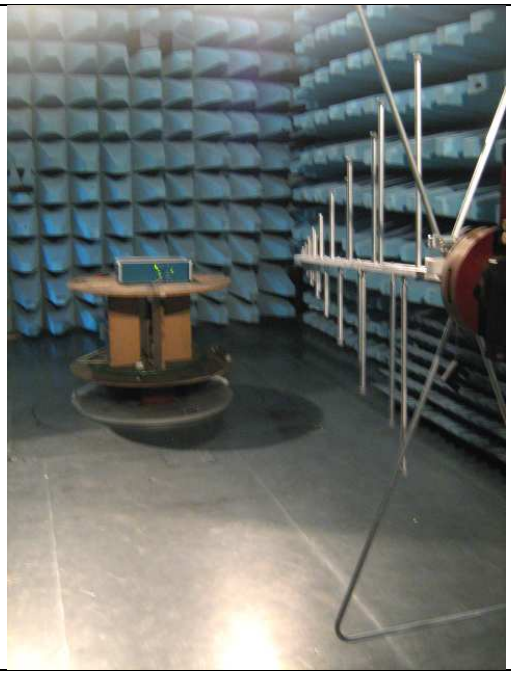
Test data
H Pol, 1-2 GHz, Carrier 174 MHz, 25 W, 12.5 kHz channel spacing, Limit -20 dBm erp, RBW 1 MHz

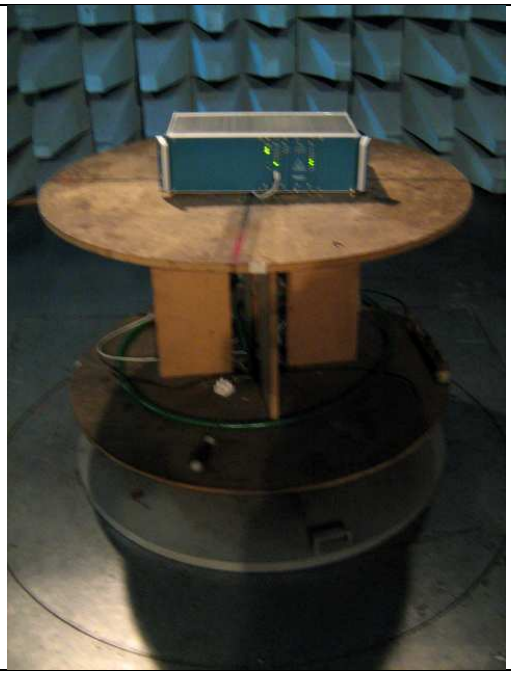
Frequenza	Level measured	Correction factor	Spurious radiation	Limit	Detector
GHz	dBm erp	dB	dBm erp	dBm erp	
1.044	-60.78	-2.42	-58.36	-20	PK
1.218	-64.22	-0.97	-63.25	-20	PK
1.329	-65.38	-4.26	-61.12	-20	PK
1.566	-63.69	-2.13	-61.56	-20	PK

All other spurious were lower than -40 dBm erp.

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).





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	–	50
150–174	[5, 11] 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: 2011/02/10-17

Test results: Pass

Special notes

In 150-174 MHz band according to note 5: “fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm.

Clause 90.213 Frequency stability, continued

Test data, continued

Conditions	Frequency (MHz)	Offset (ppm)
+55 °C, Nominal power	162.00002500	+ 0.154321
+50 °C, Nominal power	162.00001900	+ 0.117284
+40 °C, Nominal power	162.00000600	+ 0.037037
+30 °C, Nominal power	161.99998834	- 0.071976
+20 °C, +15 % power (15.9Vdc)*	161.99996491	- 0.216605
+20 °C, Nominal power (13.8Vdc)	161.99996493	- 0.216481
+20 °C, -15 % power (10.8Vdc)*	161.99996492	- 0.216543
+10 °C, Nominal power	161.99996111	- 0.240062
0 °C, Nominal power	161.99995491	- 0.278333
-10 °C, Nominal power	161.99996956	- 0.187901
-20 °C, Nominal power	161.99998091	- 0.117839
-25 °C, Nominal power	161.99998497	- 0.092777
-30 °C, Nominal power	161.99995270	- 0.291975

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

$F_{reference}$ = 162 MHz.

