

TEST REPORT

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Project Number: 3059390
June 30, 2004

Testing performed on the
CDMA-2000 IP-Base Station
Model Number AW 96/20
FCC ID: R4HAW96R19AJ1A01
to
FCC Part 24E
for
AirWalk Communications, Inc.



A2LA Certificate Number: 1755-01

Test Performed by:
Intertek Testing Services
1365 Adams Court
Menlo Park, CA 94025

Test Authorized by:
AirWalk Communications, Inc.
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Richardson, TX, 75081

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1.0 Job Description

1.1 Applicant information

Applicant name & address	AirWalk Communications, Inc. 1830 North Greenille Ave., Suite 164 Richardson, TX, 75081
Contact info	Chris Osborn
Telephone:	972-638-9400
Fax:	972-638-9401
Email	cosborn@airwalkcom.com

1.2 Test Summary

FCC Rule	Description of Test	Result	Page
2.1046	RF Power Output	Complies 20 W - average	7
24.232	EIRP	Complies	14
2.1047	Modulation Requirements	Not Applicable	-
2.1049	Occupied Bandwidth, Emission Designator	1M25F9W	15
2.1051, 24.238	Spurious emissions at Antenna Terminals	Complies	19
2.1053	Field Strength of Spurious Radiation	Complies	45
2.1055	Frequency Stability vs. Temperature and Voltage	Complies	47
2.1091	RF Exposure	Complies	49

The test results in this report pertain only to the item tested.

1.3 Product Description

The AW 96/20 is a CDMA-2000 IP-Base Station. The AW-96/20, IP-RAN (Internet Protocol Radio Access Network), is composed of two main modules: the IP based BSC and the IP based BTS.

The structural elements are:

- AW-96
CPIB (Channel processor and IF interface board)
PCPM (primary Call Processor module)
XCVB (RF Transceiver Board)
GPSR (Global Positioning System Receiver)
PSA (Power Supply Assembly)
- RU (Remote RF Unit)
HPAU (High Power Amplifier Unit)
AFEU (Antenna Front End Unit)
RRCU (Remote RF Controller Unit)
RPSU (Remote RF Power Supply Unit)
- PA (power Amplifier)

For more information, please refer to the attached product specification.

Use of Product	Internet Protocol Radio Access Network
Cellular Phone standards	CDMA-2000
Channel Bandwidth	1.25 MHz
Type(s) of Emission	1M25F9W
Rated RF Output Power	13 dBm – 43 dBm (average)
Frequency Range	1975 - 1990 MHz (Block C)
Configuration	1FA/Omni
Antenna(s) & Gain used with the device	17 dBi maximum
DC voltage and current into the final RF stage	27V, 10A typical, 15A max.
External input	Digital Data
Operating Temperature	-20 ⁰ C ~ +50 ⁰ C

EUT receive date:	June 19, 2004
EUT receive condition:	The EUT was received in good condition with no apparent damage.
Test start date:	June 21, 2004
Test completion date:	June 25, 2004

1.3 EUT Test Configuration

The EUT configuration, specified by AirWalk, was made according to the photograph below.



Attenuator 20 dB

50 Ω Termination – for radiated emission test; SA - for other tests

50 Ω Termination – for all tests except frequency stability; SA (ref in) - for frequency stability test

1.4 Justification

For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case emissions.

For radiated emission measurements, the EUT is placed on the wooden turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible).

The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

1.5 Mode of Operation

The EUT was setup to transmit continuously a CDMA signal on selected channels.

1.6 Related Submittal(s) Grants

None

1.7 Test Facility

The test site and conducted measurement facility used to collect the radiated data is site 1 (10 m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC and A2LA accredited.

2.0 RF Output Power
FCC 2.1046

2.1 Test Procedure

A spectrum analyzer was connected to the transmitter output via a RF attenuator. The conducted RF Output Power was measured with the Rohde & Schwarz FSP40 Spectrum Analyzer having a build-in CDMA personality. The average Channel Power was measured at three frequencies (at lowest, middle, and highest channels). The maximum and minimum RF output power was measured.

2.2 Test Equipment

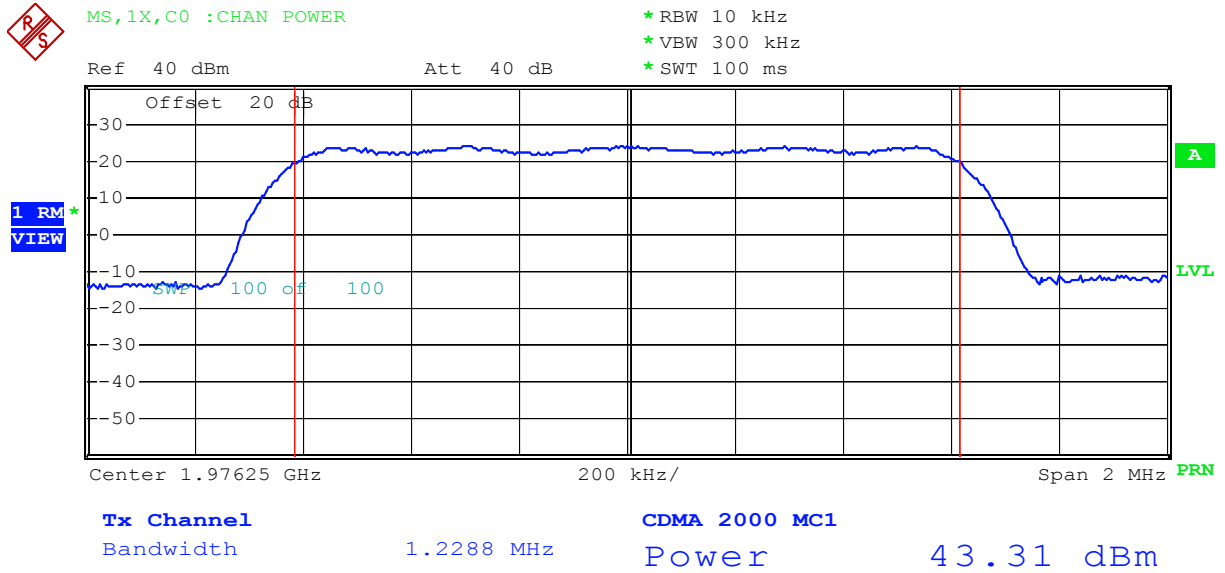
Rohde & Schwarz FSP40 Spectrum Analyzer

2.3 Test Results

Frequency, MHz	Channel number	Average Power, dBm	Average Power, W	Plot Number
1976.25	925	max 43.3	max 21.3	2.1
		min 13.8	min 0.024	2.4
1982.50	1050	max 43.3	max 21.3	2.2
		min 13.4	min 0.022	2.5
1988.75	1175	max 43.1	max 20.4	2.3
		min 13.8	min 0.024	2.6

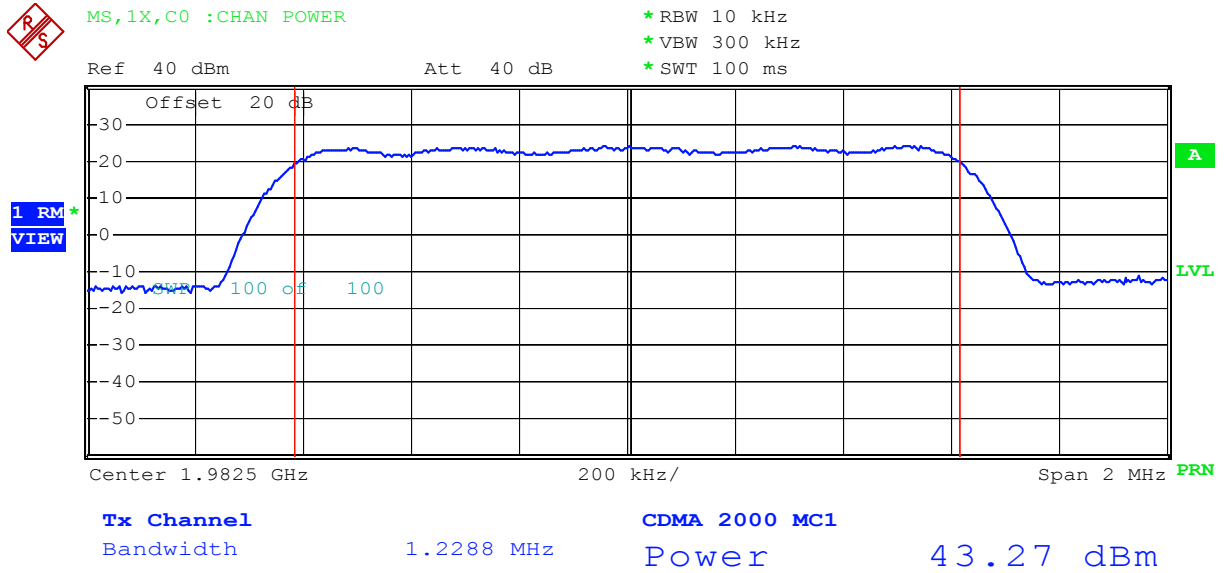
For more details refer to the attached plots.

Plot 2.1



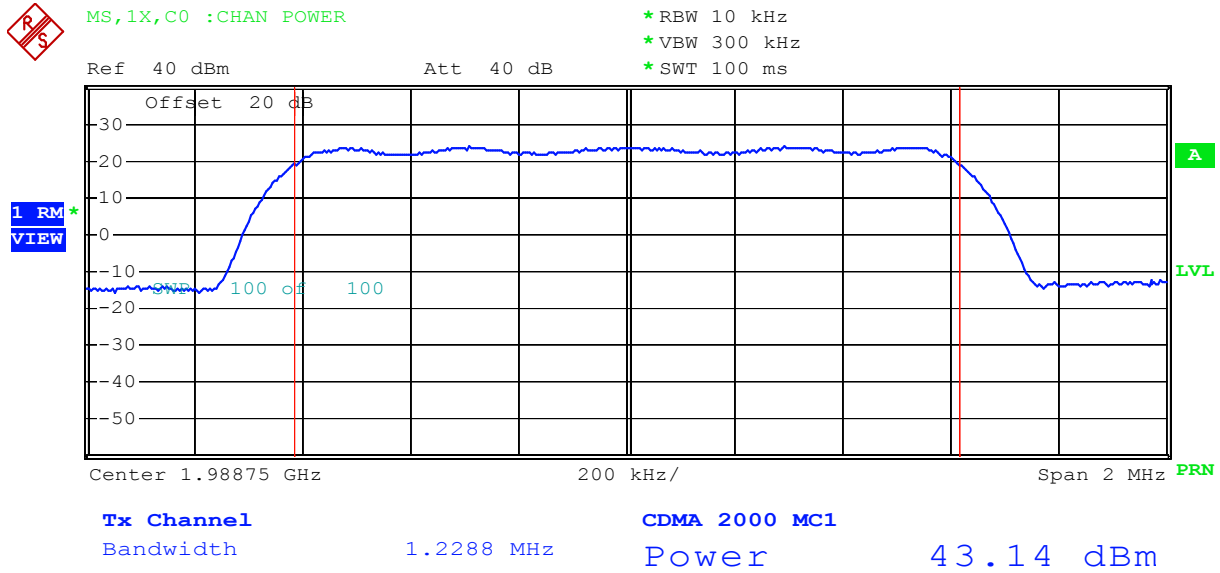
Comment: Channel 925, Output Power
Date: 22.JUN.2004 20:27:03

Plot 2.2



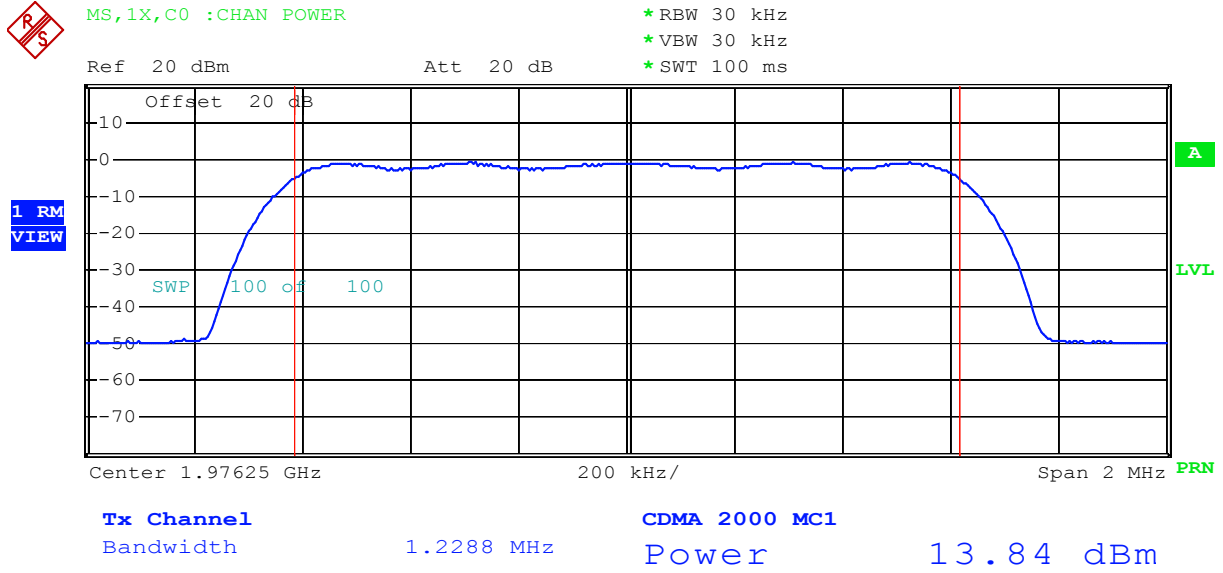
Comment: Channel 1050, Output Power
Date: 22.JUN.2004 20:29:13

