

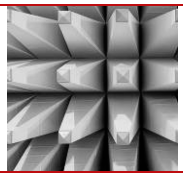

CETECOM™
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consulting - testing - certification

TEST REPORT

DAkkS Deutsche Akkreditierungsstelle D PL 12076 01 01

Test report no.: 1-3424-01-02/11-B

Testing laboratory

CETECOM ICT Services GmbH
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Accredited test laboratory:
The test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025
DAkkS registration number: D-PL-12076-01-01

Area of Testing: Radio/Satellite Communications

Applicant

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Manufacturer

KAPSCH TrafficCom AG
Am Europlatz 2
1120 Wien / AUSTRIA

Test standard/s

47 CFR Part 90	Title 47 of the Code of Federal Regulations; Chapter I Part 90 - Land mobile services
ASTM E2213	Standard Specification for Telecommunications and Information Exchange between Roadside and Vehicle Systems – 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications

For further applied test standards please refer to section 3 of this test report.

Test item

Kind of test item:	**RSU Maut System**
Model name:	**MTX-9450/TRX-9450**
FCC ID:	**XZU9450A**
IC:	**-/-**
Frequency:	**5860 MHz – 5920 MHz**
Power supply:	**48.0 V DC**
Temperature range:	**-40 °C to +64 °C**

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test performed:

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Stefan Bös

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Marco Bertolino

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2 General information

2.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM ICT Services GmbH.
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2.2 Application details

Date of receipt of order:	2011-05-05
Date of receipt of test item:	2011-05-09
Start of test:	2011-05-09
End of test:	2011-05-19
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Version	Test standard description
47 CFR Part 90	2009-10	Title 47 of the Code of Federal Regulations; Chapter I Part 90 - Land mobile services
ASTM E2213	2003	Standard Specification for Telecommunications and Information Exchange between Roadside and Vehicle Systems – 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications

4 Test environment

Temperature:	T_{nom}	+23 °C during room temperature tests
	T_{max}	+64 °C during high temperature test
	T_{min}	-40 °C during low temperature test
Relative humidity content:		53 %
Air pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	48.0 V DC
	V_{max}	52.8 V
	V_{min}	21.6 V

5 Test item

Kind of test item	:	**RSU Maut System**
Type identification	:	**MTX-9450/TRX-9450**
S/N serial number	:	**IPK00178**
HW hardware status	:	**RF-board: GS08** **Unit: GS06**
SW software status	:	**5.4b7-f33e1bab**
Frequency band [MHz]	:	**5860 MHz – 5920 MHz**
Type of modulation	:	**OFDM ➔ BPSK (3 MBit/s) / 64 QAM (54 MBit/s)**
Number of channels	:	**7**
Antenna	:	**Integrated PCB antenna (for more informations, please take a look at Annex C)** **The external antennas are connected by N-type connectors (No specified antenna information available)**
Power supply	:	**48.0 V DC**
Temperature range	:	**-40°C to +64 °C**

6 Test laboratories sub-contracted

None

7 Summary of measurement results

☒ **No deviations from the technical specifications were ascertained**

☐ There were deviations from the technical specifications ascertained

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	47 CFR Part 2 / 47 CFR Part 90 M 802.11 a / ASTM E2213	Passed	2011-09-15	-/-

Test Specification Clause	Test Case	Temperature Conditions	Power Source Voltages	Pass	Fail	NA	NP	Results (max.)
None	Antenna gain	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM – 8.9.4 FCC Part 2 / 90	Transmit Center Frequency Tolerance	Nominal	Extreme	☒	☐	☐	☐	complies
		Extreme	Nominal	☒	☐	☐	☐	
ASTM – 8.9.2 FCC Part 2 / 90	Spectrum Bandwidth of a OFDM System / 20dB BW	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM – 8.9.2 FCC Part 2 / 90	Transmit Spectrum Mask	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM Table 3 FCC Part 2 / 90	Modulation characteristics	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM – 8.9.1 FCC Part 2 / 90	Field Maximum output power (conducted)	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM – 8.9.1 FCC Part 2 / 90	Max. peak output power (radiated)	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM – 8.9.2 FCC Part 2 / 90	Spurious Emission - conducted (Transmitter)	Nominal	Nominal	☒	☐	☐	☐	complies
ASTM – 8.9.2 FCC Part 2 / 90	Spurious Emission - radiated (Transmitter)	Nominal	Nominal	☒	☐	☐	☐	complies

Note: NA = Not Applicable; NP = Not Performed

8 RF measurements

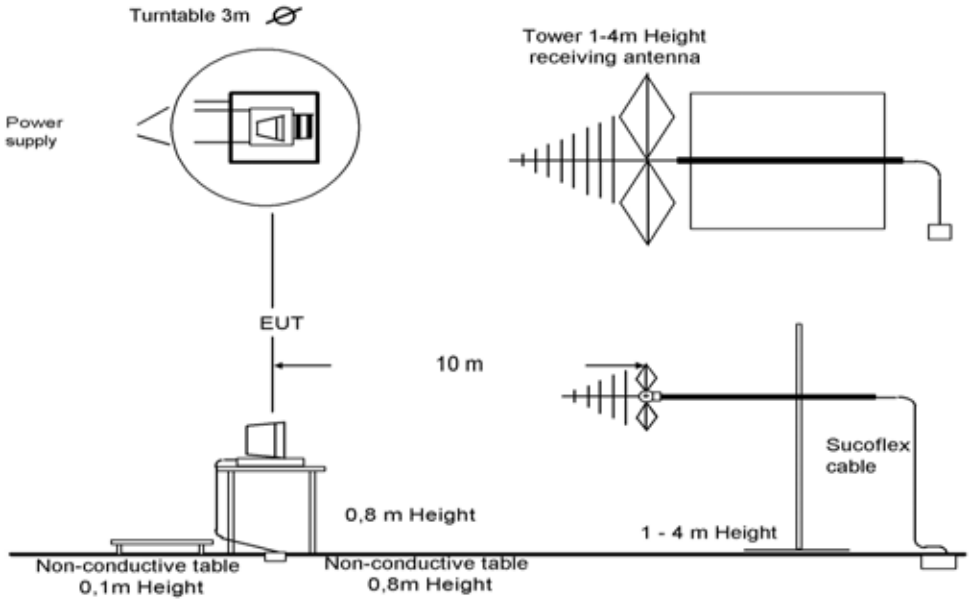
8.1 Description of test setup

For the spurious measurements we use the substitution method according TIA/EIA 603.

8.1.1 Radiated measurements

The radiated emissions from the EUT are performed in a semi anechoic chamber. The EUT is placed on a conductive turntable and powered with nominal voltage. The signalling is performed either from outside the chamber with a signalling unit (AP or other) by air link using a signalling antenna or directly by special test software from the customer.

Semi anechoic chamber

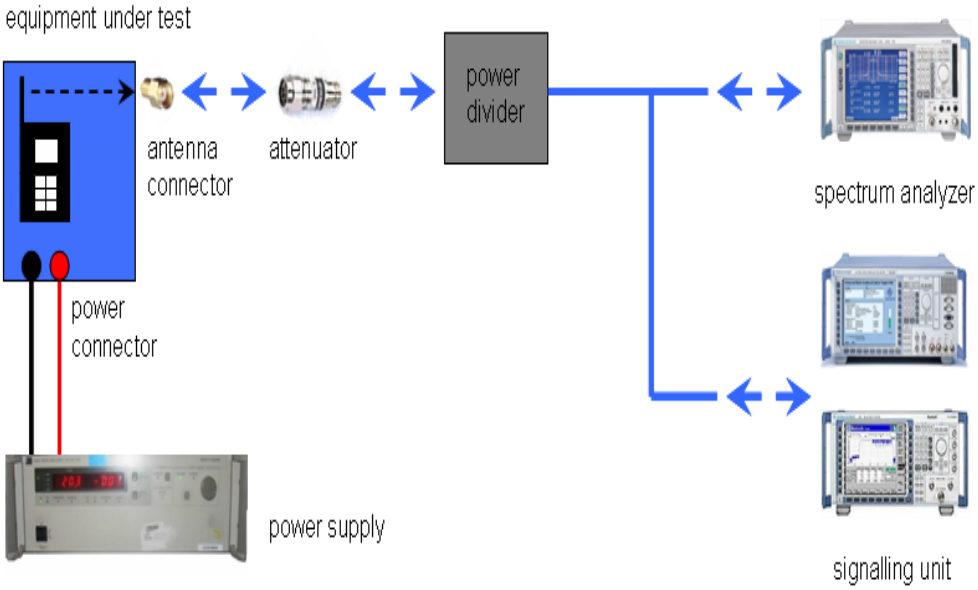


Picture 1: Diagram radiated measurements

9 kHz - 30 MHz:	active loop antenna
30 MHz – 1 GHz:	tri-log antenna
> 1 GHz:	horn antenna

8.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is first 10dB attenuated before it is power divided (~6dB loss per branch). One of the signal paths is connected to the signalling unit (AP or other), the other one is connected to the spectrum analyzer. The specific losses for both signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm. If special software is used, there is no power divider necessary.



Picture 2: Diagram conducted measurements

The term measuring receiver refers to either a selective voltmeter or a spectrum analyser.

Frequency being measured f	Measuring receiver bandwidth 6 dB	Spectrum analyser bandwidth 3dB
f < 150 kHz	200 Hz or	300 Hz
150 kHz ≤ f < 25 MHz	9 kHz or	10 kHz
25 MHz ≤ f < 1000 MHz	120 kHz or	100 kHz
1000 MHz ≤ f		1 MHz
NOTE: Specific requirements in CEPT/ERC/Recommendation 70-03 [2] shall be applied where applicable.		

8.2 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions:

Power setting for antenna port 1: 28 = 20 dBm
Power setting for antenna port 2: 20 = 10 dBm

Manufacturer declaration: Differences between MTX and TRX

- The MTX-9450 unit disposes of the possibility to connect two external antennas. In this mode the internal antennas are deactivated.
- Integrated GPS module with external antenna connector
- and an additional system connector

All measurements are performed with the fully equipped transceiver unit (MTX-9450).

9 Measurement results

9.1 Antenna gain

Measurement:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal Bluetooth® devices, the GFSK modulation is used.

Measurement parameters:

Measurement parameter	
Detector:	RMS
Sweep time:	1 s
Video bandwidth:	10 MHz
Resolution bandwidth:	10 MHz
Span:	30 MHz
Trace-Mode:	Max hold

Limits:

No restrictions

Results: Port 1 (High power)

Test conditions		Output power [dBm]				
T_{nom}	V_{nom}	5860 MHz	5875 MHz	5890 MHz	5905 MHz	5920 MHz
Conducted power [dBm]		18.9	8.6	18.6	8.5	19.1
Radiated power [dBm]		32.1	22.5	33.0	22.5	32.2
Gain [dBi] Calculated		13.2	13.9	14.4	14.0	13.1

Results: Port 2 (Low power)

Test conditions		Output power [dBm]				
T_{nom}	V_{nom}	5860 MHz	5875 MHz	5890 MHz	5905 MHz	5920 MHz
Conducted power [dBm]		8.2	5.9	7.5	5.8	7.9
Radiated power [dBm]		18.0	16.3	19.0	16.1	18.4
Gain [dBi] Calculated		9.8	10.4	11.5	10.3	10.5

9.2 Frequency Tolerance (2.1055 / 90.213 / 90.379 / ASTM §8.9.4 / IEEE 802.11 a 17.3.9.4)

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 kHz
Video bandwidth:	1 kHz
Span:	100 kHz
Trace-Mode:	ClrWrt

Limits:

FCC
CFR § 2.1055 CFR § 90.379 / ASTM – 8.9.4
The transmitted center frequency tolerance shall be ± 10 ppm maximum.

Results:

TEST CONDITIONS		Frequency tolerance [kHz / ppm]					
		Port 1			Port 2		
Temperature [°C]	Voltage [V]	lowest channel 5860 MHz	middle channel 5890 MHz	highest channel 5920 MHz	lowest channel 5860 MHz	middle channel 5890 MHz	highest channel 5920 MHz
-40	V_{nom}	26.8 / 1.0	30.4 / 1.5	31.6 / 1.7	18.8 / 0.7	19.2 / 0.8	19.6 / 0.7
-30	V_{nom}	53.2 / 5.5	53.6 / 5.4	54.4 / 5.6	36.0 / 3.6	36.0 / 3.6	36.0 / 3.5
-20	V_{nom}	57.6 / 6.2	58.8 / 6.3	59.2 / 6.4	46.0 / 5.3	46.0 / 5.3	46.4 / 5.2
-10	V_{nom}	55.6 / 5.9	55.6 / 5.6	55.2 / 5.7	47.2 / 5.6	47.6 / 5.6	47.6 / 5.4
0	V_{nom}	48.0 / 4.6	47.2 / 4.3	46.4 / 4.2	40.0 / 4.3	40.0 / 4.3	40.0 / 4.2
10	V_{nom}	30.4 / 1.6	30.4 / 1.5	30.0 / 1.5	31.2 / 2.8	31.6 / 2.9	32.0 / 2.8
20	V_{min}	21.3 / 0.0	21.6 / 0.0	21.6 / 0.0	14.7 / 0.0	15.0 / 0.0	15.3 / 0.0
	V_{nom}	21.3 / 0.0	21.6 / 0.0	21.6 / 0.0	14.7 / 0.0	15.0 / 0.0	15.3 / 0.0
	V_{max}	21.3 / 0.0	21.6 / 0.0	21.6 / 0.0	14.7 / 0.0	15.0 / 0.0	15.3 / 0.0
30	V_{nom}	21.2 / 0.0	21.6 / 0.0	21.6 / 0.0	15.6 / 0.2	15.2 / 0.1	15.2 / 0.0
40	V_{nom}	34.0 / 2.2	36.4 / 2.5	35.2 / 2.3	12.4 / -0.4	12.8 / -0.3	12.8 / -0.4
55	V_{nom}	52.4 / 5.3	52.8 / 5.3	52.8 / 5.3	27.2 / 2.1	27.2 / 2.1	28.0 / 2.1
64	V_{nom}	69.6 / 8.3	70.4 / 8.3	71.2 / 8.4	51.6 / 6.3	52.4 / 6.4	52.8 / 6.4
Measurement uncertainty		± 1 kHz					

Result: **The result of the measurement is passed.**

9.3 Spectrum Bandwidth of a OFDM System / 99% Bandwidth (2.1049 / 90.377 / 90.379 /ASTM E2213)

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	30 kHz
Span:	15 / 30 MHz
Trace-Mode:	Max. hold

Limit:

FCC

CFR § 2.1049
CFR § 90.377 / § 90.379 / ASTM – 8.9.4

Channel No.	Frequency range (MHz)	Max. EIRP [1] (dBm)	Channel use
170	5850–5855	.....	Reserved.
172	5855–5865	33	Service Channel.[2]
174	5865–5875	33	Service Channel.
175	5865–5885	23	Service Channel.[3]
176	5875–5885	33	Service Channel.
178	5885–5895	33/44.8	Control Channel.
180	5895–5905	23	Service Channel.
181	5895–5915	23	Service Channel.[3]
182	5905–5915	23	Service Channel.
184	5915–5925	33/40	Service Channel.[4]

[1] An RSU may employ an antenna with a height exceeding 8 meters but not exceeding 15 meters provided the EIRP specified in the table above is reduced by a factor of 20 log(Ht/8) in dB where Ht is the height of the radiation center of the antenna in meters above the roadway bed surface. The EIRP is measured as the maximum EIRP toward the horizon or horizontal, whichever is greater, of the gain associated with the main or center of the transmission beam. The RSU antenna height shall not exceed 15 meters above the roadway bed surface.
[2] Channel 172 is designated for public safety applications involving safety of life and property.
[3] Channel Nos. 174/176 may be combined to create a twenty megahertz channel, designated Channel No. 175. Channels 180/182 may be combined to create a twenty-megahertz channel, designated Channel No. 181.
[4] Channel 184 is designated for public safety applications involving safety of life and property. Only those entities meeting the requirements of § 90.373(a) are eligible to hold an authorization to operate on this channel.

Results: Port 1

Test conditions		99% - Bandwidth [MHz]				
T_{nom}	V_{nom}	5860 MHz	5875 MHz	5890 MHz	5905 MHz	5920 MHz
99% - Bandwidth [MHz]		8.28	16.62	8.24	16.62	8.32

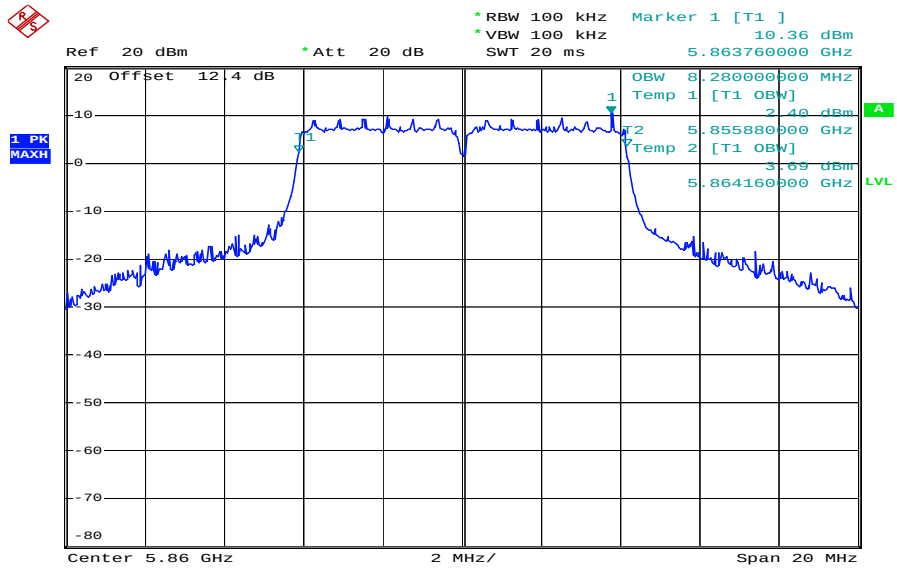
Results: Port 2

Test conditions		99% - Bandwidth [MHz]				
T_{nom}	V_{nom}	5860 MHz	5875 MHz	5890 MHz	5905 MHz	5920 MHz
99% - Bandwidth [MHz]		8.28	16.62	8.24	16.62	8.32

Result: **The result of the measurement is passed.**

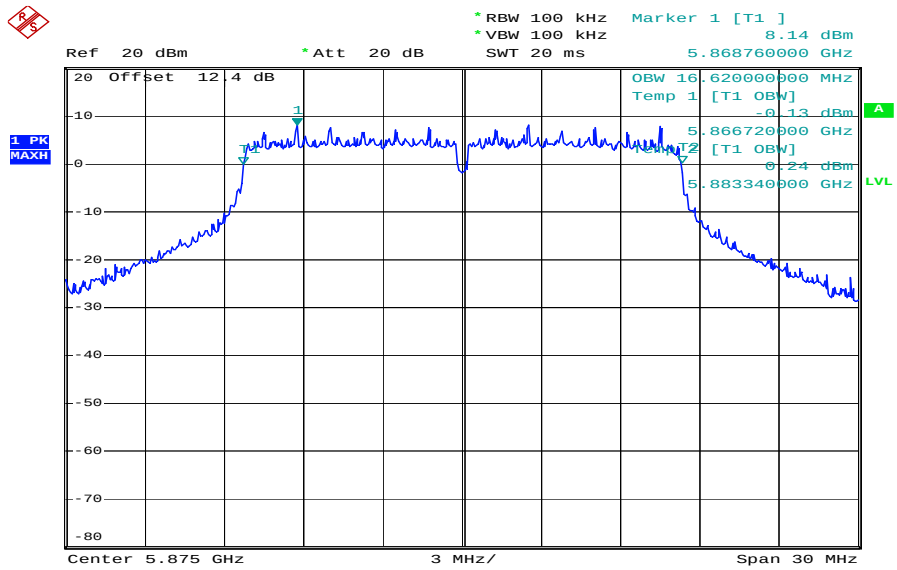
Plots of the measurement:

Plot 1: 5860 MHz / Port 1



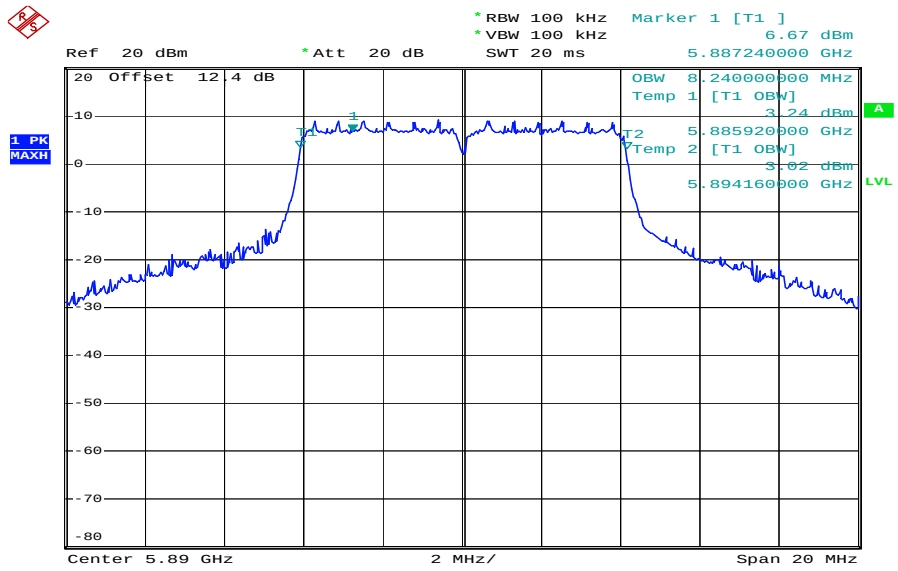
Date: 11.JUN.2011 08:32:32

Plot 2: 5875 MHz / Port 1



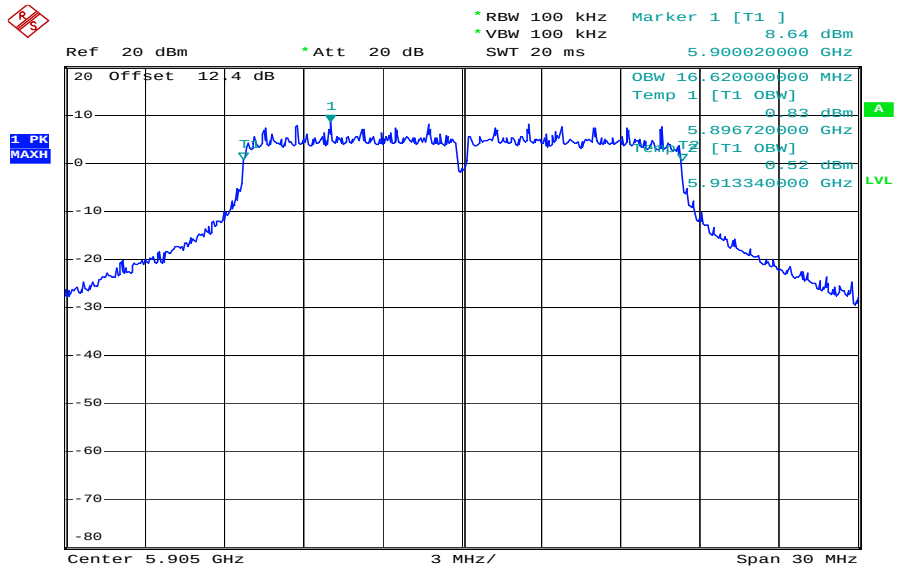
Date: 11.JUN.2011 08:34:27

Plot 3: 5890 MHz / Port 1



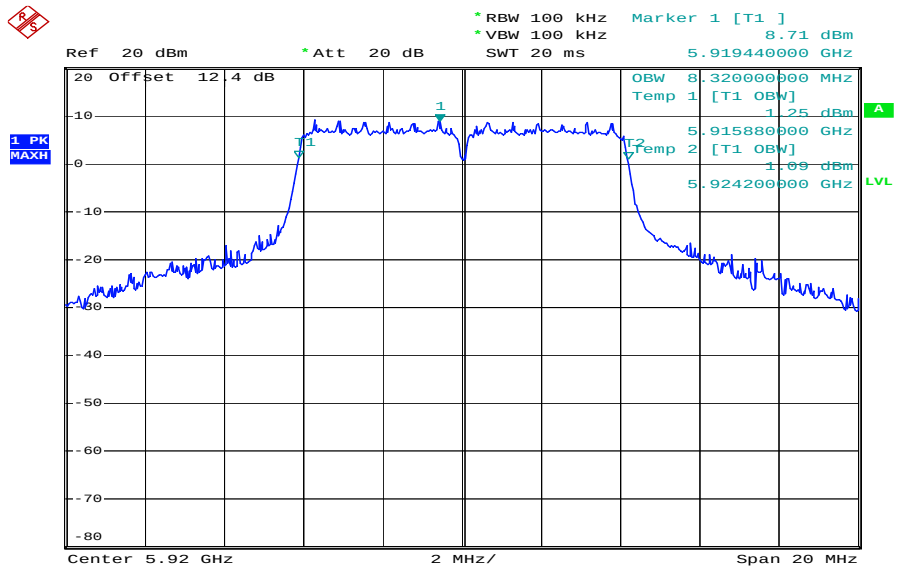
Date: 11.JUN.2011 08:30:56

Plot 4: 5905 MHz / Port 1



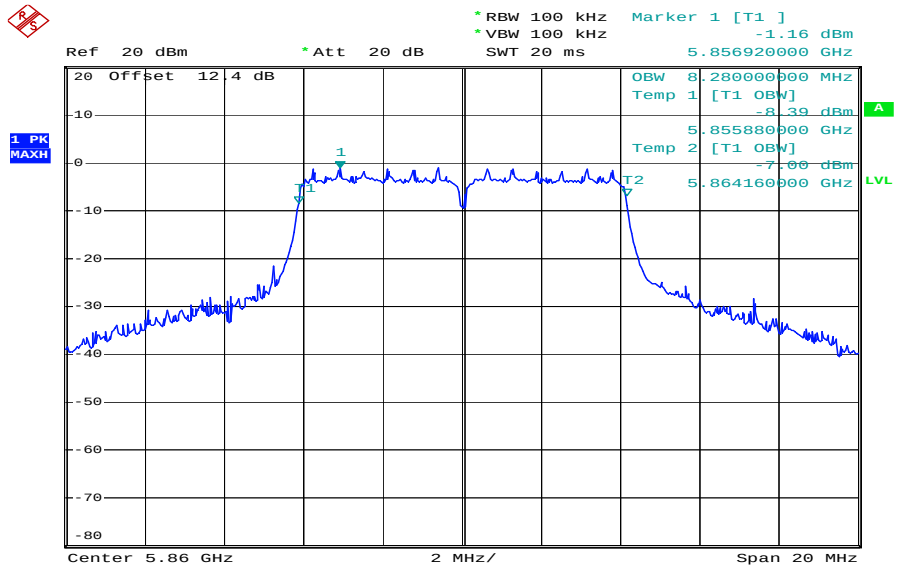
Date: 11.JUN.2011 08:35:36

Plot 5: 5920 MHz / Port 1



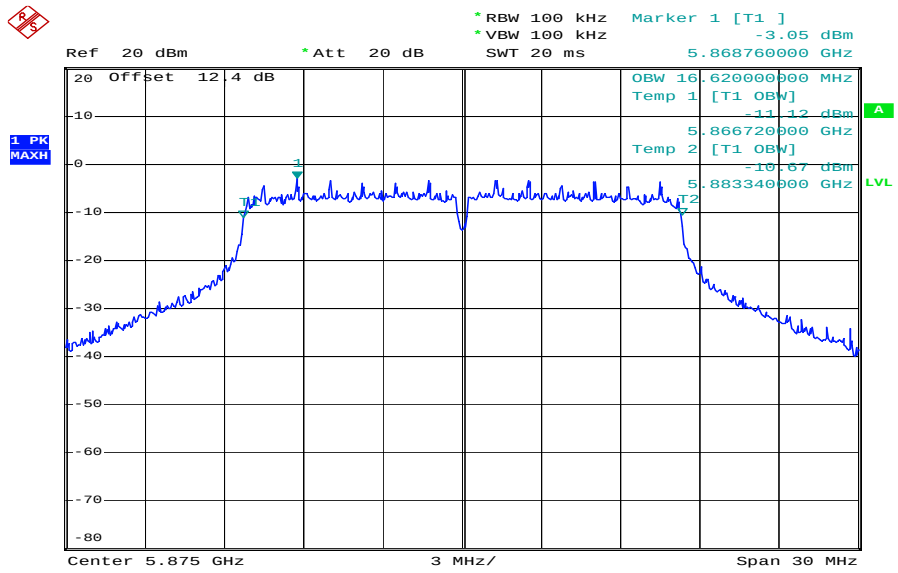
Date: 11.JUN.2011 08:31:41

Plot 6: 5860 MHz / Port 2



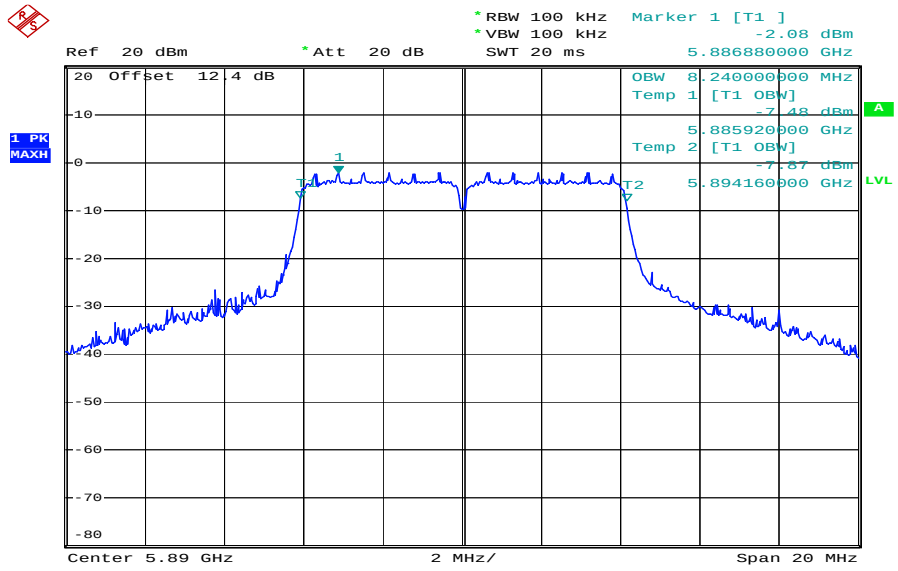
Date: 11.JUN.2011 08:39:00

Plot 7: 5875 MHz / Port 2



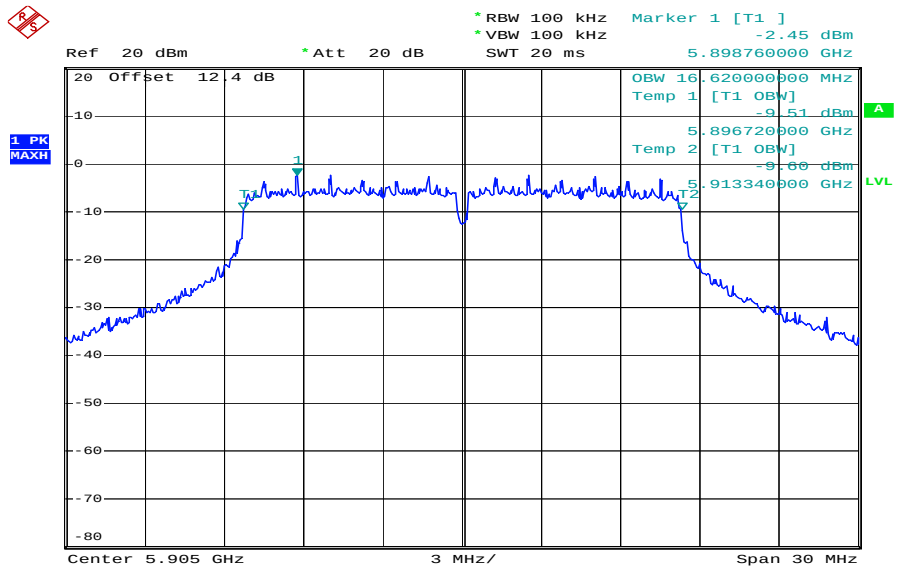
Date: 11.JUN.2011 08:37:57

Plot 8: 5890 MHz / Port 2



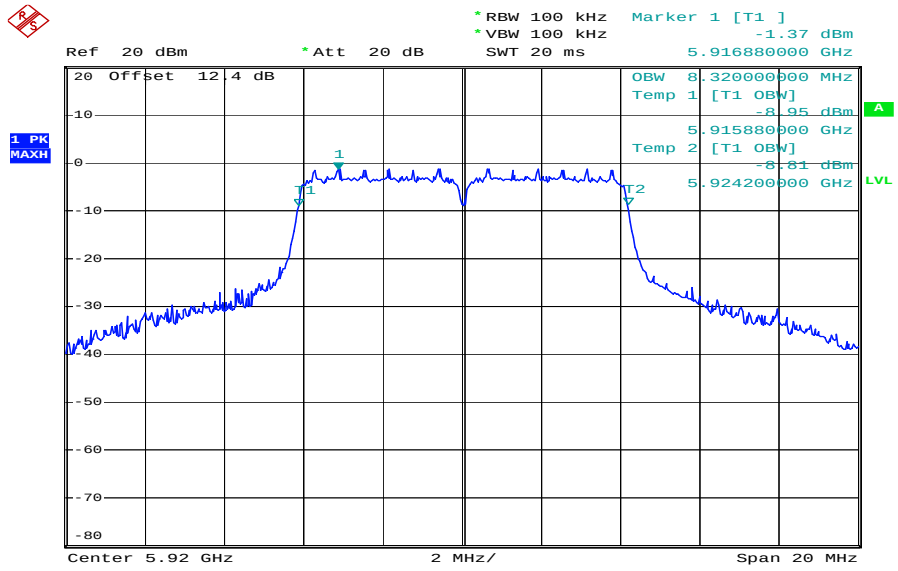
Date: 11.JUN.2011 08:39:47

Plot 9: 5905 MHz / Port 2



Date: 11.JUN.2011 08:37:20

Plot 10: 5920 MHz / Port 2



Date: 11.JUN.2011 08:40:36

9.4 Transmit Spectrum Mask (90.210 / 90.379 / ASTM 8.9.2)

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	30 kHz
Span:	15 / 30 MHz
Trace-Mode:	AVG 100
EUT specification:	Class C

All 10 MHz channels were checked according the requirements for Class C equipment.
All 20 MHz channels were checked according the requirements for Class B equipment.