VCTCXO not 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

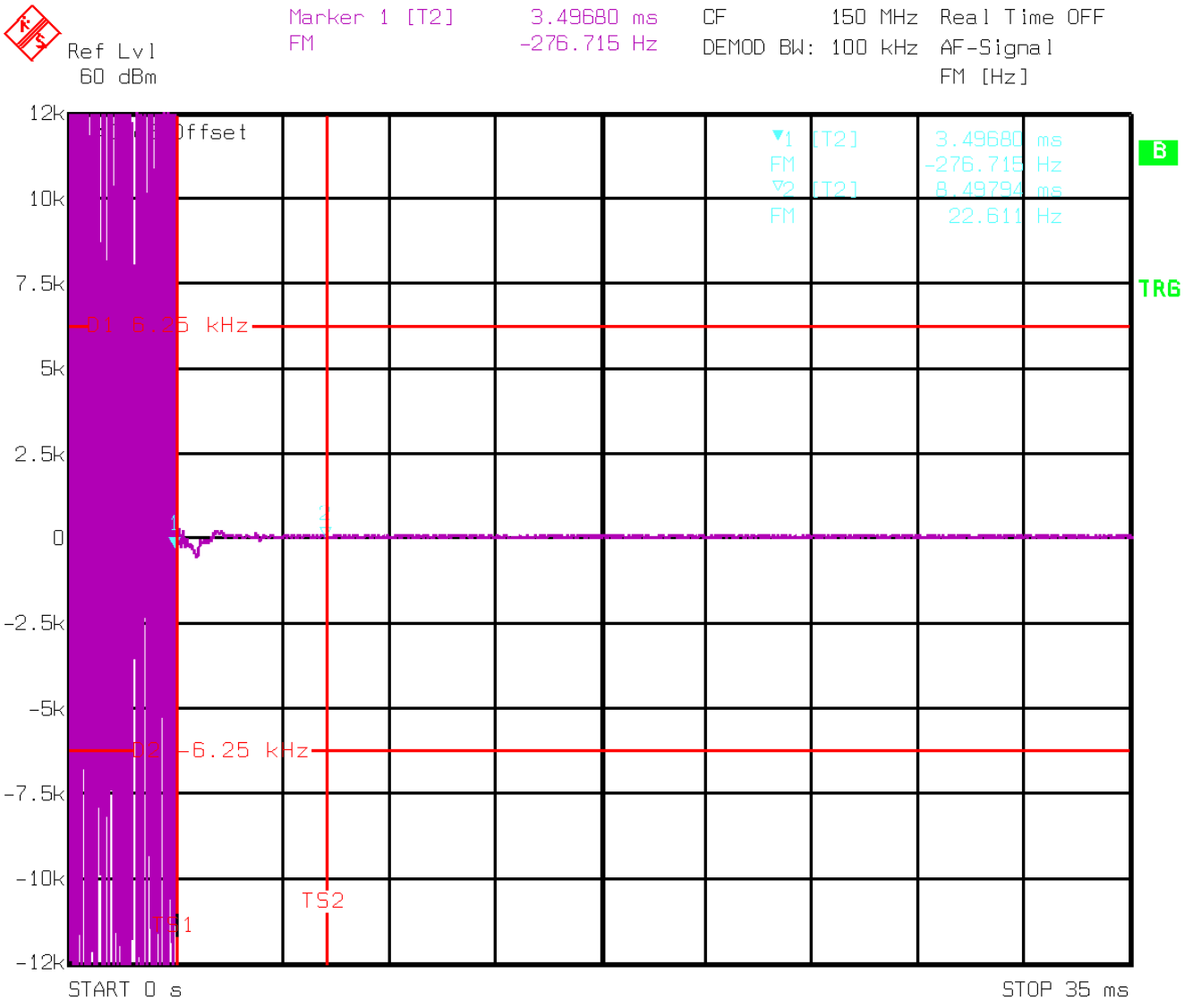
