

Test report no. : 108941-5

Item tested : MC-CD-PLL-458

Type of equipment : Low Power Transceiver Module

FCC ID : TB8MC-CD-458

Client : Cavotec Micro-Control AS

FCC Parts 90.217(a)

Licensed Transmitter

RSS-119, Issue 9

Land Mobile and Fixed Radio Transmitters and Receivers
Operating in the Frequency Range 27.41-960 MHz

25 July 2008

Authorized by : Frode Sveinsen

Frode Sveinsen
Technical Verificator



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1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko AS
Address : Nemko Comlab
Gåsevikveien 8, Box 96
N-2027 Kjeller, NORWAY
Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
E-mail: comlab@nemko.com
FCC test firm registration # : 994405
IC OATS registration # : 2040D-1
Total Number of Pages: 31

1.2 Client Information

Name : Cavotec Micro-Control AS
Address : Wesselsvei 2, 7500 Stjørdal, Norway

Contact:

Name : Stian Arntsen
Phone : +47 74 83 98 60
E-mail : stian.arntsen@cavotec.com

1.3 Manufacturer

Name : Cavotec Micro-Control AS
Address : Wesselsvei 2, 7500 Stjørdal, Norway



2 Test Information

2.1 Test Item

Name :	Low Power Transceiver Module
FCC ID :	TB8MC-CD-458
Model/version :	MC-CD-PLL-458 or MC-CD-TRX-458
Serial number :	N/A
Hardware identity and/or version:	2
Software identity and/or version :	080612
Frequency Range :	458.525 – 459.175 MHz
Tunable Bands :	1
Channel separation:	25kHz
Emissions Designator :	20K0F2D
Number of Channels :	23
Type of Modulation :	FSK
User Frequency Adjustment :	None, Software controlled
Rated Output Power :	10mW
Type of Power Supply :	DC 6 – 15V
Antenna Connector :	Integral antenna only
Desktop Charger :	N/A

Theory of Operation

The MC-CD-PLL and MC-CD-TRX modules are operating in frequency band 458.525 – 459.175 MHz. The device is used for industrial applications such as overhead cranes, chain hoist, winches etc. The models MC-CD-PLL and MC-CD-TRX are identical except for the programming interface.

The required frequencies, modulation and modes are selected by preprogrammed software on the EUT.

Exposure Evaluation

The EUT is exempted from RF Exposure Evaluation to Industry Canada SAR requirements since the time averaged Output Power is below the limit in RSS-102 Issue 2, clause 2.5.1 for General Public Use.

2.2 Test Environment

2.2.1 *Normal test condition*

Temperature: 22 - 23 °C

Relative humidity: 30 - 50 %

Normal test voltage: 7.2 V DC

The values are the limit registered during the test period. All tests except the Frequency Stability

The Frequency stability test was performed with a regulated DC Power Supply.

2.3 Test Period

Item received date: 2008-06-17

Test period: from 2008-07-04 to 2008-07-08



3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Cavotec Micro-Control AS

Model No.: See paragraph 2.1

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 90 and Industry Canada RSS-119 Issue 9.

Radiated tests were conducted in accordance with ANSI C63.4-2003. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10metres.

<input checked="" type="checkbox"/> New Submission	<input checked="" type="checkbox"/> Production Unit
<input type="checkbox"/> Class II Permissive Change	<input type="checkbox"/> Pre-production Unit
TNB Equipment Code	<input type="checkbox"/> Family Listing

THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

**Deviations from, additions to, or exclusions from the test specifications are described in
“Summary of Test Data”.**



TEST REPORT #: 108941-5

TESTED BY: G.Suhanthakumar
G.Suhanthakumar, Test Engineer

DATE: 25 July 2008

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3.2 Test Summary

Name of test	FCC Parts 2 and 90 reference	RSS-119 Issue 9 reference	Result
RF Power Output	2.1046, 90.217	5.4	Complies
Occupied Bandwidth	2.1049, 90.217	5.5	Complies
Conducted transmitter spurious emissions	2.1051, 2.1057, 90.217	5.10	Complies
Field Strength of Transmitter Spurious Radiations	2.1053, 2.1057, 90.217	5.10	Complies
Frequency Stability	2.1055, 90.217	5.3	Complies
Exemption from technical standards	90.217(a)	5.10	Complies
Receiver Spurious Emissions	/	5.11	Complies

¹ The tested equipment only transmits messages and uses digital modulation.

² The tested equipment has integrated antenna only.

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

The tested equipment does not have any mechanism for frequency selection. The frequency is changed by programming the unit and by tuning the antenna.

3.5 Family List Rational

Not applicable.



4 TEST RESULTS

4.1 RF Output Power, ERP

Para. No.: 2.1046, 90.217

Test Performed By: G.Suhanthakumar	Date of Test: 08-Jul-08
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Test Results: Complies

Measurement Data:

MC-CD-PLL-458:

Frequency	Maximum ERP dBm	Maximum ERP mW	Conducted power at 50 ohm dBm	Conducted power at 50 ohm mW	Calculated antenna gain* dBi
458.525 MHz	5.28	3.37	9.82	9.59	-4.54
458.850 MHz	3.21	2.09	9.36	8.62	-6.15
459.175 MHz	5.88	3.87	8.93	7.82	-3.05

* gain = 10 log (ERP/conducted power).

The EUT always transmit at maximum output power. No change of out-put power is observed due to test voltage variation from 6 to 15 V DC.

This measurement was performed with a RBW of 100 kHz and Peak Detector.

The measurement is performed with the substitution method in accordance with ANSI/TIA-603-B-2002 test standard and with the EUT transmitting continuously and unmodulated.

The EUT was rotated in 3 planes during testing. The procedure was repeated with vertical and horizontal polarization. The maximum e.r.p. is obtained at horizontal polarization. Measured at 10 m distance

The tested equipment has integral antenna only. But for testing purposes a temporary 50 ohm connector is provided.

Requirements:

Less than 120 mW (+20.792 dBm)

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in Subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart.



4.2 Occupied Bandwidth

Para. No.: 2.1049, 90.217(a)

Test Performed By: G.Suhanthakumar	Date of Test: 07-Jul-08
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Test Results: Complies

The EUT is designed to operate with a 25kHz channel bandwidth. The measured emissions at \pm 25kHz from assigned frequency is 35 dB below the unmodulated carrier.

$$B_n = 2M + 2DK$$

Where: B_n = Necessary Bandwidth

M = Maximum modulation frequency

For Data transmission , $M = B/2$, Where: B = Modulation rate in Baud

D = Peak deviation, K = Constant , For Data transmission this is typically 1.2

25kHz:

FSK, 9600bps with 3.15 kHz deviation (according to operation Guide STD-302N-R-458M)

We have $B=9.6$, $D=3.15$, $K=1.2$ and

$$B_n = 9600 + 2 \times 3150 \times 1.2 = 17160$$

The measurements are performed with voltages minimum (6.0Vdc). Nominal(7.2Vdc) and maximum (15Vdc). The temperature from -30 ° C to +50 ° C , with 10 ° C step.

Measurement Data:

See attached graph.

For this test the EUT was made to transmit continuously with modulation activated.

Requirements:

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in Subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart, but must instead comply with the following:

(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.



4.3 Field Strength of Spurious Radiations

Para. No.: 2.1053, 2.1057, 90.217 (a)

Test Performed By: G.Suhanthakumar

Date of Test: 04-Jul-08

Test Results: Complies

Measurement Data:

Spurious Frequency MHz	erp/eirp nW	erp/eirp dBm	Difference between Carrier and emission dB	Limit Below the carrier dB
50	1.89	-57.2	54	>30
129	2.38	-56.2	52	>30
2292.6	69.49	-41.6	38	>30
2751.2	20.76	-46.8	44	>30
3209.9	35.00	-44.6	41	>30
4126.8	44.88	-43.5	40	>30
All other harmonics	< 1	< -60	>60	>30

Under 1 GHz e.r.p. measured relative to half dipole and over 1GHz e.i.r.p. (effective Isotropic radiated power) measured. The spurious plots scan are in dBuv/m. The is is only a scan to locate frequencies. After locating the frequencies , these frequencies were individually maximized in dBm scale without the transducer factor.

The measurement is performed with the substitution method in accordance with ANSI/TIA-603-B-2002 test standard.

ERP (dBm)= power (dBm) – cable loss(dB) + Antenna gain (dBi)

For 50MHz ; ERP = -82 dBm+24.8 dB(cable loss + antenna gain) = -57.2 dBm

Worst case spurious under 1GHz is observed in VP and over 1GHz in HP.

The harmonics below 1GHz are checked with RBW of 100 kHz and Peak Detector. All other harmonics from 1 to 5 GHz are measured with 1 MHz RBW and Peak Detector.

The measurement was performed at 3m distance above 1GHz & 10m distance below 1GHz. All other harmonics which are lower than the ones reported above are not listed.

The harmonics for the units on highest and lowest frequency did not differ significantly from the values reported above.

EUT was transmitting continuously with modulation activated. The EUT was rotated in 3 planes for this test.

Conducted:

The measured harmonics are over 50 dB below the out-put power. And none other spurious detected between 9kHz to 5GHz. See attached graph

Requirements:

(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

In all of the measurements set forth in 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.