Plot 2.3



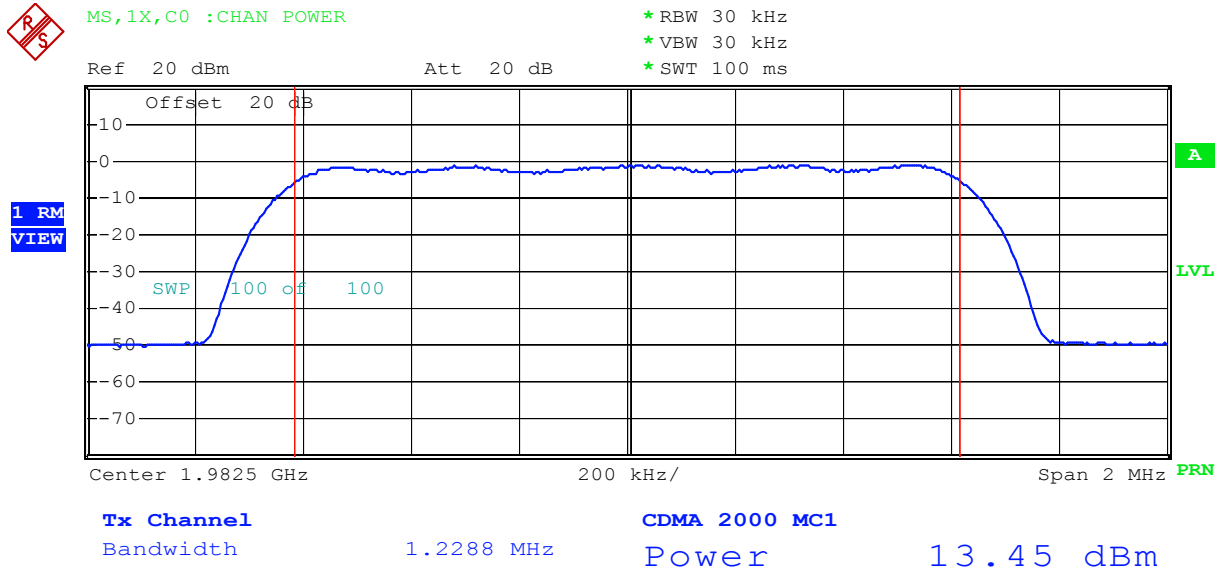
Comment: Channel 1175, Output Power
Date: 22.JUN.2004 20:09:05

Low Power Plot 2.4



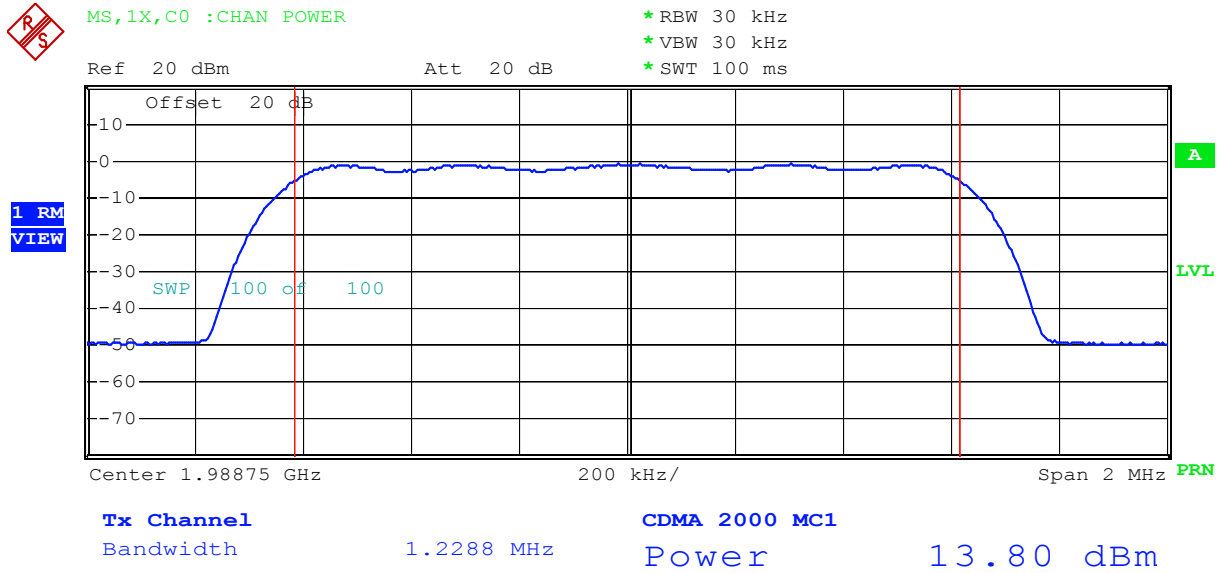
Comment: Channel 925, output power, low power
Date: 23.JUN.2004 02:08:45

Low Power Plot 2.5



Comment: Channel 1050, output power, low power
Date: 23.JUN.2004 02:07:04

Low Power Plot 2.6



Comment: Channel 1175, output power, low power
Date: 23.JUN.2004 02:04:53

3.0 Radiated Power

FCC 24.232

Requirement

The Equivalent Isotropically Radiated Power (EIRP) of base stations must not exceed 1640 Watts.

Result

The EIRP may be calculated by adding the antenna gain (in dBi) to the output power in dBm. In order not to exceed the EIRP limit, the maximum antenna gain may be used with the EUT is 18.9 dBi.

4.0 Occupied Bandwidth FCC 2.1049

4.1 Test Procedure

A spectrum analyzer was connected to the transmitter output via a RF attenuator. The Occupied Bandwidth (defined as the 99% Power Bandwidth) was measured with the Rohde & Schwarz FSP40 Spectrum Analyzer having a build-in CDMA personality.

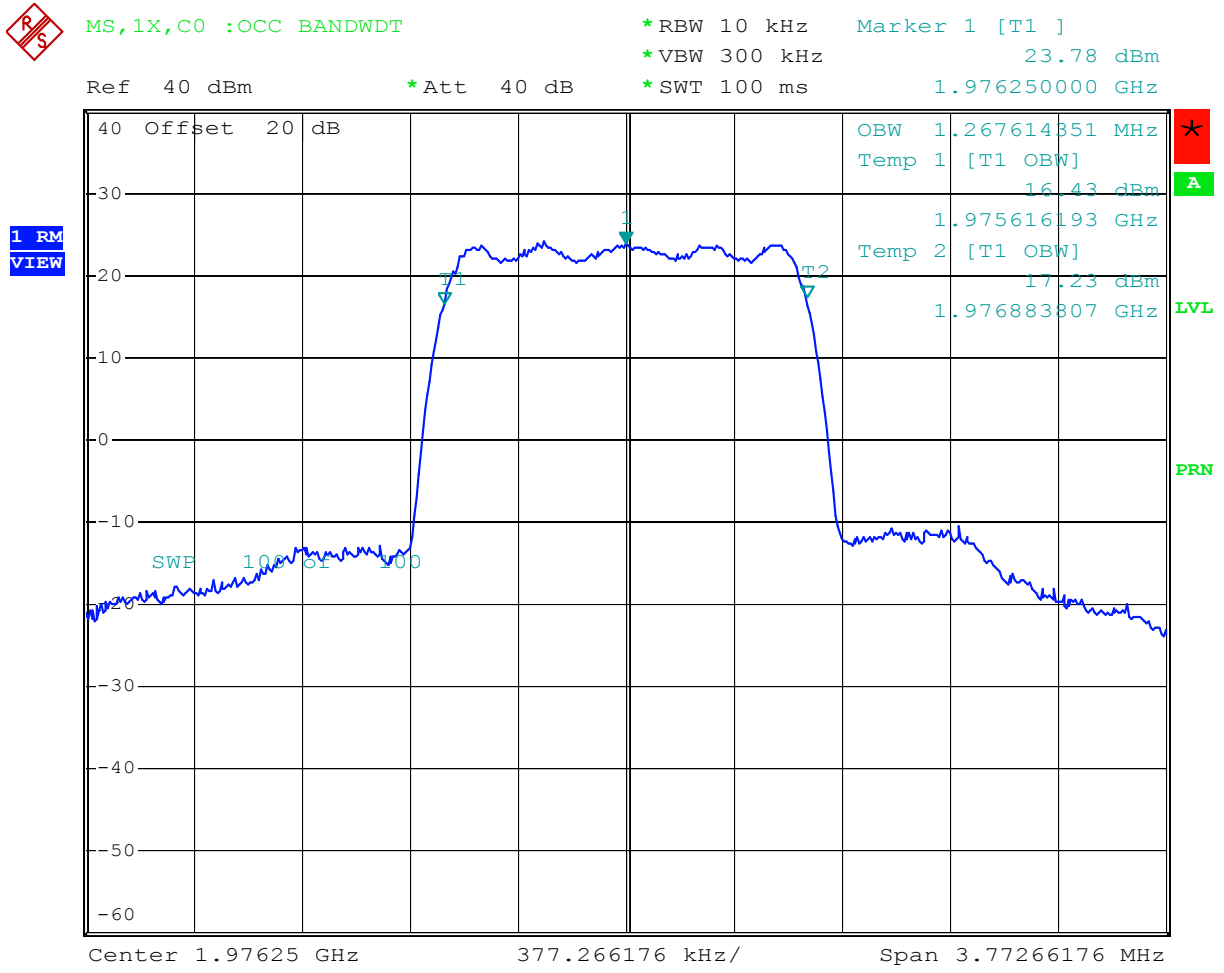
4.2 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

4.3 Test Results

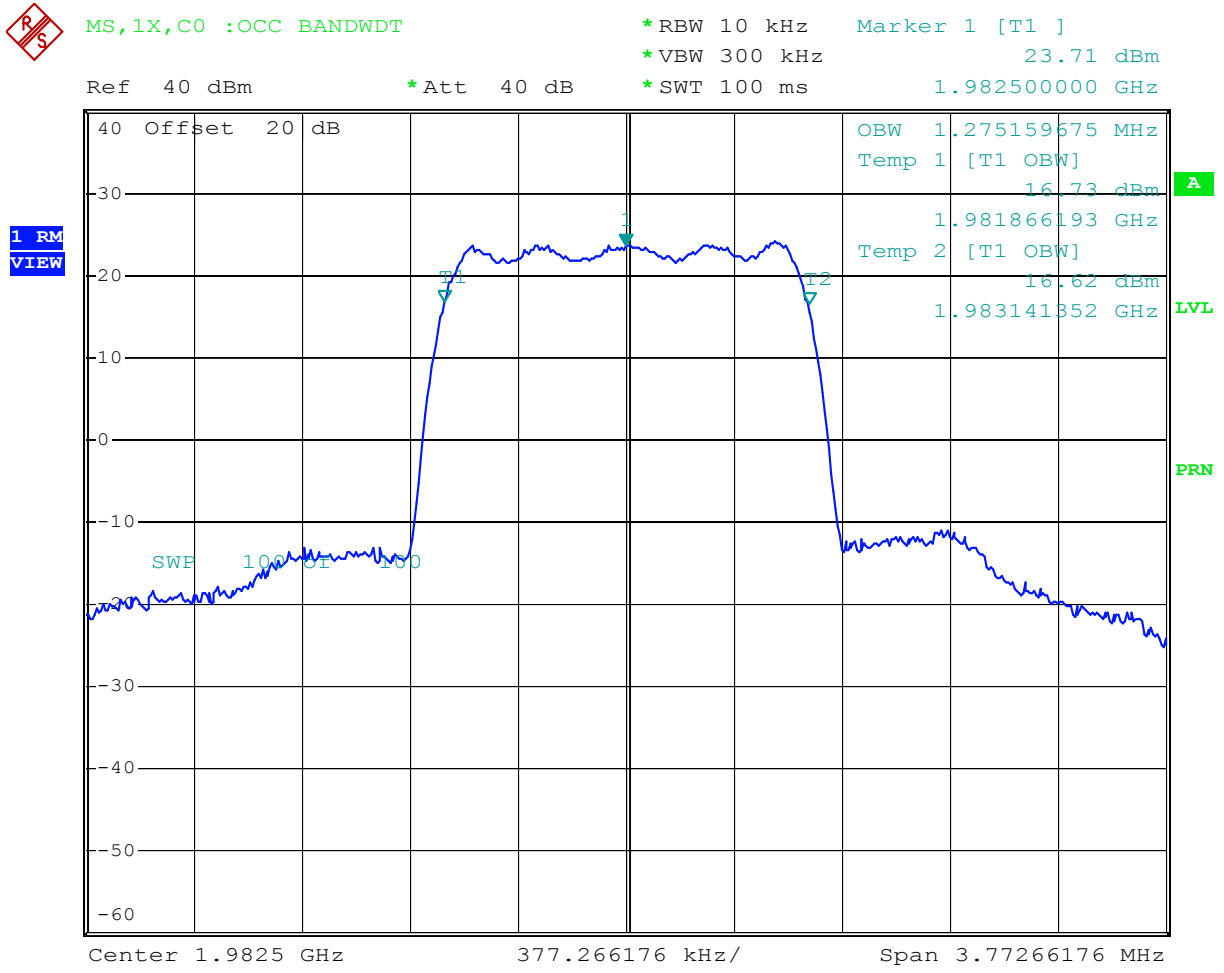
See attached plots 4.1-4.3. The Emission Designator was determined as 1M25F9W