Test date: 2011/02/11

Test results: Pass

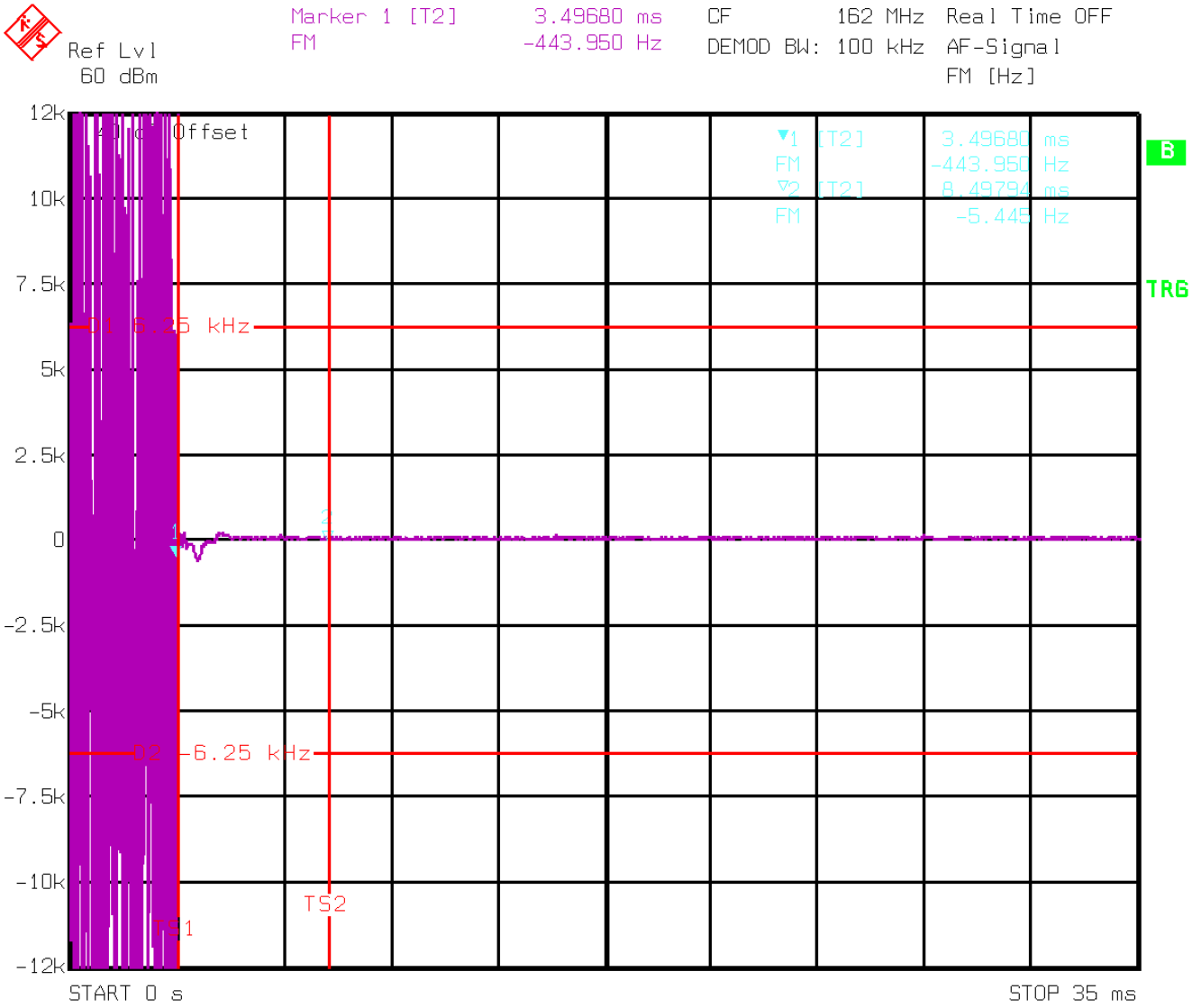
Special notes

None