4.4 Frequency Stability

Para. No.: 2.1055, 90.217(a)

Test Performed By: G.Suhanthakumar

Date of Test: 07-Jul-08

Test Results: Complies

Measurement Data:

Temperature	Measured Frequency (MHz)	Deviation (kHz)	Deviation (ppm)
+50 degrees C	458.52433	-0.78	1.70
+40 degrees C	458.52473	-0.38	0.80
+30 degrees C	458.52499	-0.12	0.26
+20 degrees C	458.52511	Reference	Reference
+10 degrees C	458.52553	+0.42	0.92
0 degrees C	458.52581	+0.7	1.50
-10 degrees C	458.52598	+0.87	1.89
-20 degrees C	458.52590	+0.79	1.72
-30 degrees C	458.52573	+0.62	1.35

Nominal test voltage is used over temperature extremes.

Voltage	Measured Frequency (MHz)	Deviation (kHz)	Deviation (ppm)
15 Volts DC	458.52511	0	0
7.2 Volts (Nominal)	458.52511	Reference	Reference
6 Volts (lowest operating voltage)	458.52511	0	0

Comment: The Occupied Bandwidth Plots shows that the margin to the power mask is about 10 kHz, the Frequency Stability is within this limit.

Requirements:

(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier..

4.5 Receiver Spurious Emissions

Measurement Procedure:

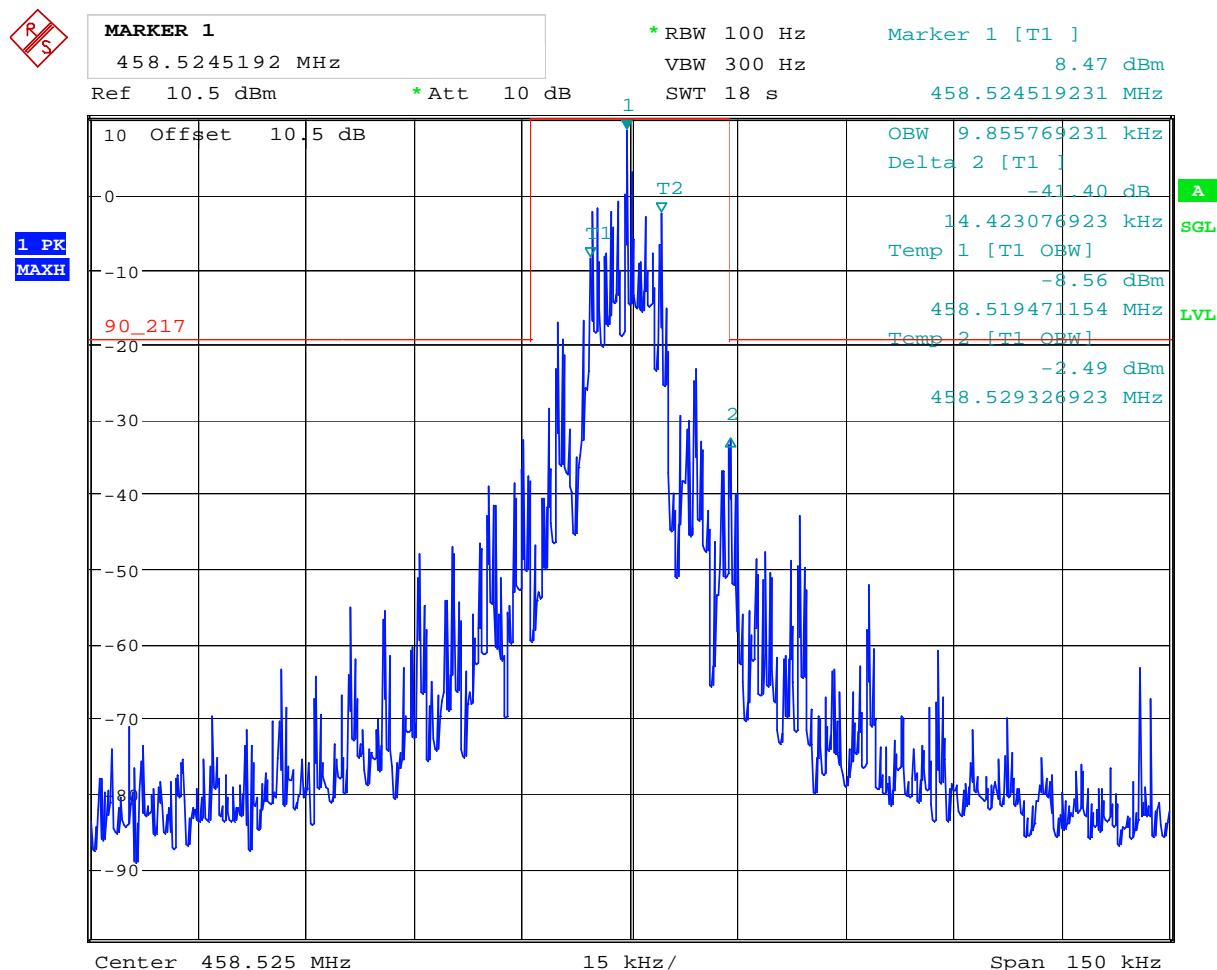
Industry Canada RSS-119 paragraph 5.11 and RSS-GEN paragraphs 4.10 and 6.

Test results:

See plot. No other Spurious Emissions from the Receiver were detected.

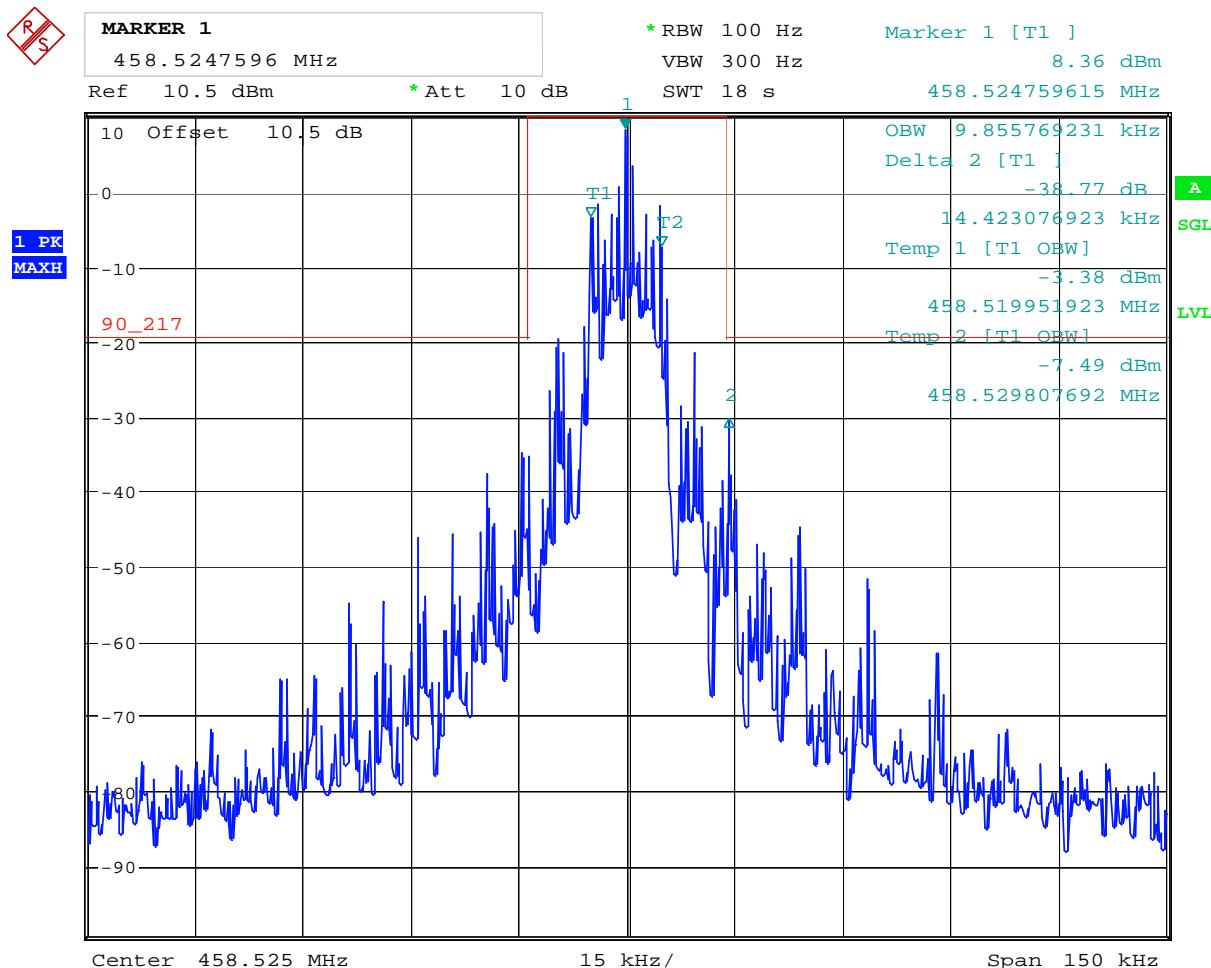
5 GRAPHS

OCCUPIED BANDWIDTH:



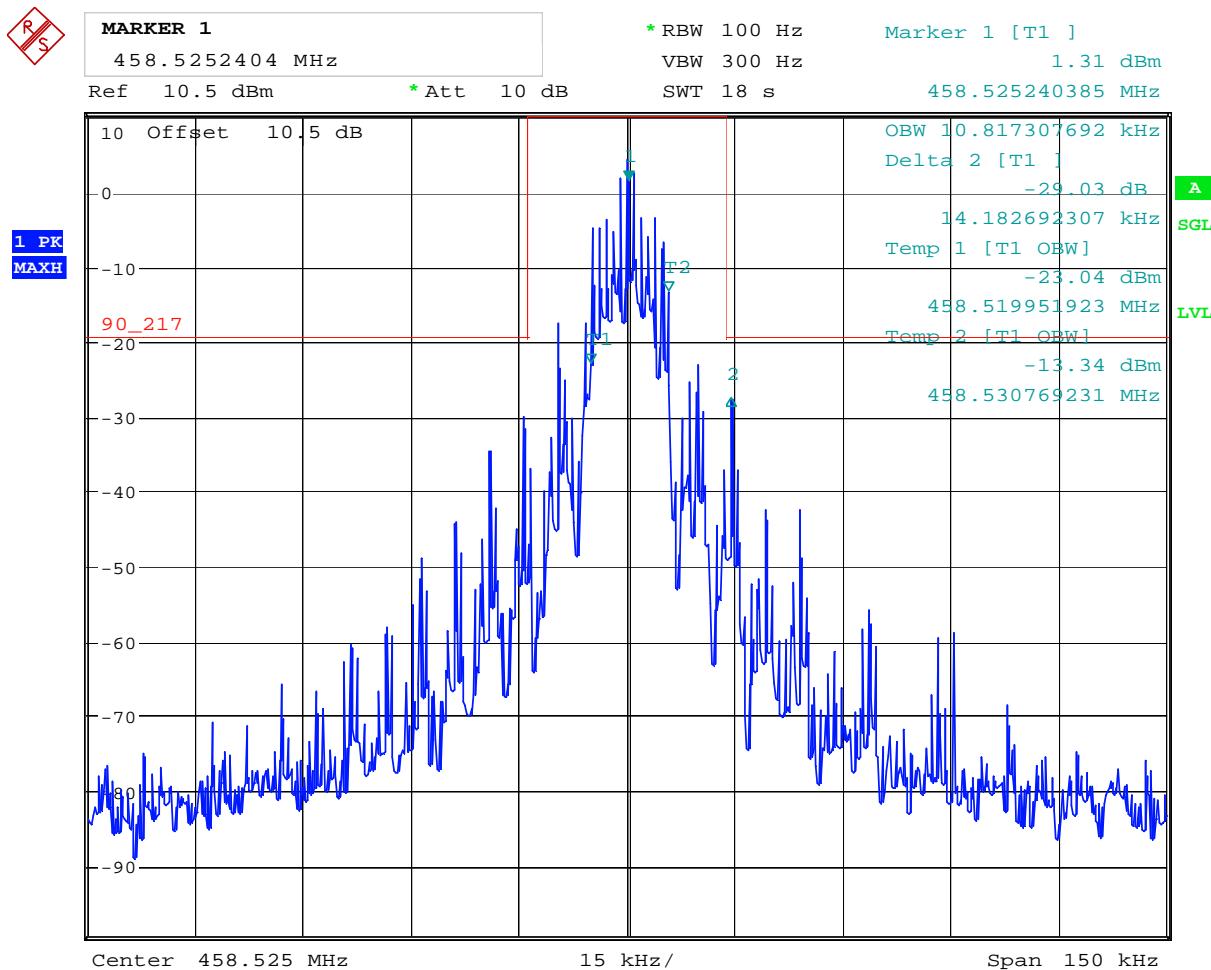
Date: 7.JUL.2008 13:47:06

Occupied Bandwidth, +50°C



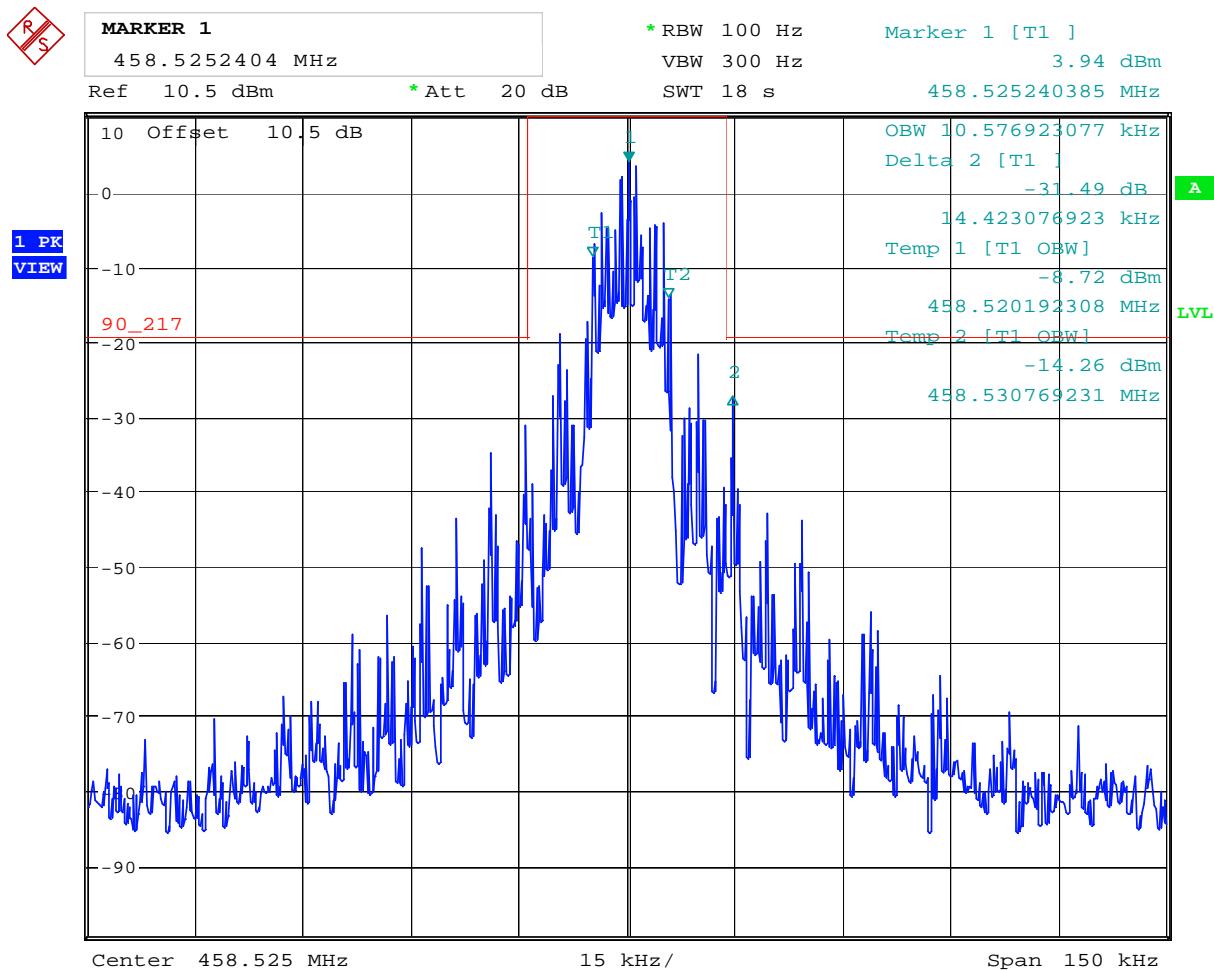
Date: 7.JUL.2008 13:14:45

Occupied Bandwidth, +40°C



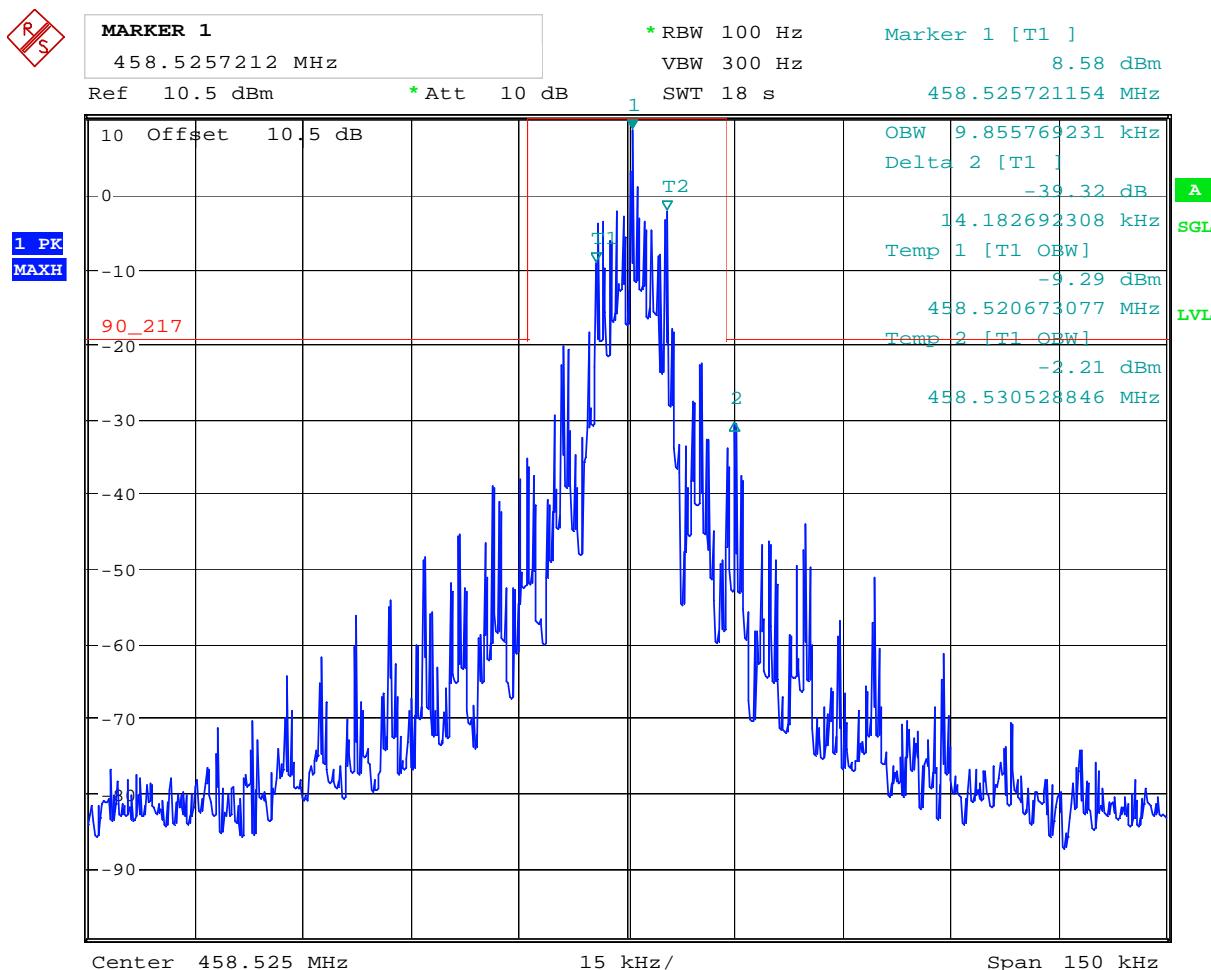
Date: 7.JUL.2008 12:25:33

Occupied Bandwidth, +30°C



Date: 7.JUL.2008 08:53:16