Plot 4.1



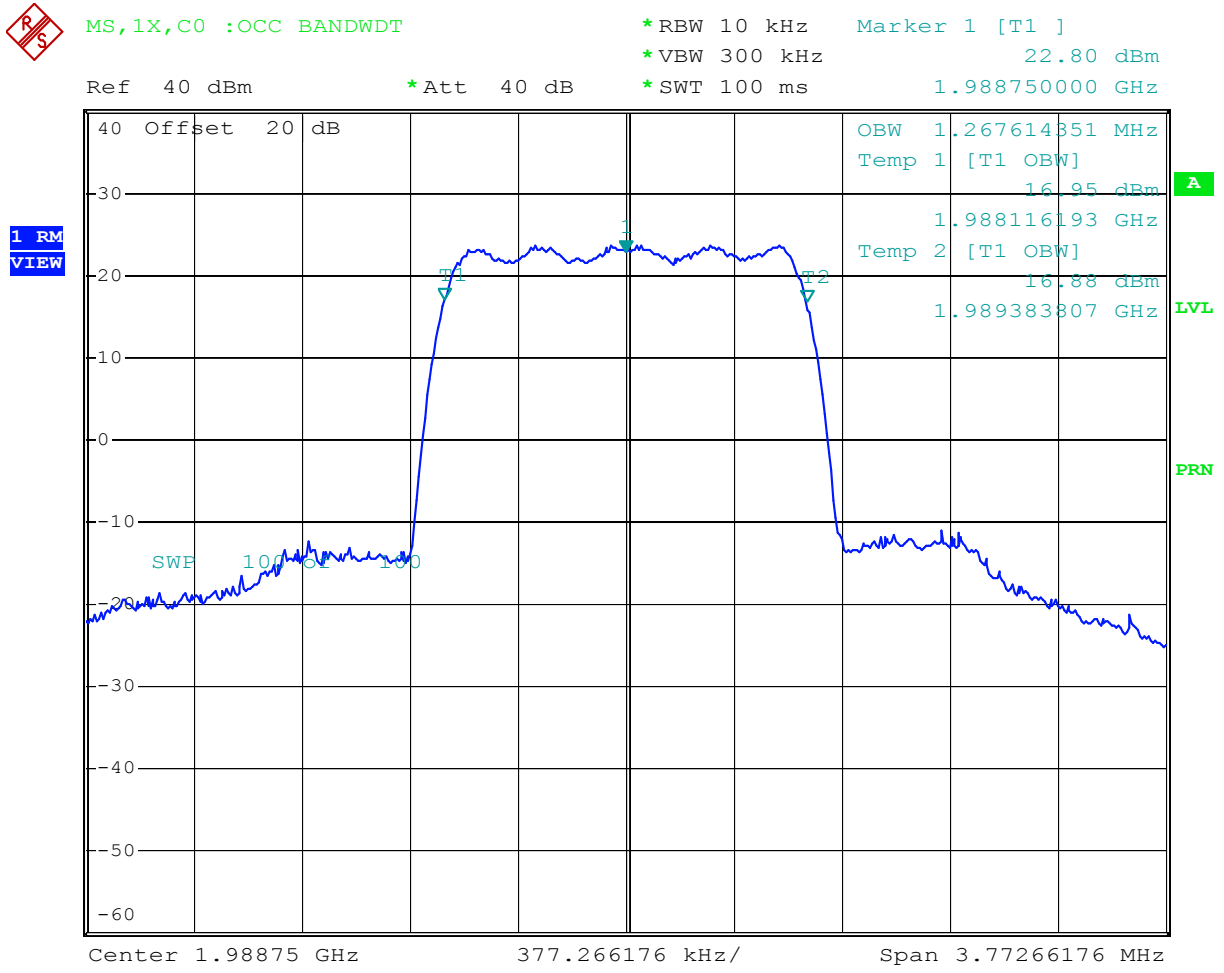
Comment: Channel 925, OBW
 Date: 22.JUN.2004 03:59:30

Plot 4.2



Comment: Channel 1050, OBW
 Date: 22.JUN.2004 04:01:55

Plot 4.3



Comment: Channel 1175, OBW
 Date: 22.JUN.2004 04:03:55

5.0 Spurious Emissions at Antenna Terminals

FCC 2.1051, 24.238

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P in Watts) on any frequency outside the frequency band by at least $(43 + 10 \log P)$ dB. This requirement corresponds to the limit of -13 dBm of conducted power (average value) of spurious emissions.

5.1 Test Procedure

A spectrum analyzer was connected to the transmitter output via a RF attenuator. For the channels 925, 1050 and 1175 several scans were taken to show the spurious emissions from 30 MHz to 20 GHz.

On frequencies within 1 MHz up or down from the block-edge frequency, the measurements were made with the spectrum analyzer resolution bandwidth (RBW) of 30 kHz; on some frequencies more than 1 MHz away from the band-edge frequency, the spectrum analyzer resolution bandwidth of 300 kHz was used (instead of 1 MHz), and a bandwidth correction factor (BCF) of $10\text{Log}[1000/300]=5.2$ dB was applied.

Measurements were performed for the maximum and minimum RF output power.

5.2 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

5.3 Test Results

Refer to the following plots.

Maximum RF Output Power

Channel	Frequency, MHz	Description	Comments	Plot number
925	1976.25	Scan 30 MHz – 1 GHz		5.1
		Scan 1GHz – 1.9 GHz		5.2
		Scan 1.9 GHz – 1.972 GHz		5.3
		Scan 1.972 GHz – 1.974 GHz	With RBW=300 kHz, BCF=5.2 dB is applied	5.4
		Scan 1.974 GHz – 1.975 GHz	With RBW=30 kHz	5.5
		Scan 1.99 GHz – 20 GHz		5.6
1050	1982.5	Scan 30 MHz – 1.975 GHz		5.7
		Scan 1.99 GHz – 20 GHz		5.8
1175	1988.75	Scan 30 MHz – 1.975 GHz		5.9
		Scan 1.99 GHz – 1.991 GHz	With RBW=30 kHz	5.10
		Scan 1.991 GHz – 1.994 GHz	With RBW=300 kHz, BCF=5.2 dB is applied	5.11
		Scan 1.994 GHz – 2.0 GHz		5.12
		Scan 2 GHz – 20 GHz		5.13

BCF = Bandwidth Correction Factor

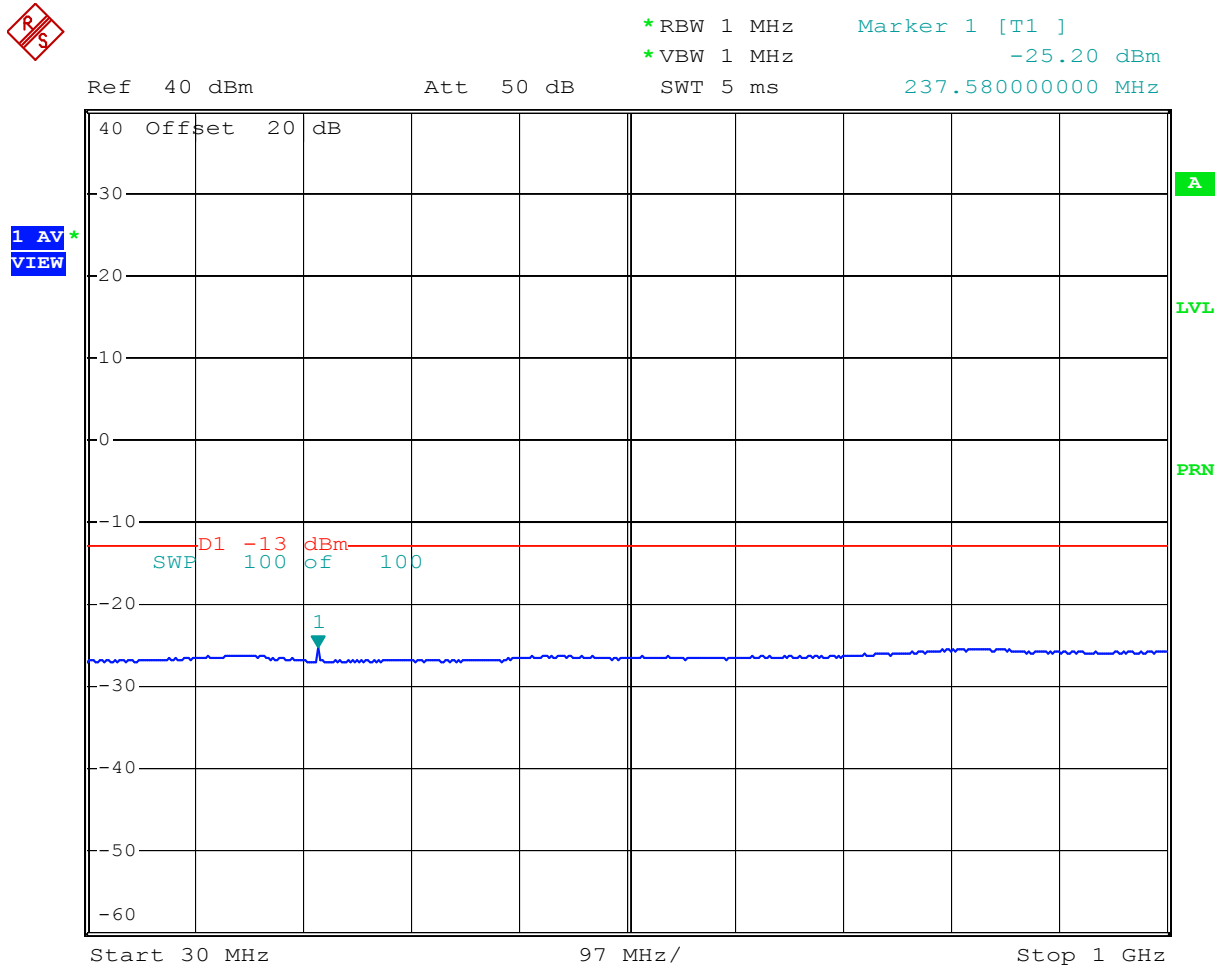
Minimum RF Output Power

Channel	Frequency, MHz	Description	Comments	Plot number
925	1976.25	Scan 30 MHz – 1 GHz		5.14
		Scan 1GHz – 1.97 GHz		5.15
		Scan 1.97 GHz – 1.974 GHz	With RBW=300 kHz, BCF=5.2 dB is applied	5.16
		Scan 1.974 GHz – 1.975 GHz	With RBW=30 kHz	5.17
		Scan 1.99 GHz – 20 GHz		5.18
		Scan 30 MHz – 1.975 GHz		5.19
1050	1982.5	Scan 1.990 GHz – 20GHz		5.20
		Scan 30 MHz – 1.975 GHz		5.21
1175	1988.75	Scan 1.99 GHz – 1.991 GHz	With RBW=30 kHz	5.22
		Scan 1.991 GHz – 1.994 GHz	With RBW=300 kHz, BCF=5.2 dB is applied	5.23
		Scan 1.994 GHz – 20 GHz		5.24
		Scan 30 MHz – 1.975 GHz		5.21

BCF = Bandwidth Correction Factor

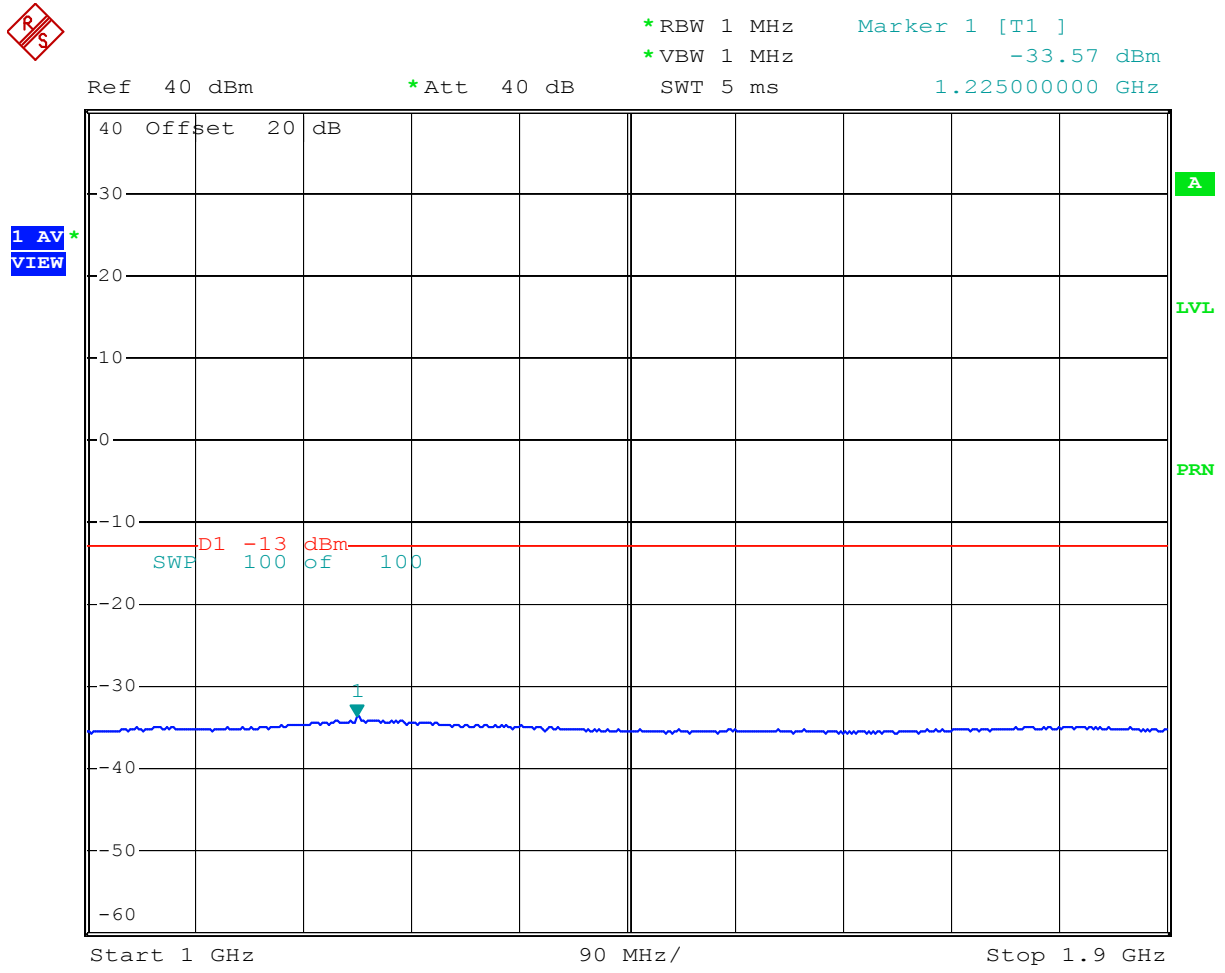
Complies	Passed by 13.8 dB
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Plot 5.1