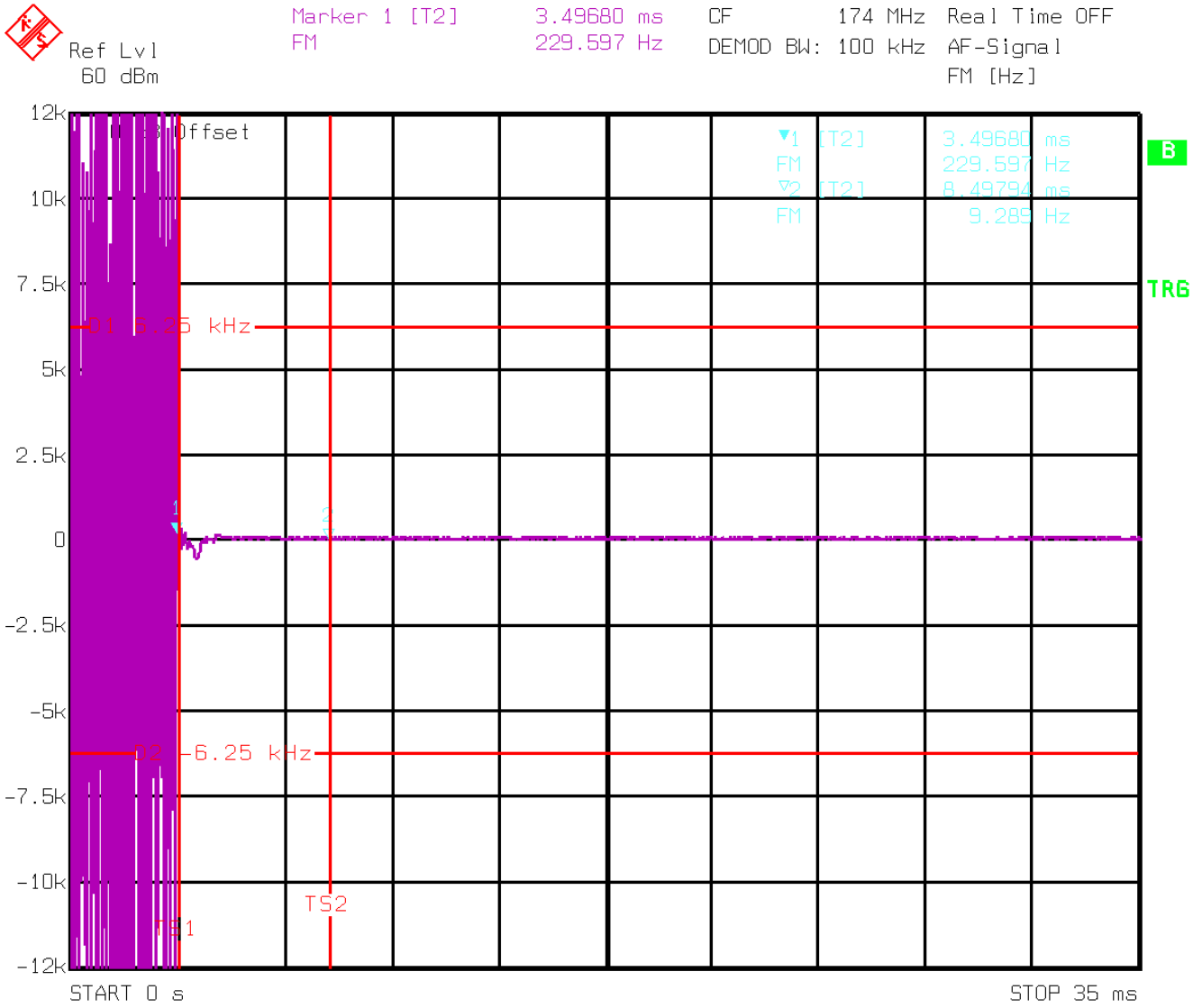
Switch on condition, t_1=5 ms, t_2=20 ms, 150 MHz, channel separation ± 12.5 kHz