Limits:

FCC
CFR § 90.210 / § 90.379 / ASTM – 8.9.2

TABLE 10 DSRC Spectrum Mask[A]

NOTE—Reduction in Power Spectral Density, dBr.

Class	± 4.5-MHz Offset	± 5.0-MHz Offset	± 5.5-MHz Offset	± 10-MHz Offset	± 15-MHz Offset
Class A	0	-10	-20	-28	-40
Class B	0	-16	-20	-28	-40
Class C	0	-26	-32	-40	-50
Class D	0	-35	-45	-55	-65

[A] From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

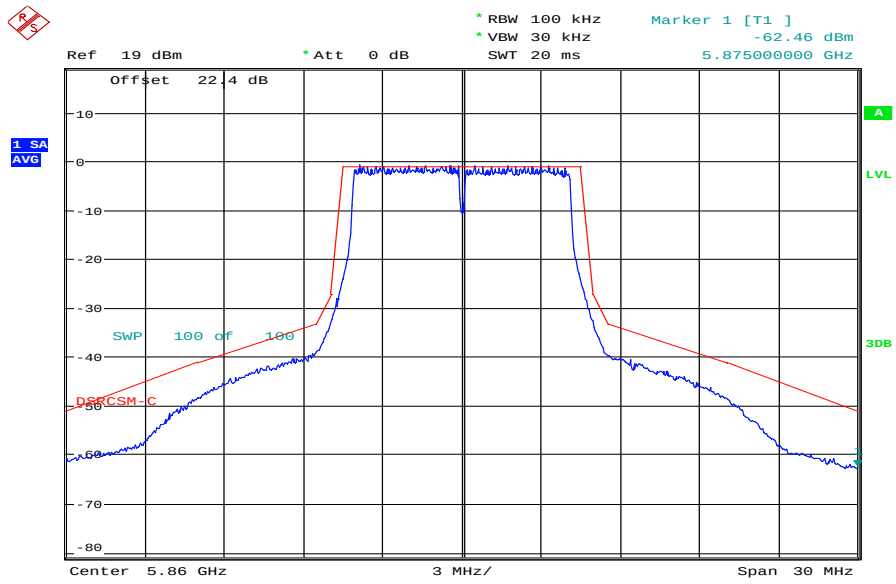
< 25kHz

Result: see plots

Result: The result of the measurement is passed.

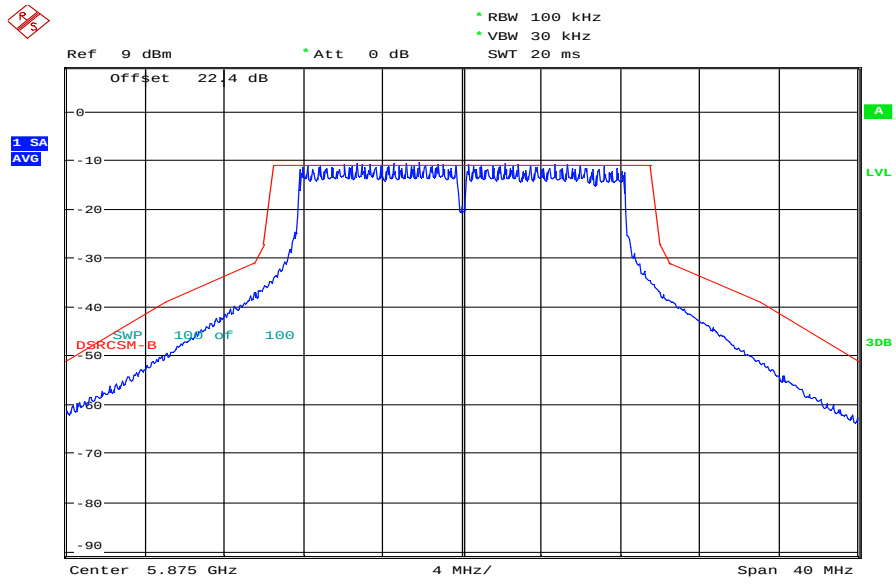
Plots of the measurement:

Plot 1: 5860 MHz / Port 1



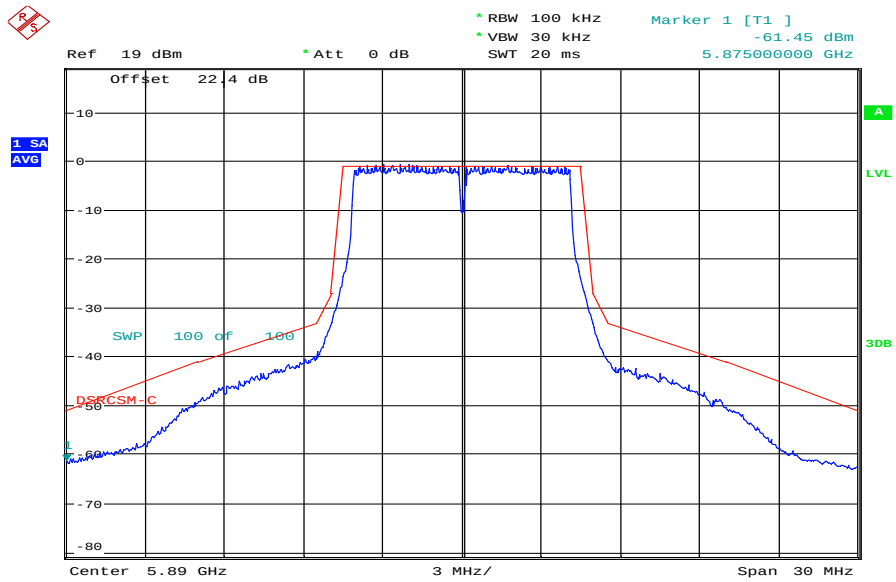
Date: 11.JUN.2011 08:55:28

Plot 2: 5875 MHz / Port 1



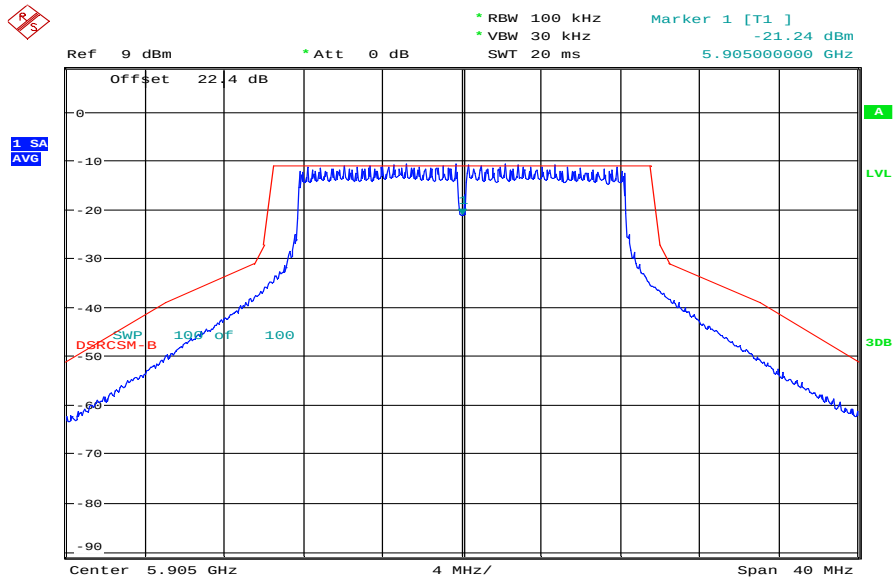
Date: 11.JUN.2011 09:02:54

Plot 3: 5890 MHz / Port 1



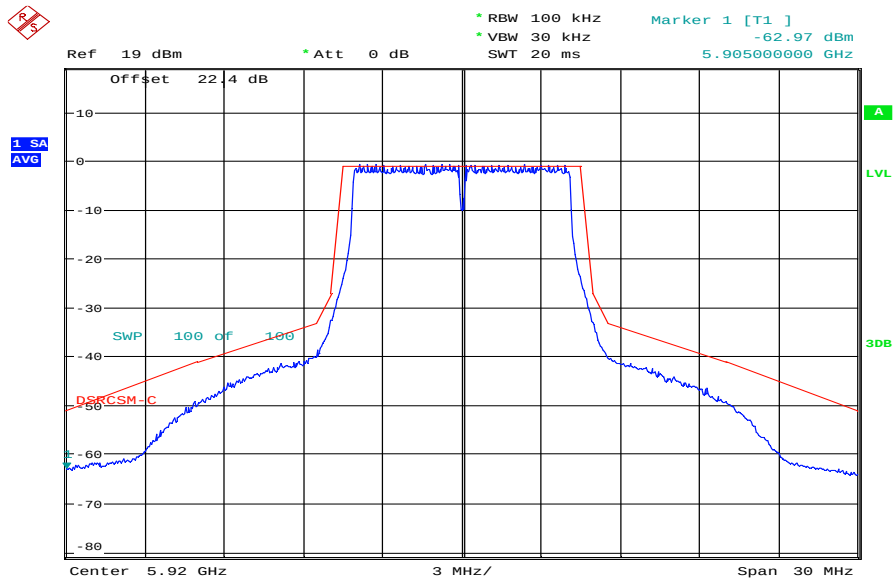
Date: 11.JUN.2011 08:56:16

Plot 4: 5905 MHz / Port 1



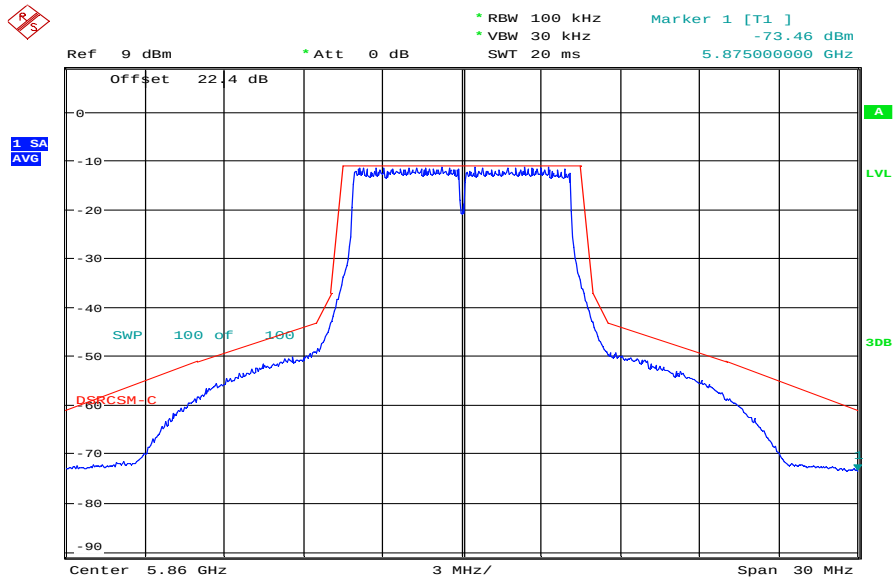
Date: 11.JUN.2011 09:02:02

Plot 5: 5920 MHz / Port 1



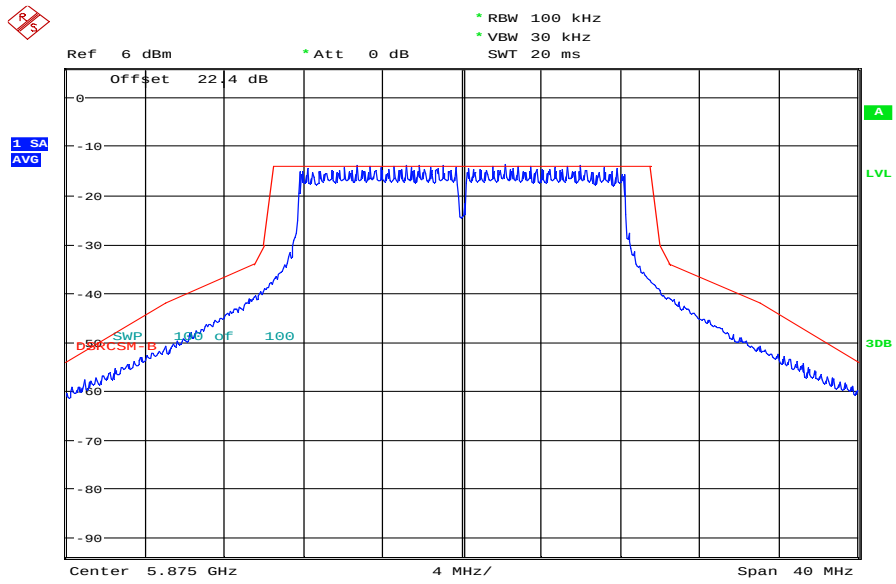
Date: 11.JUN.2011 08:56:59

Plot 6: 5860 MHz / Port 2



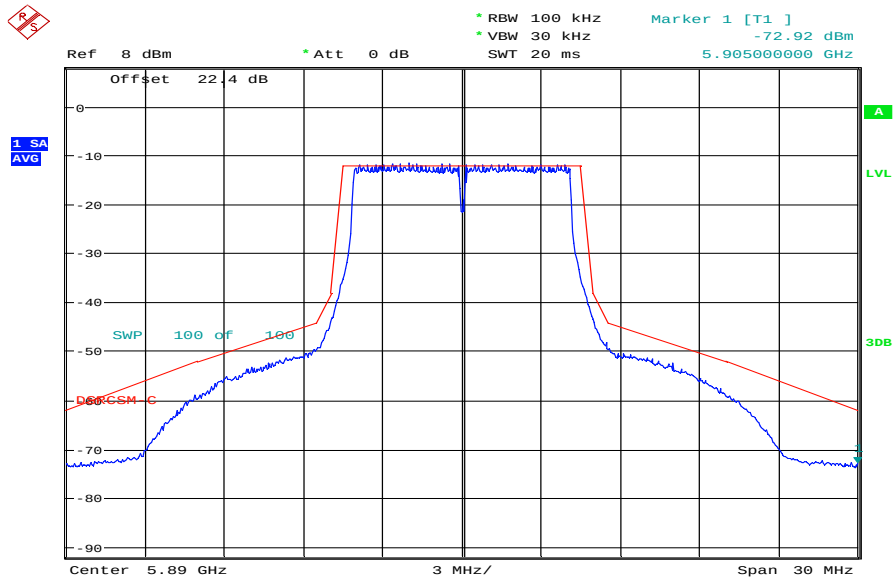
Date: 11.JUN.2011 08:53:29

Plot 7: 5875 MHz / Port 2



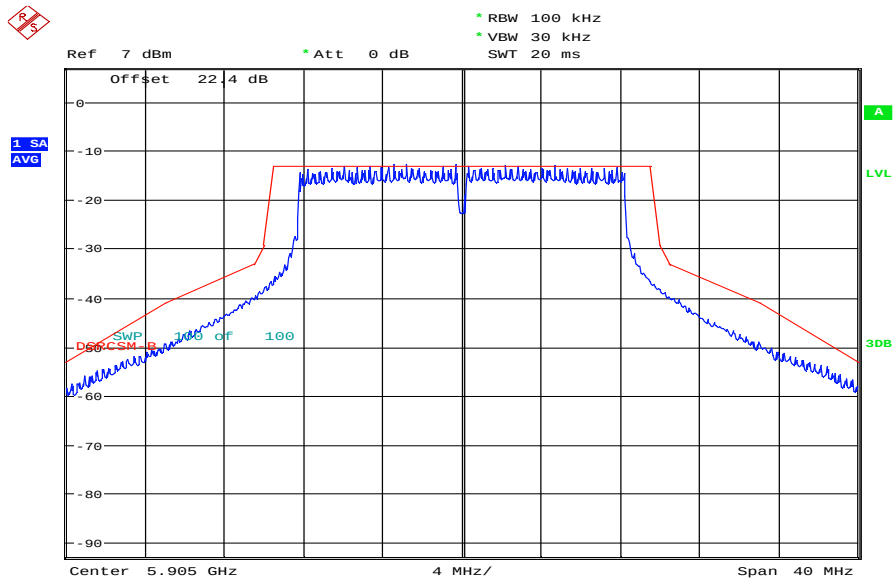
Date: 11.JUN.2011 09:03:50

Plot 8: 5890 MHz / Port 2



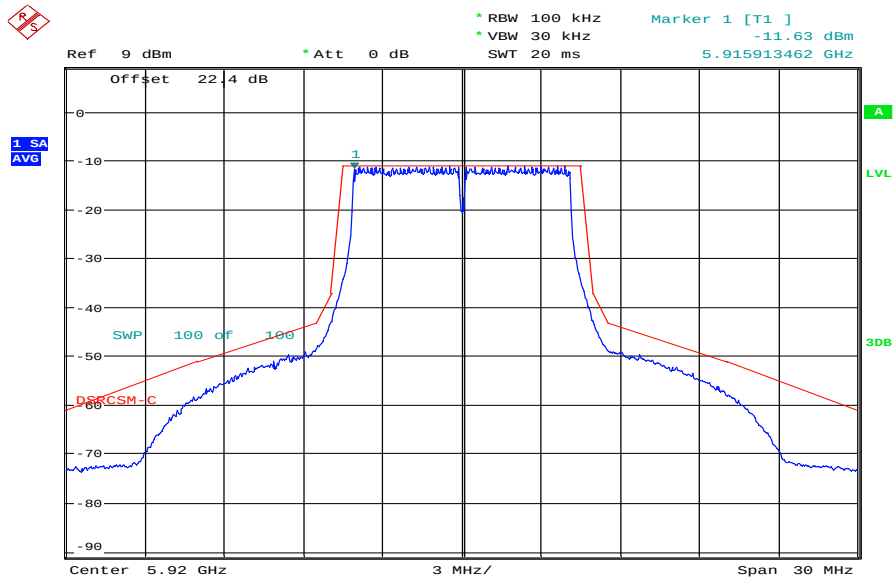
Date: 11.JUN.2011 08:52:47

Plot 9: 5905 MHz / Port 2



Date: 11.JUN.2011 09:04:25

Plot 10: 5920 MHz / Port 2



Date: 11.JUN.2011 08:52:00

9.5 Modulation characteristics (ASTM Table 3 / 2.1047 / 90.207)

The EUT used for different data rates (rates for 20 MHz channels in brackets) – different sub-carrier modulations!

3 MBit/s (3MBit/s) data rate	BPSK modulation
4.5 MBit/s (9MBit/s) data rate	BPSK modulation
6 MBit/s (12MBit/s) data rate	QPSK modulation
9 MBit/s (18MBit/s) data rate	QPSK modulation
12 MBit/s (24MBit/s) data rate	16-QAM modulation
18 MBit/s (36MBit/s) data rate	16-QAM modulation
24 MBit/s (48MBit/s) data rate	64-QAM modulation
27 MBit/s (54MBit/s) data rate	64-QAM modulation

Result: **The result of the measurement is passed.**

9.6 Maximum output power (2.1046 / 90.205 / 90.379 / ASTM 8.9.1)

Measurement:

Measurement parameter	
Detector:	RMS
Sweep time:	Auto
Resolution bandwidth:	20 MHz
Video bandwidth:	30 MHz
Span:	50 MHz / 100 MHz
Trace-Mode:	Max. hold

Limits:

FCC

47 CFR § 2.1046
47 CFR § 90.205 / §90.379 / ASTM 8.9.1

Channel No.	Frequency range (MHz)	Max. EIRP [1] (dBm)	Channel use
170	5850–5855		Reserved.
172	5855–5865	33	Service Channel.[2]
174	5865–5875	33	Service Channel.
175	5865–5885	23	Service Channel.[3]
176	5875–5885	33	Service Channel.
178	5885–5895	33/44.8	Control Channel.
180	5895–5905	23	Service Channel.
181	5895–5915	23	Service Channel.[3]
182	5905–5915	23	Service Channel.
184	5915–5925	33/40	Service Channel.[4]

[1] An RSU may employ an antenna with a height exceeding 8 meters but not exceeding 15 meters provided the EIRP specified in the table above is reduced by a factor of 20 log(Ht/8) in dB where Ht is the height of the radiation center of the antenna in meters above the roadway bed surface. The EIRP is measured as the maximum EIRP toward the horizon or horizontal, whichever is greater, of the gain associated with the main or center of the transmission beam. The RSU antenna height shall not exceed 15 meters above the roadway bed surface.

[2] Channel 172 is designated for public safety applications involving safety of life and property.

[3] Channel Nos. 174/176 may be combined to create a twenty megahertz channel, designated Channel No. 175. Channels 180/182 may be combined to create a twenty-megahertz channel, designated Channel No. 181.

[4] Channel 184 is designated for public safety applications involving safety of life and property. Only those entities meeting the requirements of § 90.373(a) are eligible to hold an authorization to operate on this channel.

Results: Port 1

Test conditions		Max. output power [dBm]				
T_{nom}	V_{nom}	5860 MHz	5875 MHz	5890 MHz	5905 MHz	5920 MHz
Conducted power [dBm]		18.9	8.6	18.6	8.5	19.1
Radiated power [dBm]		32.1	22.5	33.0	22.5	32.2

Results: Port 2

Test conditions		Max. output power [dBm]				
T_{nom}	V_{nom}	5860 MHz	5875 MHz	5890 MHz	5905 MHz	5920 MHz
Conducted power [dBm]		8.2	5.9	7.5	5.8	7.9
Radiated power [dBm]		18.0	16.3	19.0	16.1	18.4

Result: **The result of the measurement is passed.**

9.7 Spurious Emissions - conducted Transmitter (2.1051 / 90.210 / 90.379 / ASTM 8.9.2)

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	30 kHz
Resolution bandwidth:	100 kHz
Span:	9 kHz – 40 GHz
Trace-Mode:	Max Hold

Limits:

FCC
47 CFR § 2.1051 47 CFR § 90.210 / §90.379 / ASTM 8.9.2
-25 dBm

Note: For emissions that fall into restricted bands you find the radiated emissions later in the report.

Results: Port 1

Spurious Emission Level (dBm)								
5860 MHz			5875 MHz			5890 MHz		
F	BW	p	F	BW	p	F	BW	p
6346	100 kHz	-36.8	6346	100 kHz	-36.9	6346	100 kHz	-36.3
Measurement uncertainty			± 3dB					

Spurious Emission Level (dBm)								
5905 MHz			5920 MHz					
F	BW	p	F	BW	p	F	BW	p
6346	100 kHz	-36.6	6346	100 kHz	-37.3			
Measurement uncertainty			± 3dB					

Results: Port 2

Spurious Emission Level (dBm)								
5860 MHz			5875 MHz			5890 MHz		
F	BW	p	F	BW	p	F	BW	p
6346	100 kHz	-44.0	6346	100 kHz	-43.5	6346	100 kHz	-43.9
Measurement uncertainty			Measurement uncertainty					

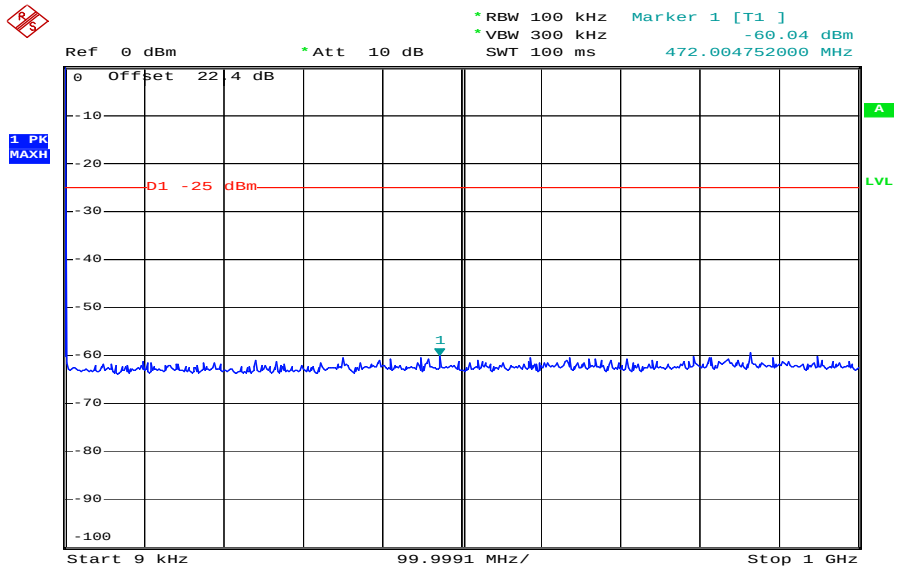
Spurious Emission Level (dBm)								
5905 MHz			5920 MHz					
F	BW	p	F	BW	p			
6346	100 kHz	-44.2	6346	100 kHz	-43.2			
Measurement uncertainty			Measurement uncertainty					

Where F = Frequency of spurious (MHz)
BW = Measurement receiver bandwidth (kHz / MHz)
p = Level of spurious (dBm)