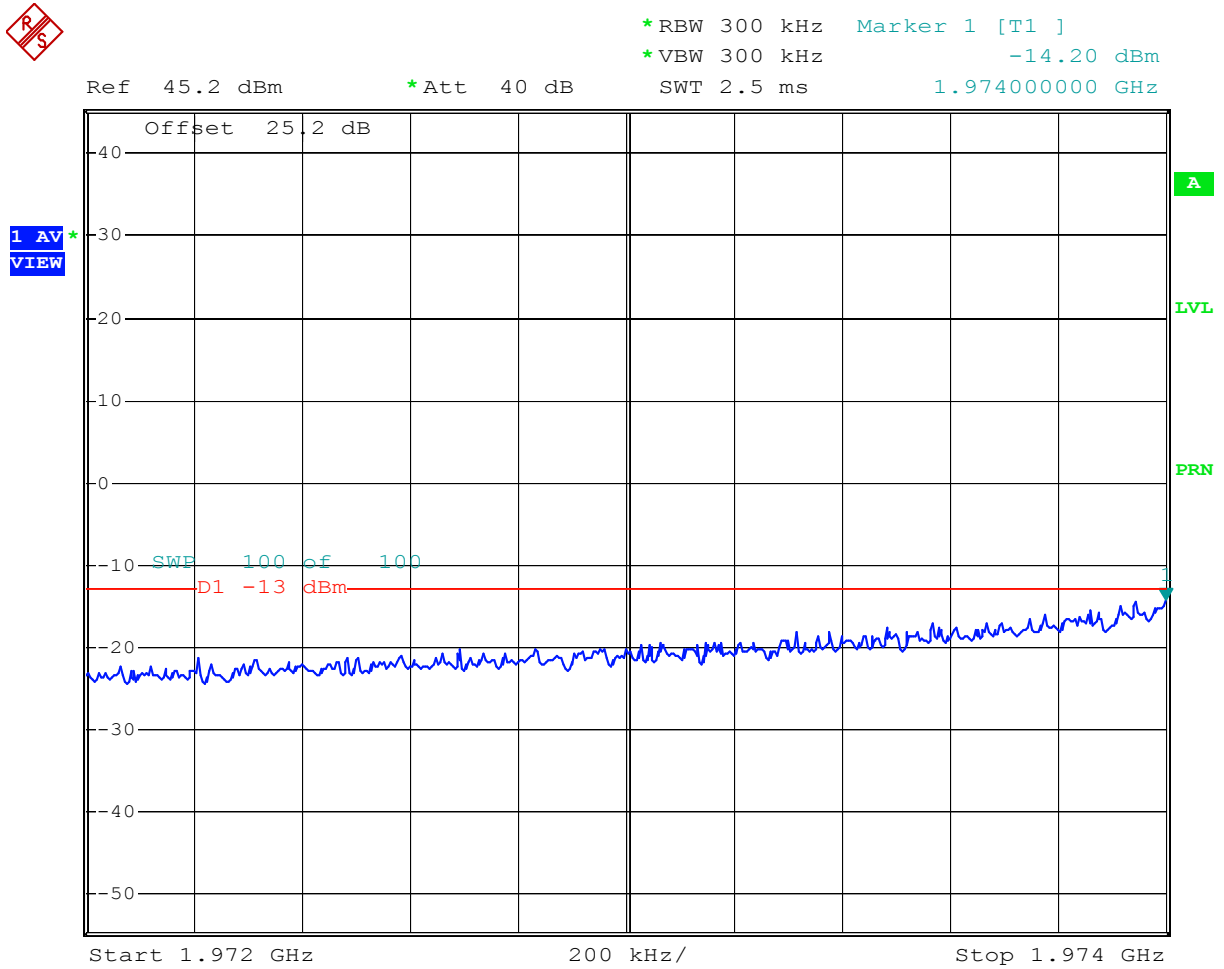
Comment: Channel 925, Out-of-band, max power
 Date: 23.JUN.2004 00:18:35

Plot 5.2



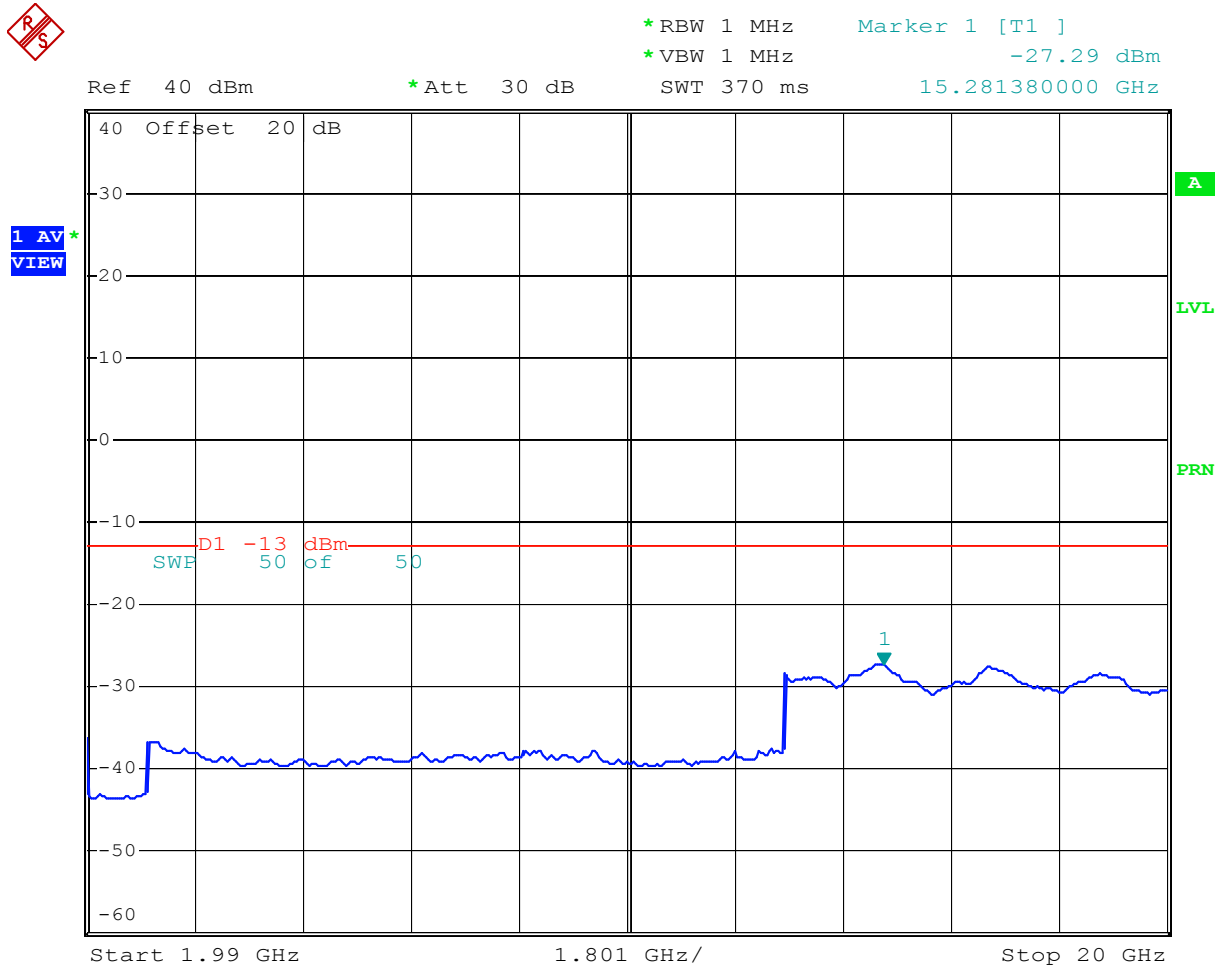
Comment: Channel 925, Out-of-band, max power
 Date: 23.JUN.2004 00:16:44

Plot 5.4



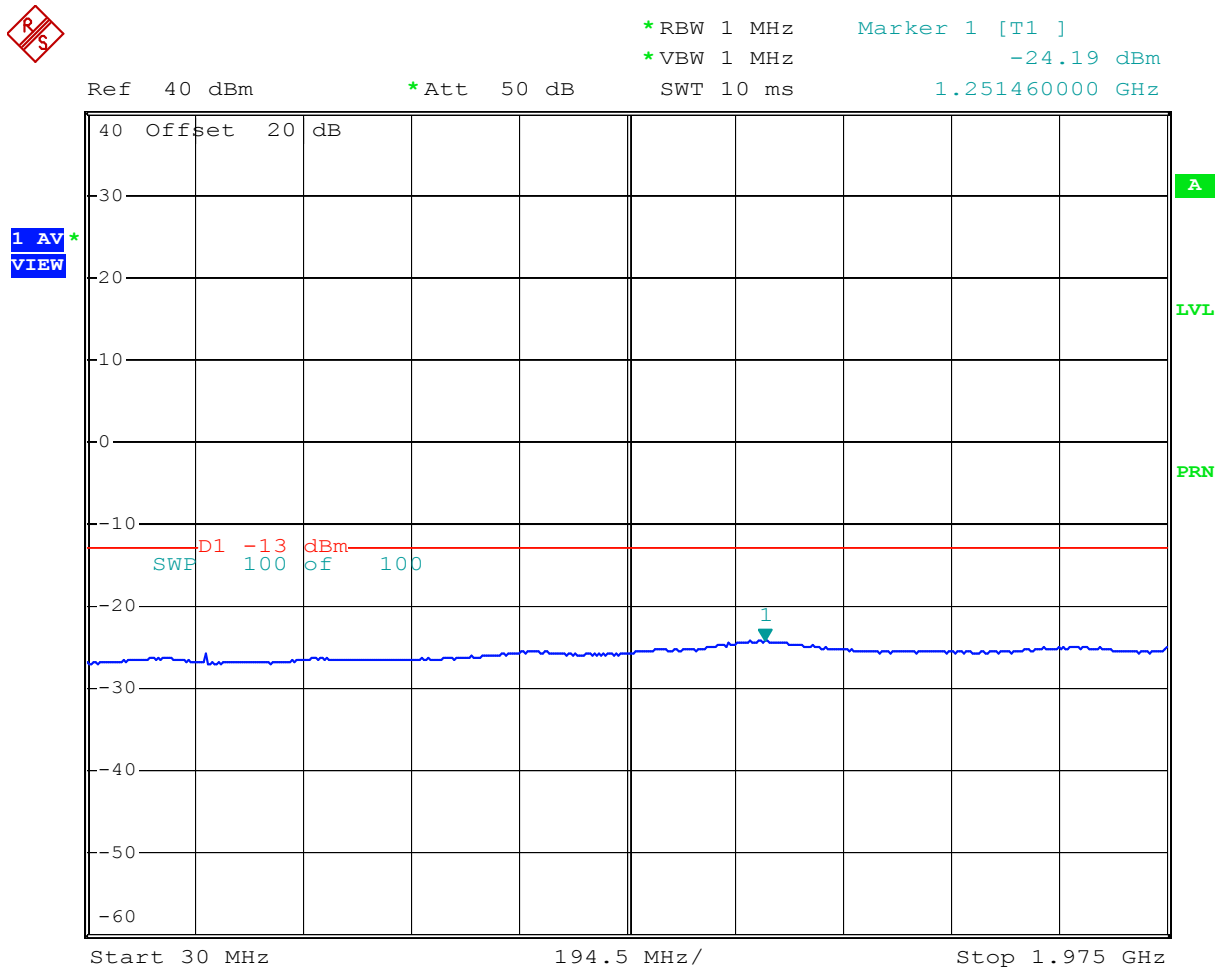
Comment: Channel 925, Out-of-band, max power, BCF=5.2 dB
 Date: 22.JUN.2004 22:32:24

Plot 5.6



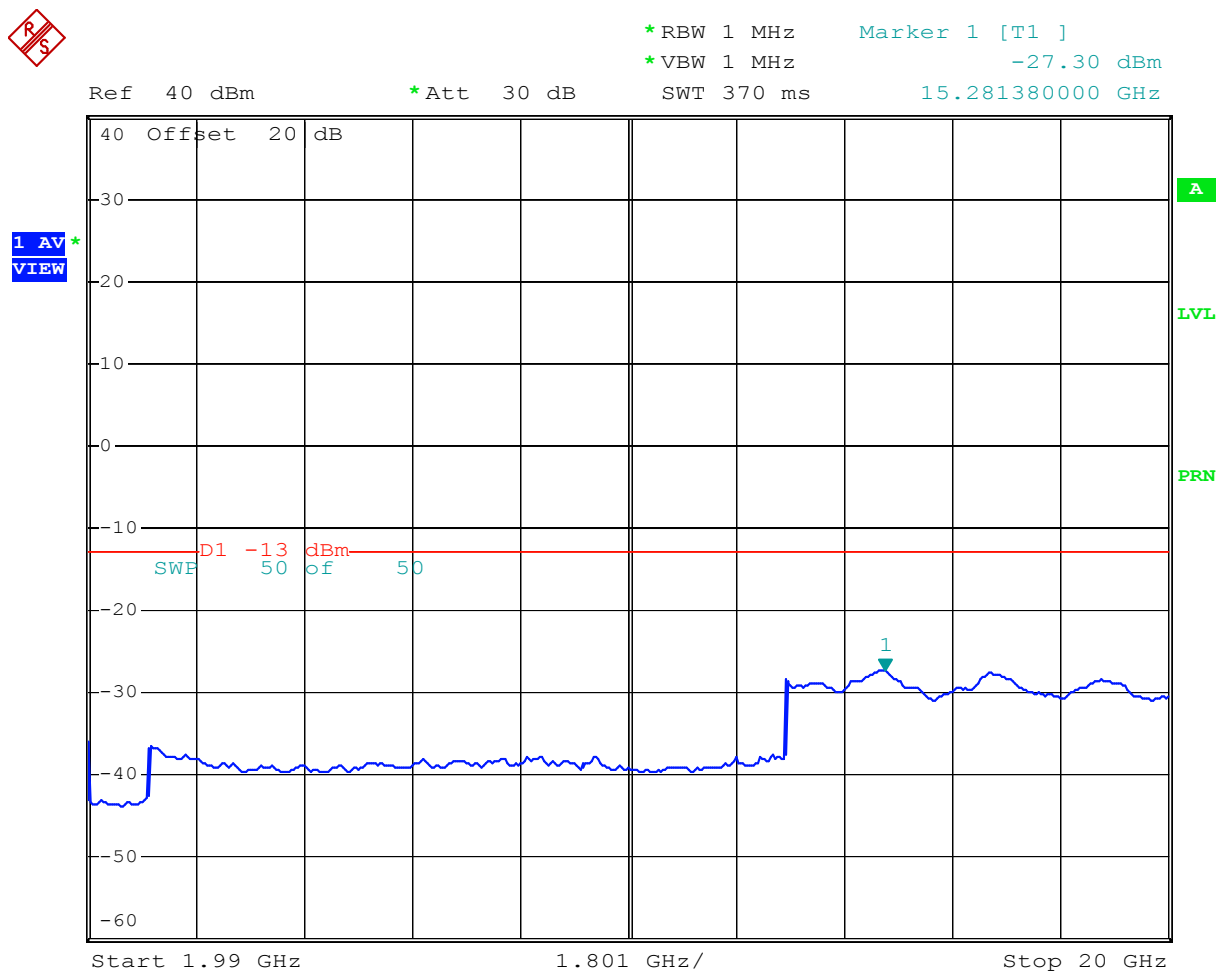
Comment: Channel 925, Out-of-band, max power
 Date: 23.JUN.2004 00:21:33