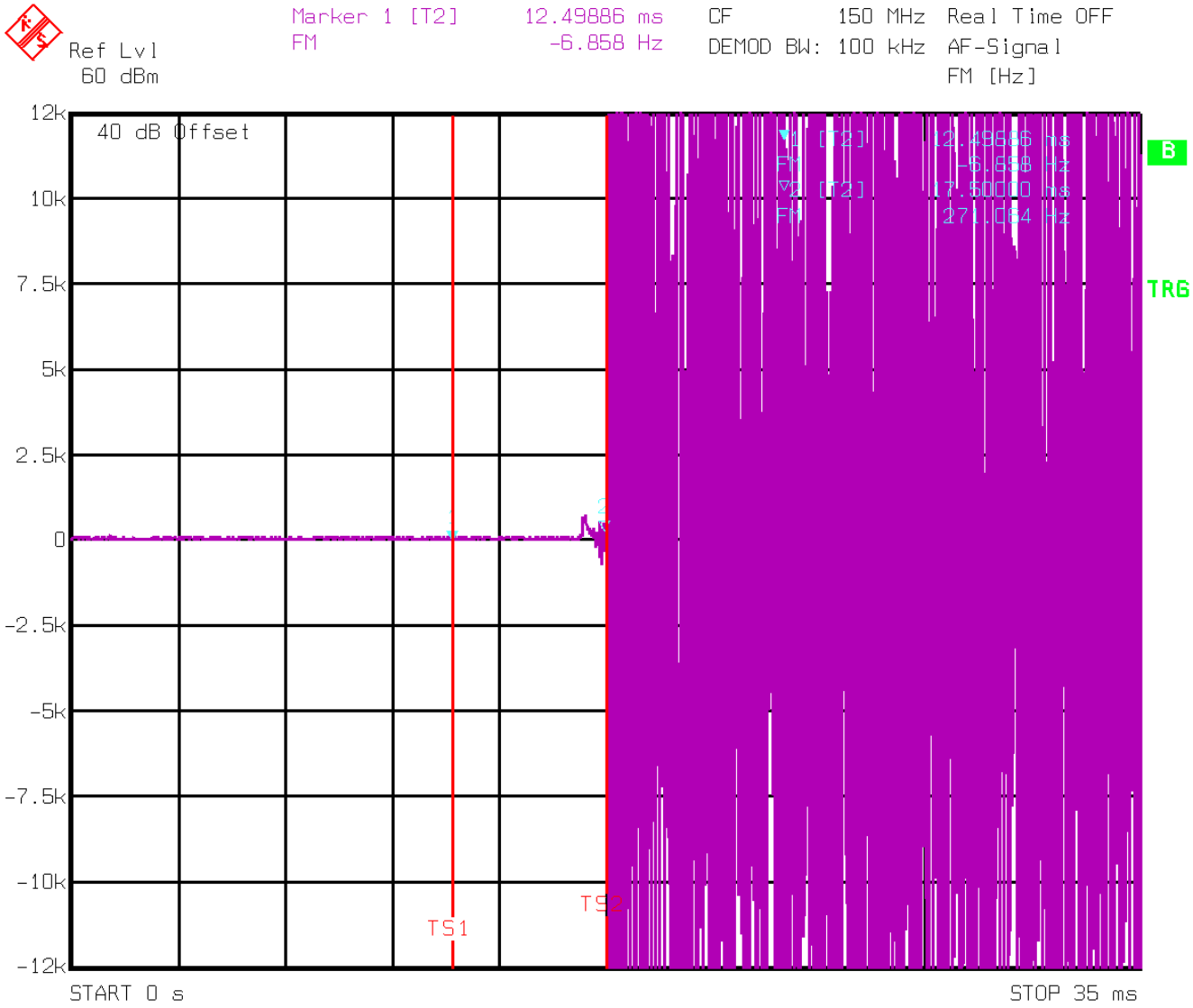
Switch on condition, t_1=5 ms, t_2=20 ms, 162 MHz, channel separation ± 12.5 kHz