Occupied Bandwidth, +20°C



Date: 7.JUL.2008 14:35:14

Occupied Bandwidth, +10°C



MARKER 1
458.5259615 MHz

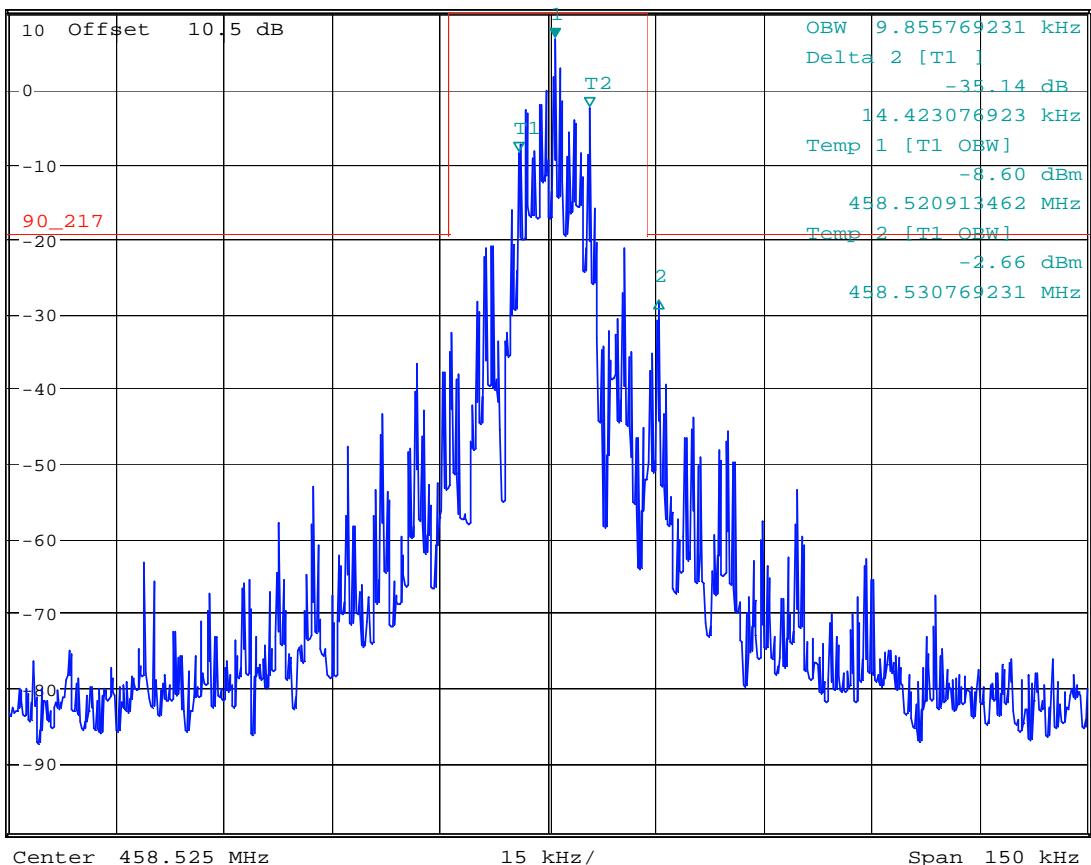
Ref 10.5 dBm * Att 10 dB

* RBW 100 Hz
VBW 300 Hz

SWT 18 s

Marker 1 [T1]
6.64 dBm
458.525961538 MHz

1 PK
MAXH

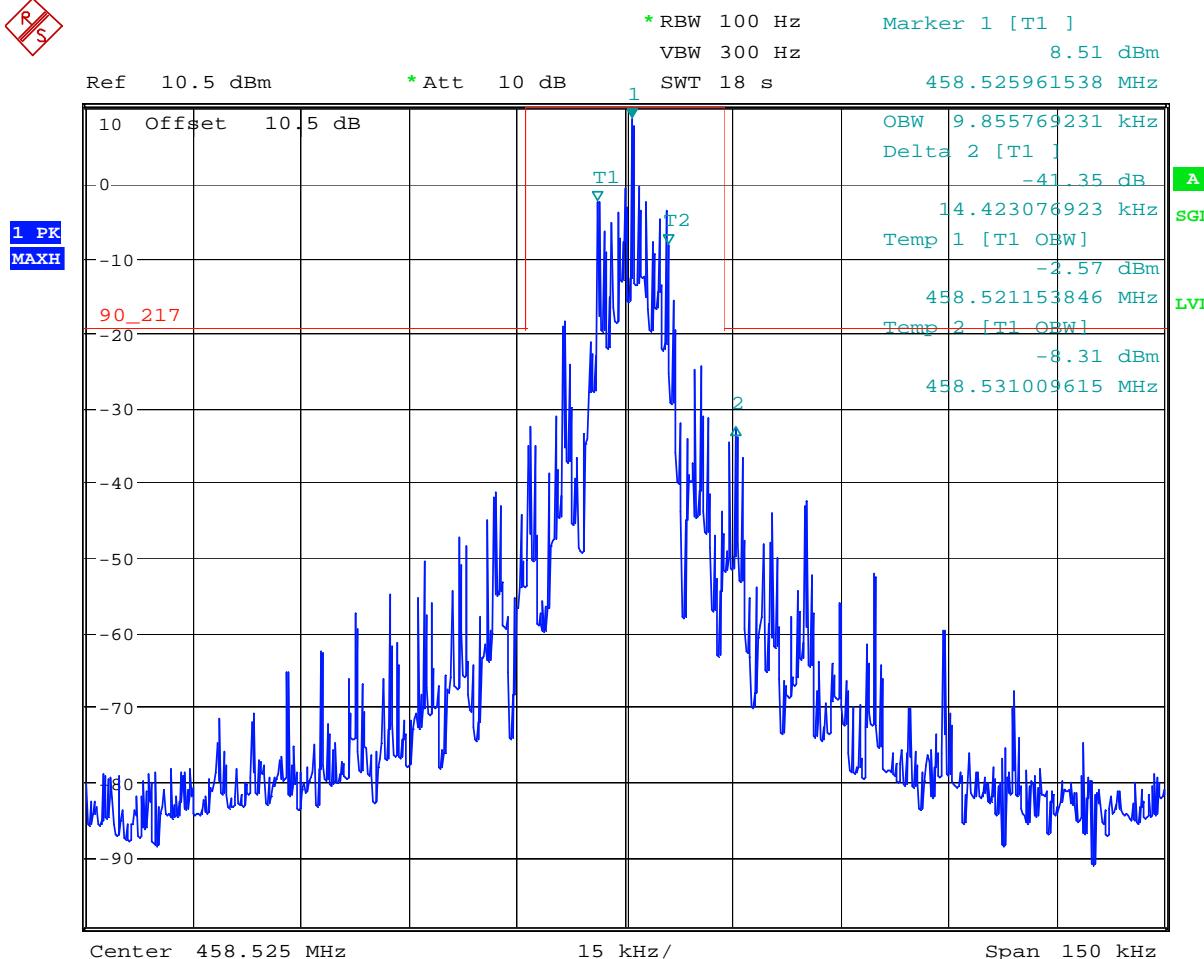


Date: 7.JUL.2008 15:02:18