Plot 5.7



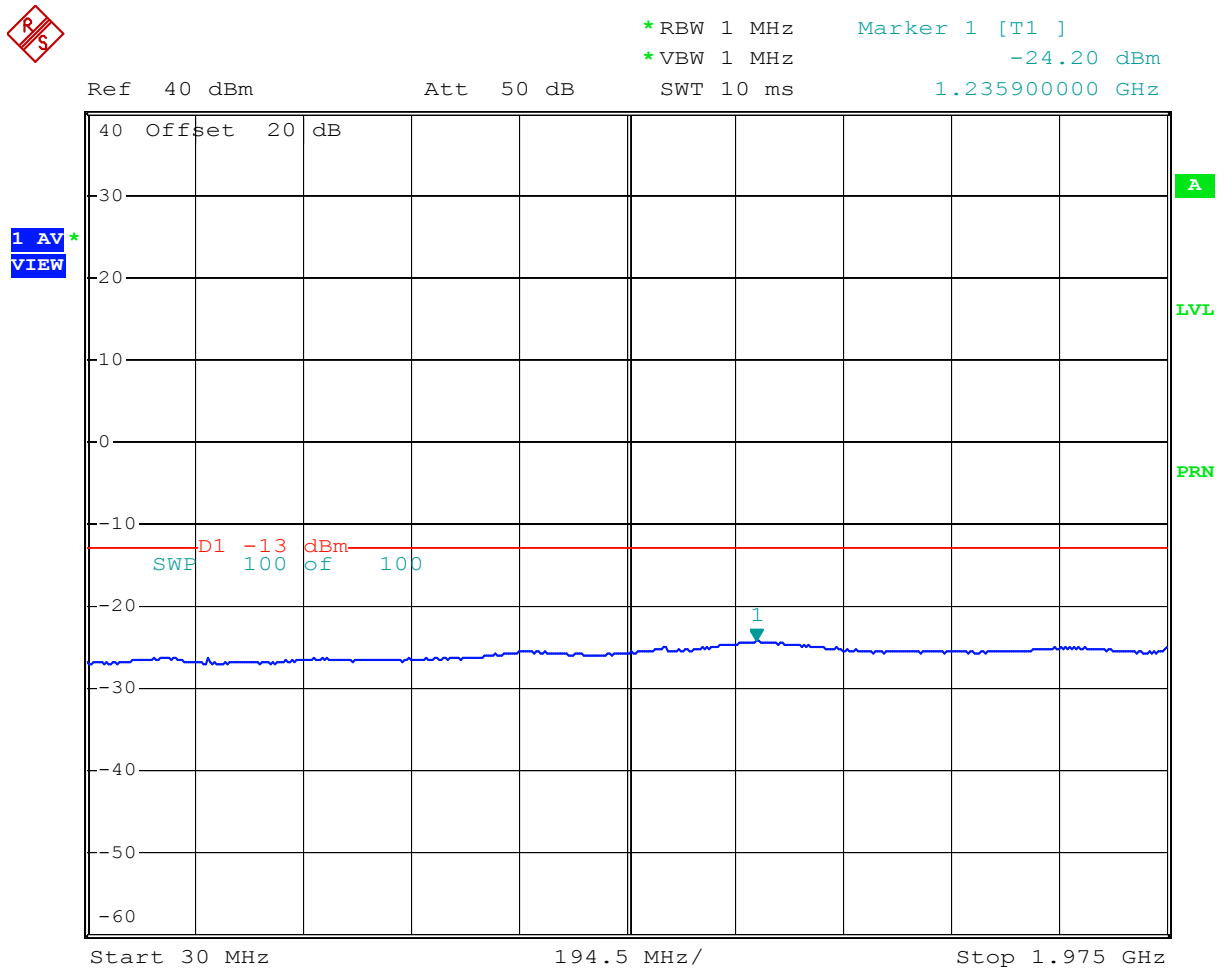
Comment: Channel 1050, Out-of-band, max power
 Date: 23.JUN.2004 00:26:38

Plot 5.8



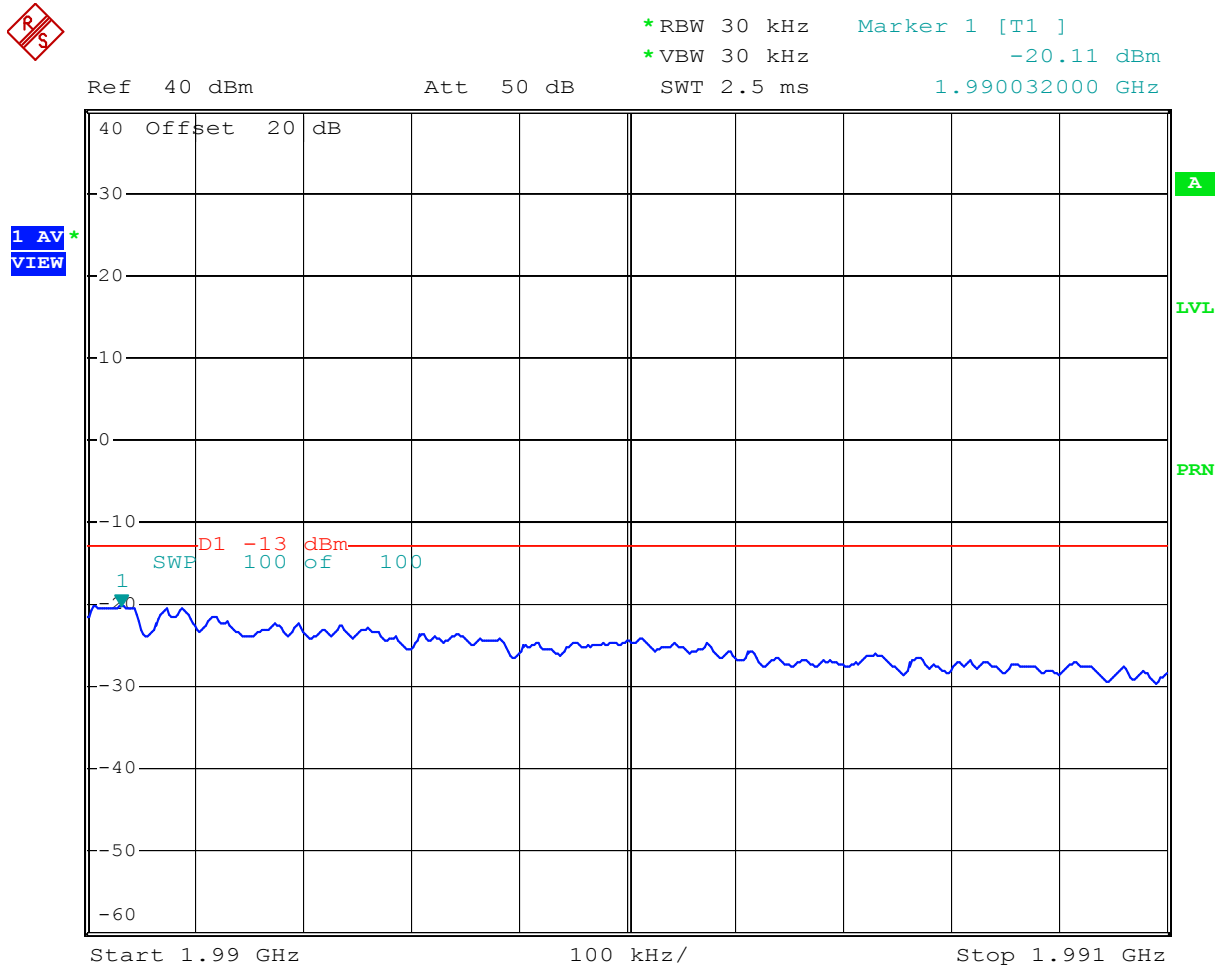
Comment: Channel 1050, Out-of-band, max power
 #Date: 23.JUN.2004 00:28:39

Plot 5.9



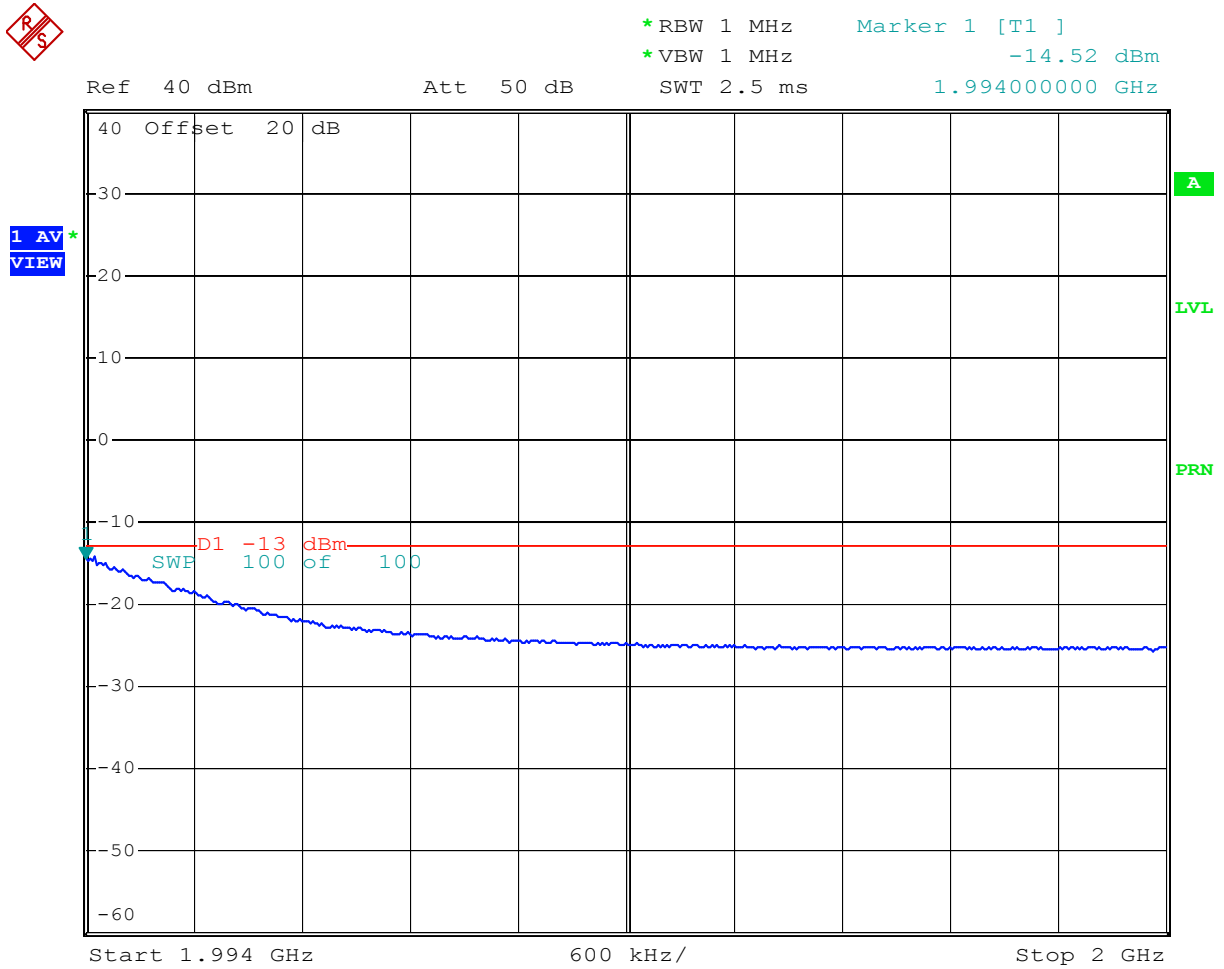
Comment: Channel 1175, Out-of-band, max power
 Date: 23.JUN.2004 01:13:12