Result: **The result of the measurement is passed.**

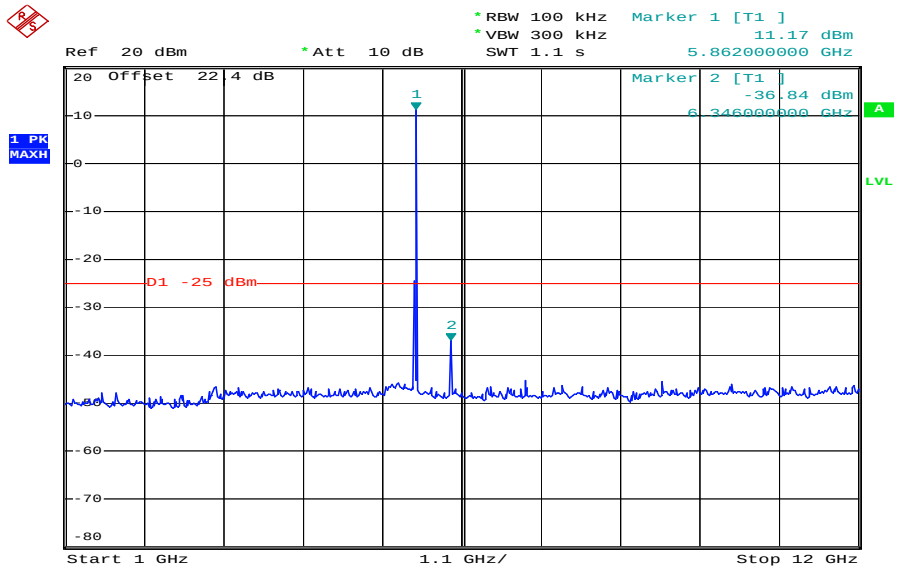
Plots of the measurements

Plot 1: Port 1, 5860 MHz, 9 kHz – 1 GHz



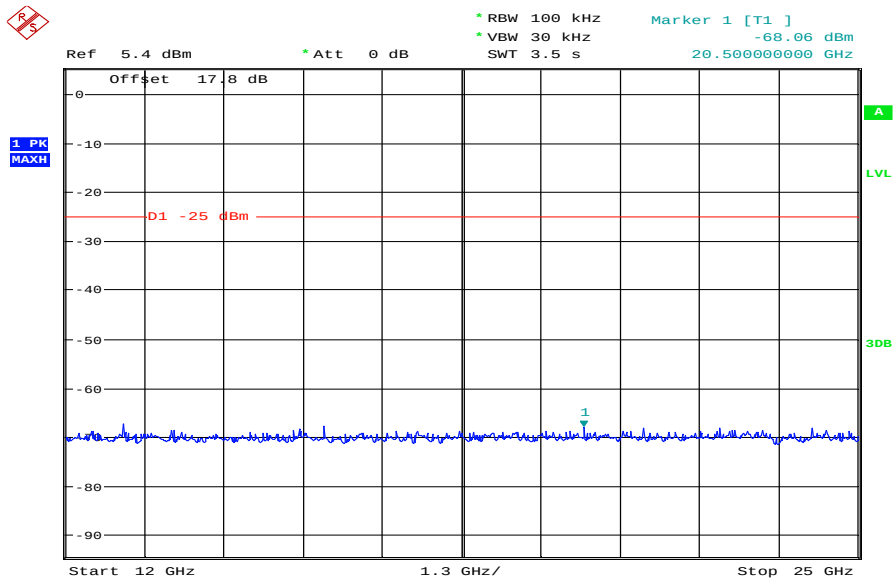
Date: 10.MAY.2011 13:13:35

Plot 2: Port 1, 5860 MHz, 1 GHz – 12 GHz



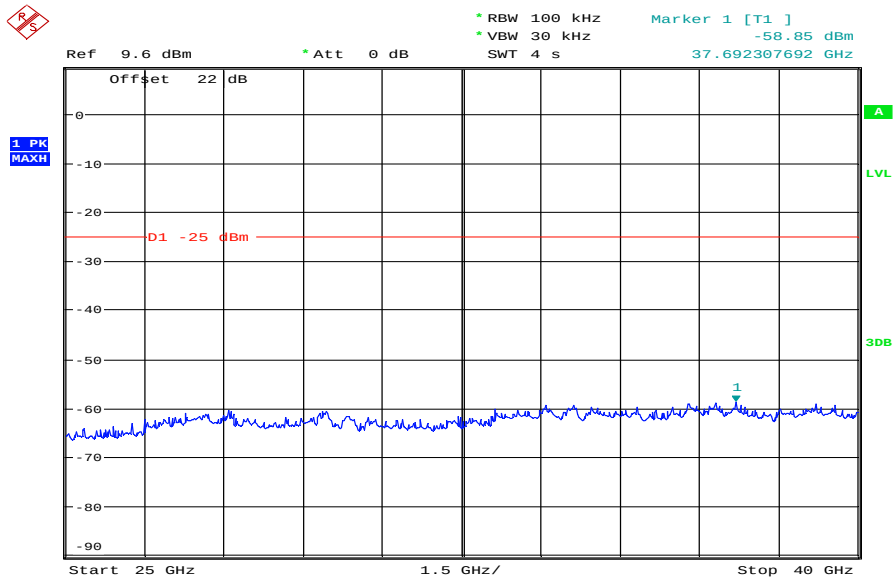
Date: 10.MAY.2011 13:21:49

Plot 3: Port 1, 5860 MHz, 12 GHz – 25 GHz



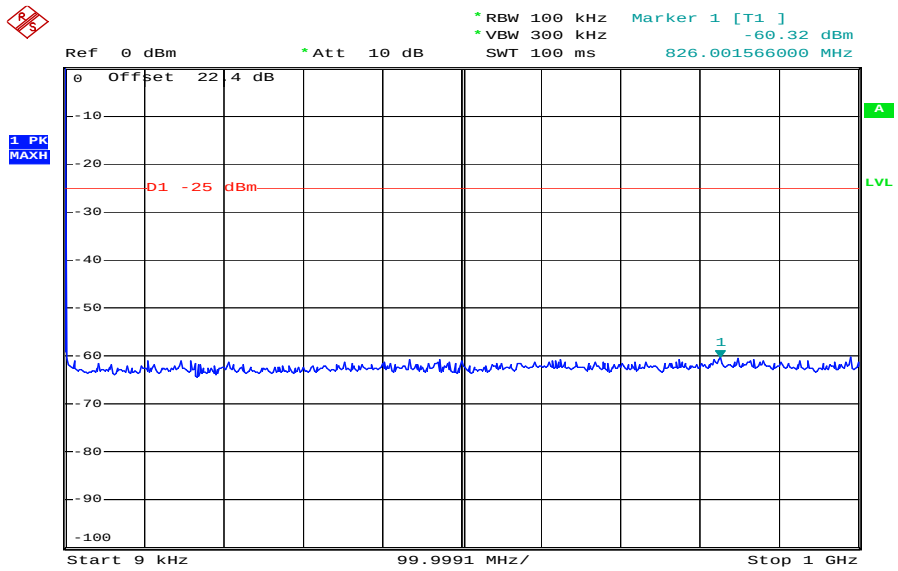
Date: 11.JUN.2011 09:48:44

Plot 4: Port 1, 5860 MHz, 25 GHz – 40 GHz



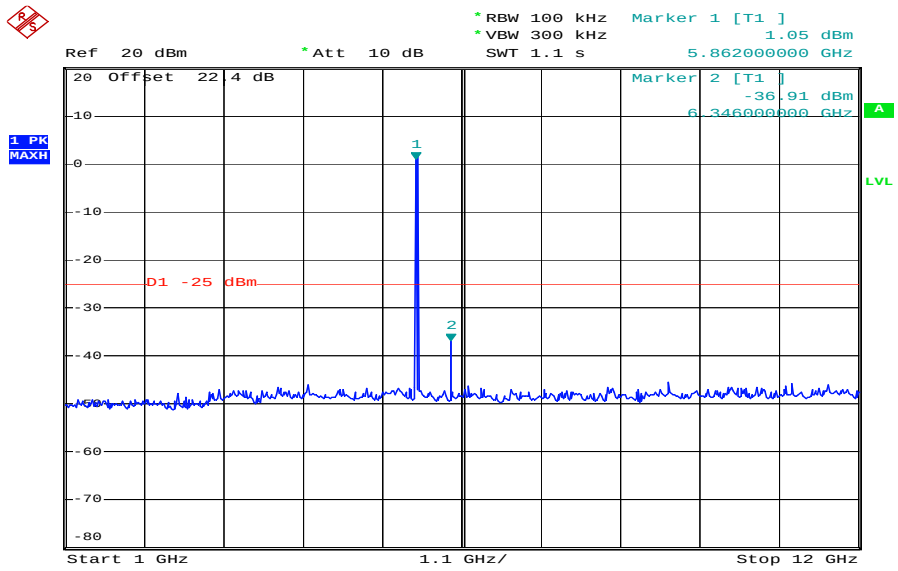
Date: 11.JUN.2011 09:42:30

Plot 5: Port 1, 5875 MHz, 9 kHz – 1 GHz



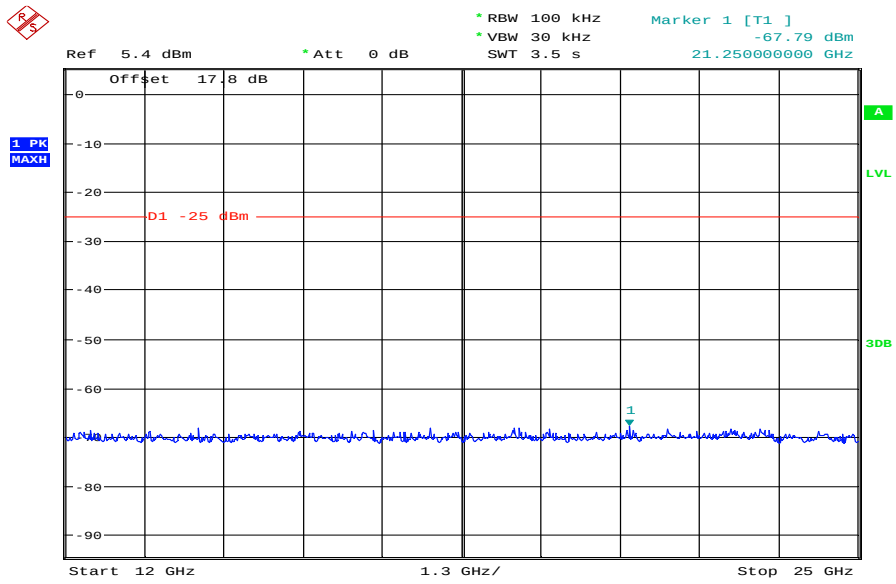
Date: 10.MAY.2011 13:16:45

Plot 6: Port 1, 5875 MHz, 1 GHz – 12 GHz



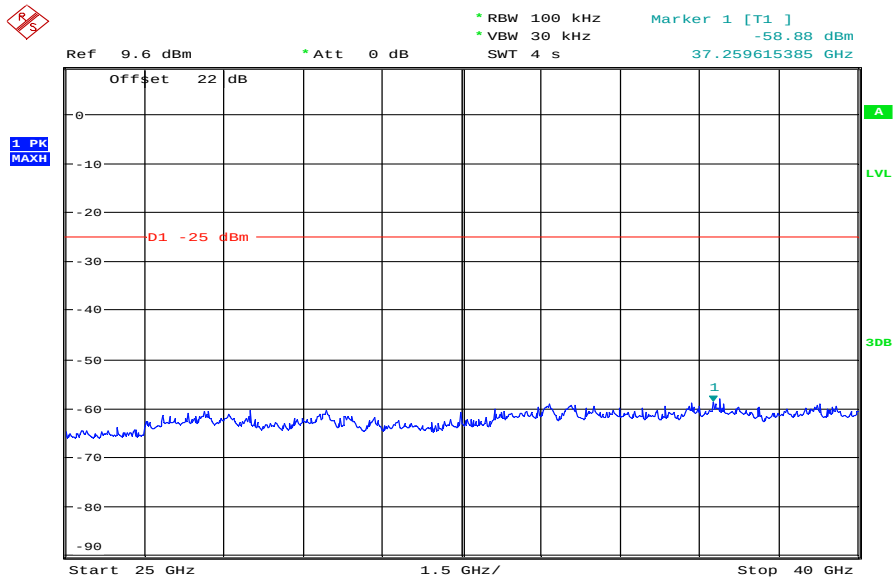
Date: 10.MAY.2011 13:22:35

Plot 7: Port 1, 5875 MHz, 12 GHz – 25 GHz



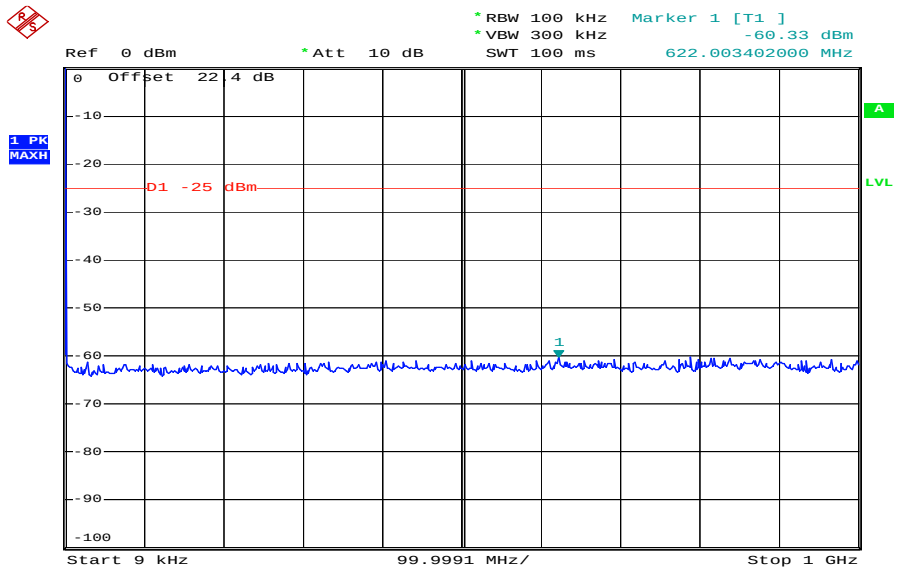
Date: 11.JUN.2011 09:45:57

Plot 8: Port 1, 5875 MHz, 25 GHz – 40 GHz



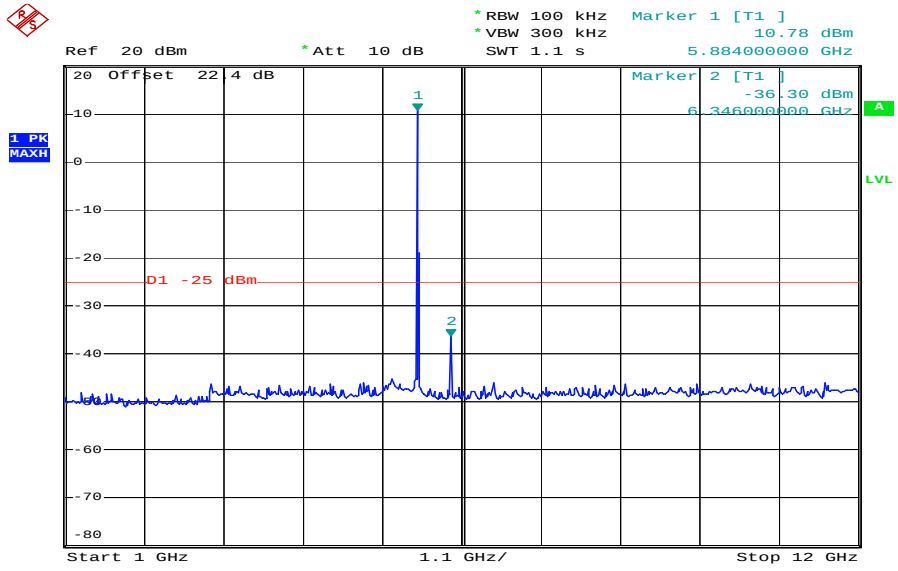
Date: 11.JUN.2011 09:45:02

Plot 9: Port 1, 5890 MHz, 9 kHz – 1 GHz



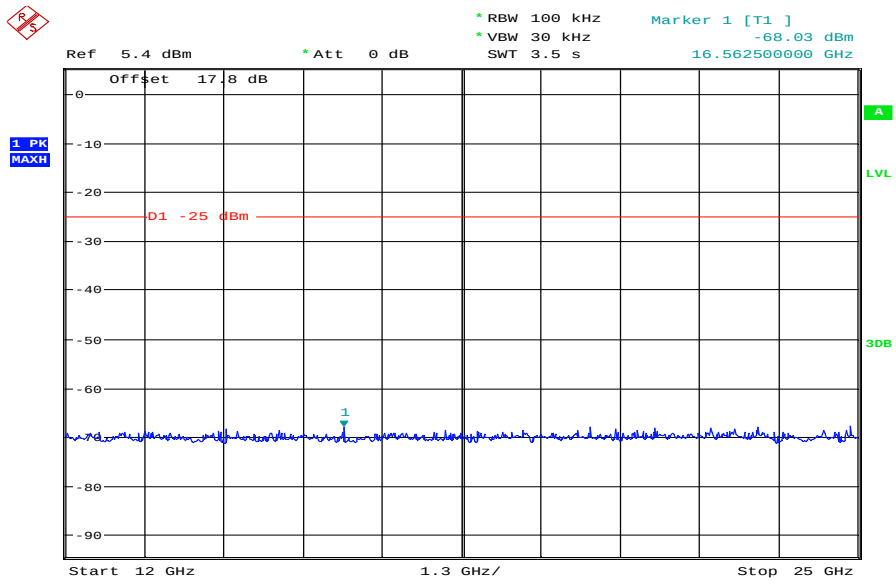
Date: 10.MAY.2011 13:14:15

Plot 10: Port 1, 5890 MHz, 1 GHz – 12 GHz



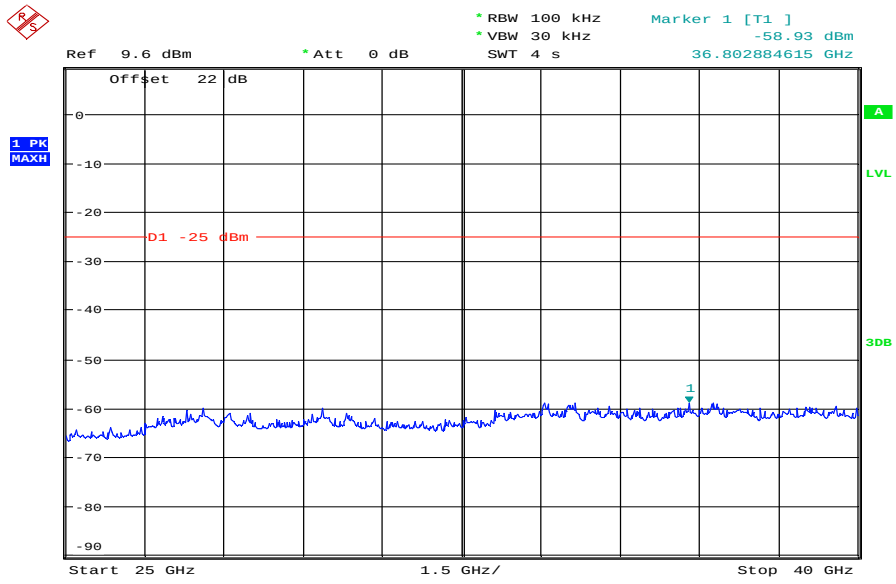
Date: 10.MAY.2011 13:20:21

Plot 11: Port 1, 5890 MHz, 12 GHz – 25 GHz



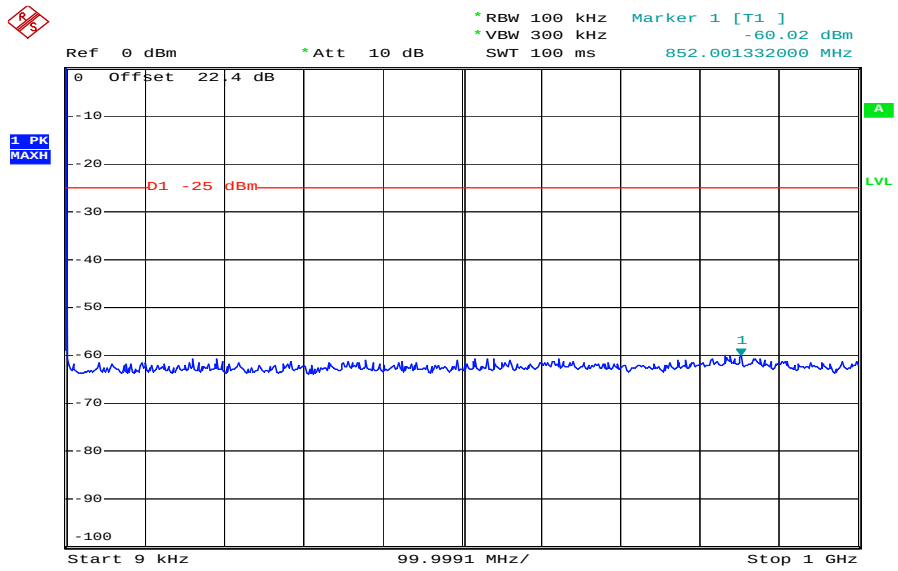
Date: 11.JUN.2011 09:48:11

Plot 12: Port 1, 5890 MHz, 25 GHz – 40 GHz



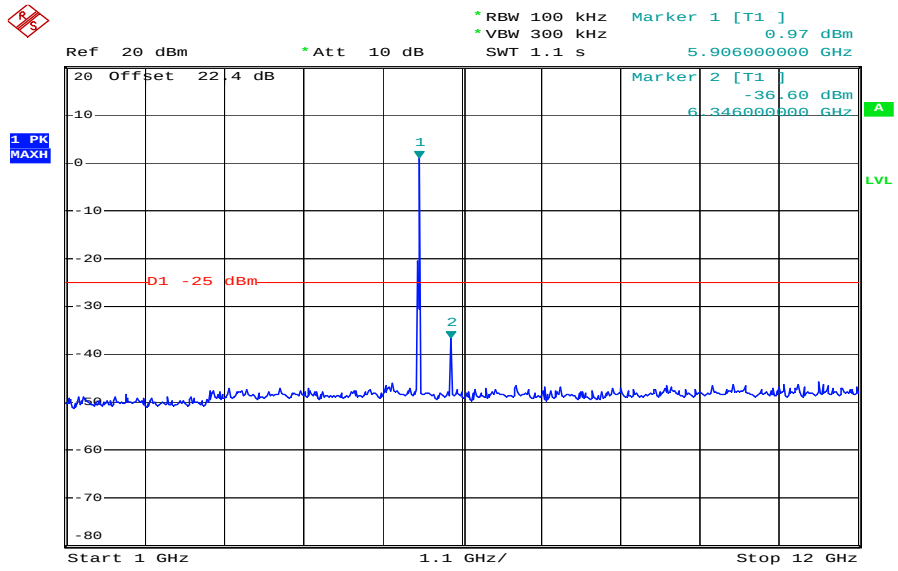
Date: 11.JUN.2011 09:43:05

Plot 13: Port 1, 5905 MHz, 9 kHz – 1 GHz



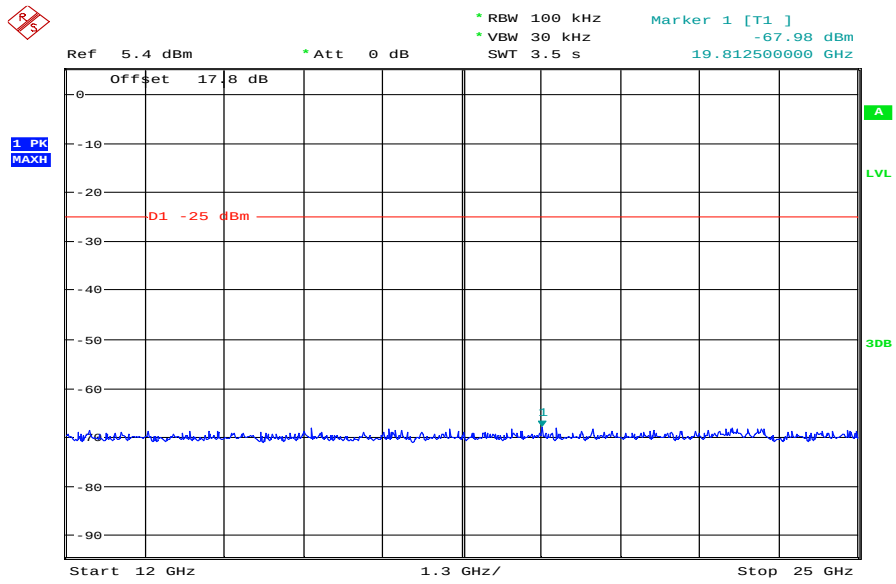
Date: 10.MAY.2011 13:15:50

Plot 14: Port 1, 5905 MHz, 1 GHz – 12 GHz



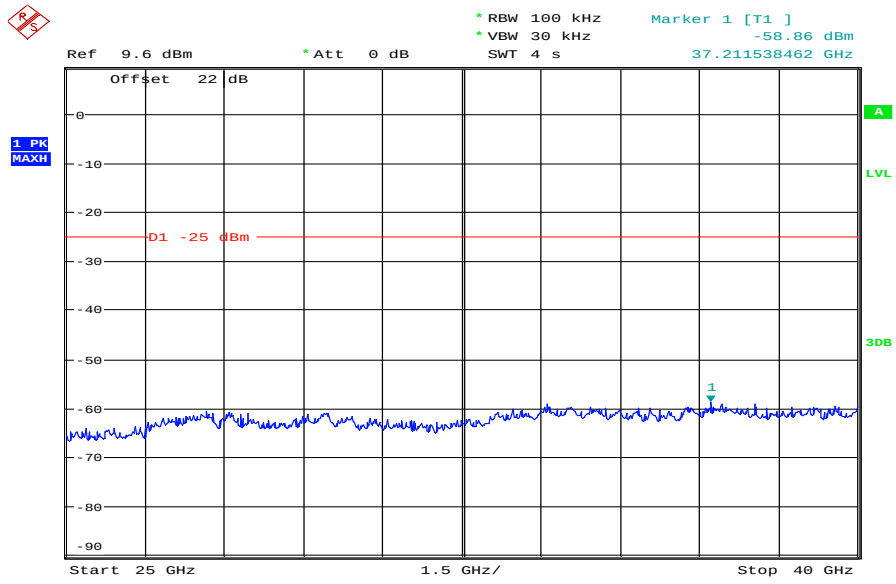
Date: 10.MAY.2011 13:23:13

Plot 15: Port 1, 5905 MHz, 12 GHz – 25 GHz



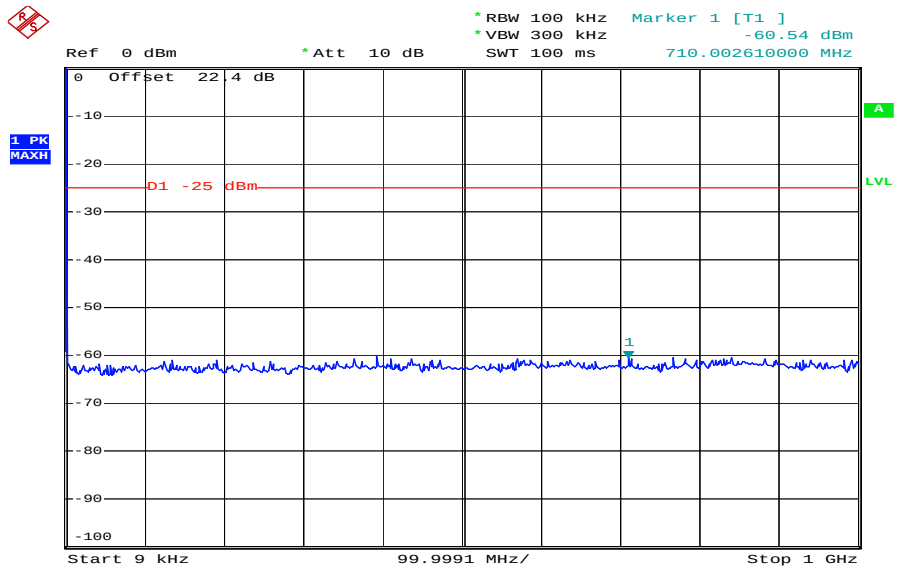
Date: 11.JUN.2011 09:46:49

Plot 16: Port 1, 5905 MHz, 25 GHz – 40 GHz



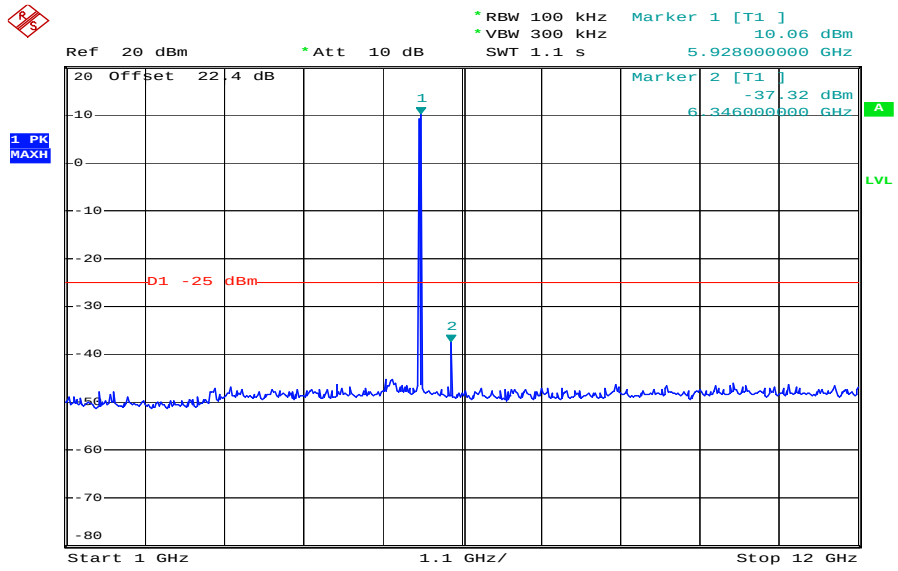
Date: 11.JUN.2011 09:44:25

Plot 17: Port 1, 5920 MHz, 9 kHz – 1 GHz



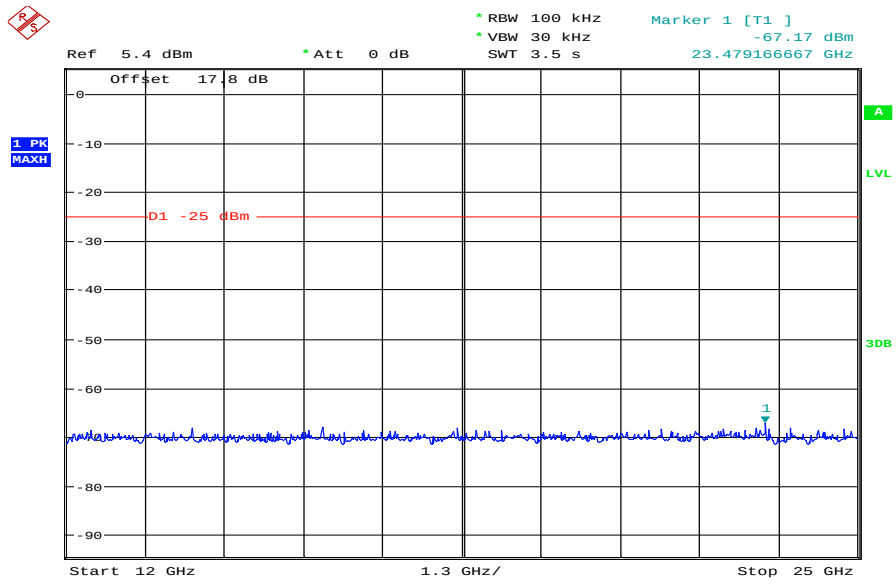
Date: 10.MAY.2011 13:15:02

Plot 18: Port 1, 5920 MHz, 1 GHz – 12 GHz



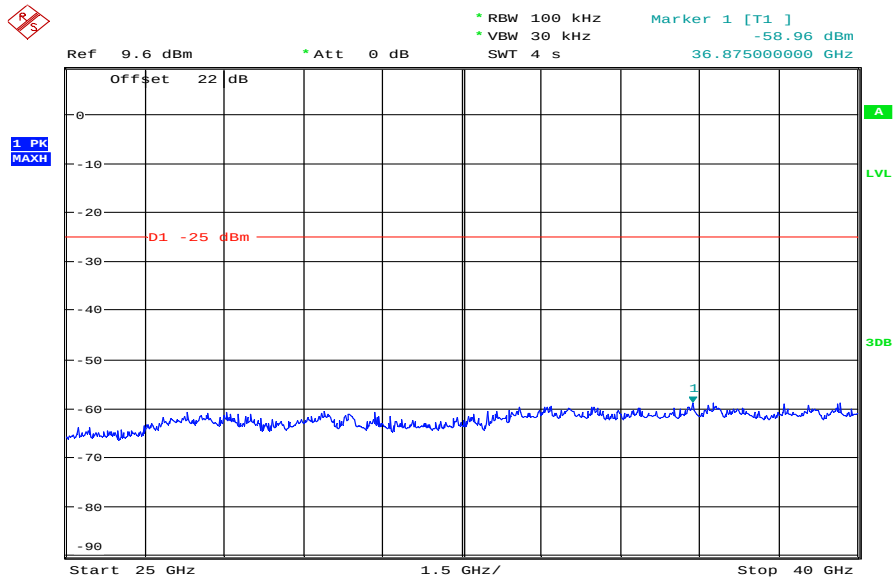
Date: 10.MAY.2011 13:19:34

Plot 19: Port 1, 5920 MHz, 12 GHz – 25 GHz



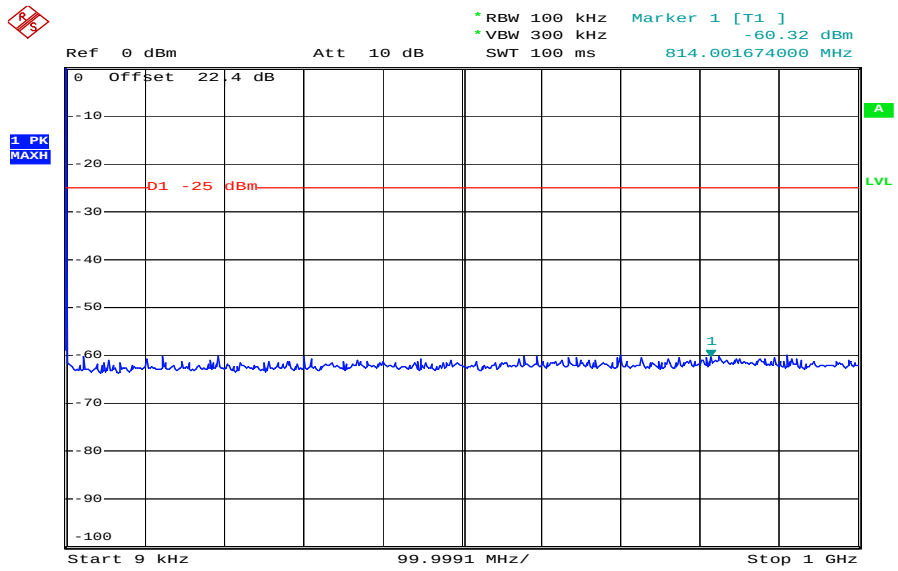
Date: 11.JUN.2011 09:47:35

Plot 20: Port 1, 5920 MHz, 25 GHz – 40 GHz



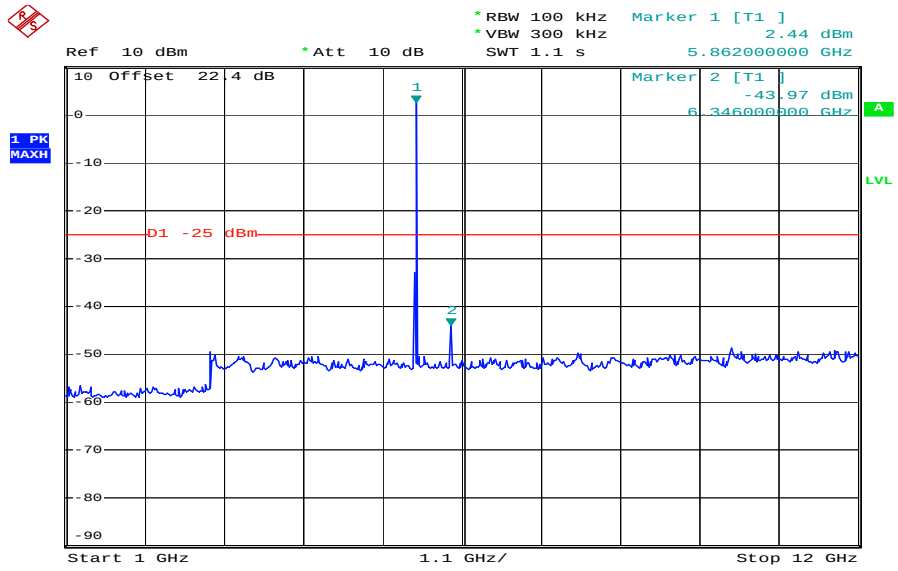
Date: 11.JUN.2011 09:43:39

Plot 21: Port 2, 5860 MHz, 9 kHz – 1 GHz



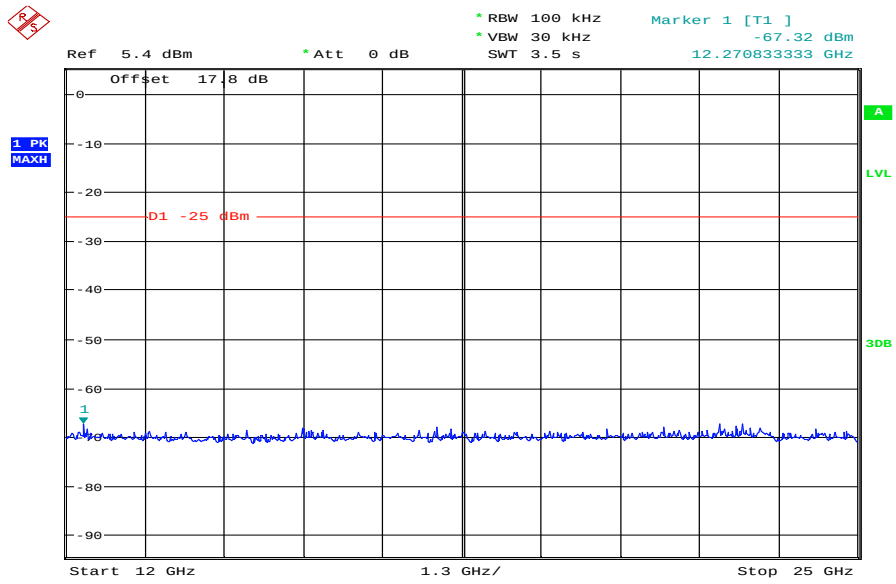