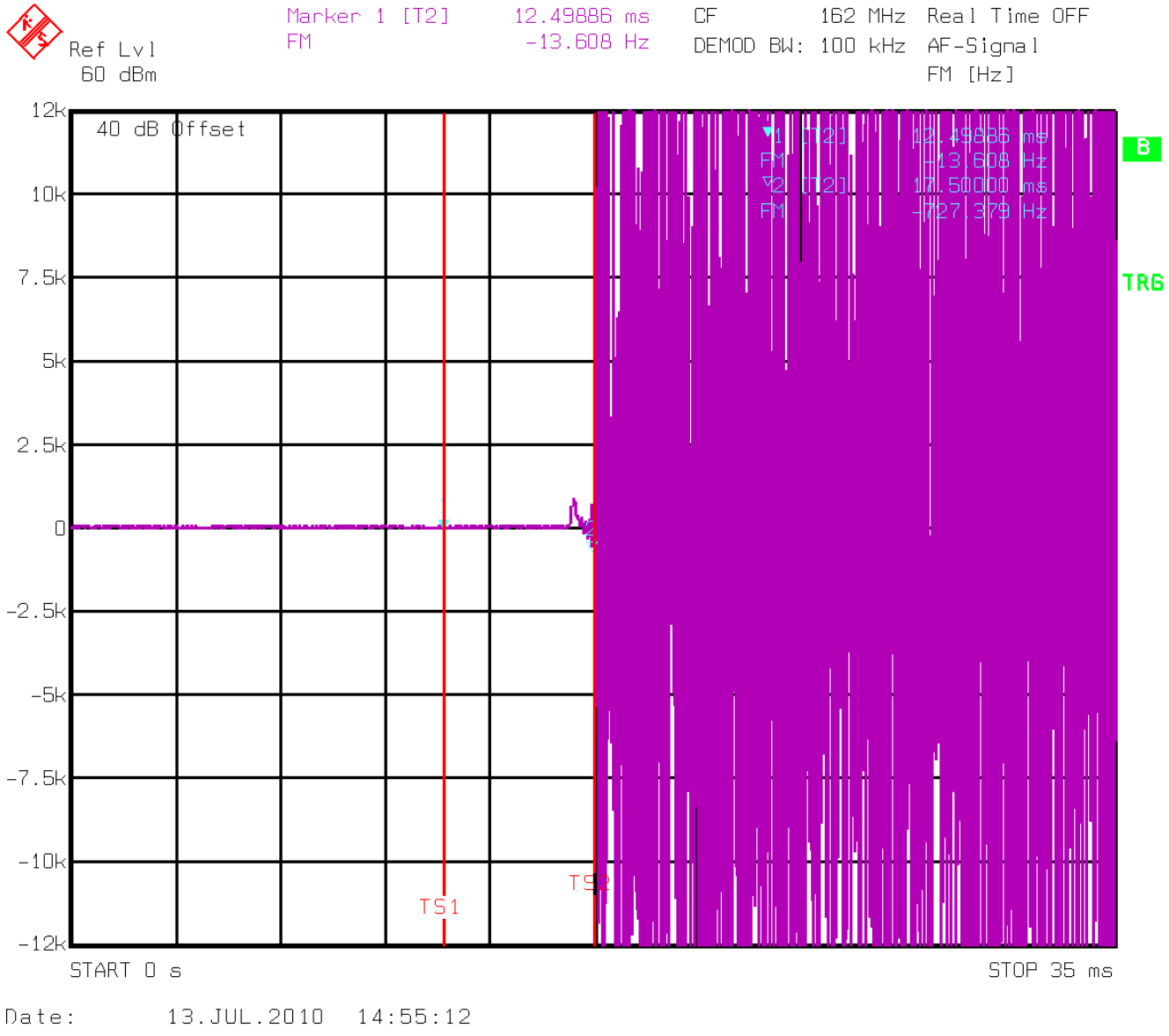
Switch on condition, t_1=5 ms, t_2=20 ms, 174 MHz, channel separation ± 12.5 kHz