Plot 5.10



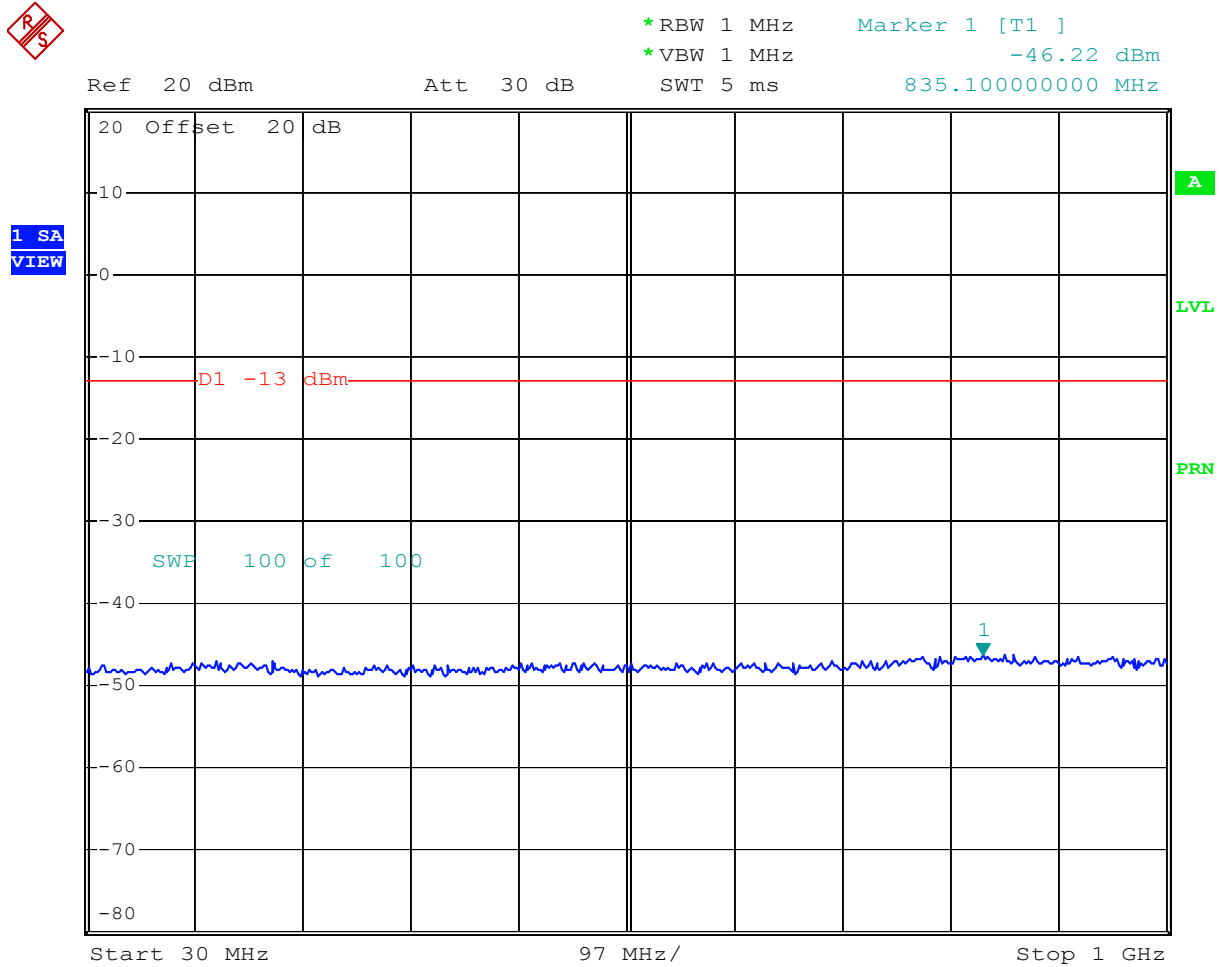
Comment: Channel 1175, Out-of-band, max power
 Date: 23.JUN.2004 00:31:48

Plot 5.12



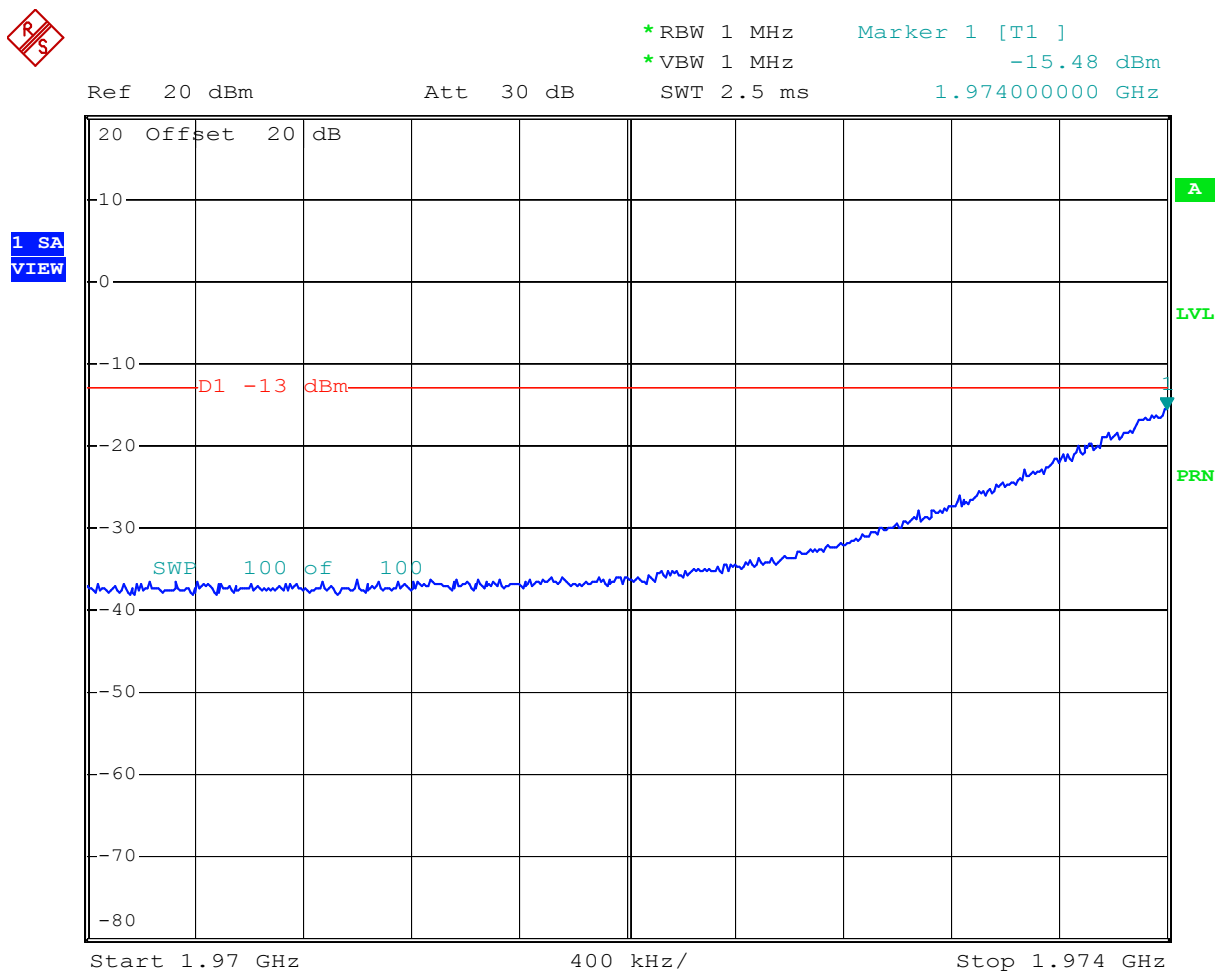
Comment: Channel 1175, Out-of-band, max power
 Date: 23.JUN.2004 00:38:30