Occupied Bandwidth, 0°C

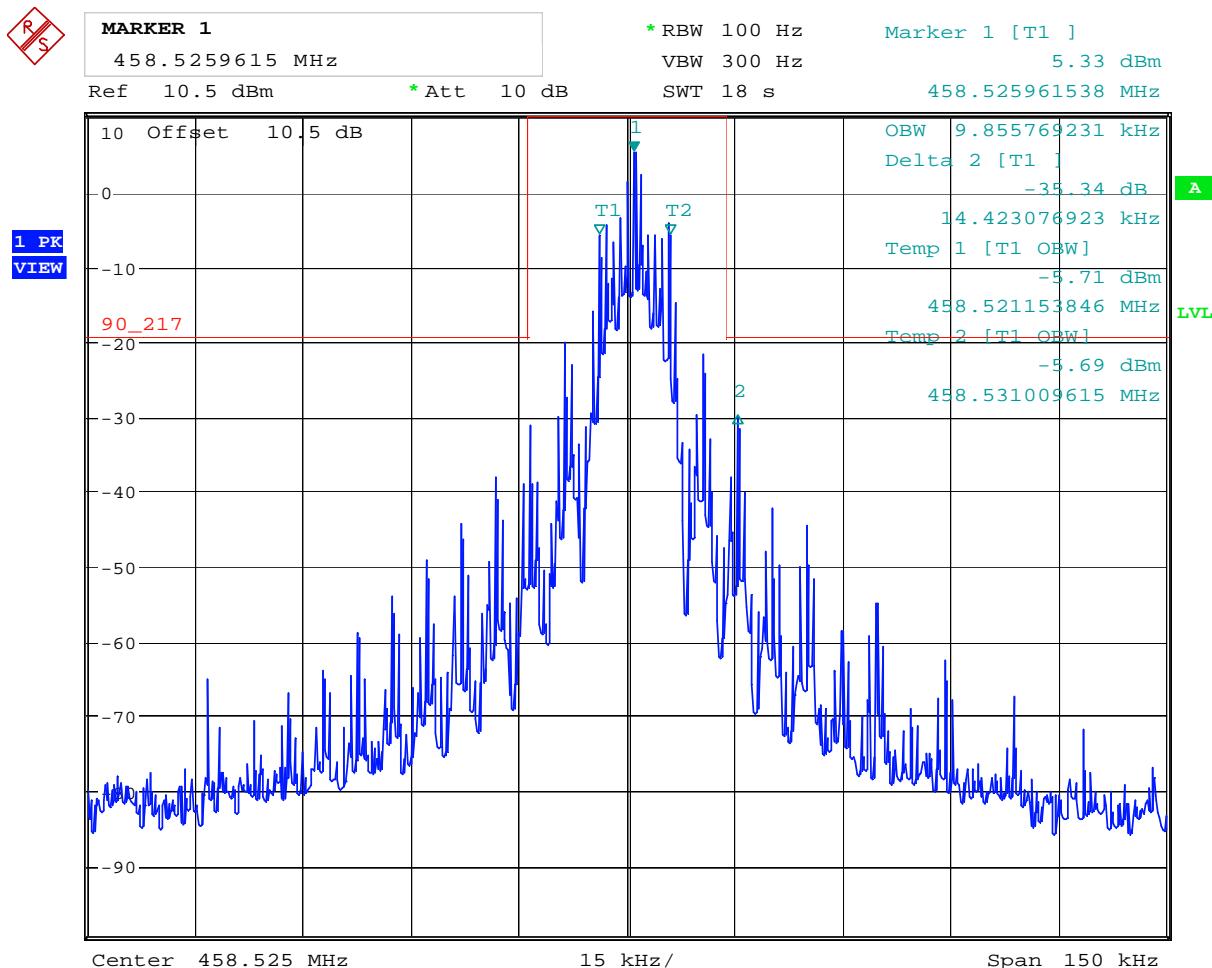


R
S



Date: 7.JUL.2008 15:15:42

Occupied Bandwidth, -10°C



Date: 7.JUL.2008 15:52:22

Occupied Bandwidth, -20°C

**MARKER 1**

458.5257212 MHz

Ref 10.5 dBm

* Att 10 dB

* RBW 100 Hz

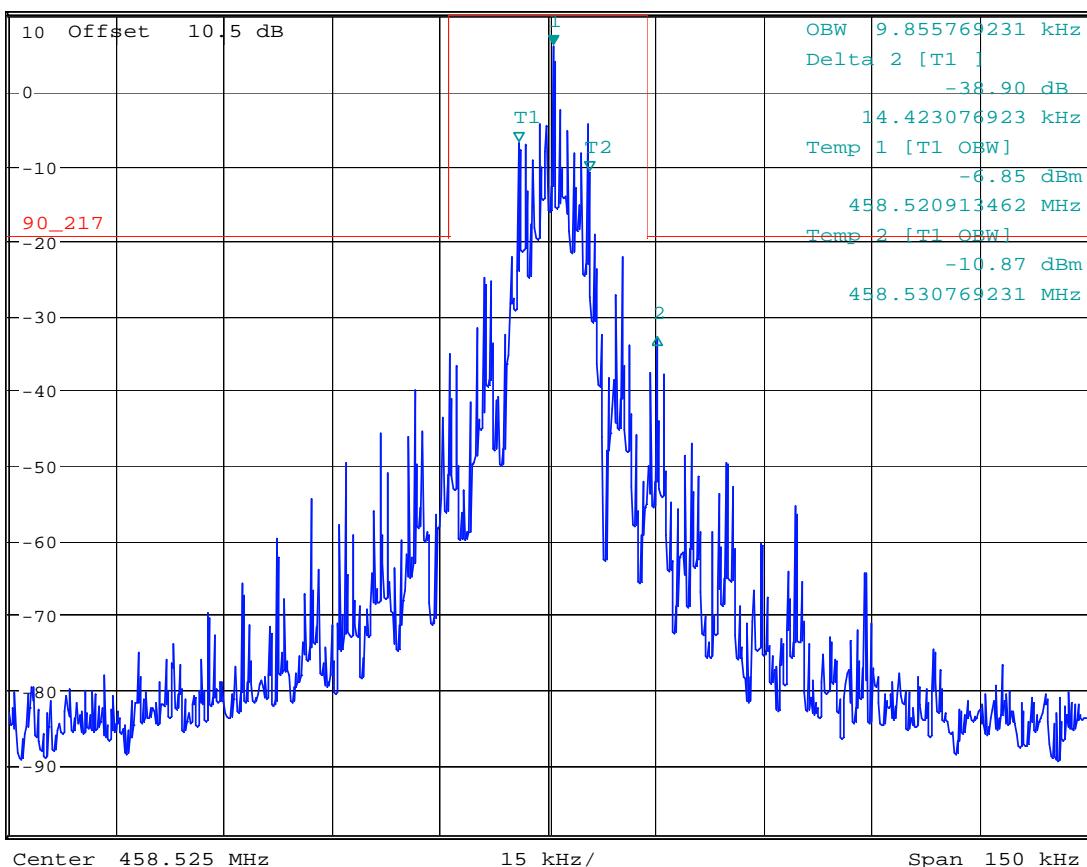
VBW 300 Hz

SWT 18 s

Marker 1 [T1]