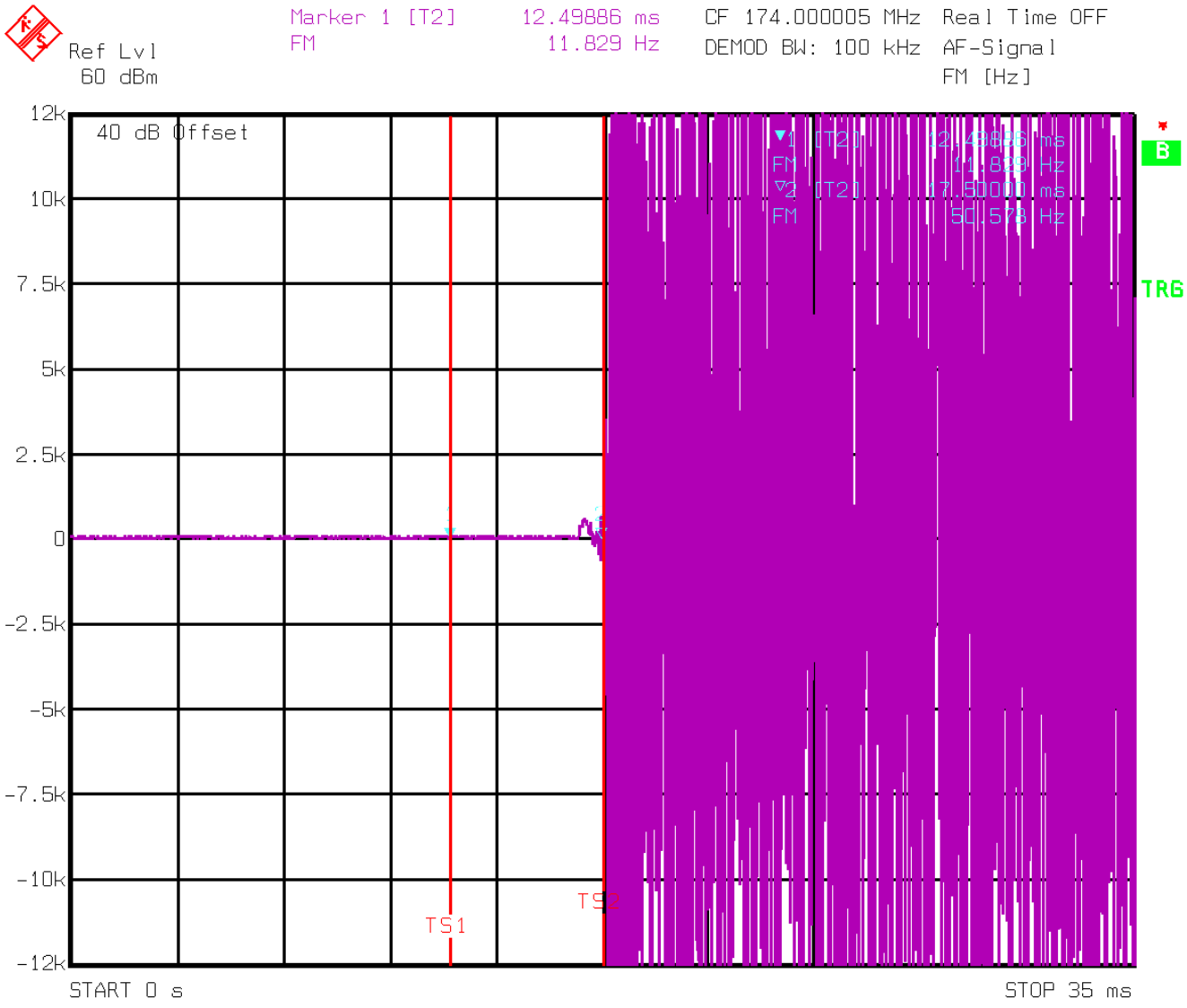
Switch off condition, t_3=5 ms, 150 MHz, channel separation ± 12.5 kHz