Plot 5.14



Comment: Channel 925, out-of-band, low power
 Date: 23.JUN.2004 02:24:26

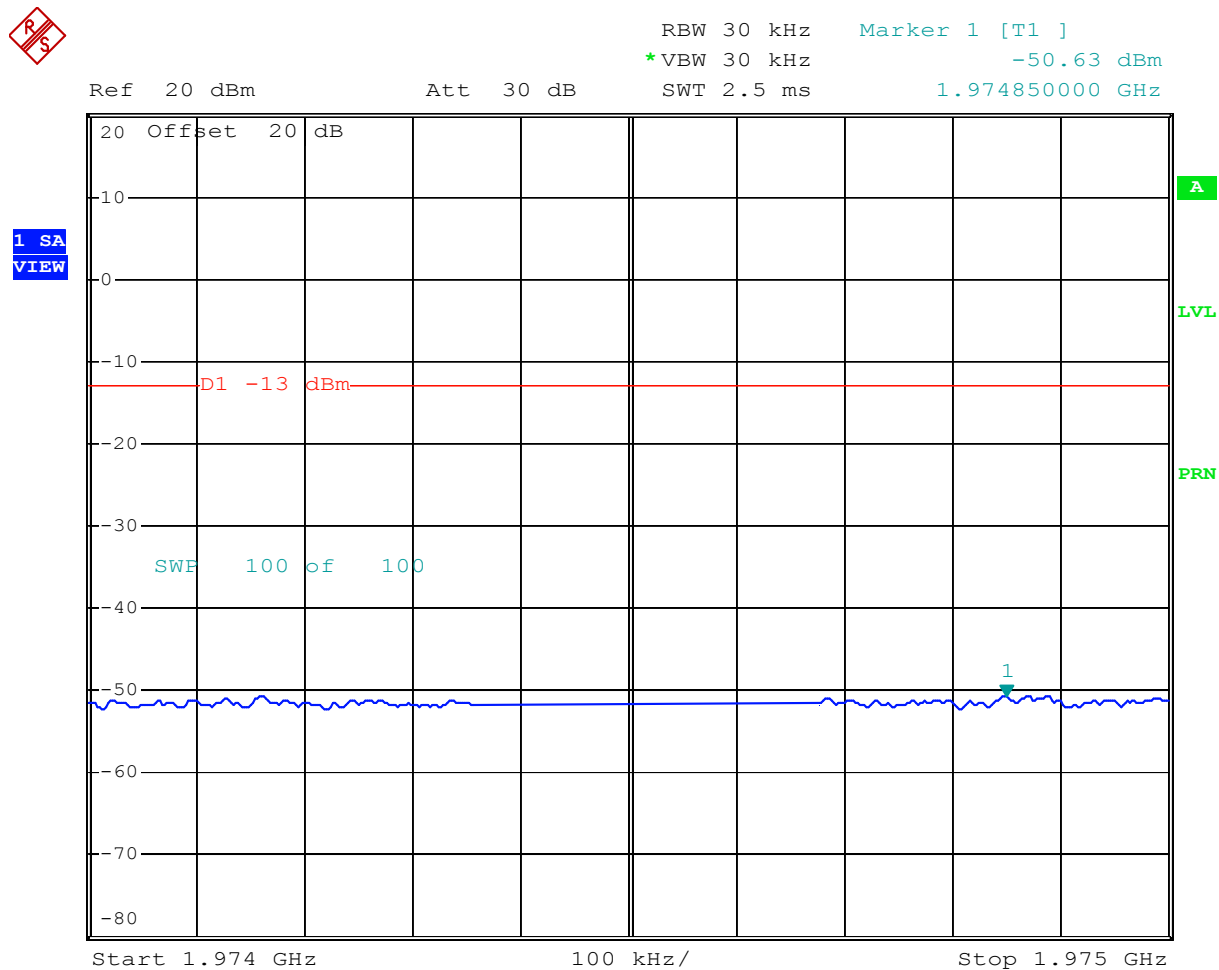
Plot 5.16



Comment: Channel 925, out-of-band, low power

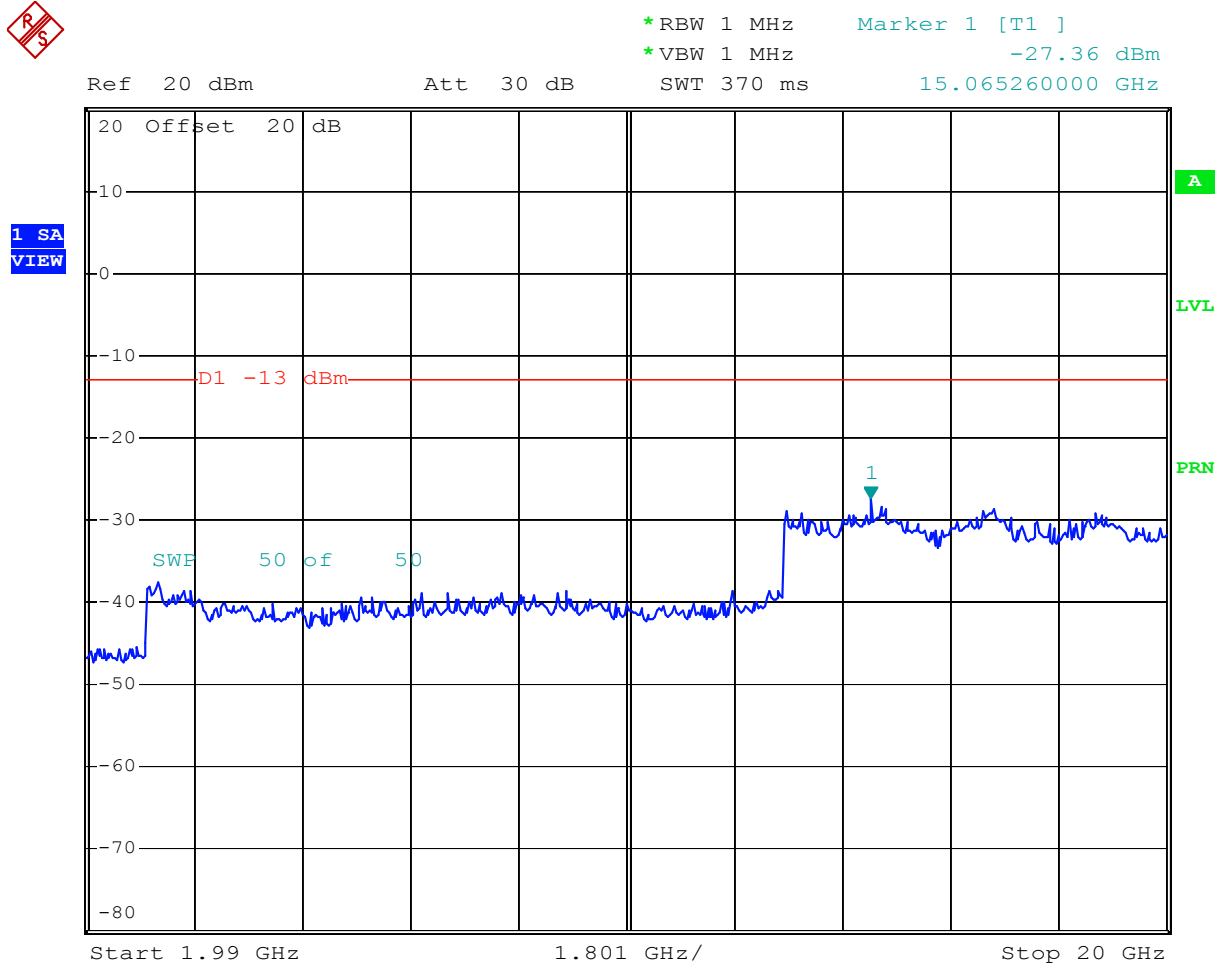
Date: 23.JUN.2004 02:22:00

Plot 5.17



Comment: Channel 925, out-of-band, low power
 Date: 23.JUN.2004 02:18:44

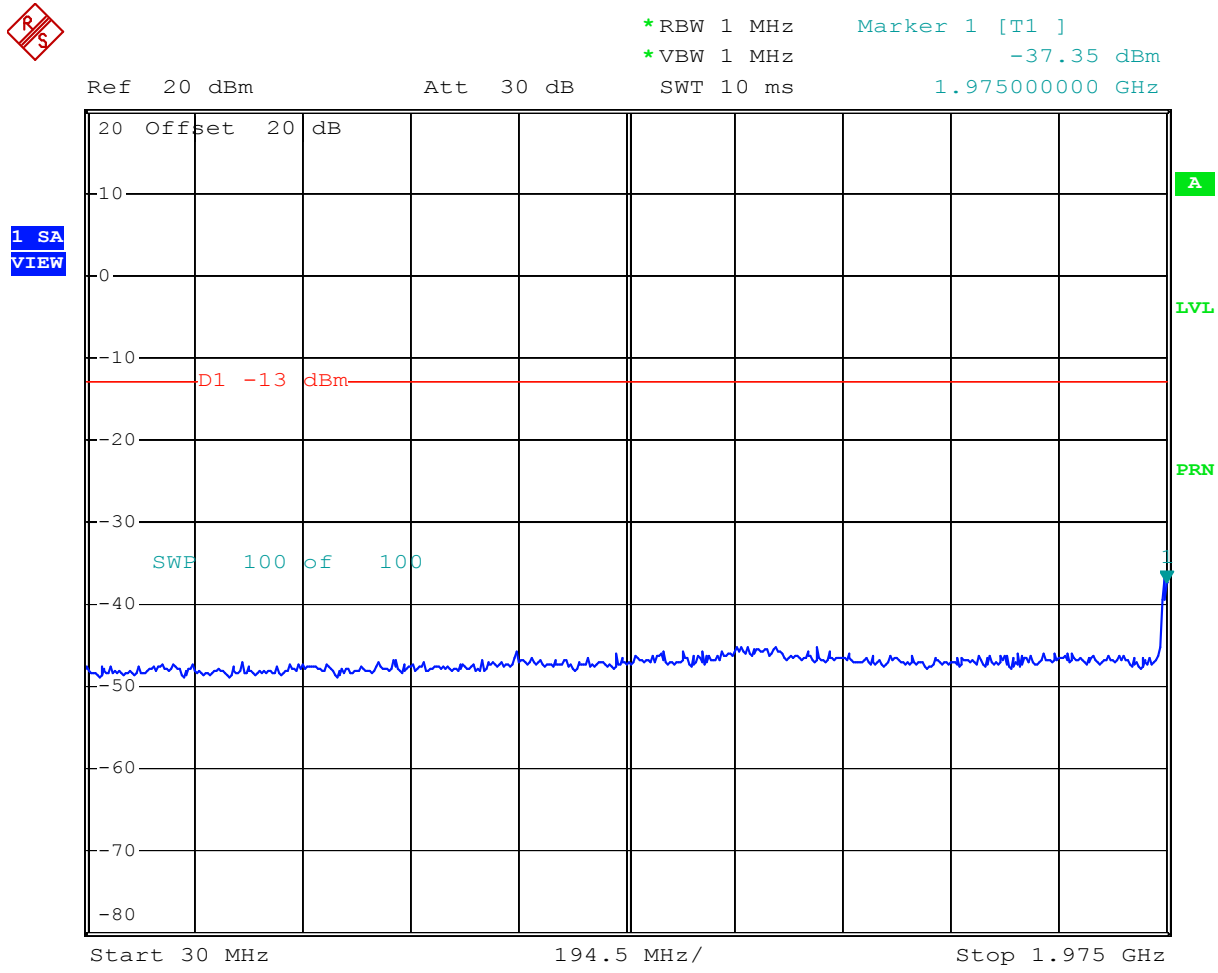
Plot 5.18



Comment: Channel 925, out-of-band, low power

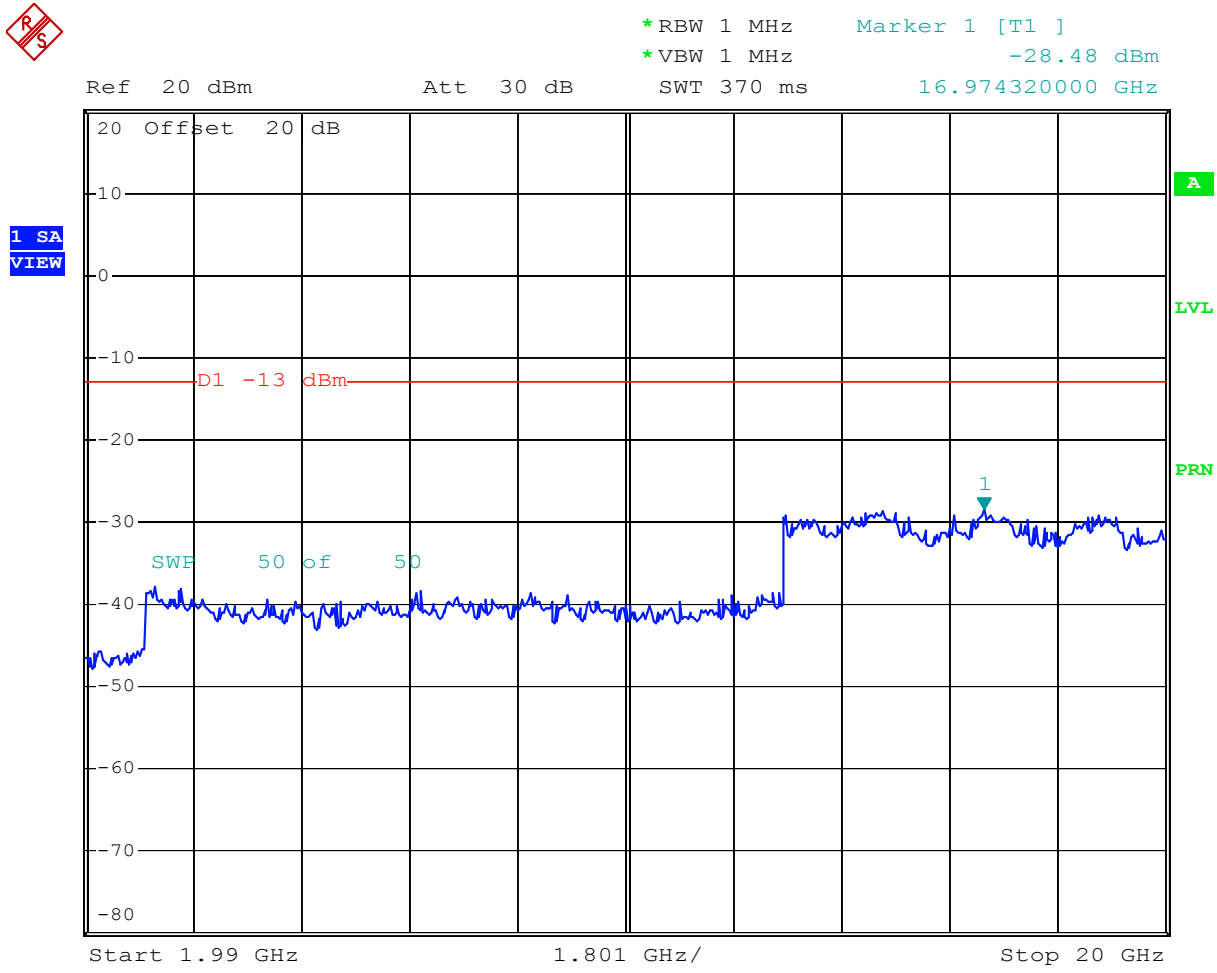
Date: 23.JUN.2004 02:26:06

Plot 5.19



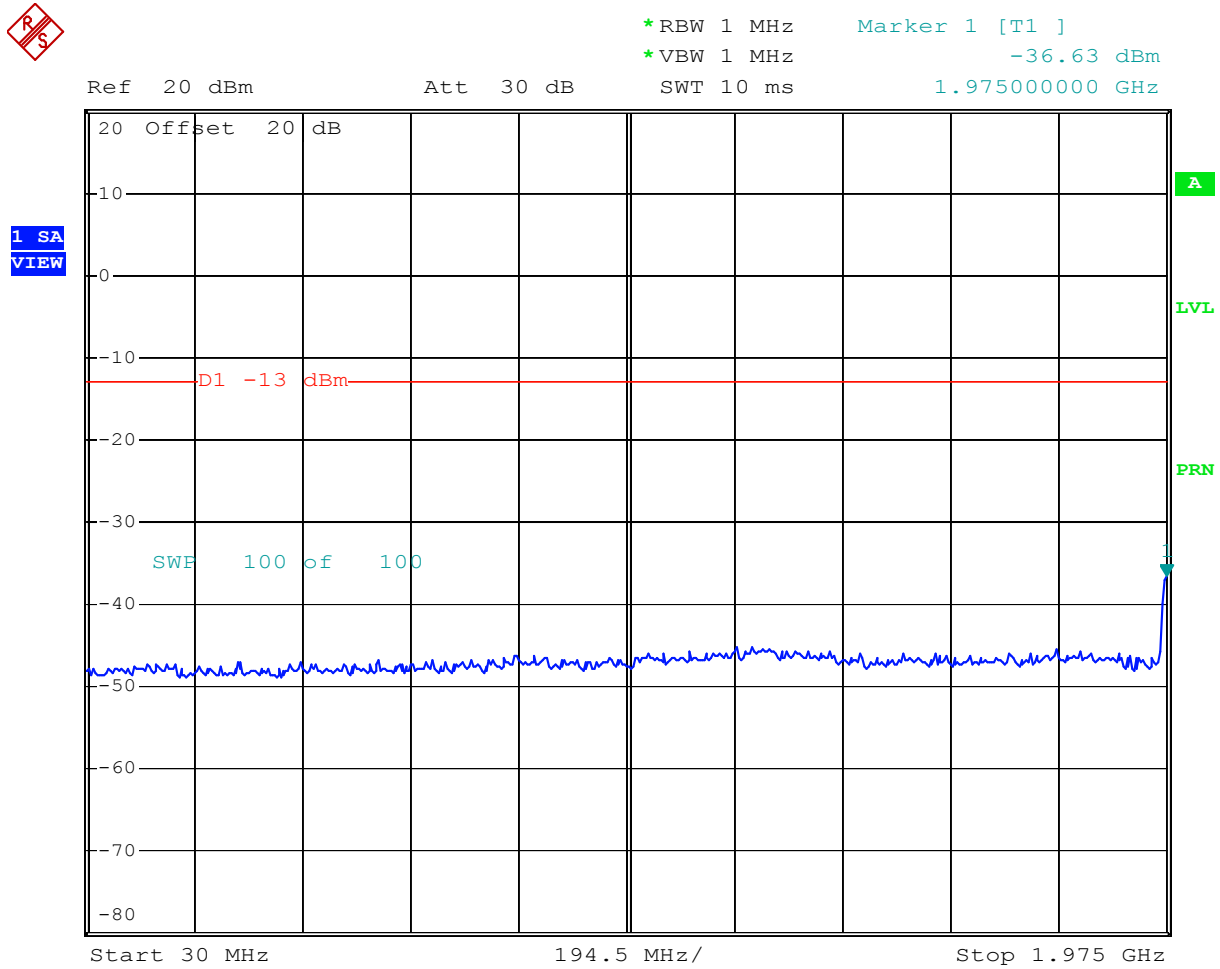
Comment: Channel 1050, out-of-band, low power
 Date: 23.JUN.2004 03:01:06