5.89 dBm

458.525721154 MHz

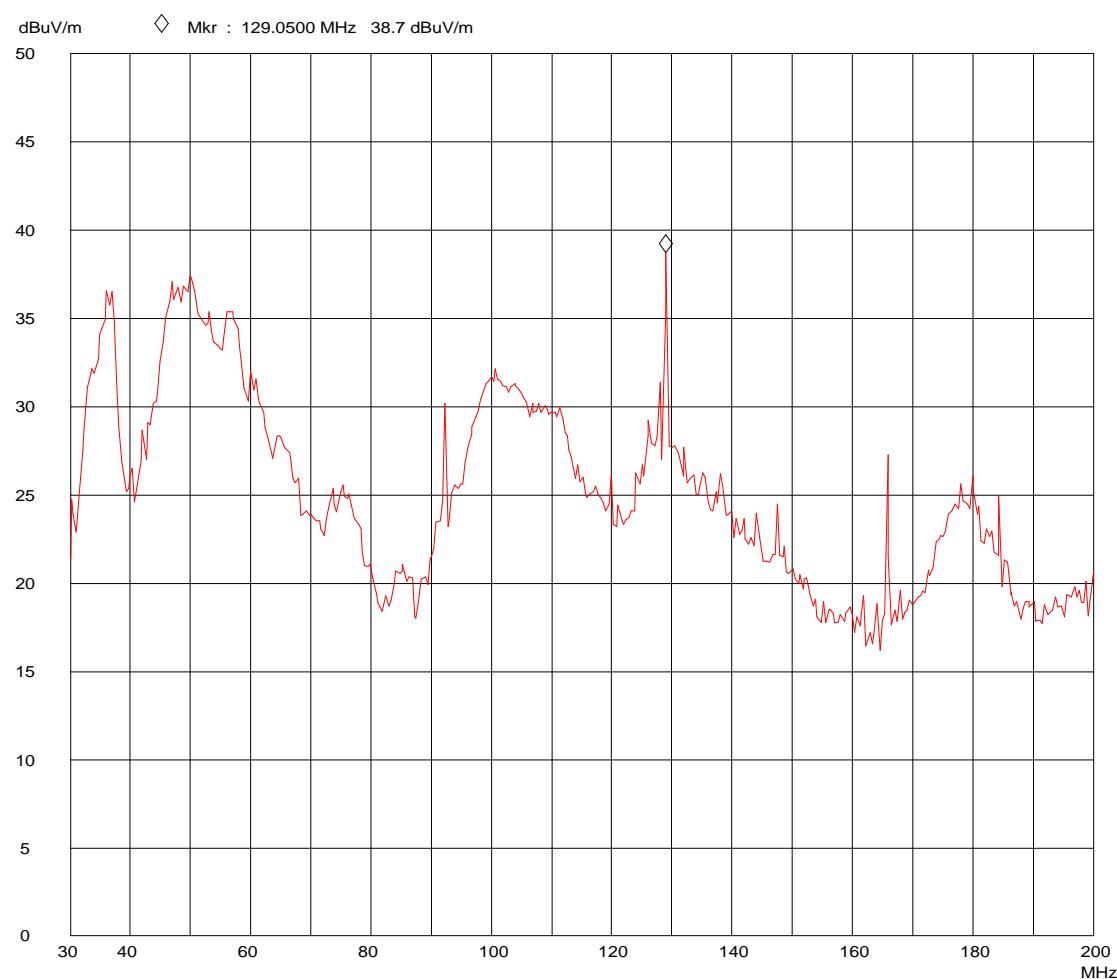
1 PK
MAXH

Date: 7.JUL.2008 16:03:33

Occupied Bandwidth, -30°C

SPURIOUS EMISSION SCAN TX**NEMKO COMLAB****Peak**

04. Jul 08 13:19

Operator: jge
Comment: Cavotek
VP 3m
TXScan Settings (1 Range)
Frequencies Receiver Settings
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
30M 200M 50k 120k PK 50ms AUTO LN ON 60dBTransducer No. Start Stop Name
20 30M 200M HK116

Vertical Polarization, 30 - 200 MHz



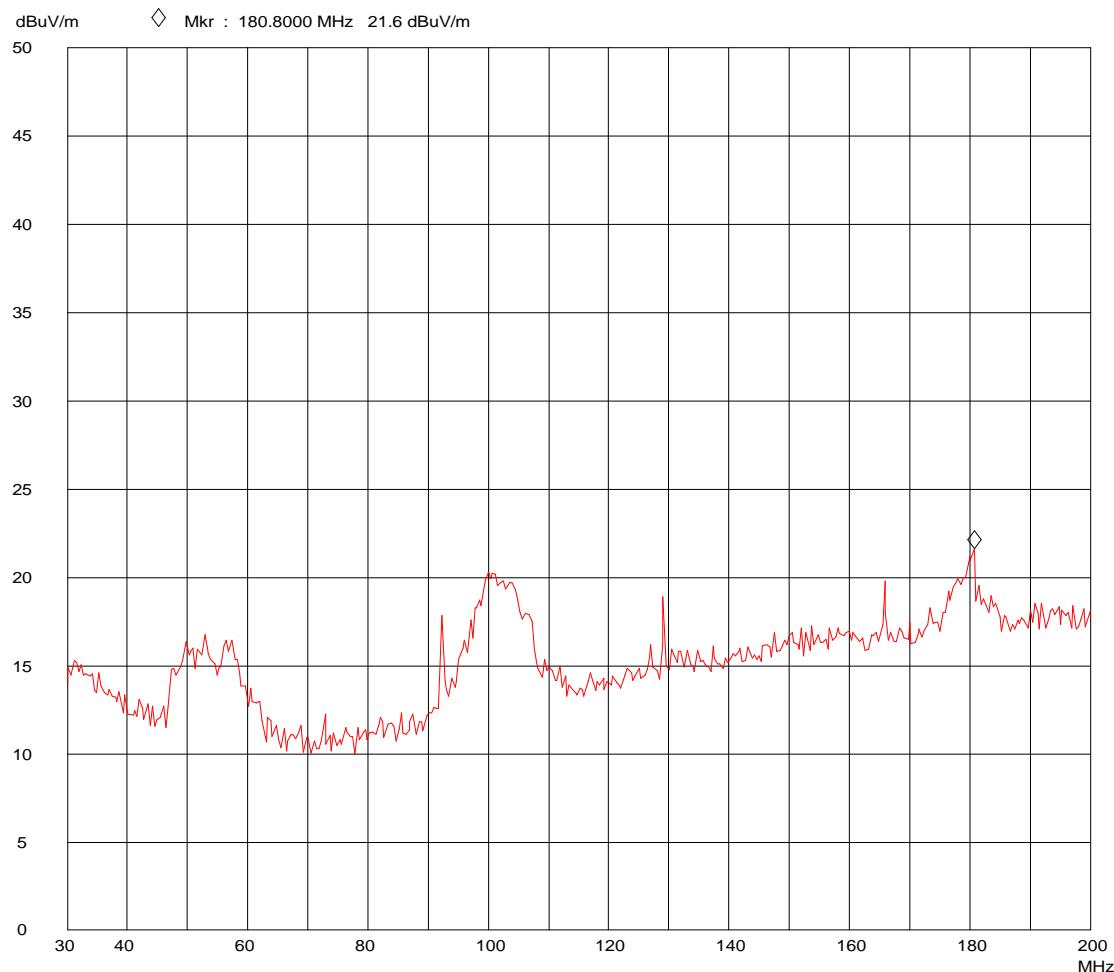
NEMKO COMLAB
Peak

04. Jul 08 13:45

Operator: jge
Comment: Cavotek
hp 3m
TX

Scan Settings (1 Range)
|----- Frequencies -----||----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
30M 200M 50k 120k PK 50ms AUTO LN ON 60dB