Date: 10.MAY.2011 13:03:05

Plot 22: Port 2, 5860 MHz, 1 GHz – 12 GHz



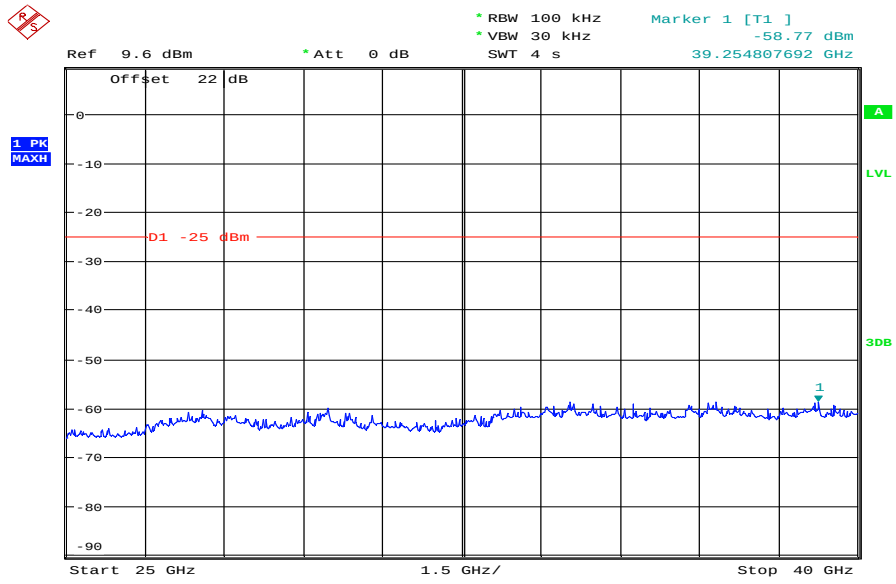
Date: 10.MAY.2011 13:08:09

Plot 23: Port 2, 5860 MHz, 12 GHz – 25 GHz



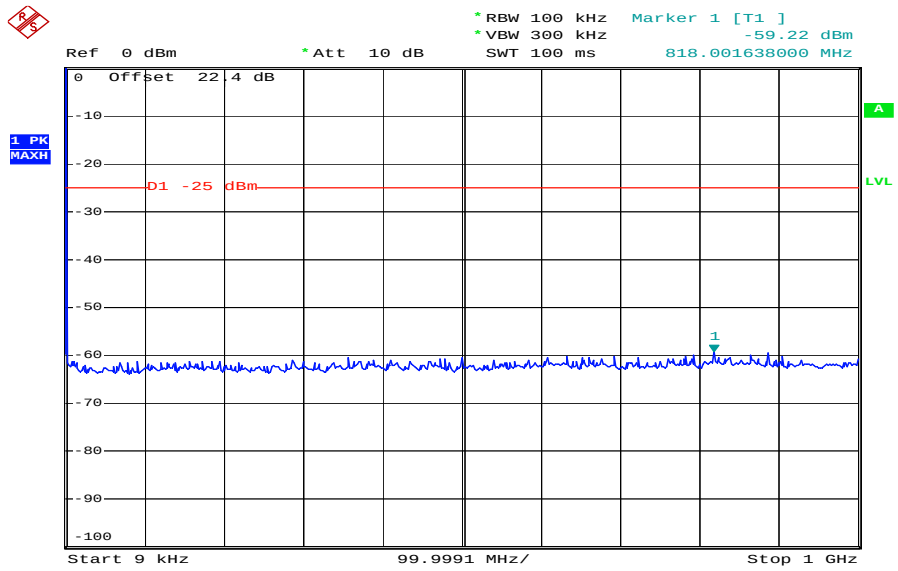
Date: 11.JUN.2011 09:35:09

Plot 24: Port 2, 5860 MHz, 25 GHz – 40 GHz



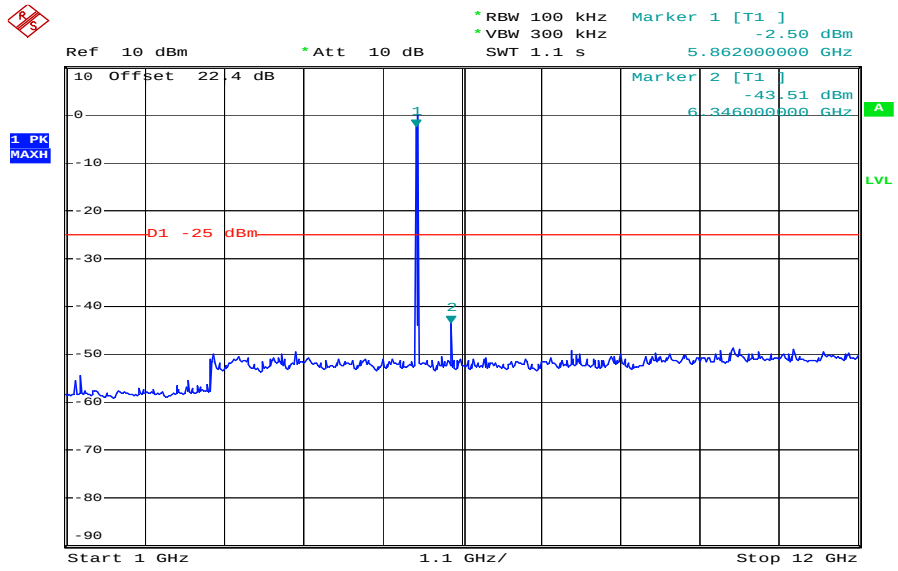
Date: 11.JUN.2011 09:41:14

Plot 25: Port 2, 5875 MHz, 9 kHz – 1 GHz



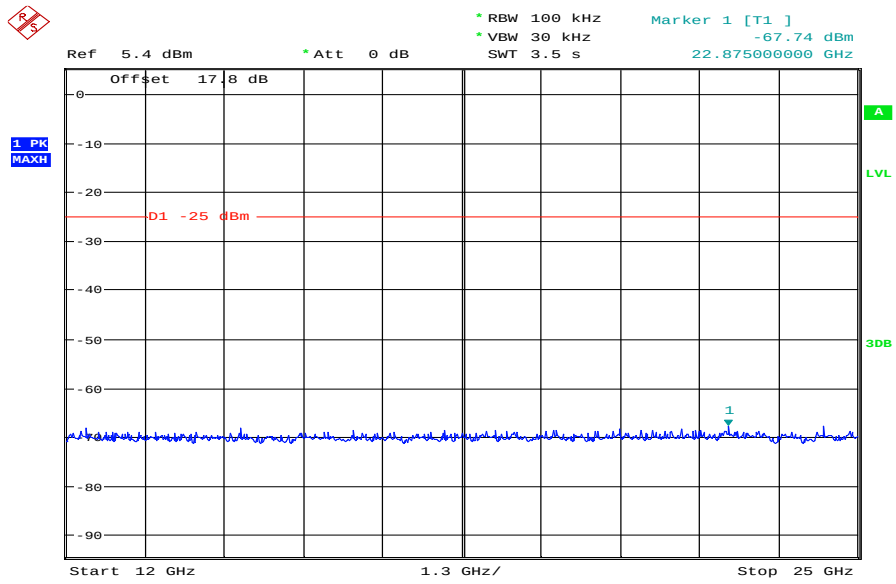
Date: 10.MAY.2011 13:12:14

Plot 26: Port 2, 5875 MHz, 1 GHz – 12 GHz



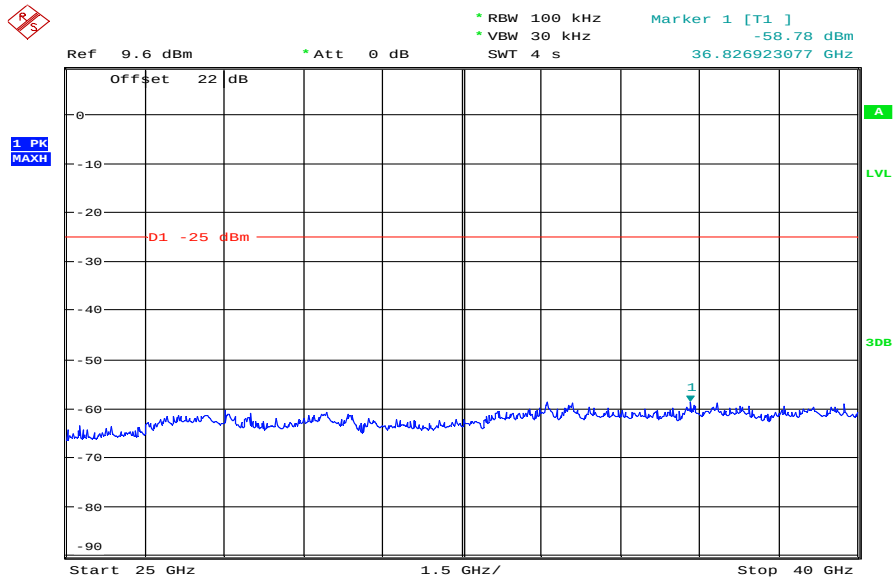
Date: 10.MAY.2011 13:08:57

Plot 27: Port 2, 5875 MHz, 12 GHz – 25 GHz



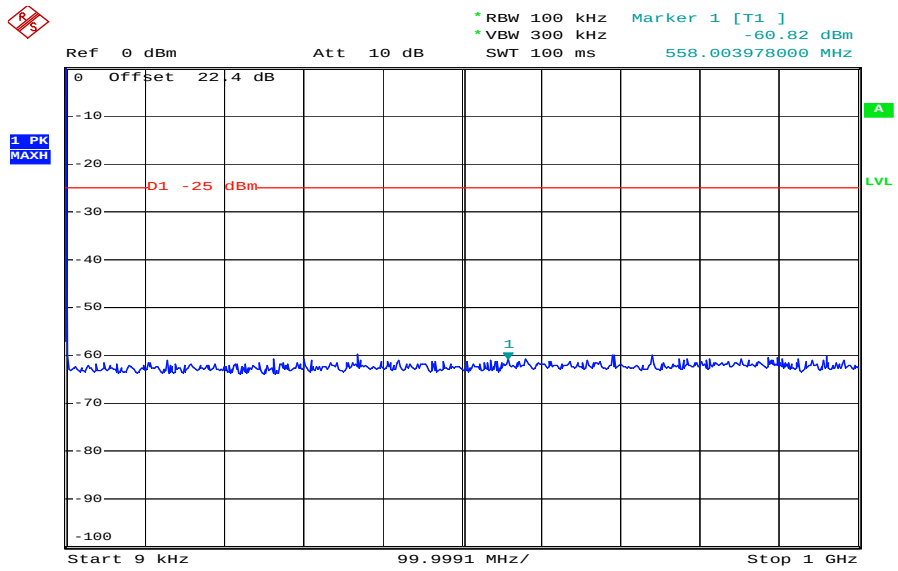
Date: 11.JUN.2011 09:37:36

Plot 28: Port 2, 5875 MHz, 25 GHz – 40 GHz



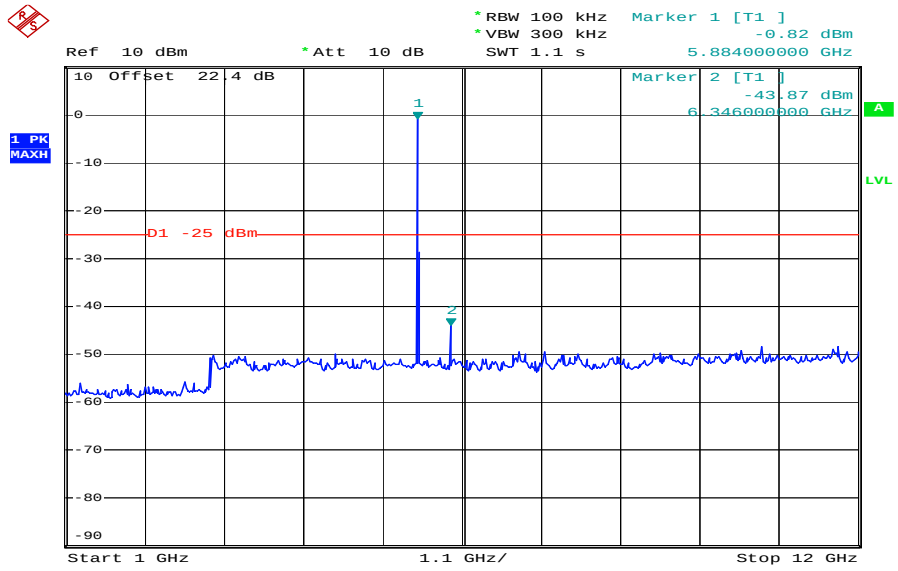
Date: 11.JUN.2011 09:38:57

Plot 29: Port 2, 5890 MHz, 9 kHz – 1 GHz



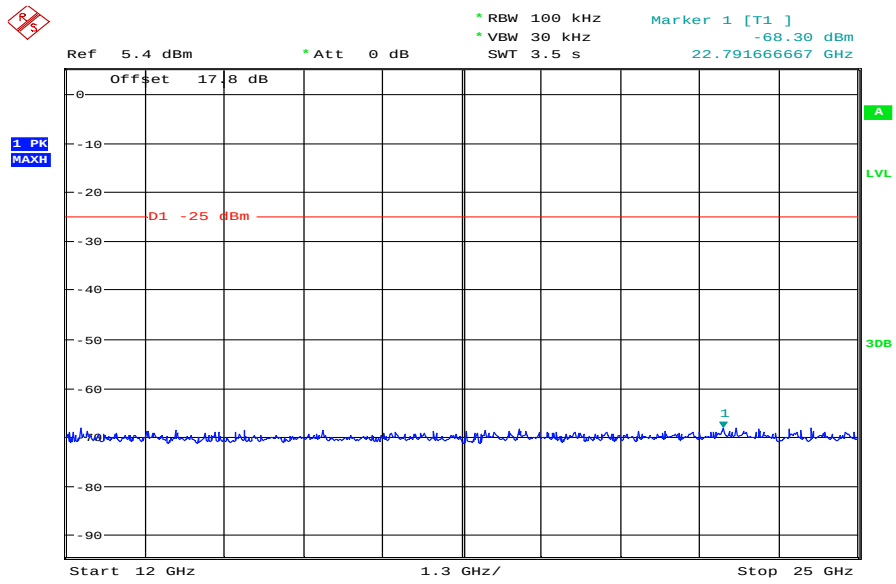
Date: 10.MAY.2011 13:04:13

Plot 30: Port 2, 5890 MHz, 1 GHz – 12 GHz



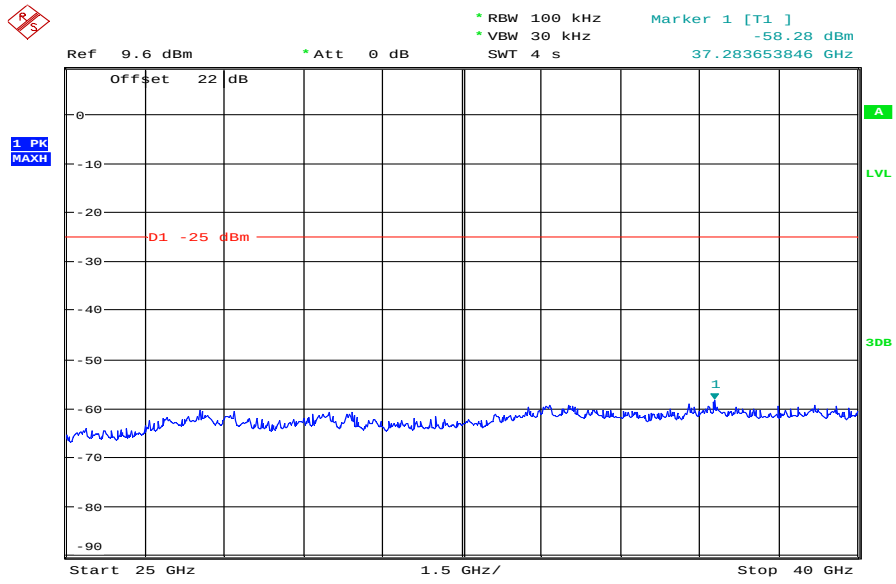
Date: 10.MAY.2011 13:07:27

Plot 31: Port 2, 5890 MHz, 12 GHz – 25 GHz



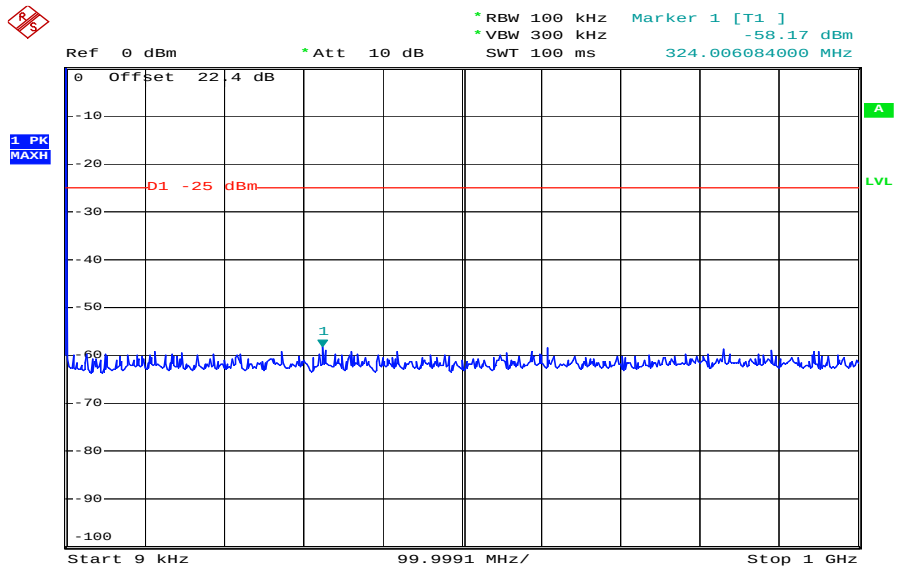
Date: 11.JUN.2011 09:35:44

Plot 32: Port 2, 5890 MHz, 25 GHz – 40 GHz



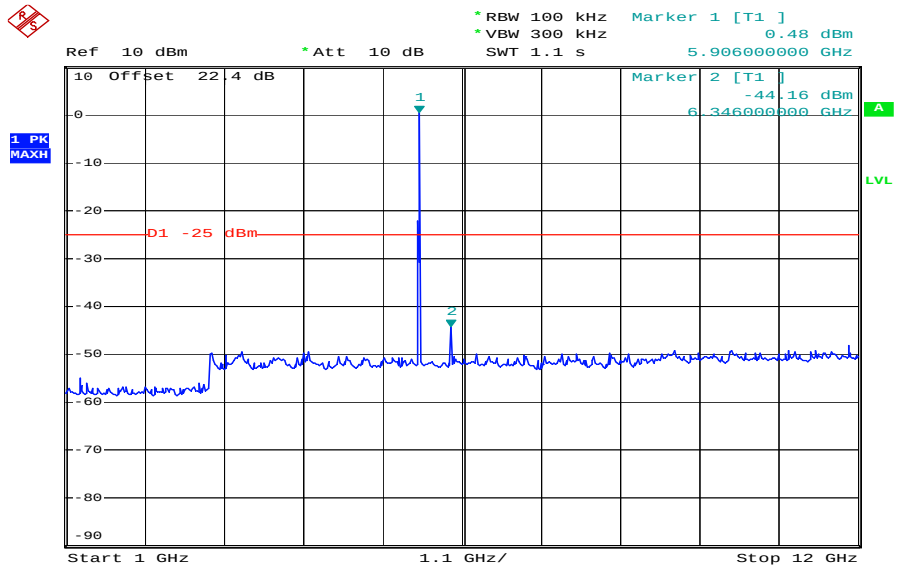
Date: 11.JUN.2011 09:40:37

Plot 33: Port 2, 5905 MHz, 9 kHz – 1 GHz



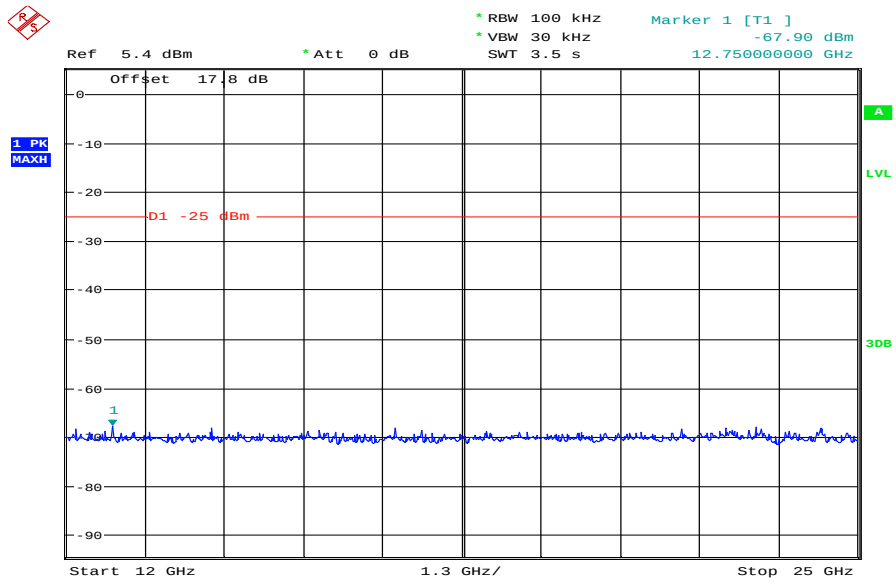
Date: 10.MAY.2011 13:11:07

Plot 34: Port 2, 5905 MHz, 1 GHz – 12 GHz



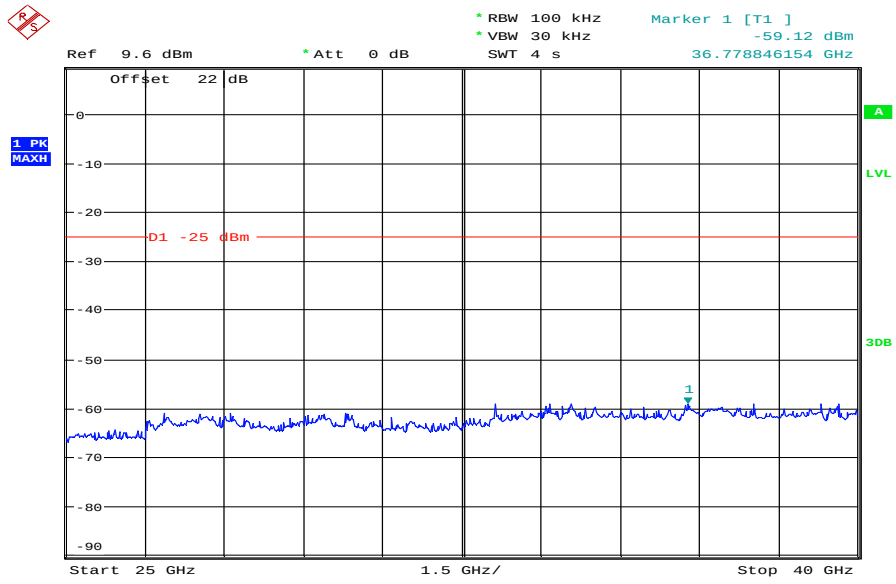
Date: 10.MAY.2011 13:10:15

Plot 35: Port 2, 5905 MHz, 12 GHz – 25 GHz



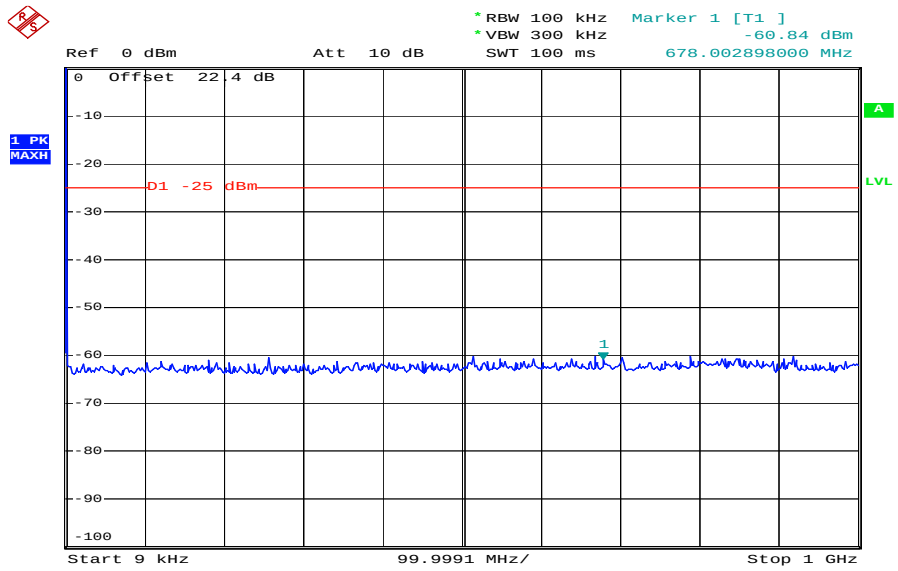
Date: 11.JUN.2011 09:36:59

Plot 36: Port 2, 5905 MHz, 25 GHz – 40 GHz



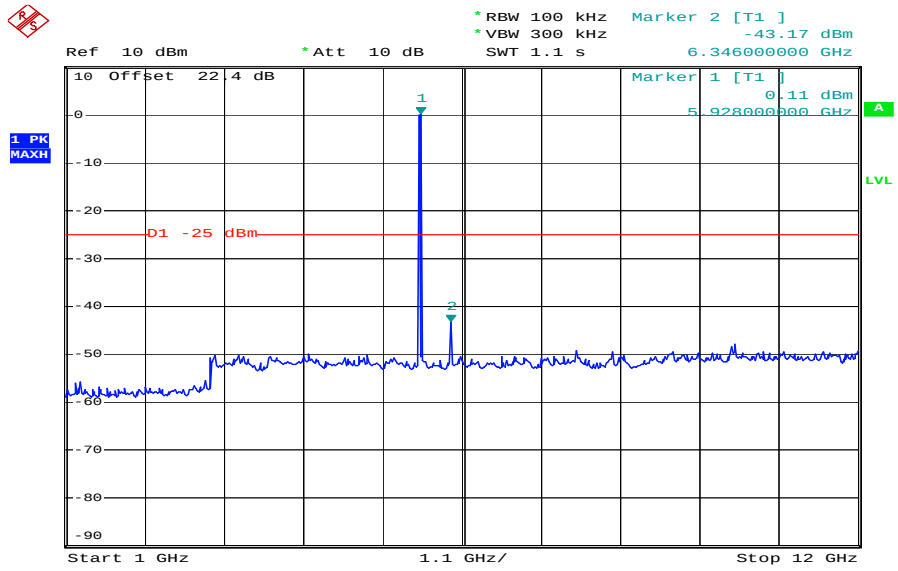
Date: 11.JUN.2011 09:39:23

Plot 37: Port 2, 5920 MHz, 9 kHz – 1 GHz



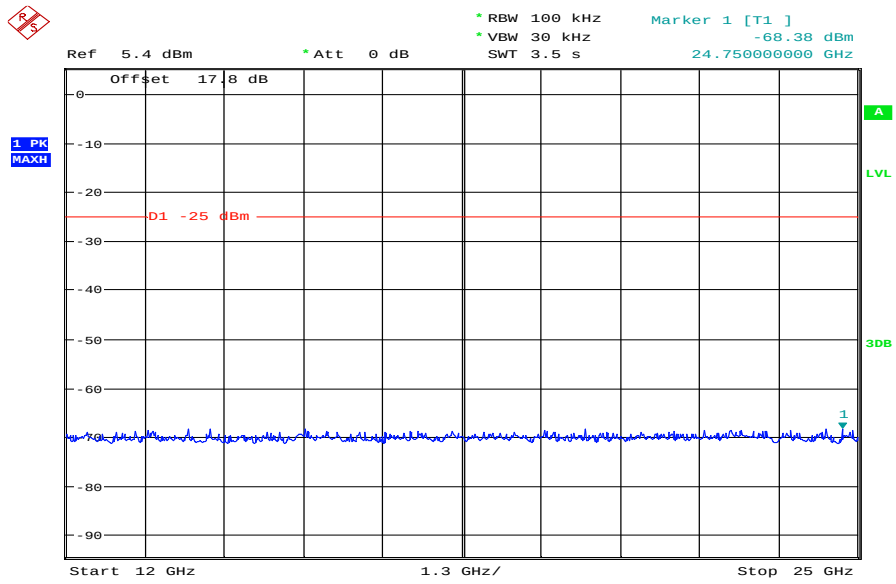
Date: 10.MAY.2011 13:04:53

Plot 38: Port 2, 5920 MHz, 1 GHz – 12 GHz



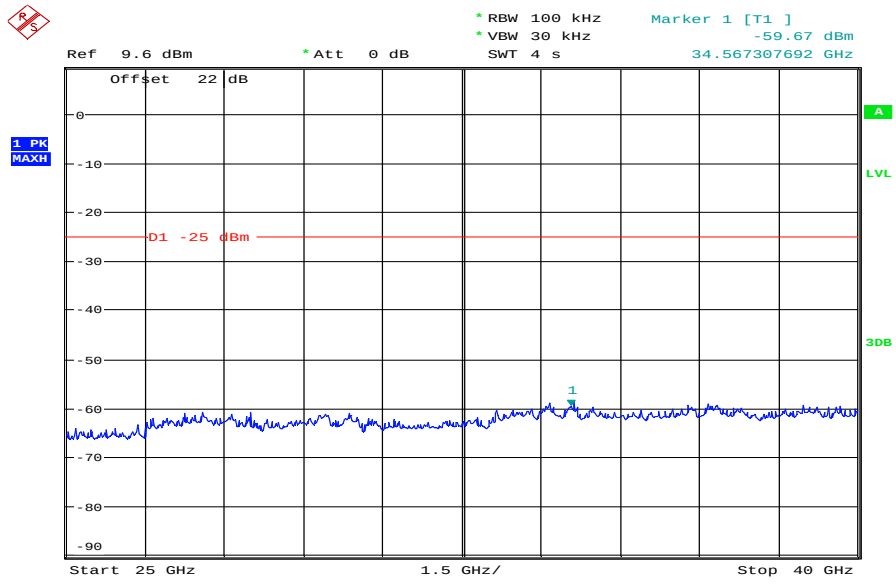
Date: 10.MAY.2011 13:06:05

Plot 39: Port 2, 5920 MHz, 12 GHz – 25 GHz



Date: 11.JUN.2011 09:36:16

Plot 40: Port 2, 5920 MHz, 25 GHz – 40 GHz



Date: 11.JUN.2011 09:40:02

9.8 Spurious Emissions - radiated Transmitter (2.1053 / 90.210 / 90.379 / ASTM 8.9.2)

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	500 kHz
Resolution bandwidth:	100 kHz
Span:	9 kHz – 40 GHz
Trace-Mode:	Max Hold

Limits:

FCC
47 CFR § 2.1053 47 CFR § 90.210 / §90.379 / ASTM 8.9.2
-25 dBm

Note: For emissions that fall into restricted bands the limits according §15.209 are valid.