Plot 5.20



Comment: Channel 1050, out-of-band, low power
 Date: 23.JUN.2004 03:03:04

Plot 5.21



Comment: Channel 1175, out-of-band, low power
 Date: 23.JUN.2004 03:05:15

Plot 5.22

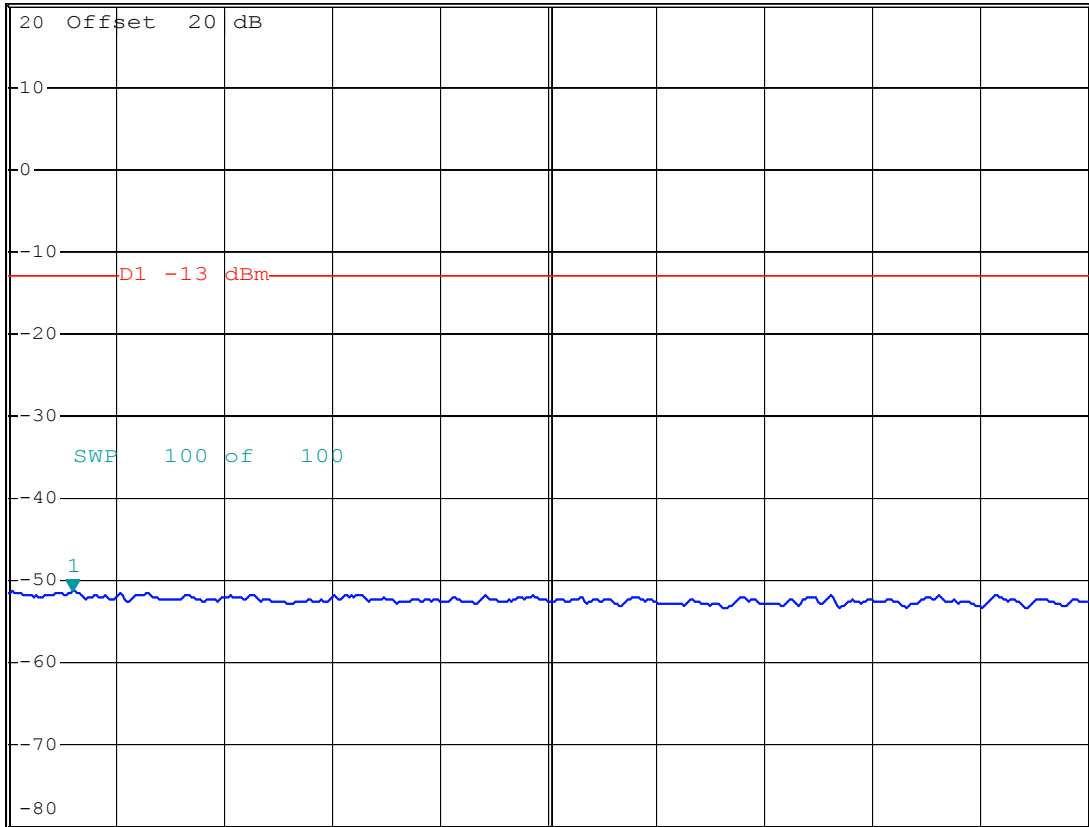


*RBW 30 kHz Marker 1 [T1]
 *VBW 30 kHz -51.24 dBm
 SWT 2.5 ms 1.990060000 GHz

Ref 20 dBm

Att 30 dB

1 SA
VIEW



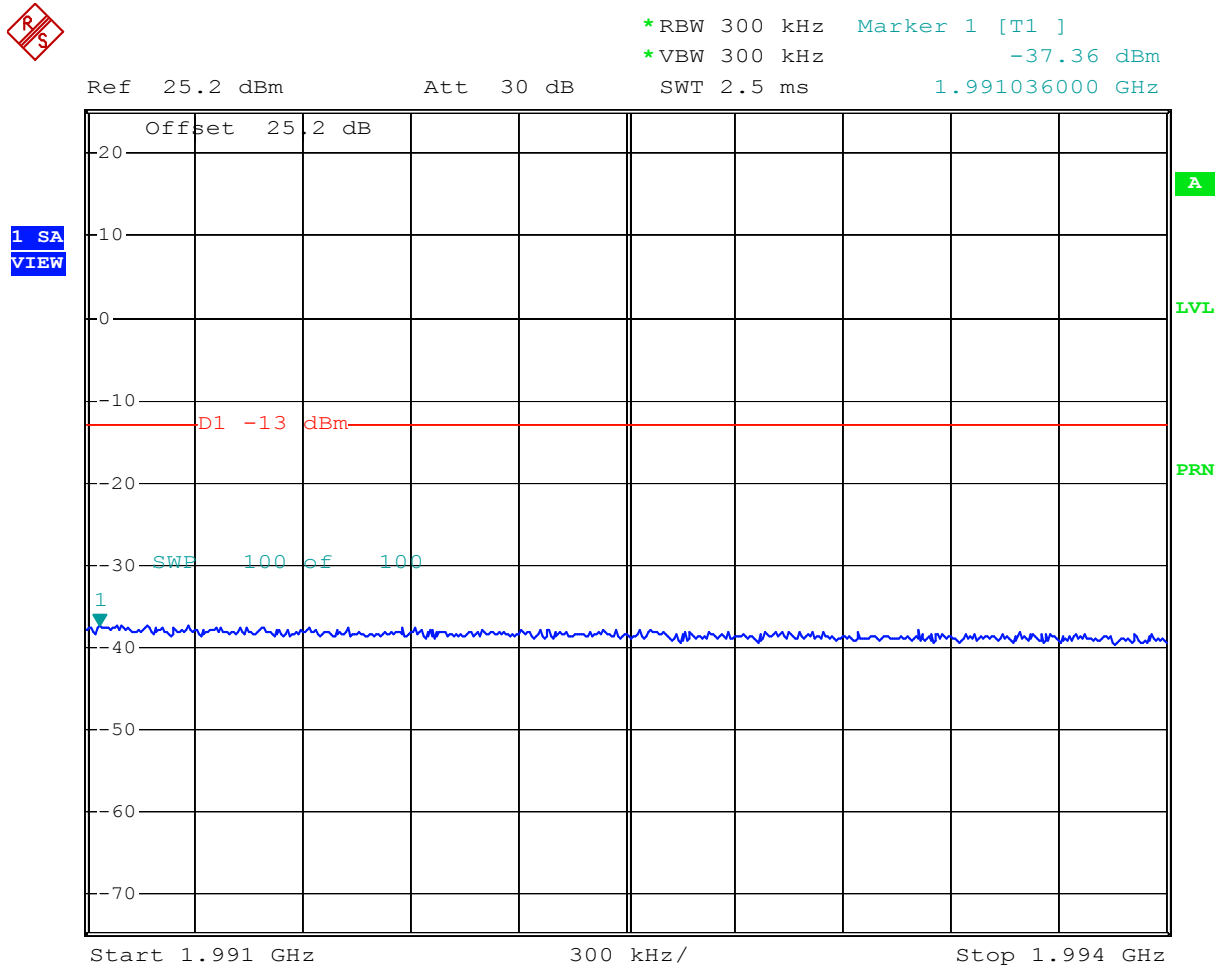
Start 1.99 GHz

100 kHz/

Stop 1.991 GHz

Comment: Channel 1175, out-of-band, low power
 Date: 23.JUN.2004 03:06:41

Plot 5.23



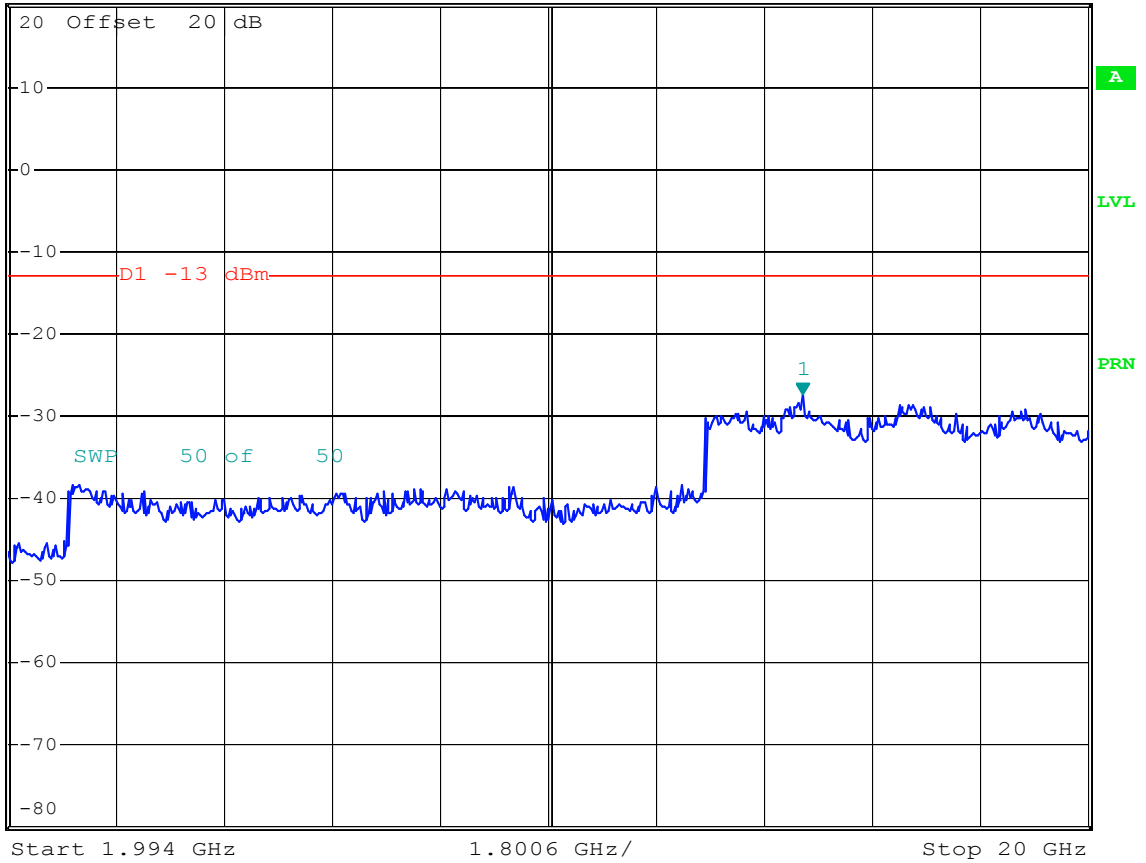
Comment: Channel 1175, out-of-band, low power, BCF=5.2 dB
 Date: 23.JUN.2004 03:09:30

Plot 5.24



*RBW 1 MHz Marker 1 [T1]
 *VBW 1 MHz -27.35 dBm
 Ref 20 dBm Att 30 dB SWT 370 ms 15.246416000 GHz

1 SA
 VIEW



Comment: Channel 1175, out-of-band, low power
 Date: 23.JUN.2004 03:11:40

6.0 Field Strength of Spurious Radiation

FCC 2.1053, 24.238

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency outside the frequency band by at least $(43 + 10 \log P)$ dB. This requirement corresponds to the limit of -13 dBm of radiated power (average value) of spurious emissions.

6.1 Test Procedure

A dummy load was connected to the EUT antenna connector. The EUT was placed on a non-conductive turntable in the 10-m anechoic chamber.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to tenth harmonic of each of the three fundamental frequency (low, middle, and high channels) was investigated.

For spurious emissions attenuation, the substitution method was used. On each frequency the EUT was substituted by a reference antenna (half-wave dipole - below 1 GHz, or Horn antenna - above 1GHz), connected to a signal generator.

The signal generator output was adjusted to obtain the same reading as from EUT. The EIRP at the spurious emissions frequency was calculated by adding the substitution antenna gain to the recorded signal generator level. The spurious emissions attenuation may be calculated as the difference between ERP at the fundamental frequency and at the spurious emissions frequency.

6.2 Test Equipment

EMCO 3115 Horn Antennas
Rohde & Schwarz FSP40 Spectrum Analyzer
HP 83732A Signal Generator
High Pass Filter
Preamplifiers

6.3 Test Results

**Effective Radiated Power
(Measured by Substitution Method)**

Frequency	SA Reading (average) (measured from EUT)	Signal Generator Output required to have the same SA Reading as from EUT	ERP *	ERP Limit	Margin
MHz	dB(μV/m) at 3m	V _g dBm	dBm	dBm	dB
<i>Tx at Channel number 925 (1976.25 MHz)</i>					
3.9525	45.3	-60.8	-51.2	-13	-38.2
5.9288	50.5	-57.3	-46.0	-13	-33.0
<i>Tx at Channel number 1050 (1982.50 MHz)</i>					
3.9650	45.6	-60.5	-50.9	-13	-37.9
5.9475	51.9	-56.5	-45.2	-13	-32.2
<i>Tx at Channel number 1175 (1988.75 MHz)</i>					
3.9775	39.6	-65.3	-55.7	-13	-42.7
5.9663	44.7	-63.1	-51.8	-13	-38.8

Temperature: 20 C, Humidity: 50%

* EIRP is calculated as: $EIRP_{(dBm)} = V_{g(dBm)} + G_{(dBi)}$
All other emissions are more than 20 dB below the limit.

Complies	Passed by more than 20 dB
----------	---------------------------

7.0 Frequency Stability vs. Temperature and Voltage

FCC 2.1055

7.1 Test Procedure

A spectrum analyzer was connected to the transmitter output via a RF attenuator. The EUT was placed inside the temperature chamber. The AC power cords and RF output cable exited the chamber through an opening made for that purpose (see the photograph).



The EUT was setup to transmit CW signal (without modulation) on channel 1075 (1983.75 MHz). The spectrum analyzer resolution bandwidth was set to 10 Hz.

After the temperature stabilized for approximately 30 minutes, the frequency output was recorded from the analyzer.

The EUT power cords were connected to a variac. The AC voltage was setup to the nominal AC value (120 V), 115% of the nominal value and 85% of the nominal value. The output frequency was recorded for each voltage.

7.2 Test Equipment

Temperature Chamber, -20⁰C to +70⁰C

Rohde & Schwarz FSP40 Spectrum Analyzer

7.3 Test Results

Test Result:	Complies
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Tx Frequency: 1983,750000 MHz
 Tolerance: +/- 100 Hz (per AW-96 specification)

Temperature (°C)	Frequency (MHz)	Difference (Hz)
50	1983,750000	0
40	1983,750000	0
30	1983,750000	0
20	1983,750000	0
10	1983,750000	0
0	1983,750000	0
-10	1983,750000	0
-20	1983,750000	0

No difference in frequency was observed in the temperature range from -20°C to +50°C

Tx Frequency: 1983,750000 MHz
 Tolerance: +/- 100 Hz (per AW-96 specification)

AC power Volts	Frequency (MHz)	Difference (Hz)
120	1983,750000	0
138	1983,750000	0
102	1983,750000	0

No difference in frequency was observed in the AC voltage range from 102 V to 138 V

8.0 RF exposure evaluation
FCC 2.1091

The EUT is a device used in fixed application. The maximum conducted power is 20 W. To show compliance with RF Exposure Requirement, the MPE was calculated assuming that antenna gain is 17 dBi.

The maximum Peak EIRP calculated is 1002 W.

The Power Density may be calculated using the formula: $S = \text{EIRP} / 4\pi D^2$

where: S is Power Density in W/m²

D is the distance from the antenna.

In the table below, the calculated Power Density and MPE Limit for General population/uncontrolled exposure and for Occupational/controlled exposure are presented.

Distance, m	Power Density, W/m ²	MPE, W/m ²	
		general population/uncontrolled exposure	occupational/controlled exposure
1.0	79.7	10.0	50.0
1.5	35.4	10.0	50.0
2.0	19.9	10.0	50.0
2.5	12.8	10.0	50.0
3.0	8.9	10.0	50.0

As can be seen from the data, the RF exposure requirements are met at 1.5 m for occupational/controlled environment and at 3 m for general population/uncontrolled environment.

9.0 List of test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	9/09/04
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	9/08/04
Spectrum Analyzer	Rohde & Schwarz	FSP40	036612004	12	2/04/05
BI-Log Antenna	EMCO	3143	9509-1160	12	10/01/04
Double-ridged Horn Antenna	EMCO	3115	9170-3712	12	8/02/04
Double-ridged Horn Antenna	EMCO	3115	8812-3049	12	4/08/05
Horn Antenna	EMCO	3160-09	Not Labeled	#	#
Pre-Amplifier	Sonoma Inst.	310	185634	12	9/21/04
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	9/06/04
Pre-Amplifier	CTT	ALO/400-8023	47526	12	3/25/05
Signal Generator	Hewlett Packard	83732A	3222A00119	12	3/04/05

No calibration required

10.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / 3059390	DC	June 30, 2004	Original document