Transducer No. Start Stop Name
20 30M 200M HK116



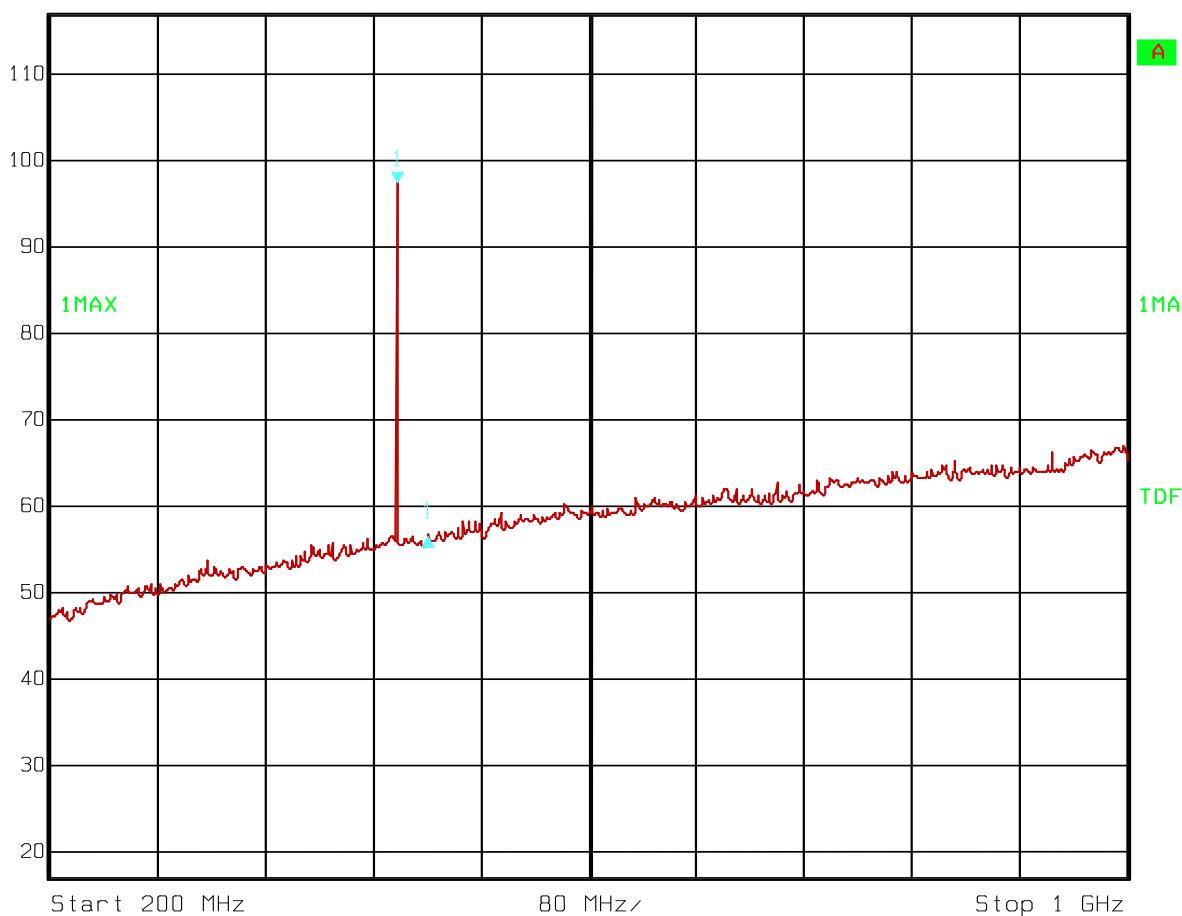
Horizontal Polarization, 30 - 200 MHz



Ref Lvl
117 dB*

Delta 1 [T1]
-40.72 dB
22.02109218 MHz

RBW 100 kHz
VBW 100 kHz
SWT 200 ms
RF Att Unit
20 dB
dB μ V/m



Date: 4.JUL.2008 11:50:32

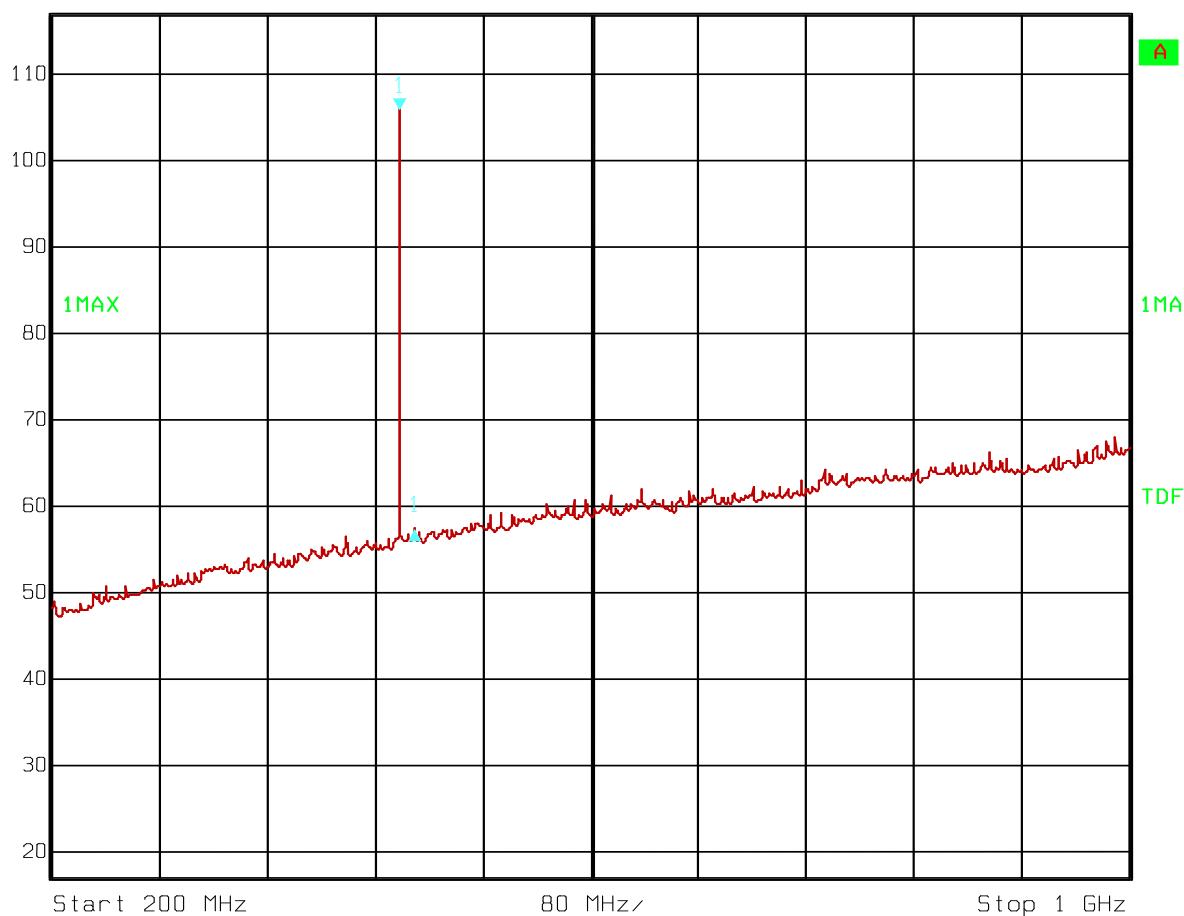
Vertical Polarization, 200 - 1000 MHz



Ref Lvl
117 dB*

Delta 1 [T1]
-48.35 dB
10.79864729 MHz

RBW 100 kHz
VBW 100 kHz
SWT 200 ms
RF Att Unit
20 dB
dB μ V/m



Date: 4.JUL.2008 11:48:31

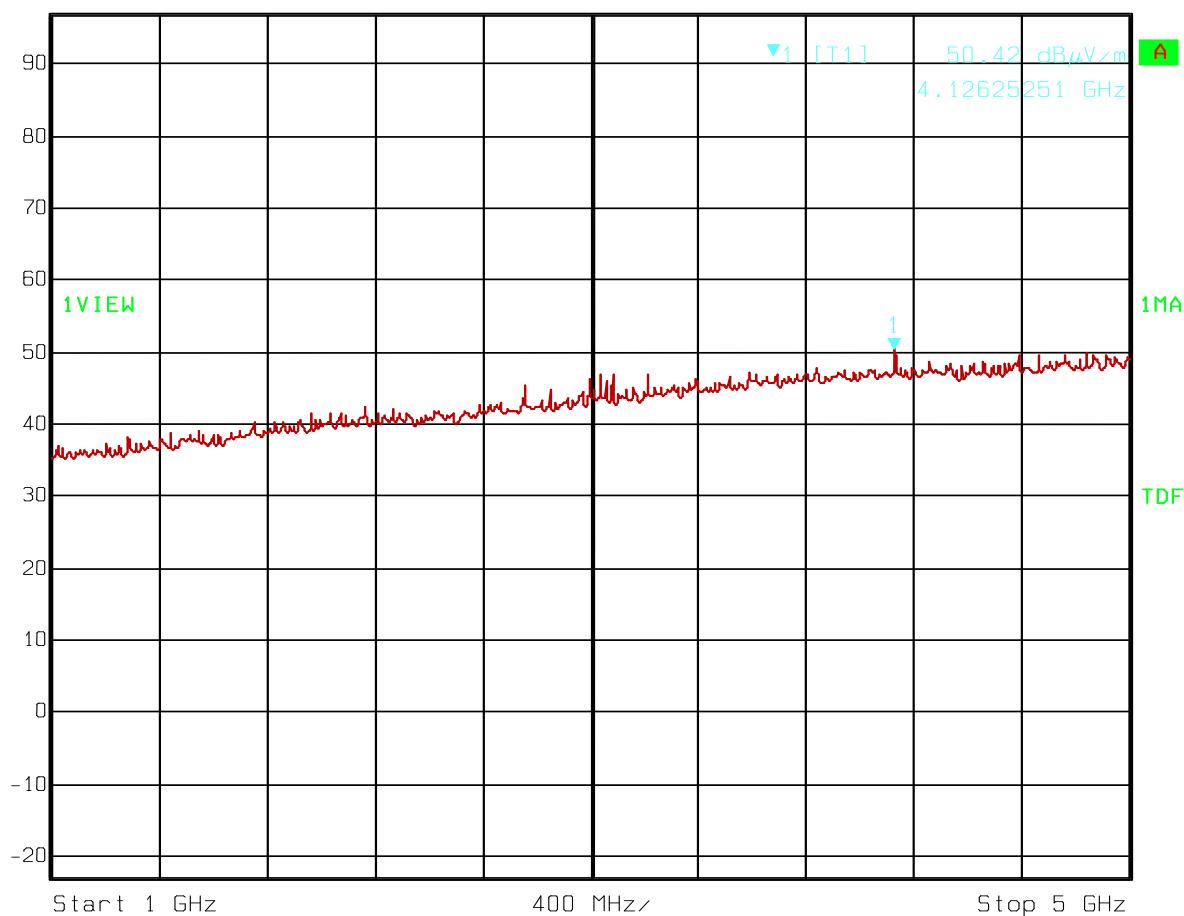
Horizontal Polarization, 200 - 1000 MHz



Ref Lvl
97 dB*

Marker 1 [T1]
50.42 dB μ V/m
4.12625251 GHz

RBW 1 MHz
VBW 1 MHz
SWT 10 ms
RF Att Unit
10 dB
dB μ V/m



Date: 4.JUL.2008 12:58:56

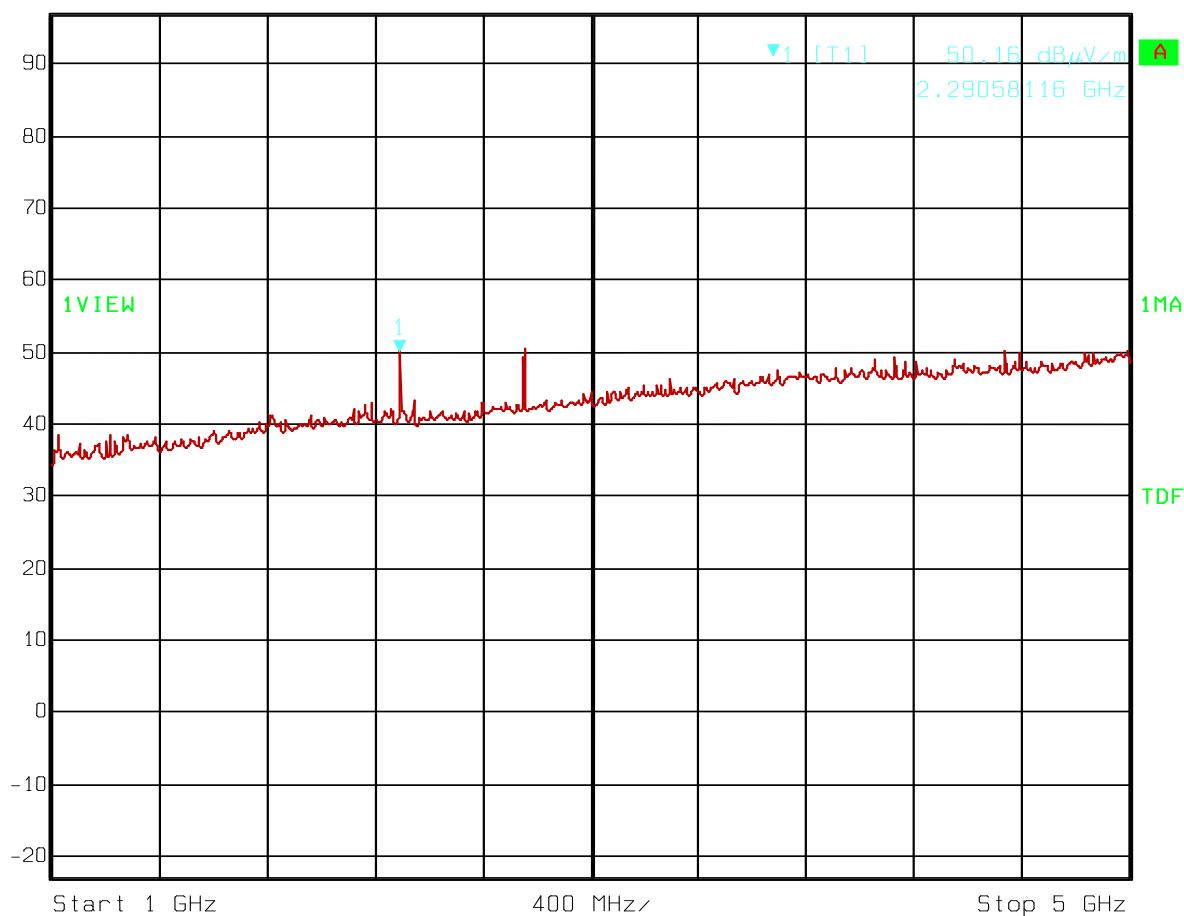
Vertical Polarization, 1 - 5 GHz



Ref Lvl
97 dB*

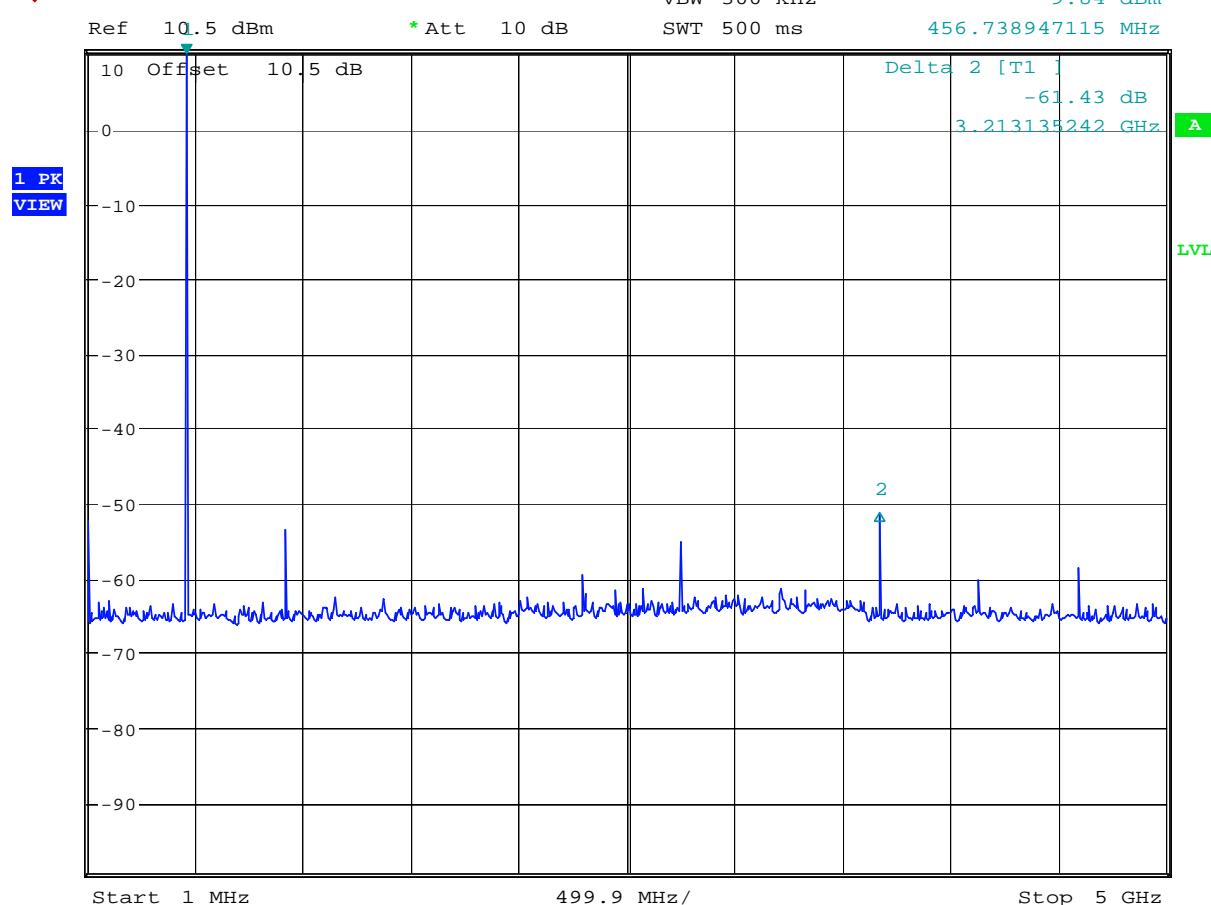
Marker 1 [T1]
50.16 dB μ V/m
2.29058116 GHz

RBW 1 MHz
VBW 1 MHz
SWT 10 ms
RF Att Unit
10 dB
dB μ V/m



Date: 4.JUL.2008 12:58:09

Horizontal Polarization, 1 - 5 GHz



Date: 7.JUL.2008 09:07:43

Conducted (50 ohm) TX spurious emission up to 5GHz