Results: Port 1/2

Spurious Emission Level (dBm)								
5860 MHz			5875 MHz			5890 MHz		
F	BW	p	F	BW	p	F	BW	p
No emissions found > 6 dB below limit. For further informations please have a look at the attached plots.								
Measurement uncertainty			± 3dB					

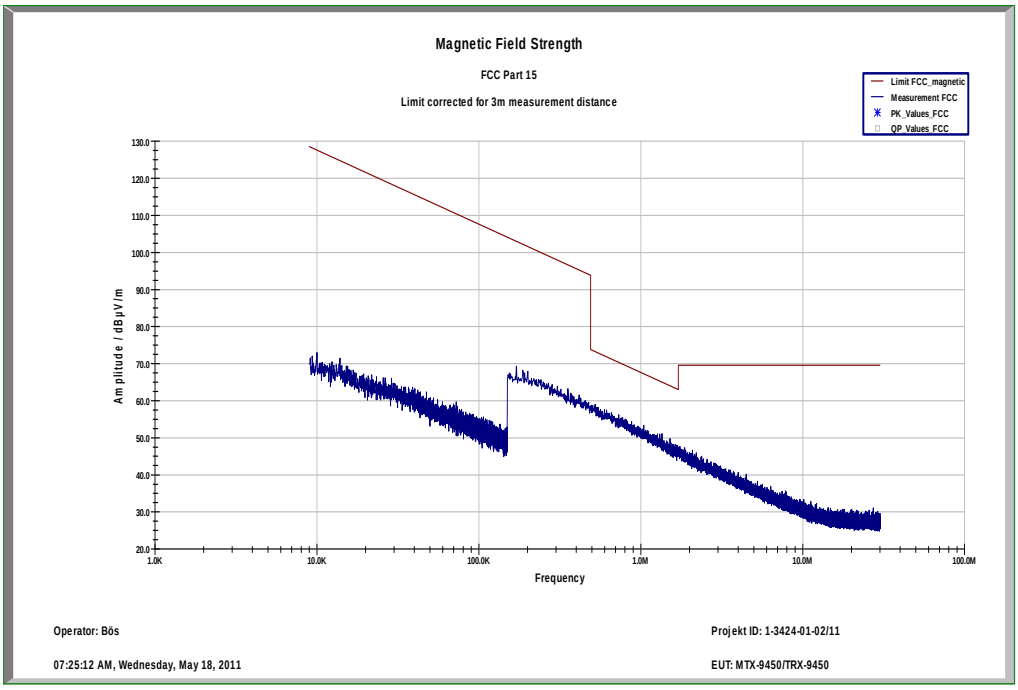
Spurious Emission Level (dBm)								
5905 MHz			5920 MHz					
F	BW	p	F	BW	p	F	BW	p
No emissions found > 6 dB below limit. For further informations please have a look at the attached plots.								
Measurement uncertainty			± 3dB					

Where F = Frequency of spurious (MHz)
BW = Measurement receiver bandwidth (kHz / MHz)
p = Level of spurious (dBm)

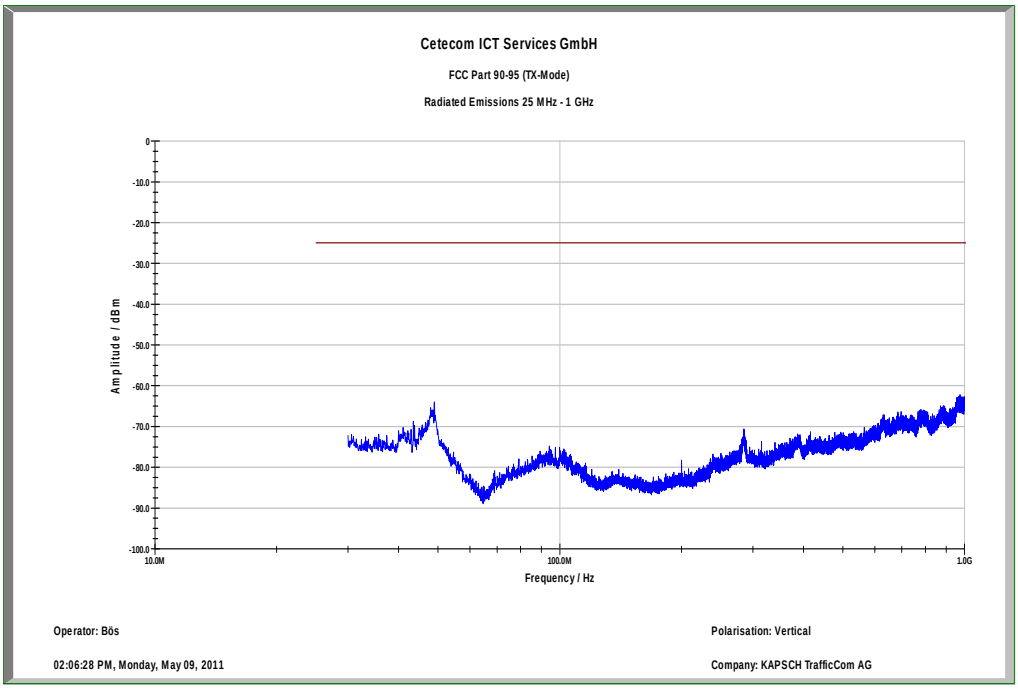
Result: **The result of the measurement is passed.**

Plots of the measurements

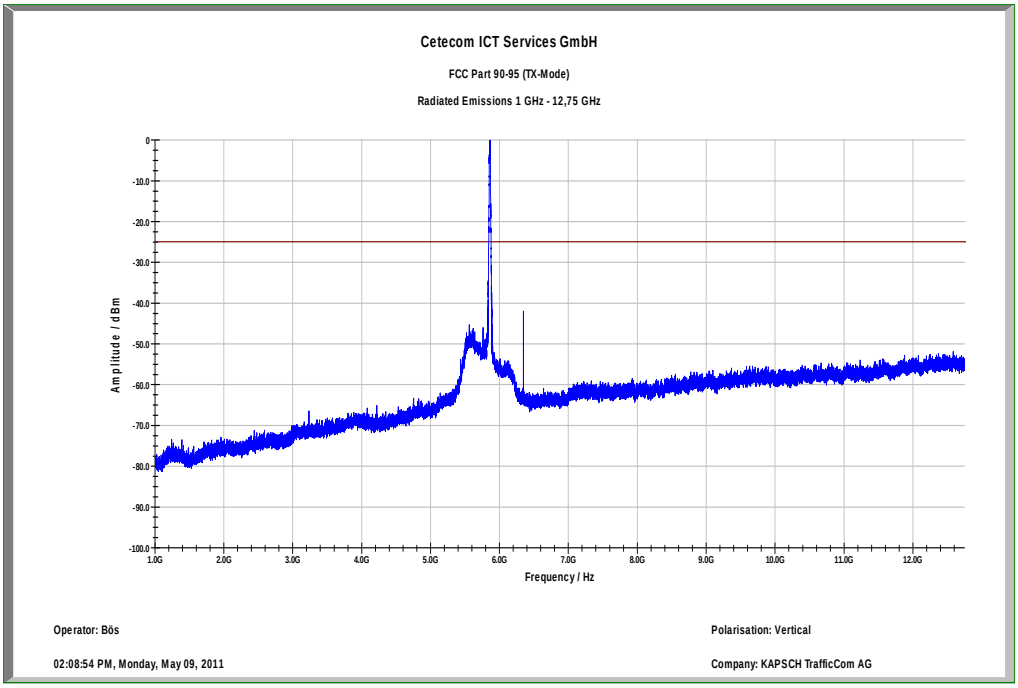
Plot 1: Port 1, 9 kHz – 30 MHz, valid for all channels (worst case result)



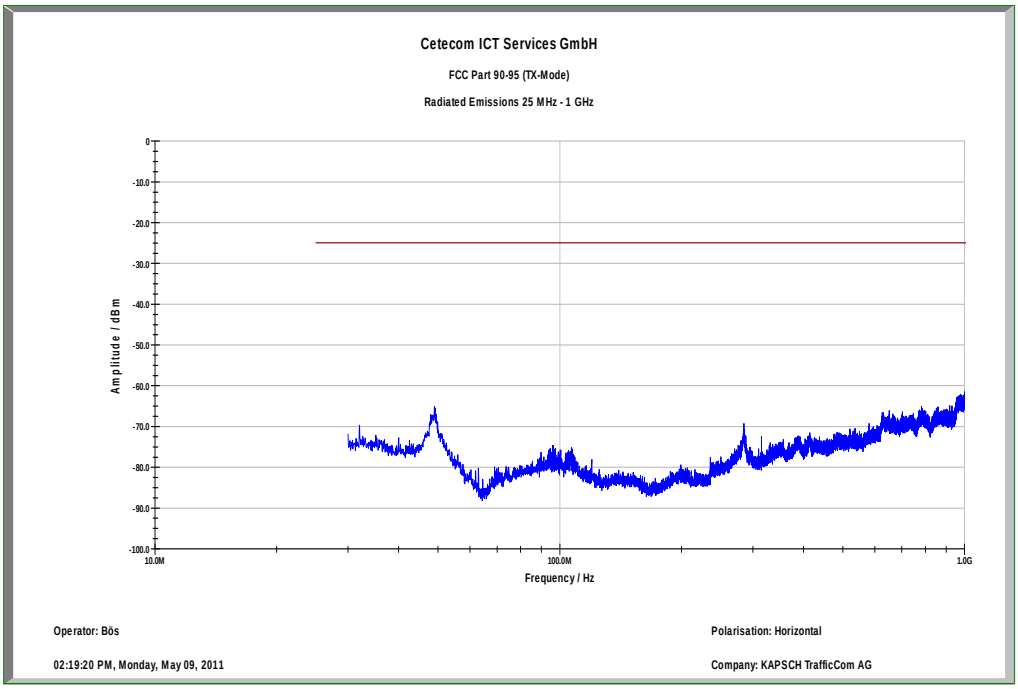
Plot 2: Port 1, 5860 MHz, 30 MHz – 1 GHz, Antenna vertical



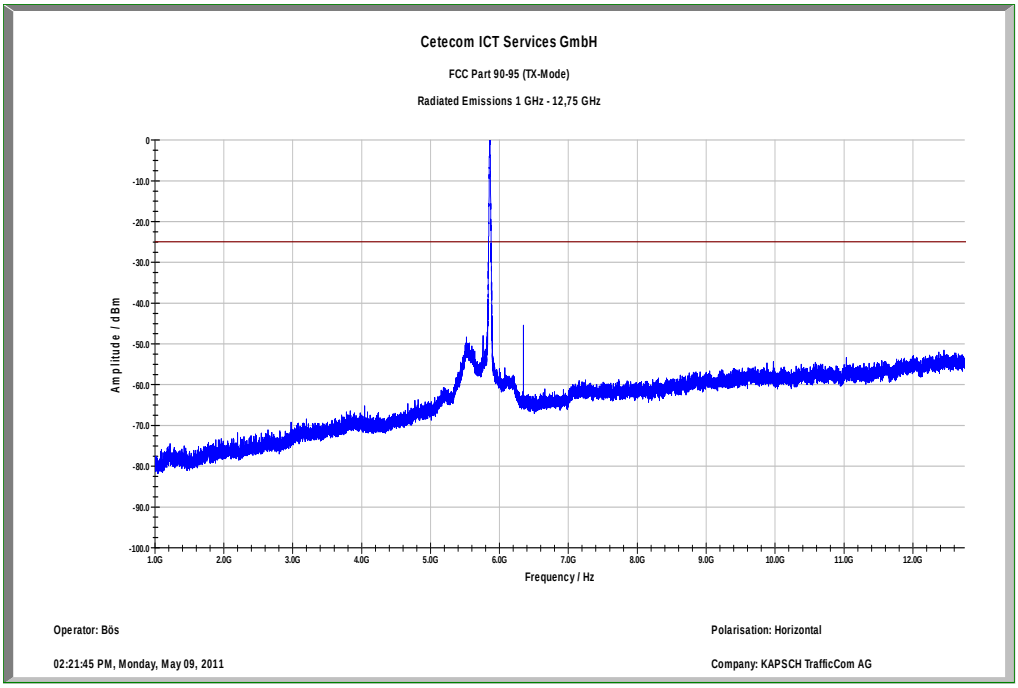
Plot 3: Port 1, 5860 MHz, 1 GHz – 12,75 GHz, Antenna vertical



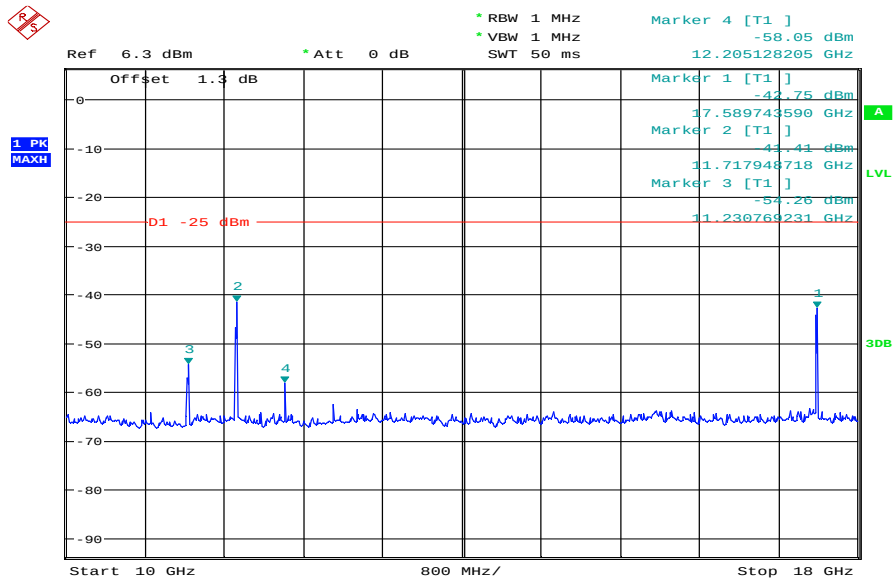
Plot 4: Port 1, 5860 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 5: Port 1, 5860 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 6: Port 1, 5860 MHz, 12 GHz – 18 GHz, horizontal + vertical



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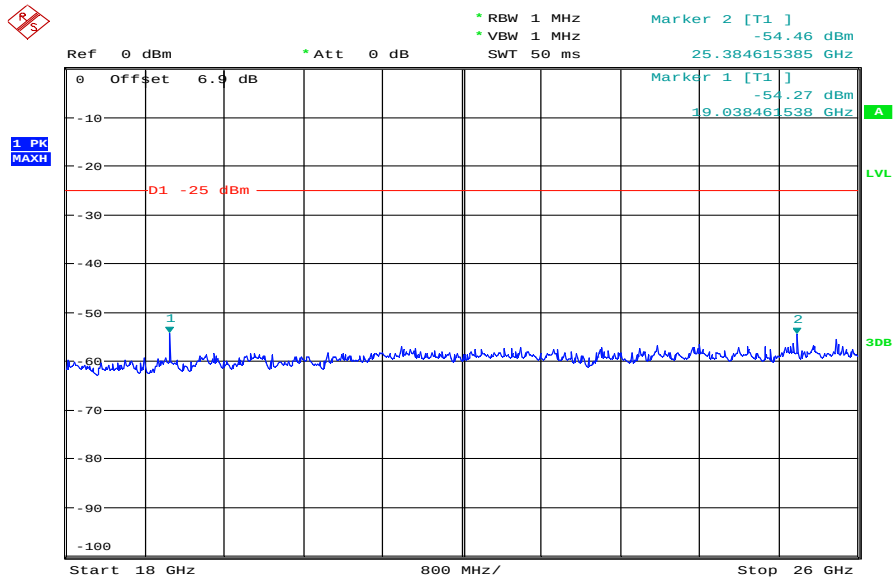
Plot 7: Port 1, 5860 MHz, 18 GHz – 26 GHz, horizontal + vertical



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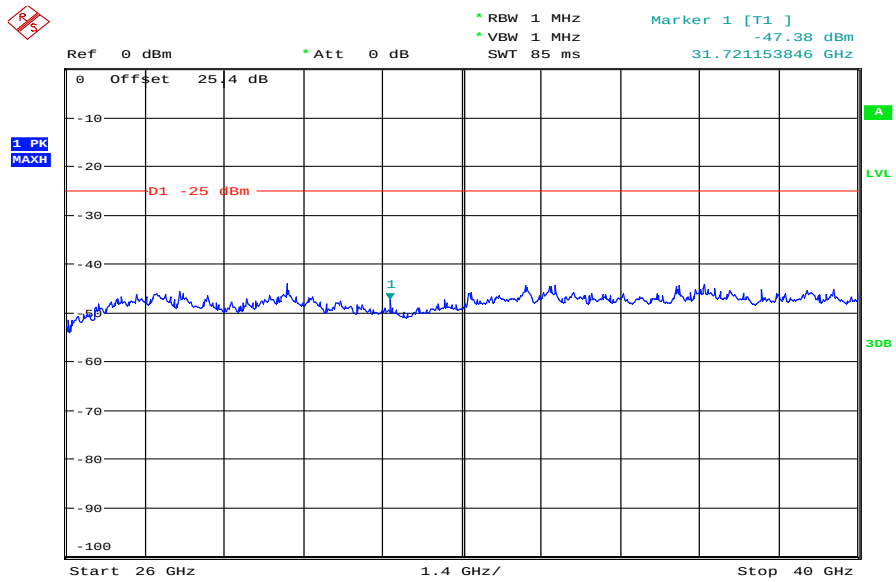
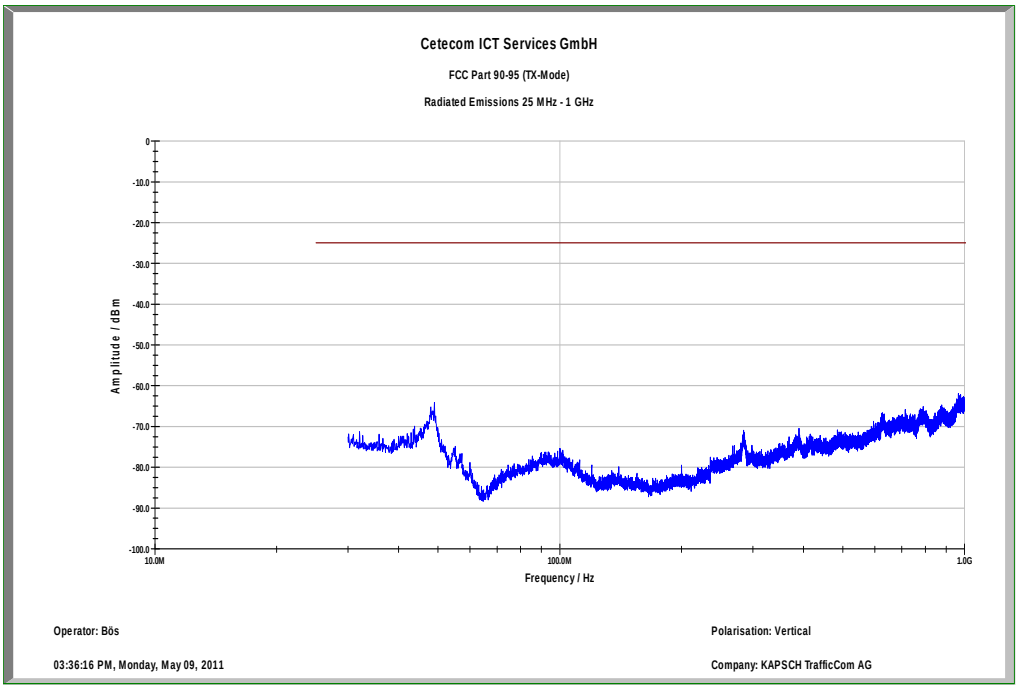
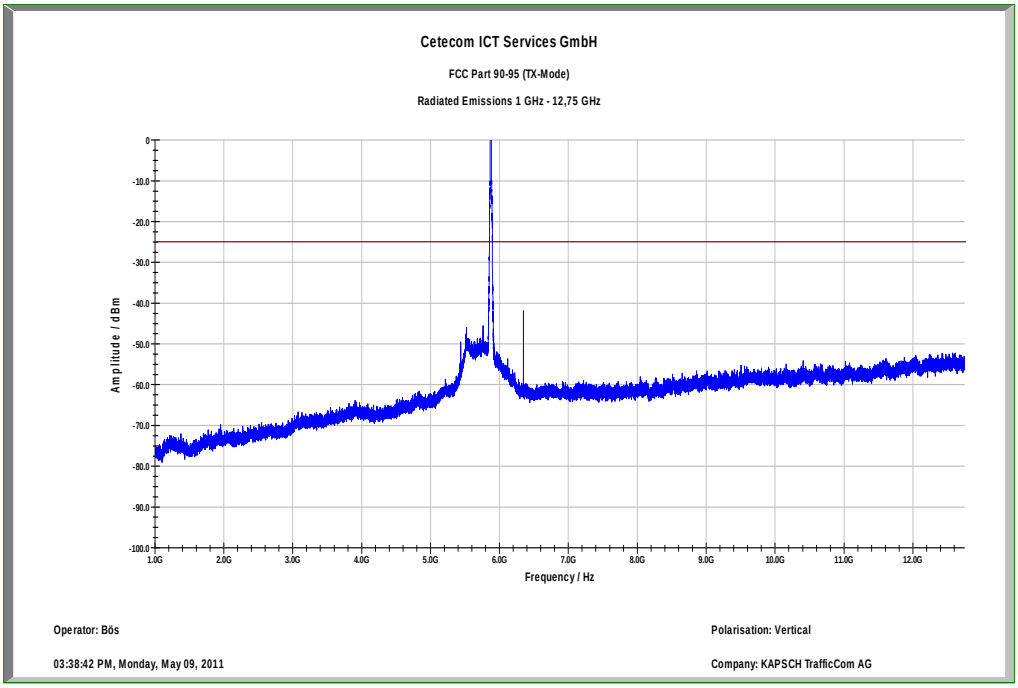
Plot 8: Port 1, 5860 MHz, 26 GHz – 40 GHz, horizontal + vertical



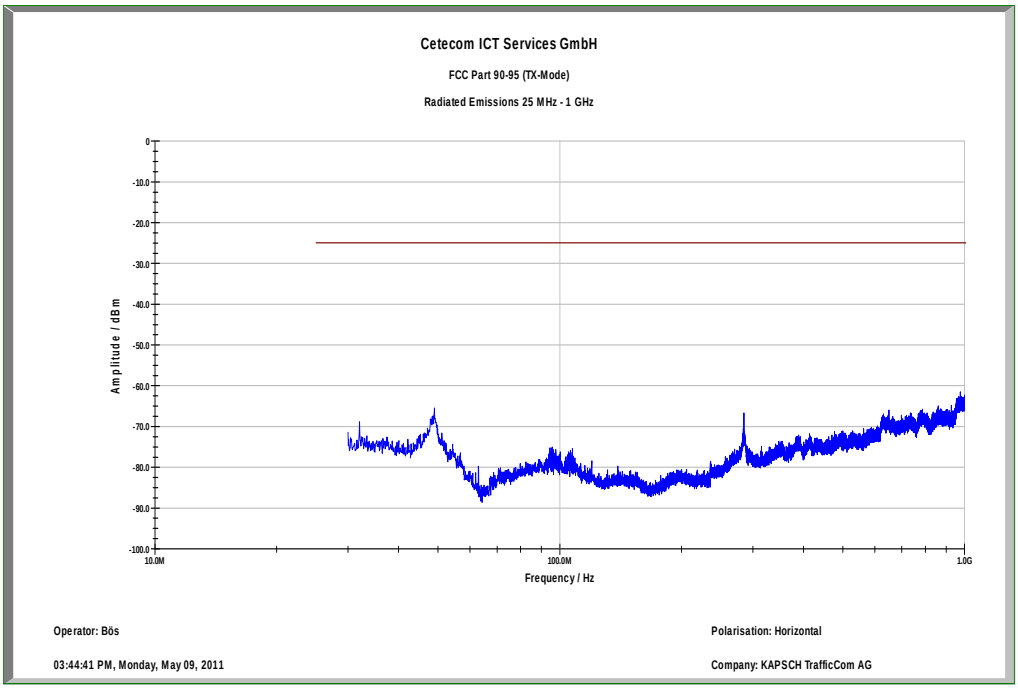
Plot 9: Port 1, 5875 MHz, 30 MHz – 1 GHz, Antenna vertical



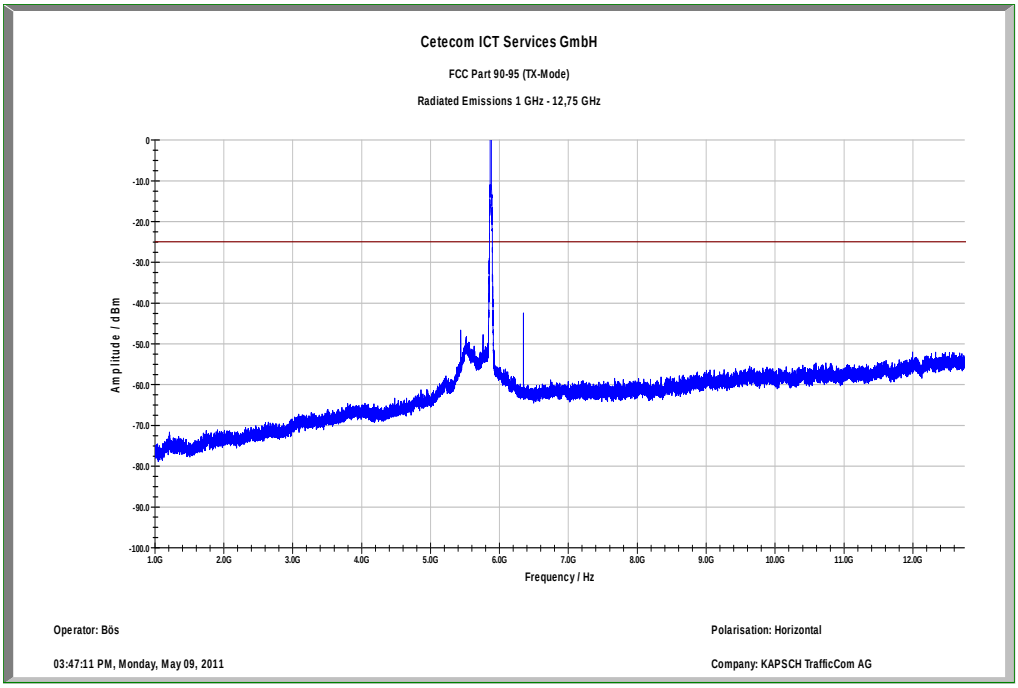
Plot 10: Port 1, 5875 MHz, 1 GHz – 12,75 GHz, Antenna vertical



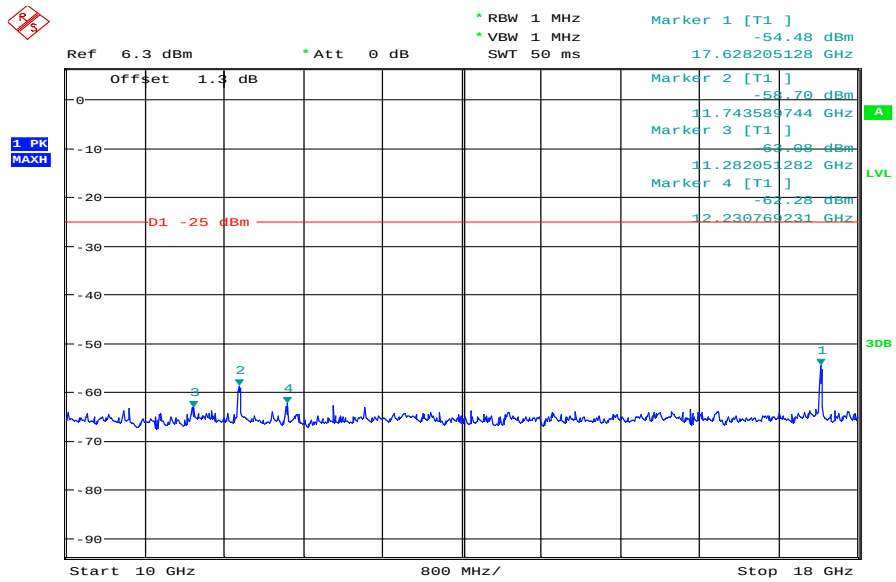
Plot 11: Port 1, 5875 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 12: Port 1, 5875 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 13: Port 1, 5875 MHz, 12 GHz – 18 GHz, horizontal + vertical



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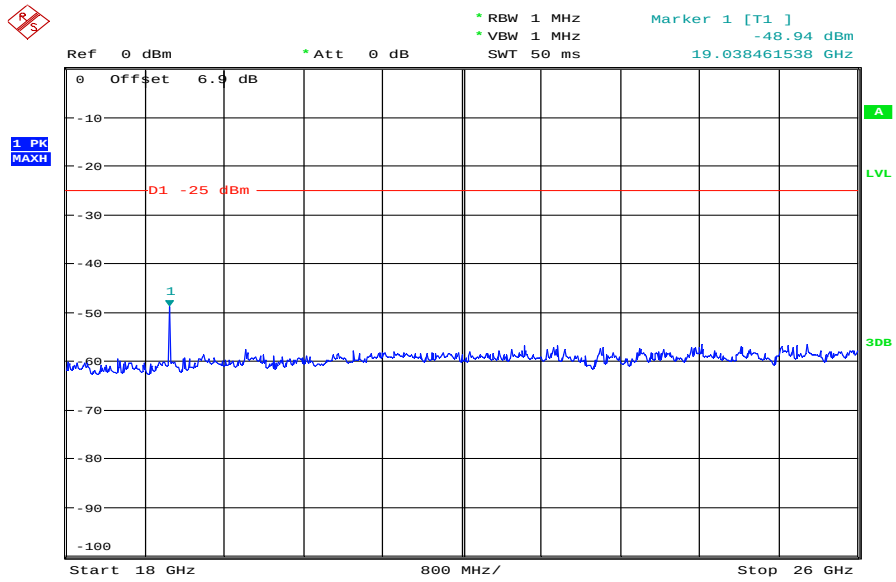
Plot 14: Port 1, 5875 MHz, 18 GHz – 26 GHz, horizontal + vertical



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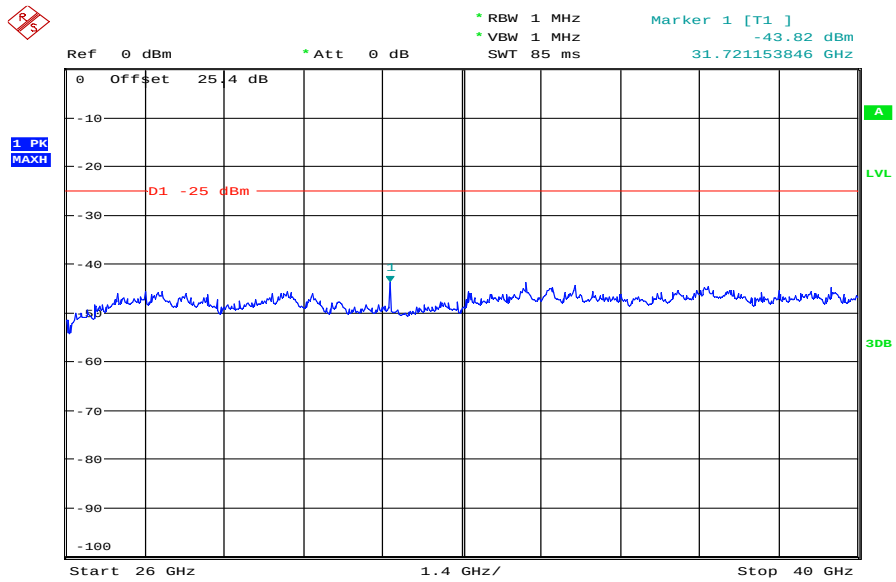
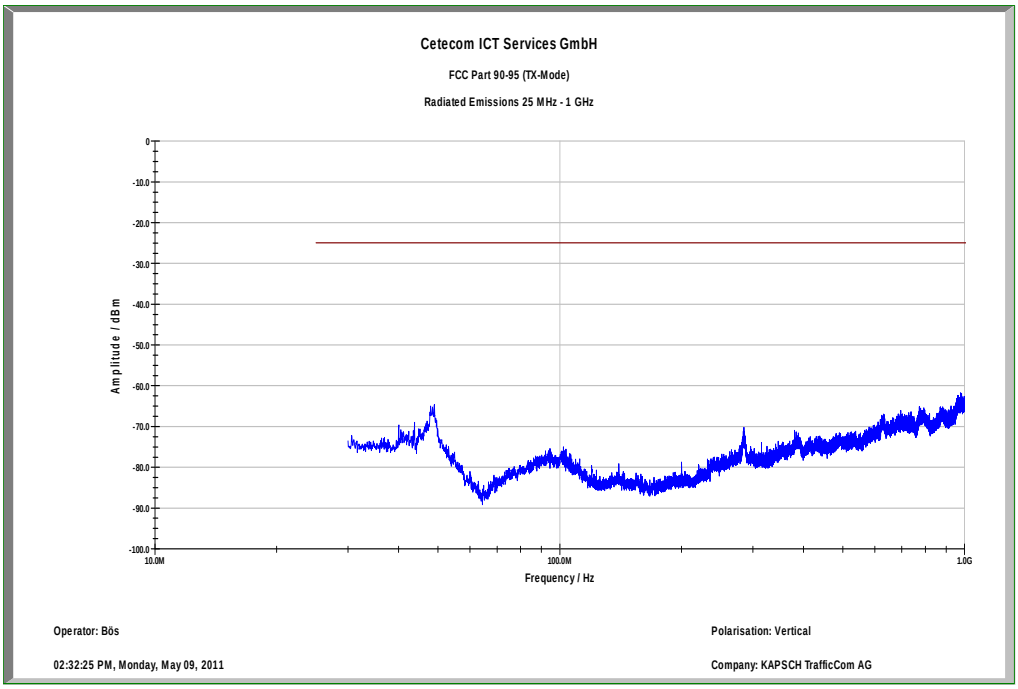
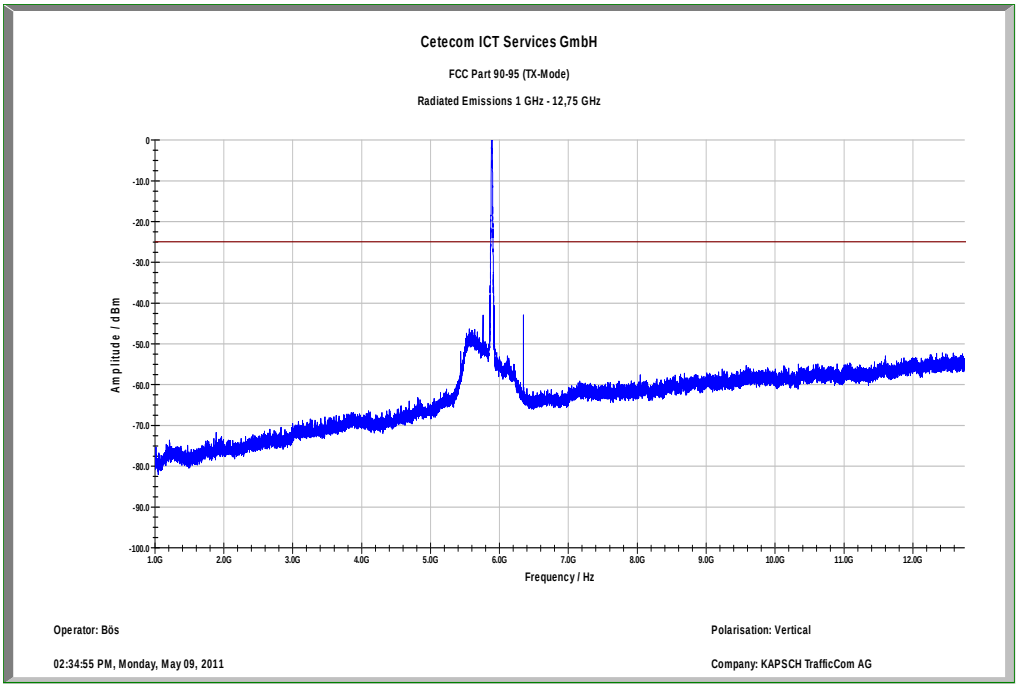
Plot 15: Port 1, 5875 MHz, 26 GHz – 40 GHz, horizontal + vertical