Switch off condition, t_3=5 ms, 162 MHz, channel separation ± 12.5 kHz

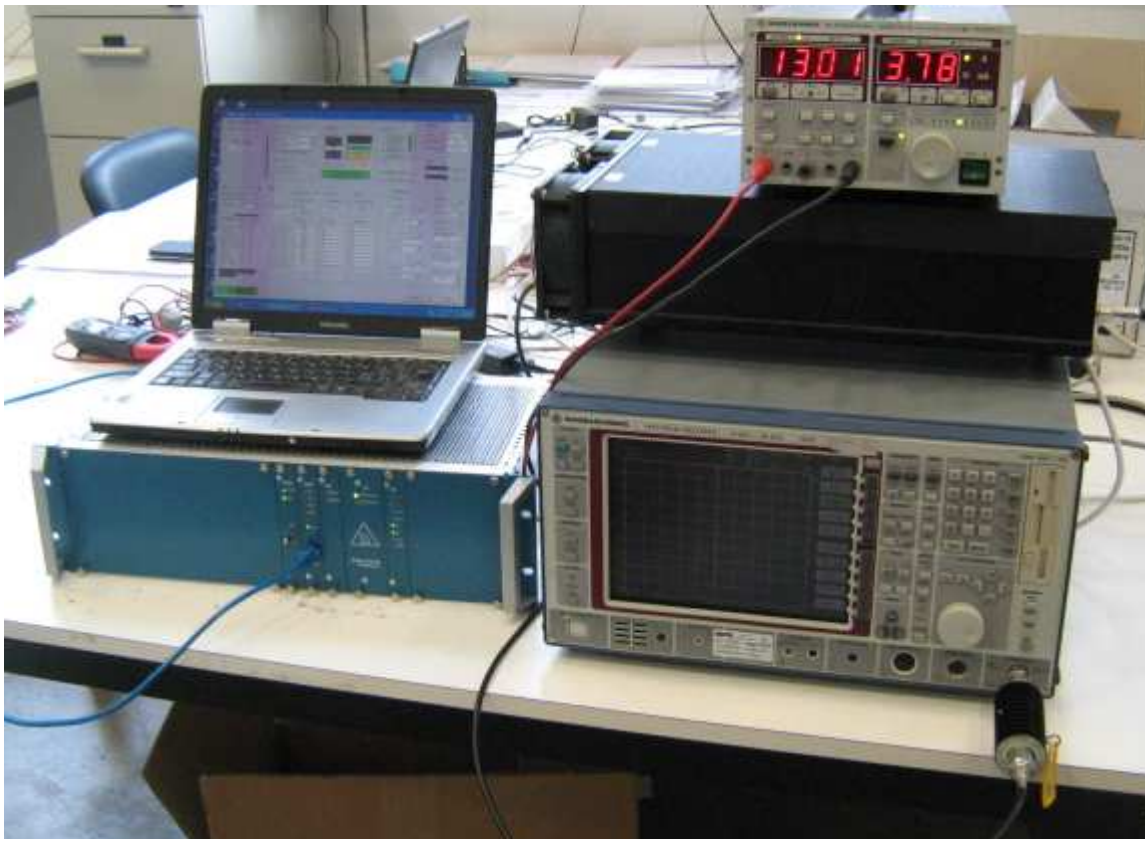


Switch off condition, t_3=5 ms, 174 MHz, channel separation ± 12.5 kHz



Switch on condition, t_1=10

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: ---

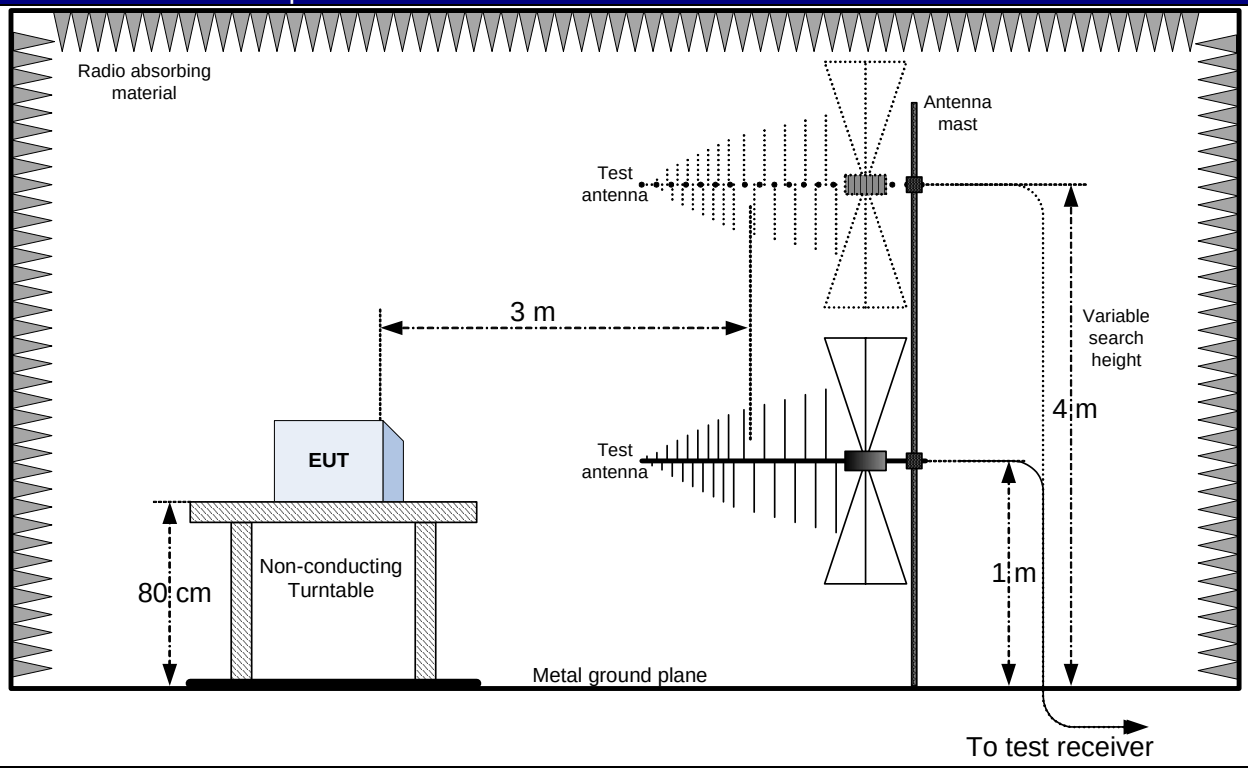
Test results: N

Special notes

None

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up



Appendix C: EUT Photos


PSM
DBF
RX
TX
I/O
LAN


RX Main
GPS
ANT
COM
LNC
MTCH
RX Div.


VHF
IP ADDR:
192.168.1.250