6 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Ref. no.	Type of instrument/ancillary	Manufacturer	Instrument/ancillary
1.	1337	Spektrum Analyzer	R&S	FSEK 1088,3494,30
2.	1410	Shielded room	ETS Euroshield	Semi-anechoic
3.	1330	Antenna Horn	EMCO	3115
4.	1505	Spektrum Analyzer	R&S	FSL6 1300.2502.16
5.	1083	Climate Chamber Temp	ACS	TY80
6.	1322	Amplifier RF	HP	8449B
7.	208	Multimeter, Digital	Fluke	77
8.	1188	Generator, SHF	Gigatr.	7200/.01-20
9.	1166	Filter Band Pass	Trilithic	5VF48/96
10.	1167	Filter Band Pass	Trilithic	5VF95/190
11.	1212	Attenuator	Suhner	6810.17.B
12.	1260	Antenna, biconical	R&S	HK 116
13.	1261	Antenna Log-periodic	R&S	HL 223
14.	1237	EMI-Receiver	R&S	ESN
15.	1359	Cable Microwave	Suhner	Sucoflex 102E
16.	1357	Cable Microwave	Suhner	Sucoflex 102E
17.	1334	Antenna Dipole	R&S	HZ-13 633,0840,00
18.	1226	Antenna Horn	EMCO	3115
19.	1170	Filter Band Pass	Trilithic	5VF500/1000
20.	191	Filter Band Pass	Texn	5VF1000/2000
21.	1013	Counter Freq	HP	5385A
22.	181	Wattmeter, RF, Wideband	HP	436A
23.	1450	Probe, RF	HP	8485A
24.	285	Antenna, loop	R&S	HFH2-Z2

7 BLOCK DIAGRAM

7.1 Test Site Radiated Emission