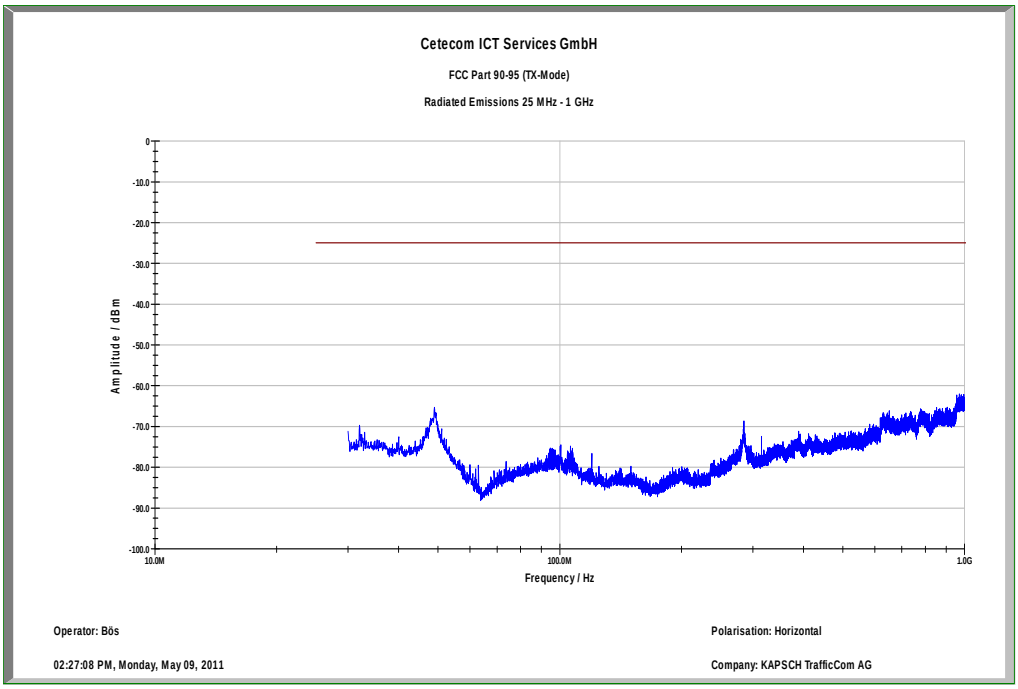
Plot 16: Port 1, 5890 MHz, 30 MHz – 1 GHz, Antenna vertical



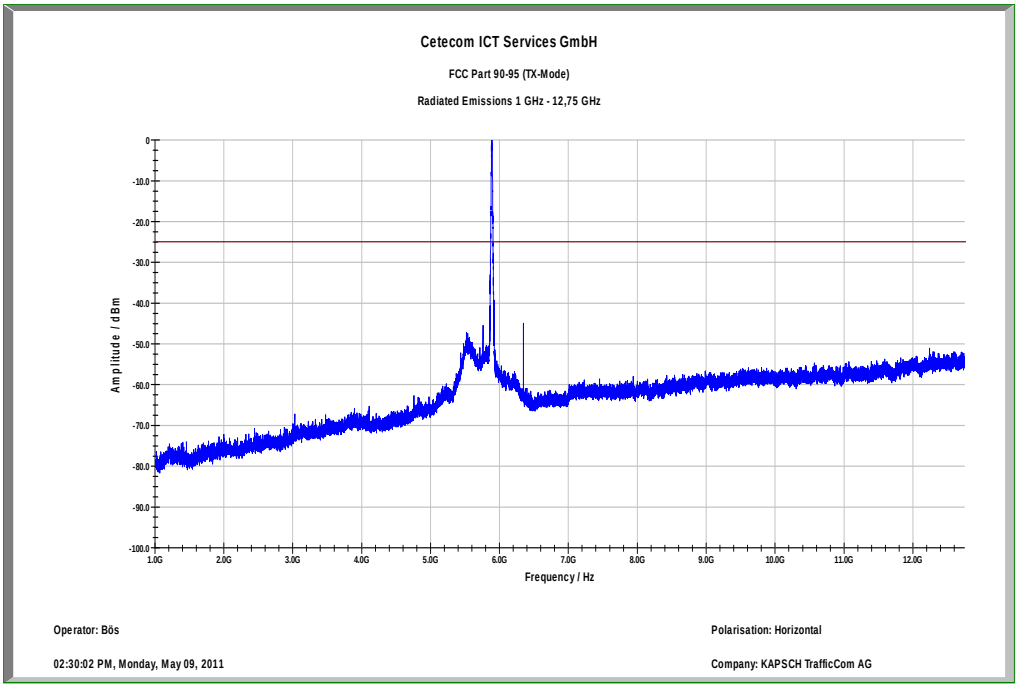
Plot 17: Port 1, 5890 MHz, 1 GHz – 12,75 GHz, Antenna vertical



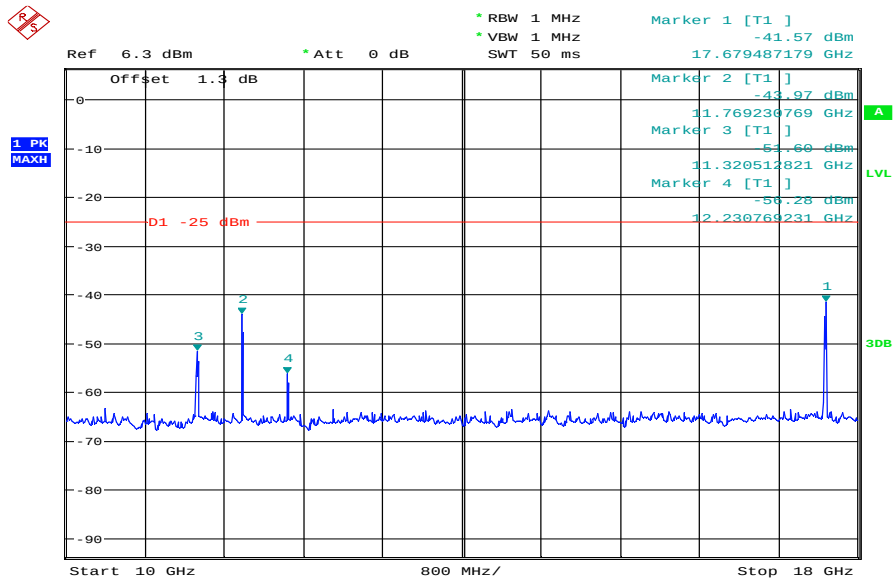
Plot 18: Port 1, 5890 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 19: Port 1, 5890 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 20: Port 1, 5890 MHz, 12 GHz – 18 GHz, horizontal + vertical



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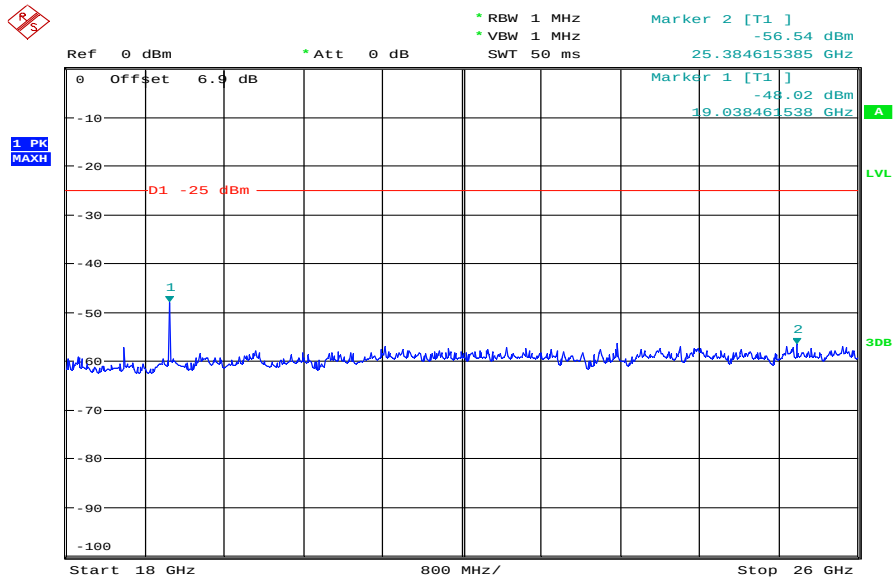
Plot 21: Port 1, 5890 MHz, 18 GHz – 26 GHz, horizontal + vertical



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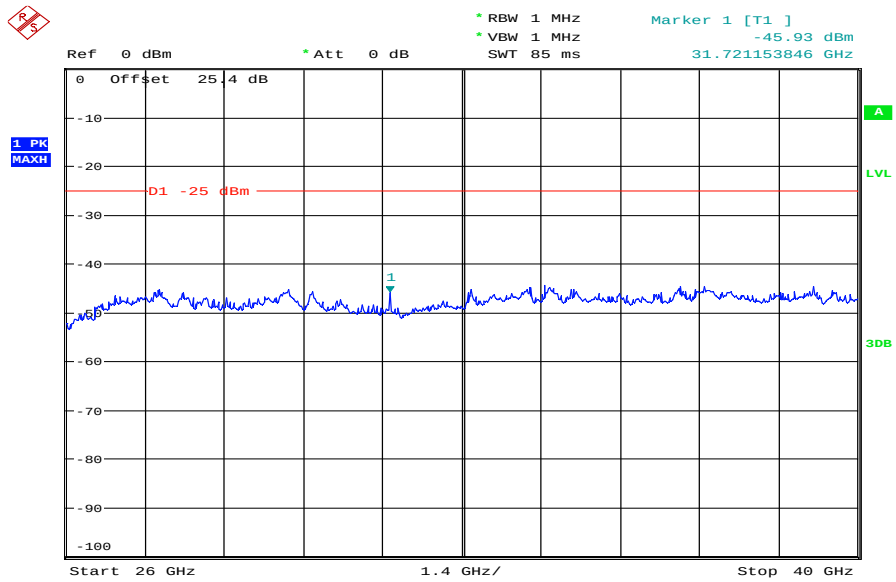
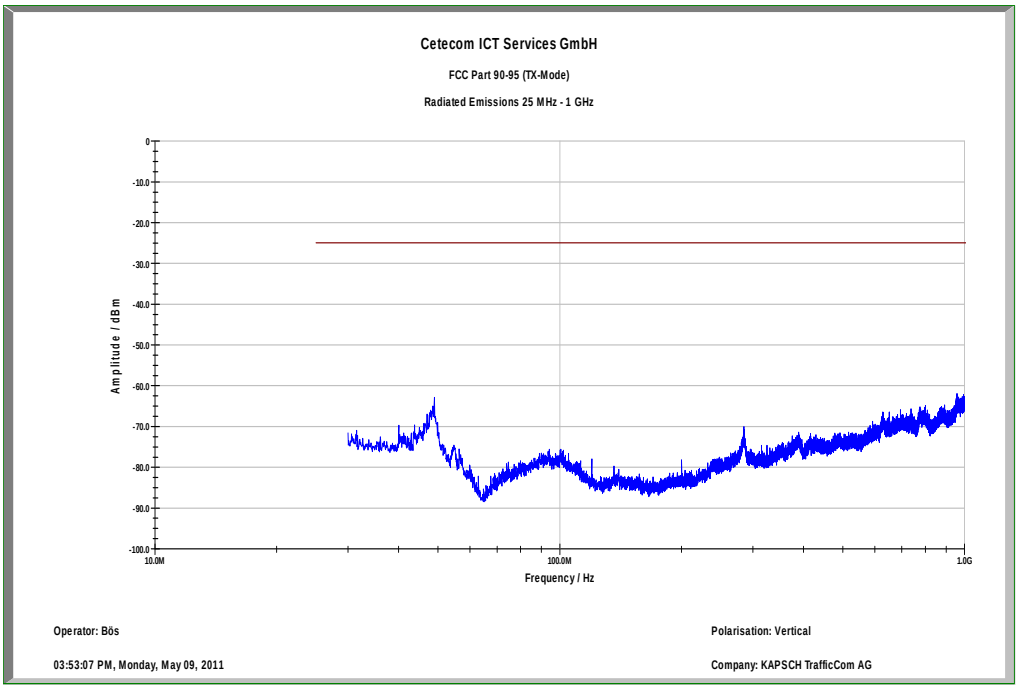
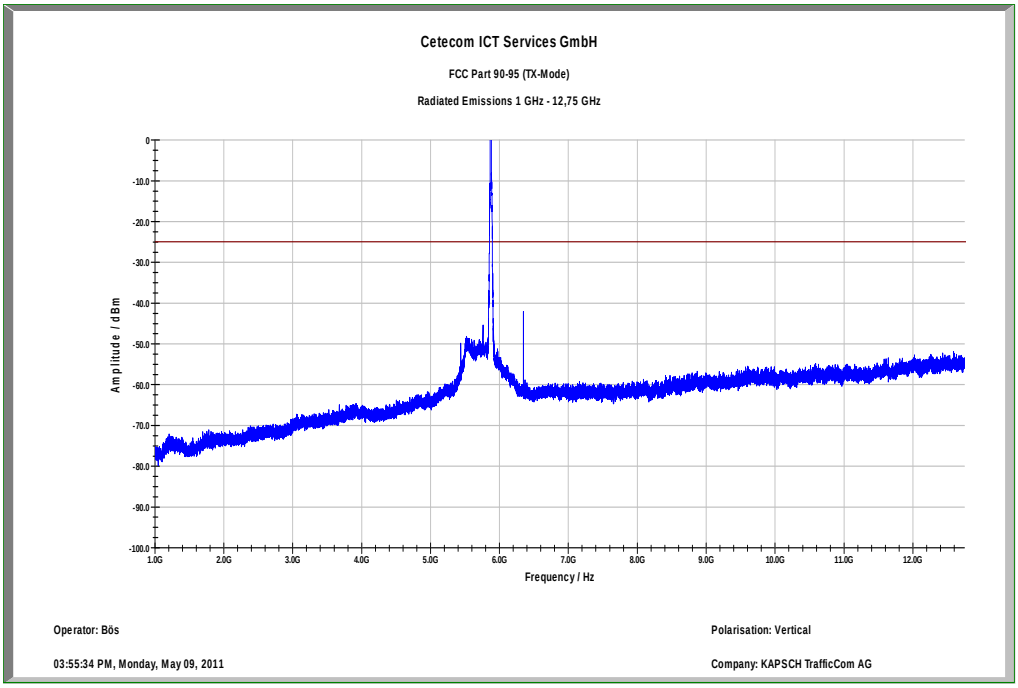
Plot 22: Port 1, 5890 MHz, 26 GHz – 40 GHz, horizontal + vertical



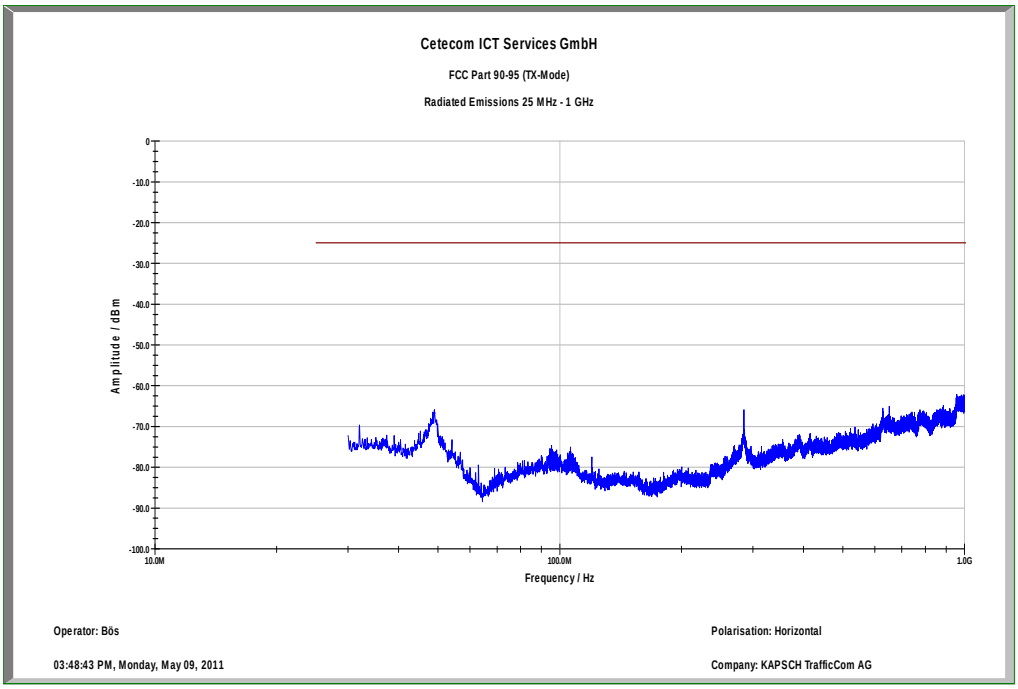
Plot 23: Port 1, 5905 MHz, 30 MHz – 1 GHz, Antenna vertical



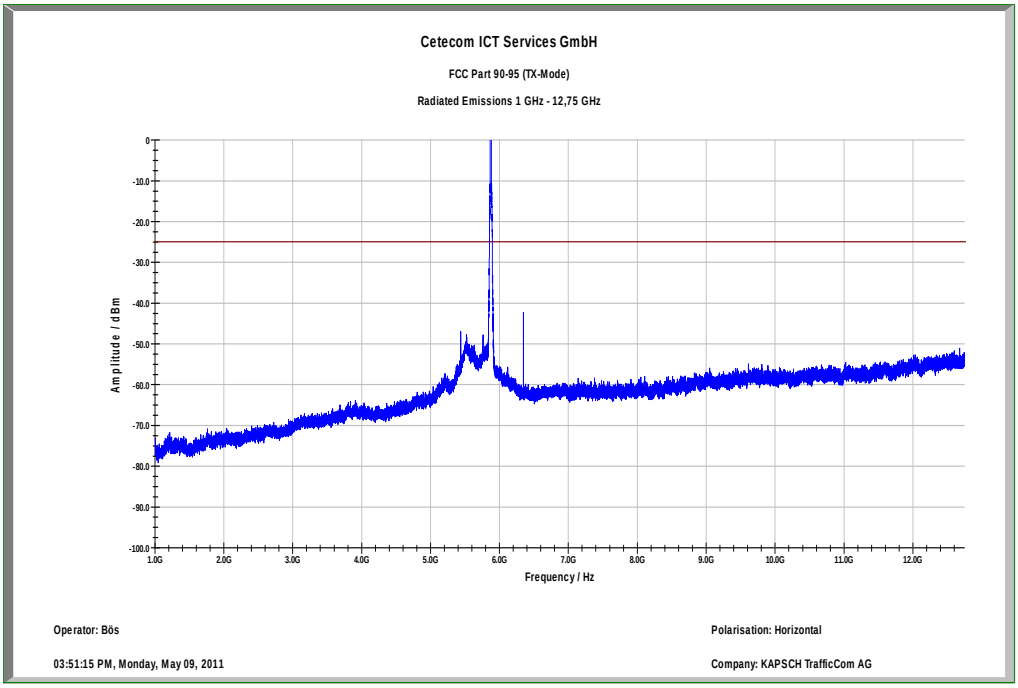
Plot 24: Port 1, 5905 MHz, 1 GHz – 12,75 GHz, Antenna vertical



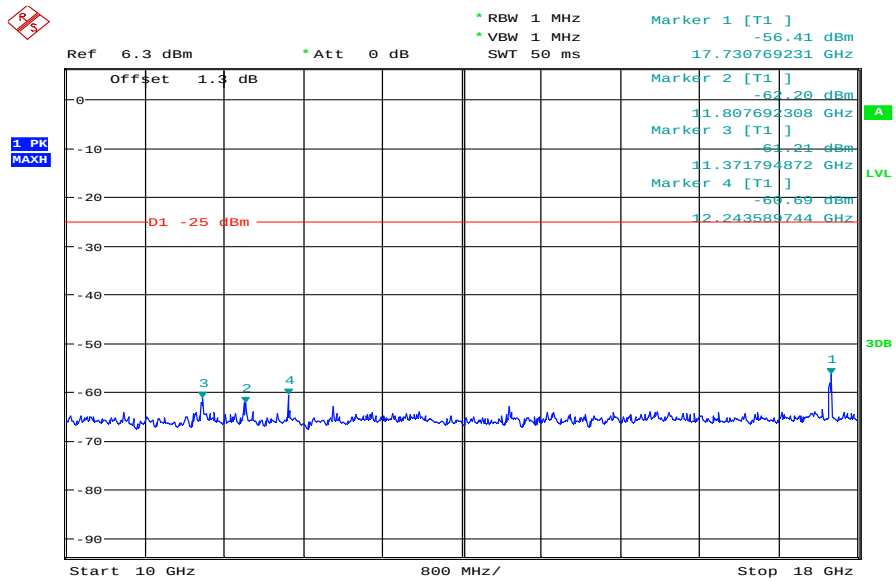
Plot 25: Port 1, 5905 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 26: Port 1, 5905 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 27: Port 1, 5905 MHz, 12 GHz – 18 GHz, horizontal + vertical



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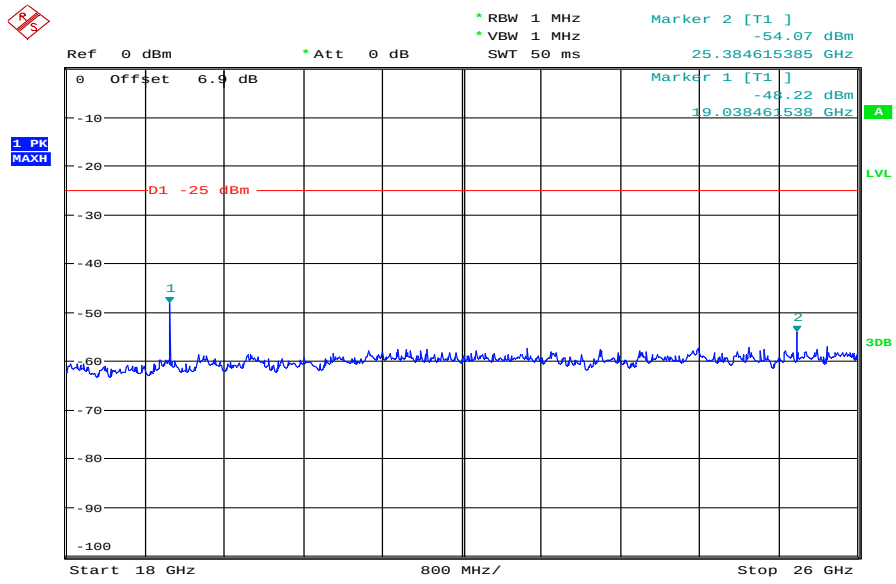
Plot 28: Port 1, 5905 MHz, 18 GHz – 26 GHz, horizontal + vertical



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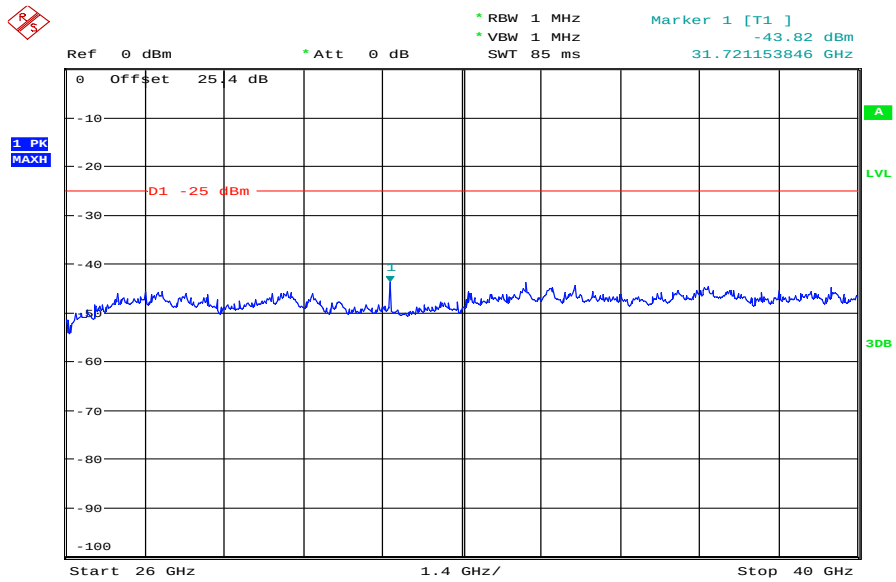
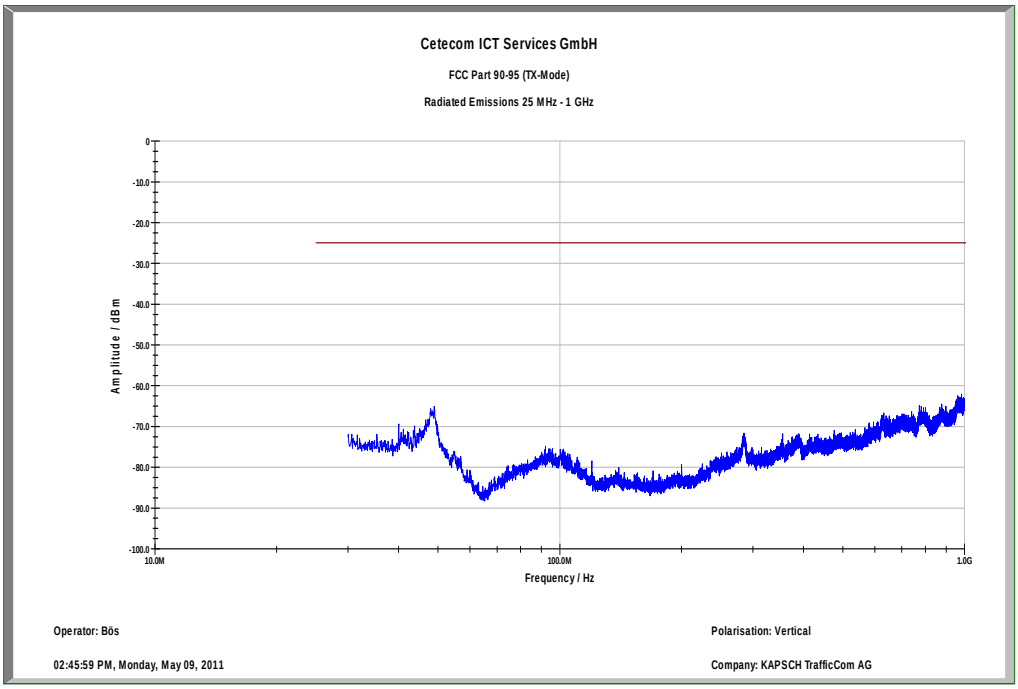
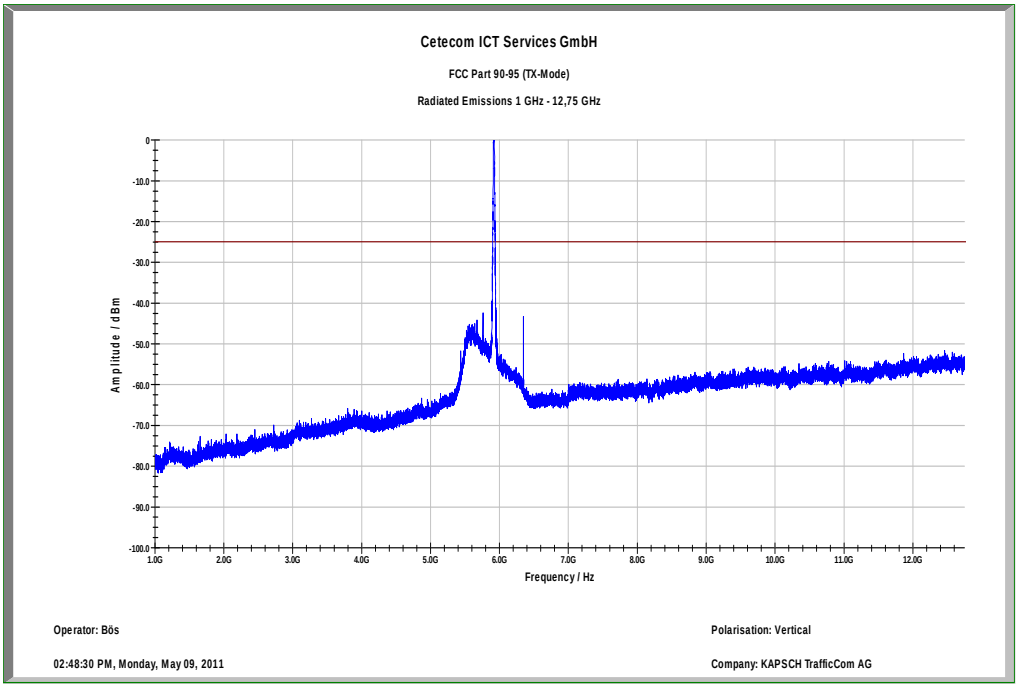
Plot 29: Port 1, 5905 MHz, 26 GHz – 40 GHz, horizontal + vertical



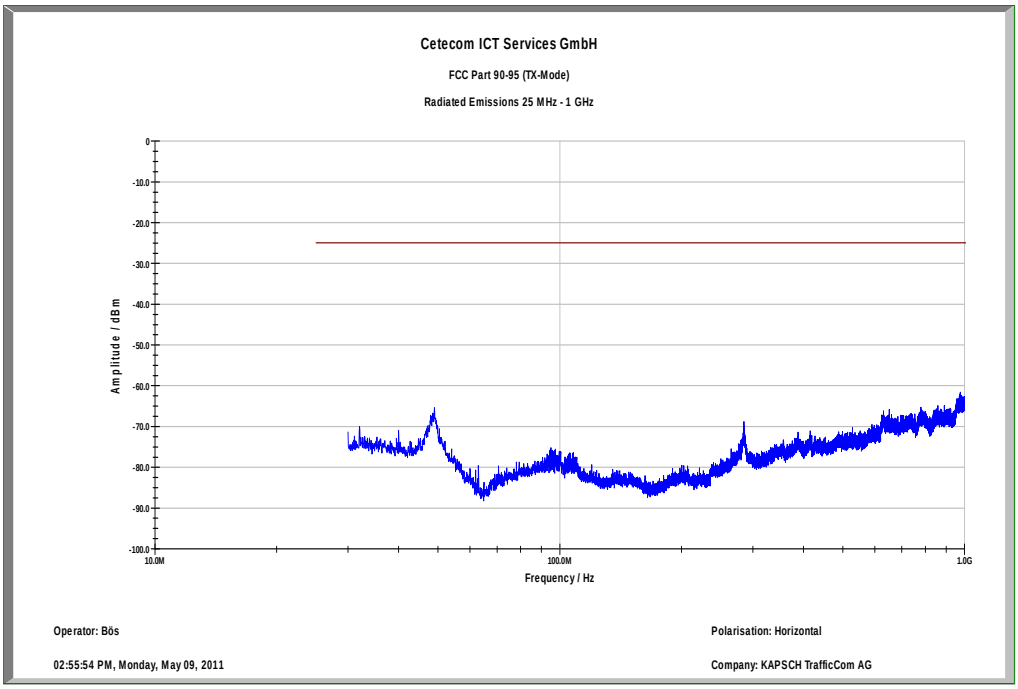
Plot 30: Port 1, 5920 MHz, 30 MHz – 1 GHz, Antenna vertical



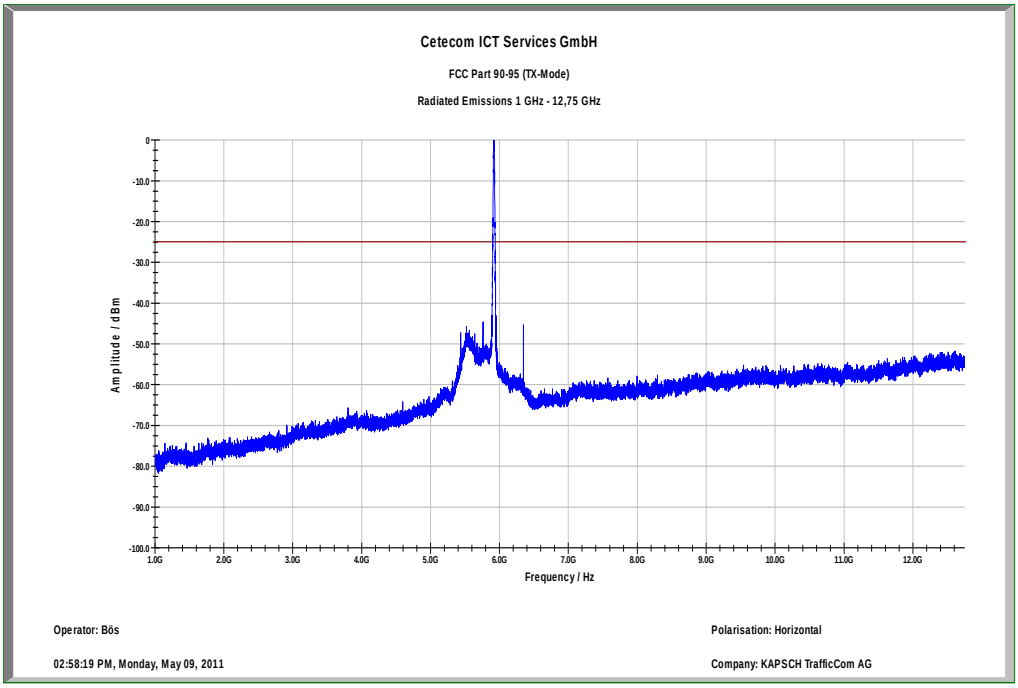
Plot 31: Port 1, 5920 MHz, 1 GHz – 12,75 GHz, Antenna vertical



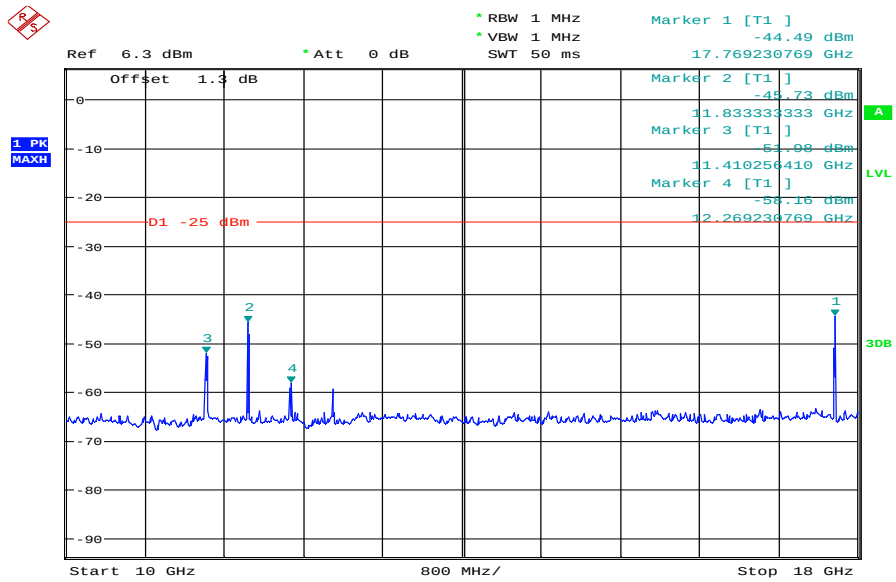
Plot 32: Port 1, 5920 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 33: Port 1, 5920 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 34: Port 1, 5920 MHz, 12 GHz – 18 GHz, horizontal + vertical



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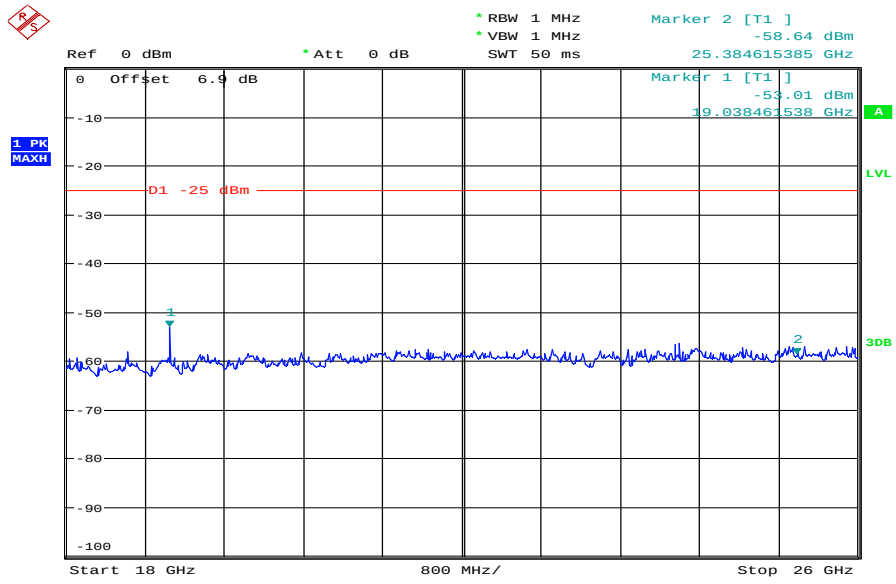
Plot 35: Port 1, 5920 MHz, 18 GHz – 26 GHz, horizontal + vertical



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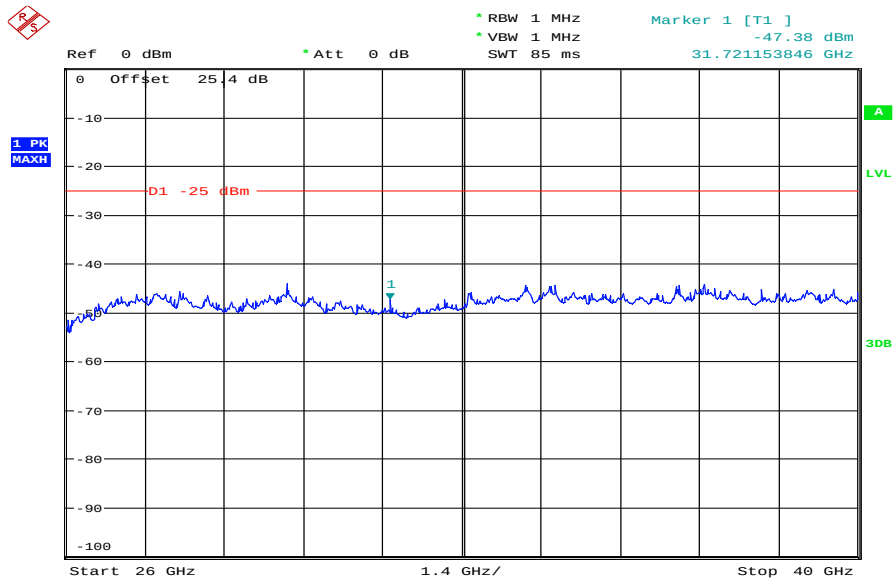
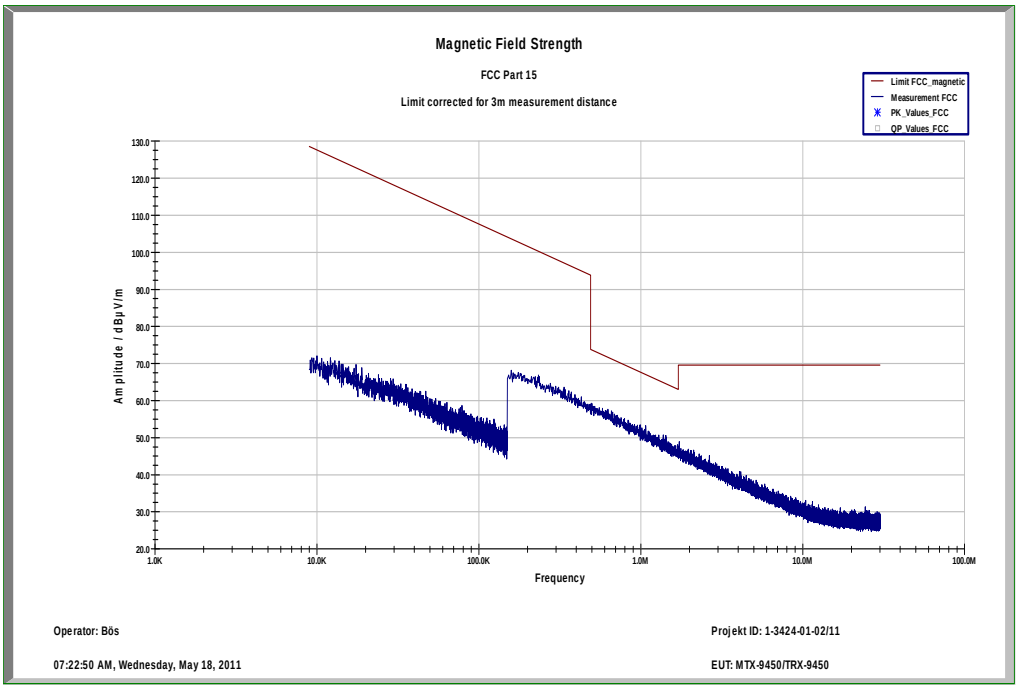
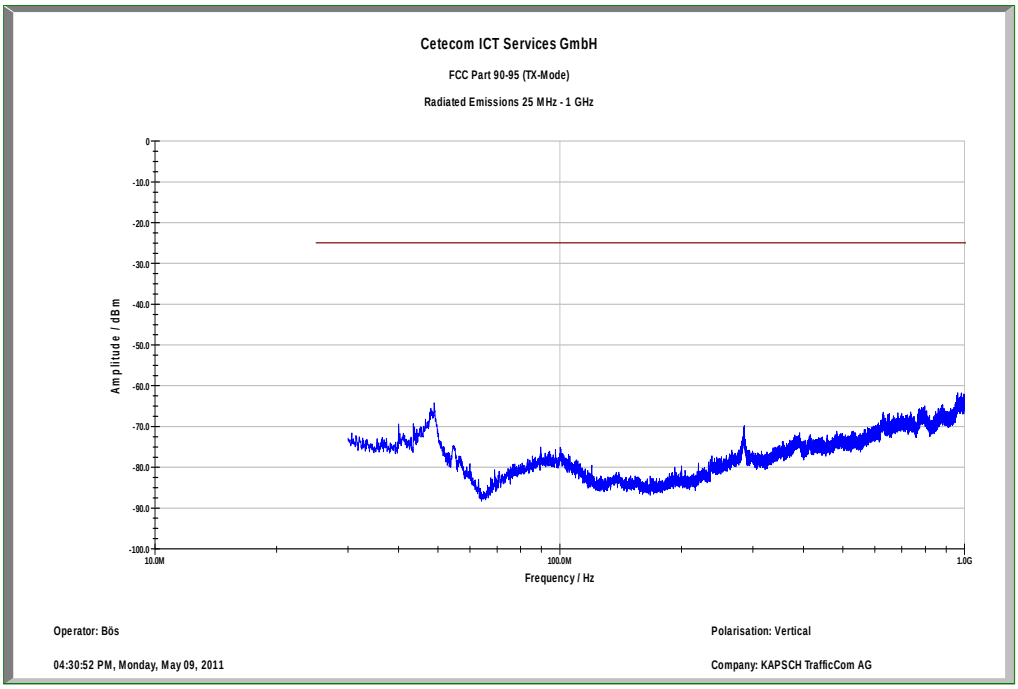
Plot 36: Port 1, 5920 MHz, 26 GHz – 40 GHz, horizontal + vertical



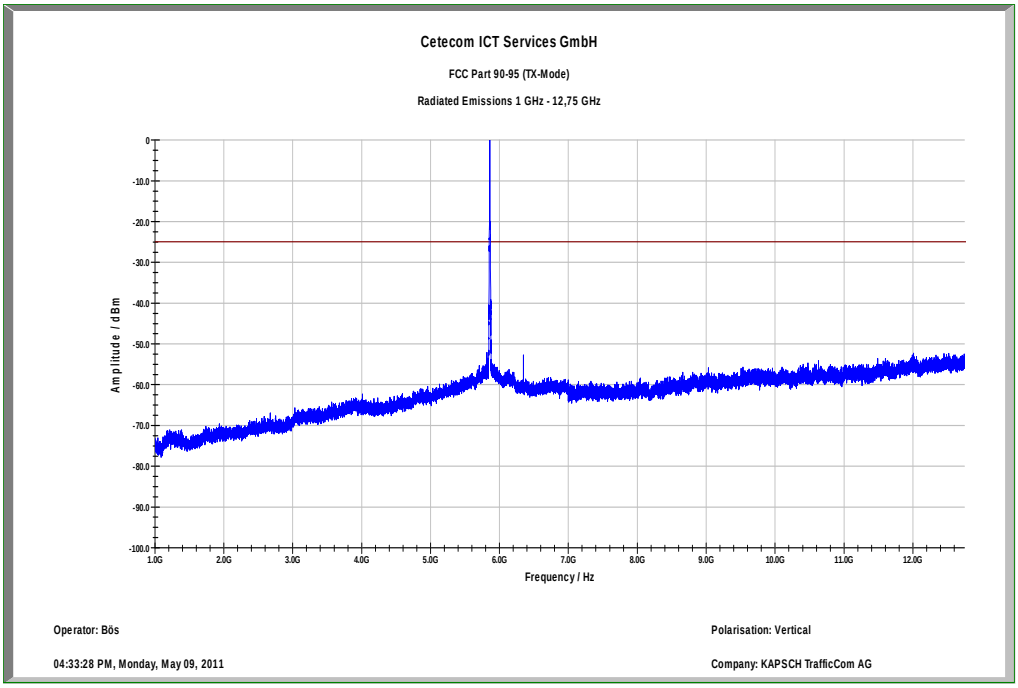
Plot 37: Port 2, 9 kHz – 30 MHz, valid for all channels (worst case result)



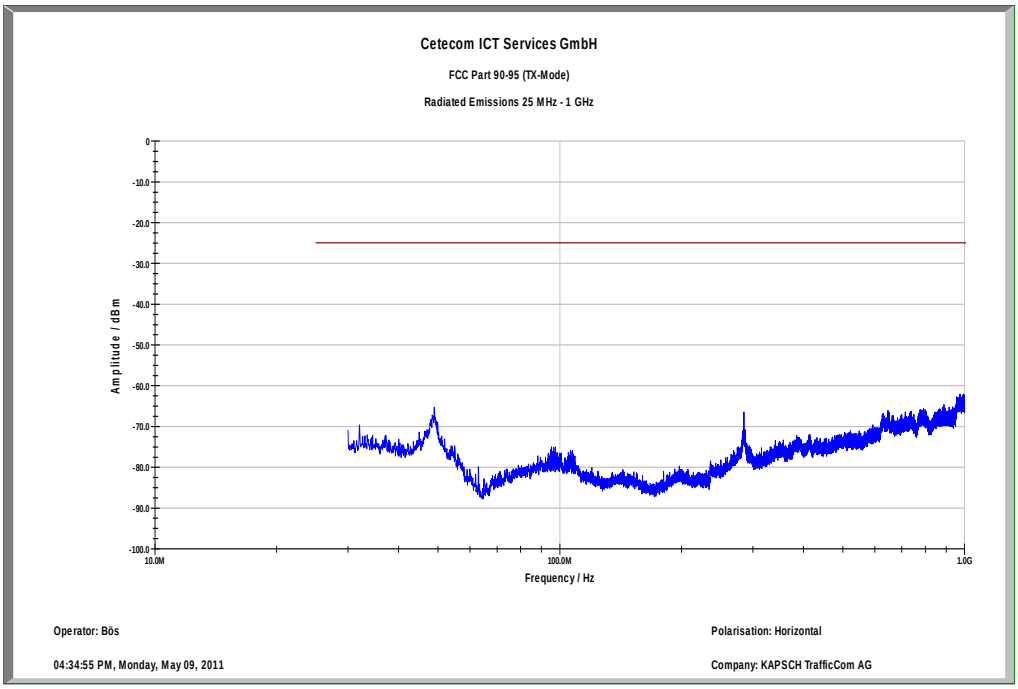
Plot 38: Port 2, 5860 MHz, 30 MHz – 1 GHz, Antenna vertical



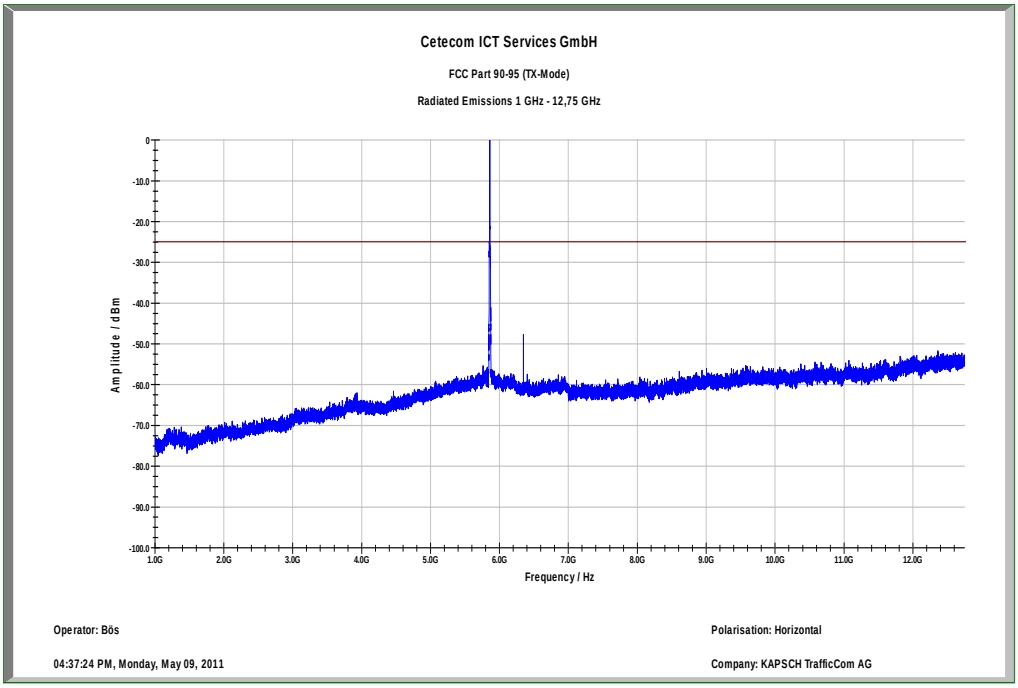
Plot 39: Port 2, 5860 MHz, 1 GHz – 12,75 GHz, Antenna vertical



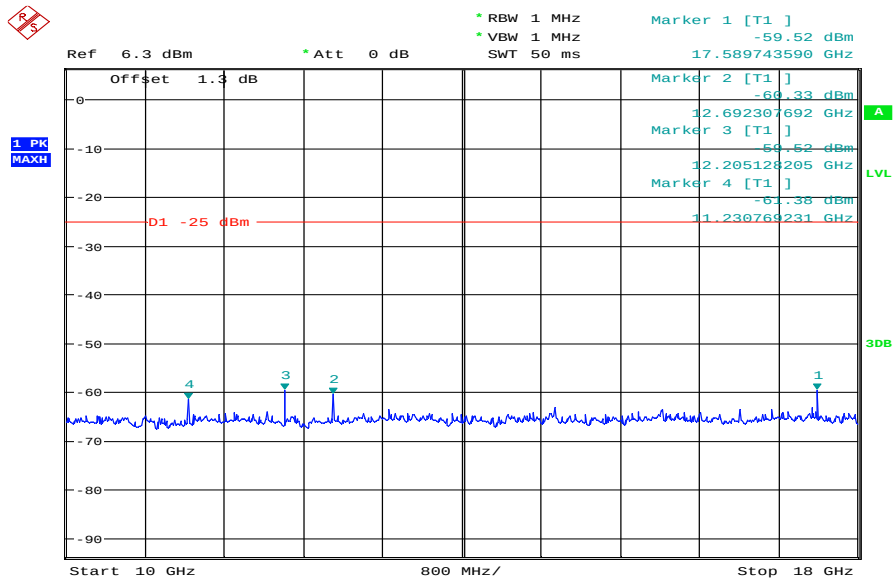
Plot 40: Port 2, 5860 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 41: Port 2, 5860 MHz, 1 GHz – 12,75 GHz, Antenna horizontal

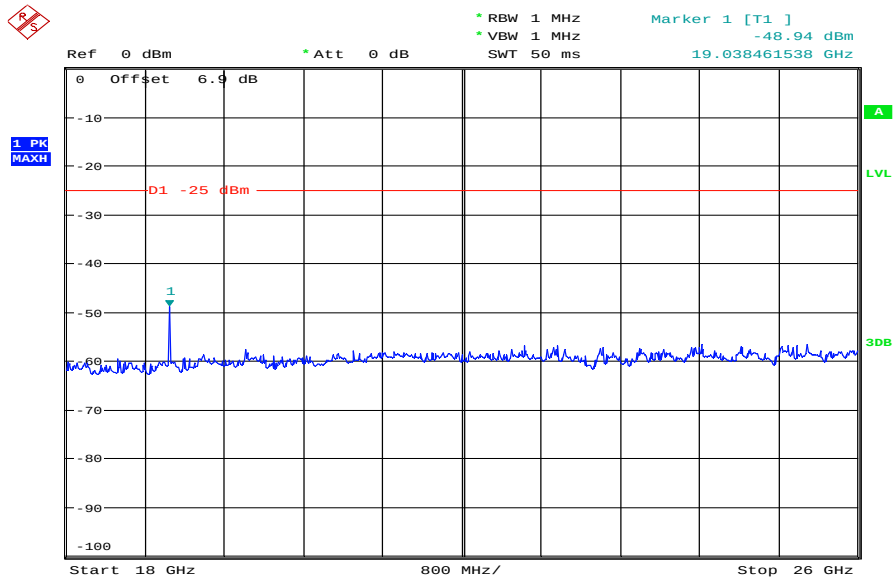


Plot 42: Port 2, 5860 MHz, 12 GHz – 18 GHz, horizontal + vertical



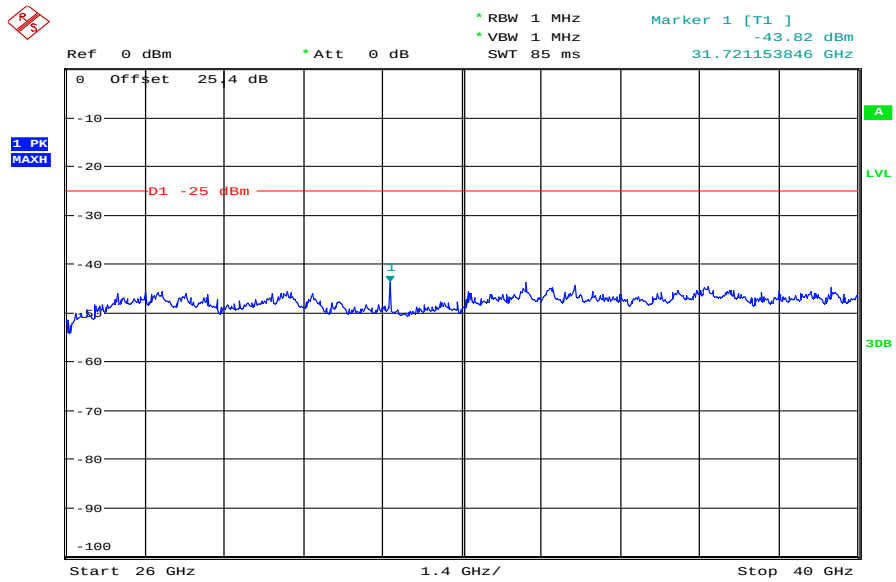
Date: 11.MAY.2011 09:46:47

Plot 43: Port 2, 5860 MHz, 18 GHz – 26 GHz, horizontal + vertical

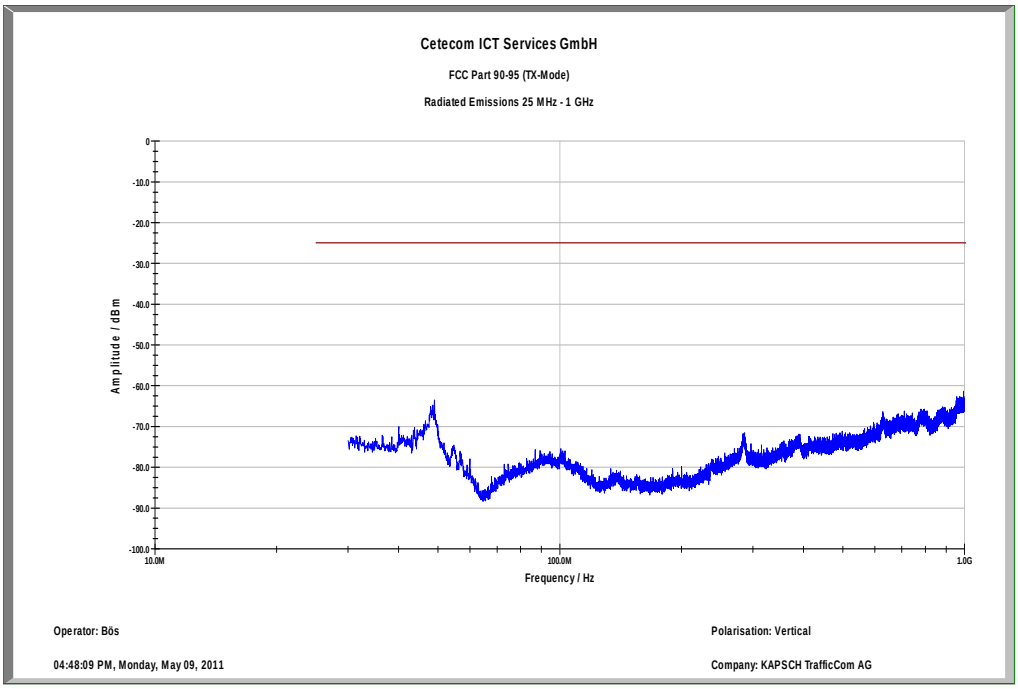


Date: 11.MAY.2011 09:04:02

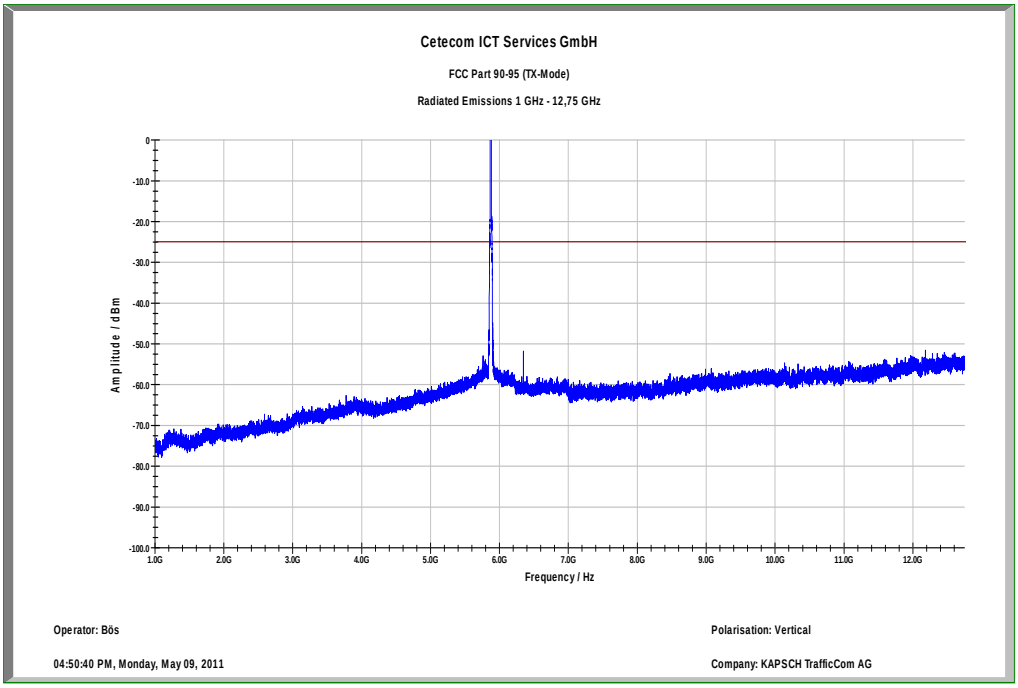
Plot 44: Port 2, 5860 MHz, 26 GHz – 40 GHz, horizontal + vertical



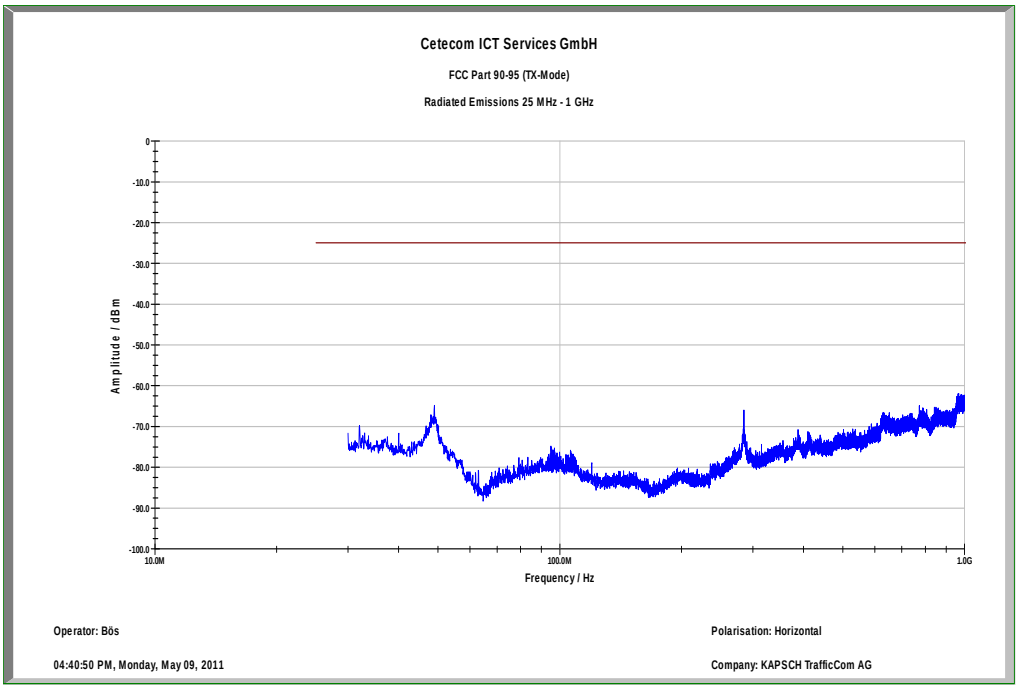
Plot 45: Port 2, 5875 MHz, 30 MHz – 1 GHz, Antenna vertical



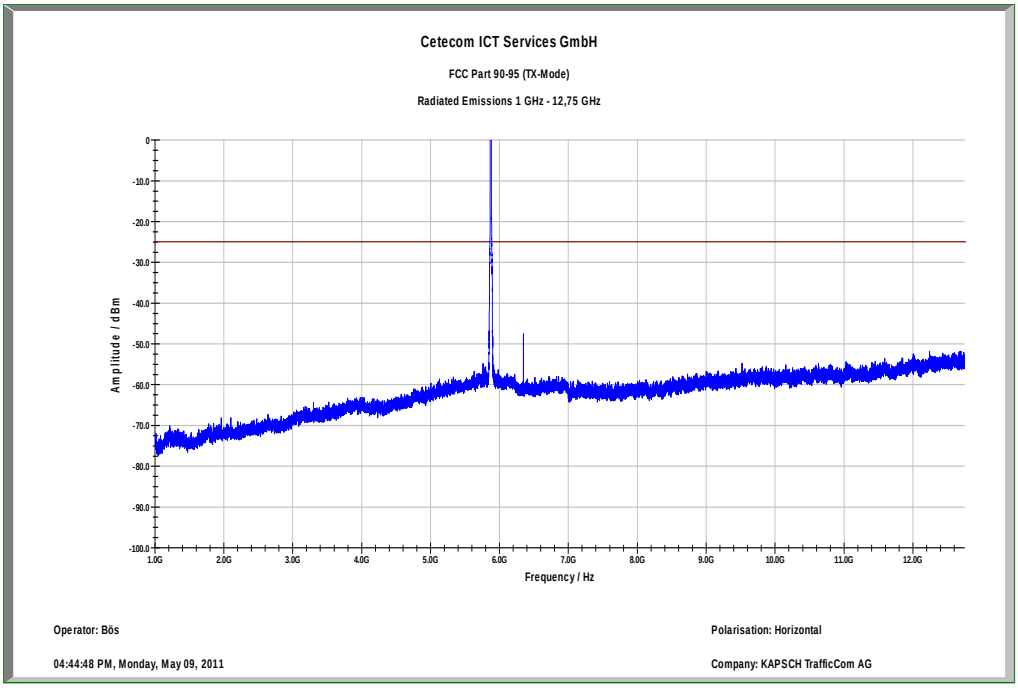
Plot 46: Port 2, 5875 MHz, 1 GHz – 12,75 GHz, Antenna vertical



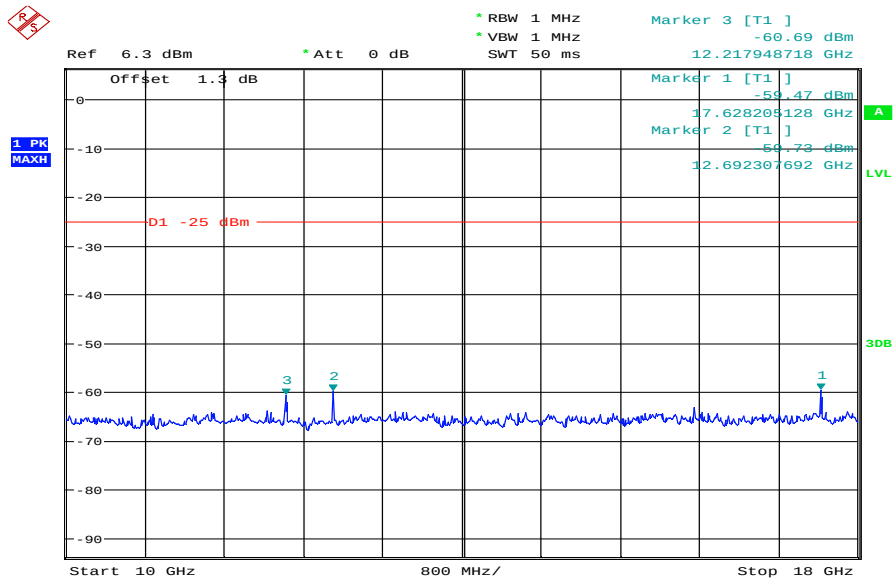
Plot 47: Port 2, 5875 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 48: Port 2, 5875 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 49: Port 2, 5875 MHz, 12 GHz – 18 GHz, horizontal + vertical



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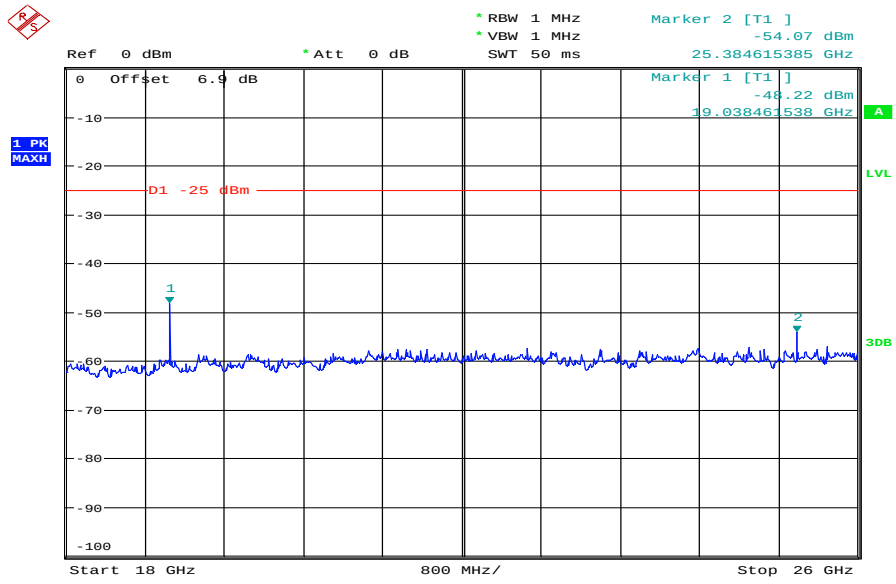
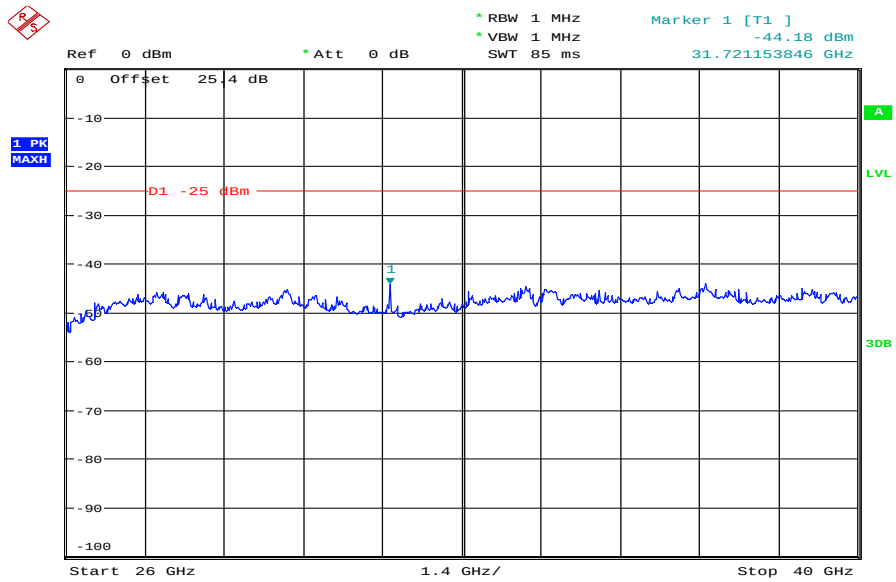
Plot 50: Port 2, 5875 MHz, 18 GHz – 26 GHz, horizontal + vertical

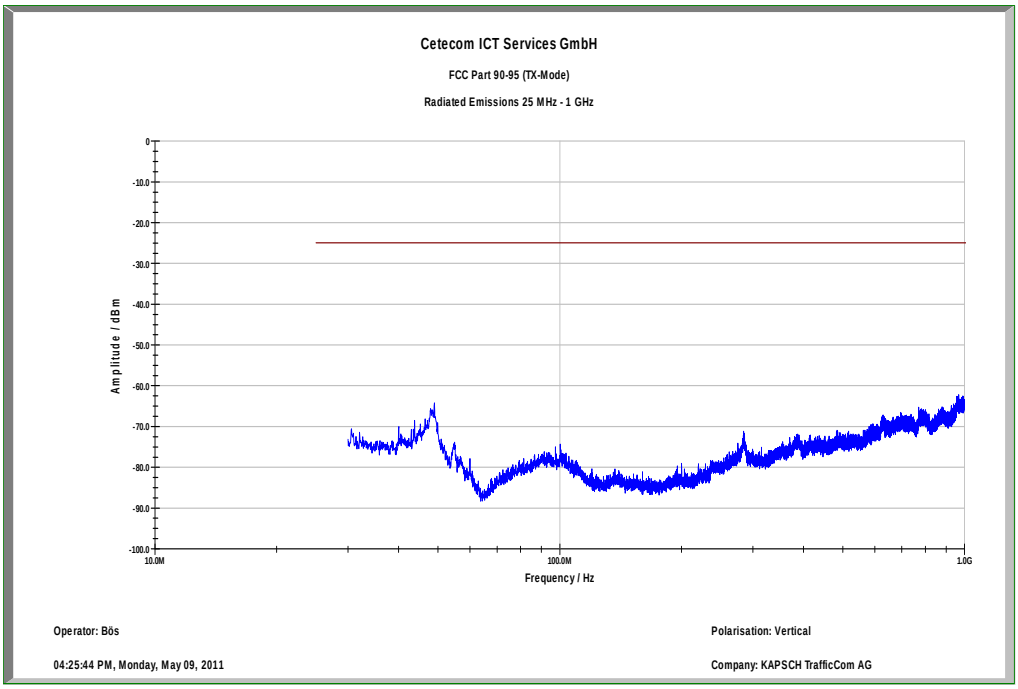


Date: 11.MAY.2011 09:13:20

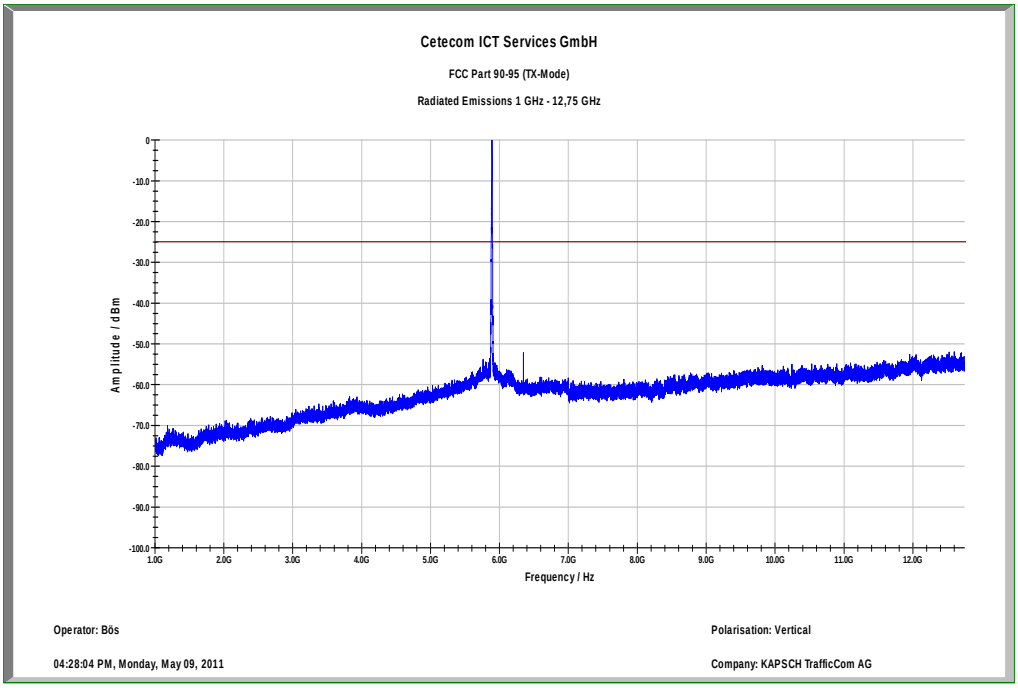
Plot 51: Port 2, 5875 MHz, 26 GHz – 40 GHz, horizontal + vertical



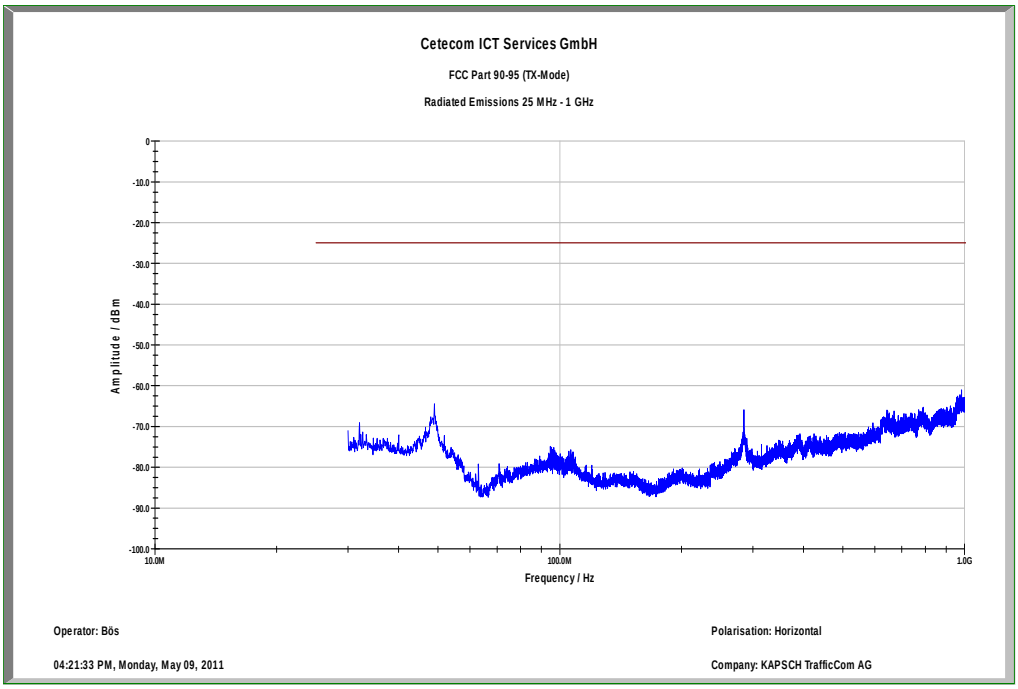
Plot 52: Port 2, 5890 MHz, 30 MHz – 1 GHz, Antenna vertical



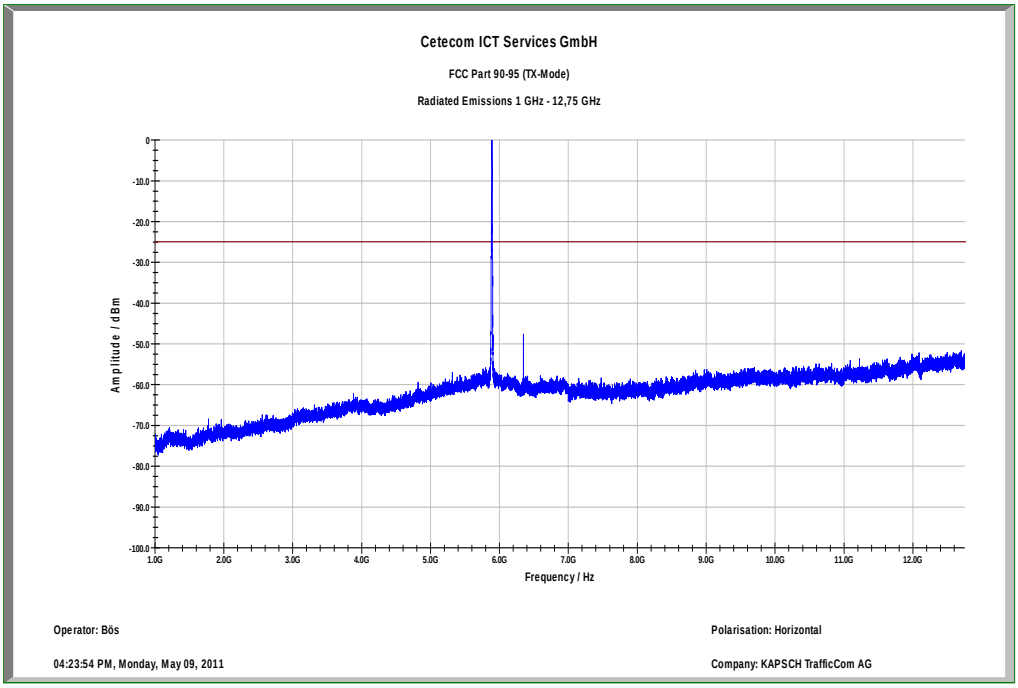
Plot 53: Port 2, 5890 MHz, 1 GHz – 12,75 GHz, Antenna vertical



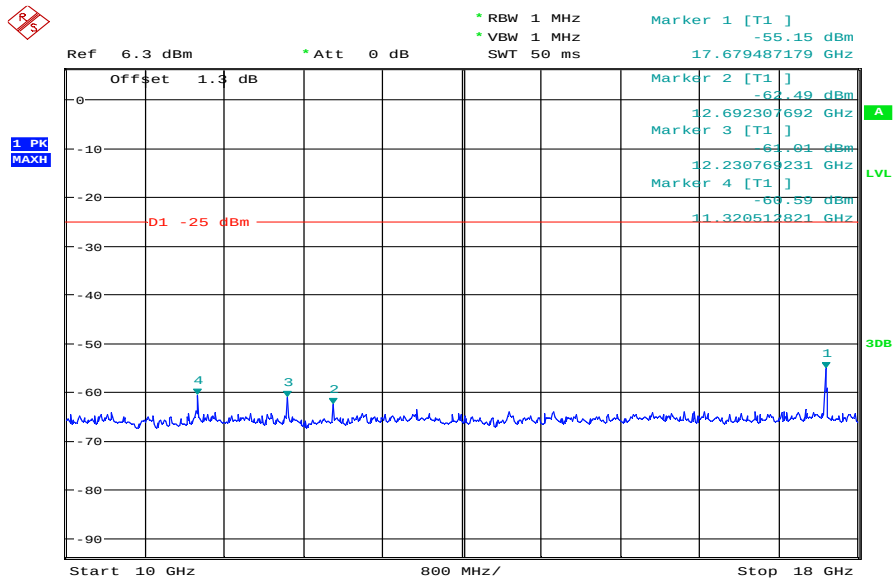
Plot 54: Port 2, 5890 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 55: Port 2, 5890 MHz, 1 GHz – 12,75 GHz, Antenna horizontal

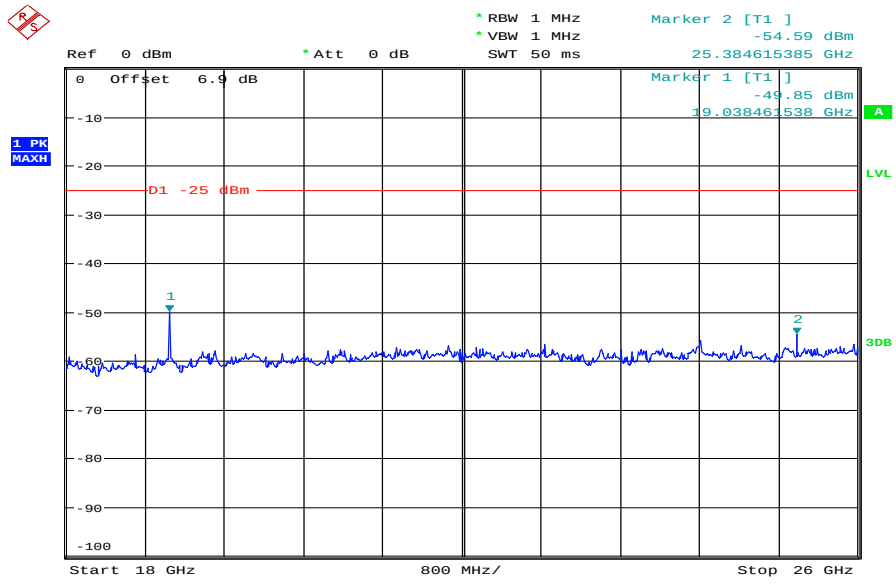


Plot 56: Port 2, 5890 MHz, 12 GHz – 18 GHz, horizontal + vertical



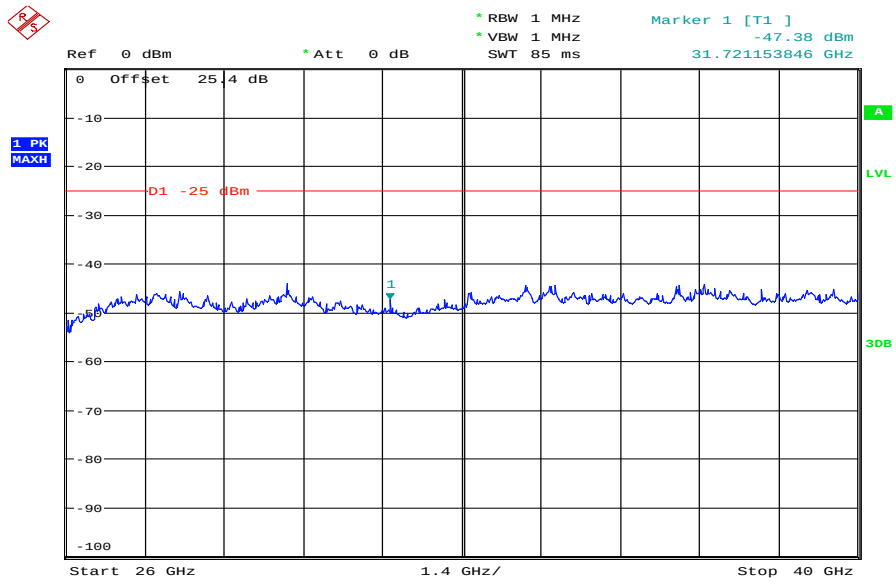
Date: 11.MAY.2011 09:45:12

Plot 57: Port 2, 5890 MHz, 18 GHz – 26 GHz, horizontal + vertical

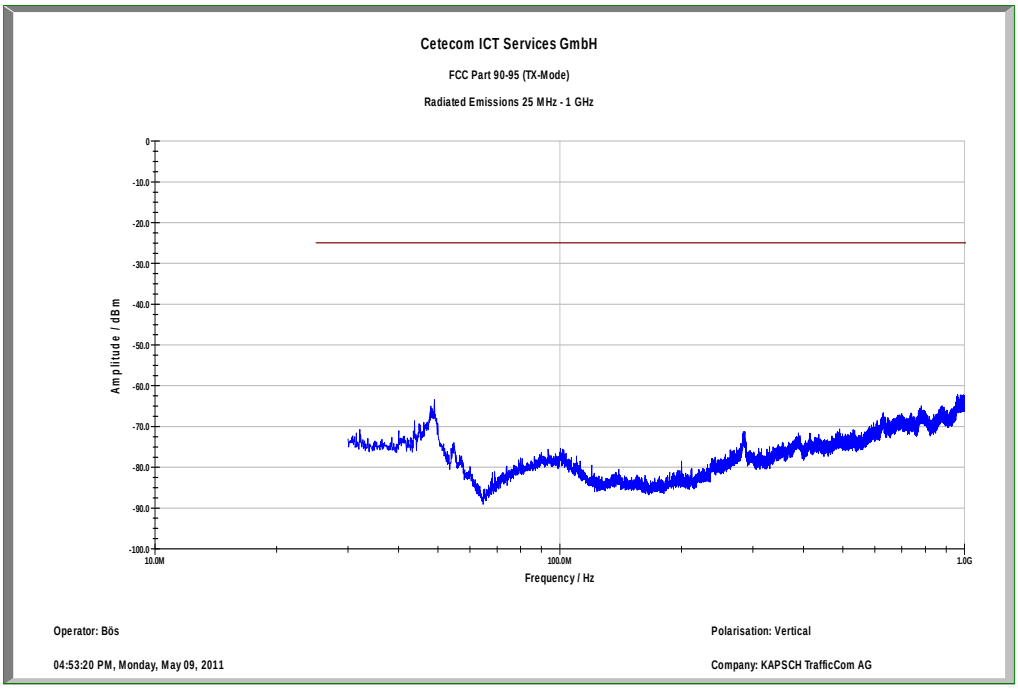


Date: 11.MAY.2011 09:05:25

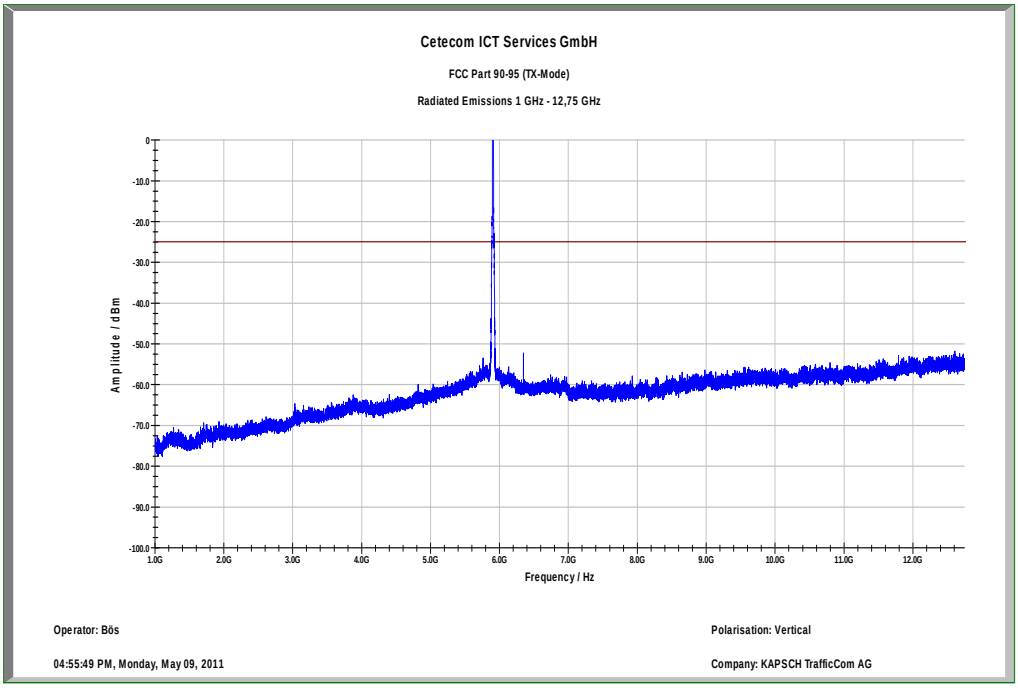
Plot 58: Port 2, 5890 MHz, 26 GHz – 40 GHz, horizontal + vertical



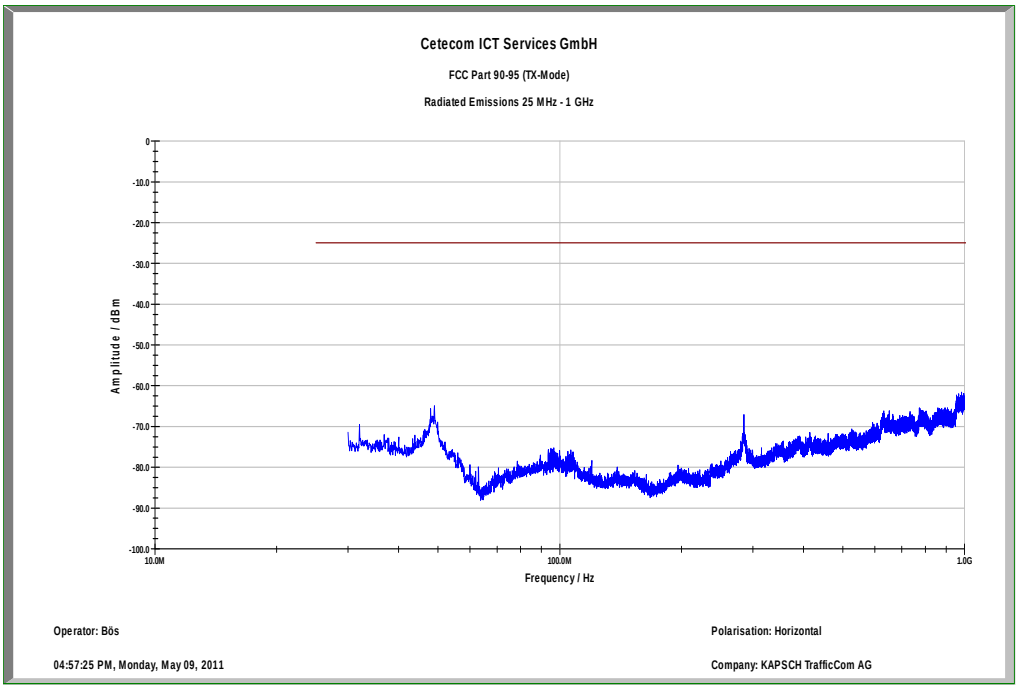
Plot 59: Port 2, 5905 MHz, 30 MHz – 1 GHz, Antenna vertical



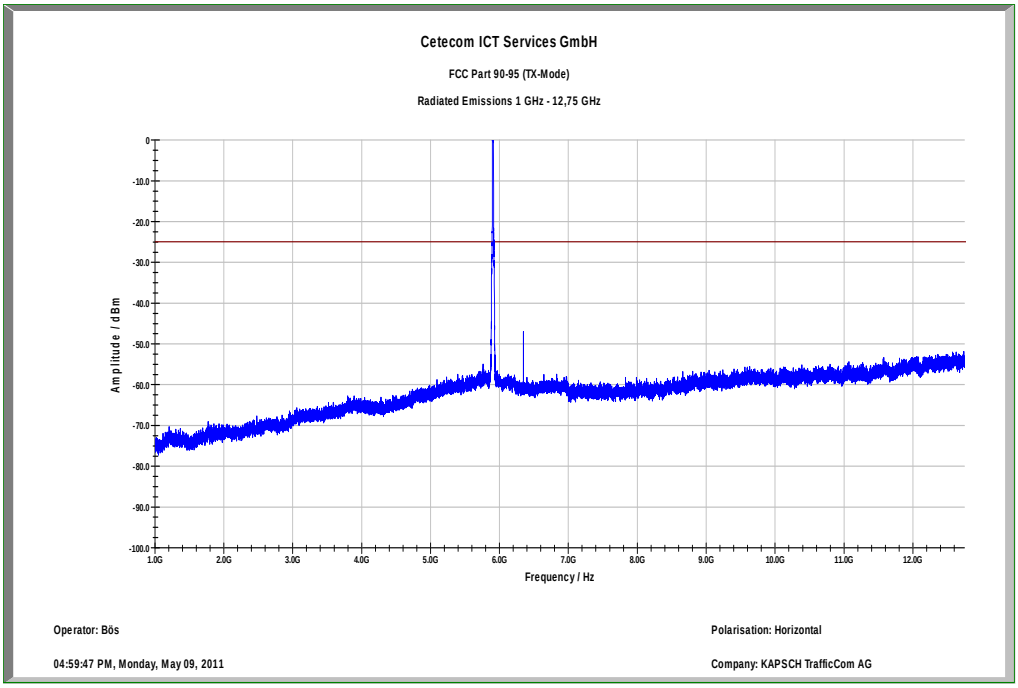
Plot 60: Port 2, 5905 MHz, 1 GHz – 12,75 GHz, Antenna vertical



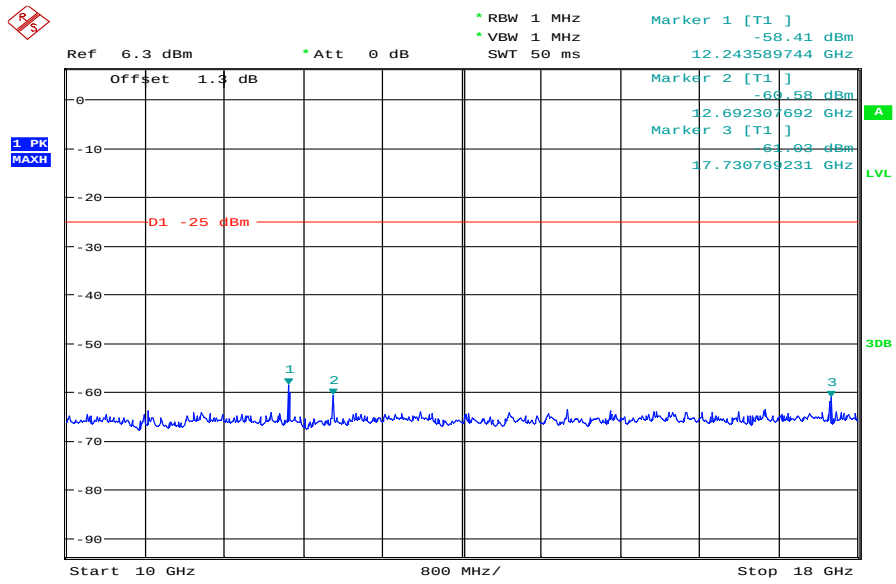
Plot 61: Port 2, 5905 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 62: Port 2, 5905 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 63: Port 2, 5905 MHz, 12 GHz – 18 GHz, horizontal + vertical



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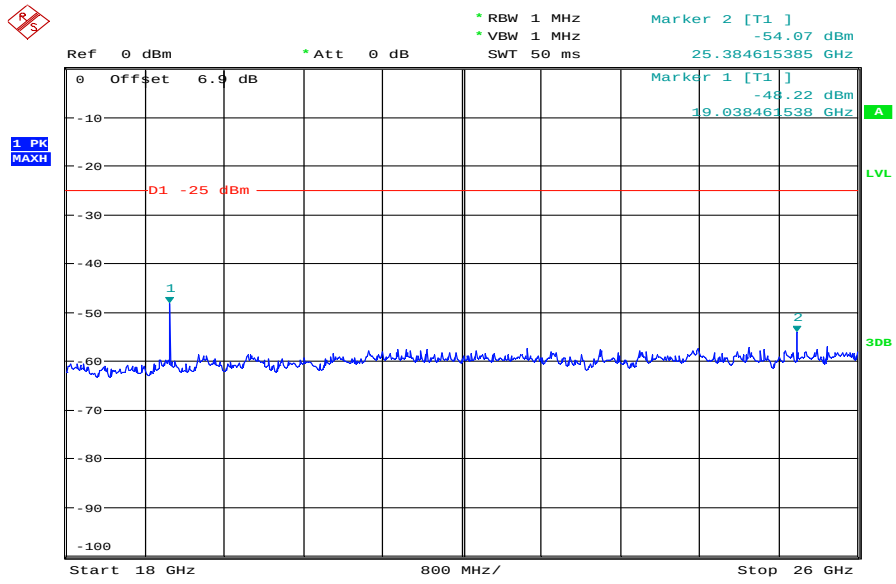
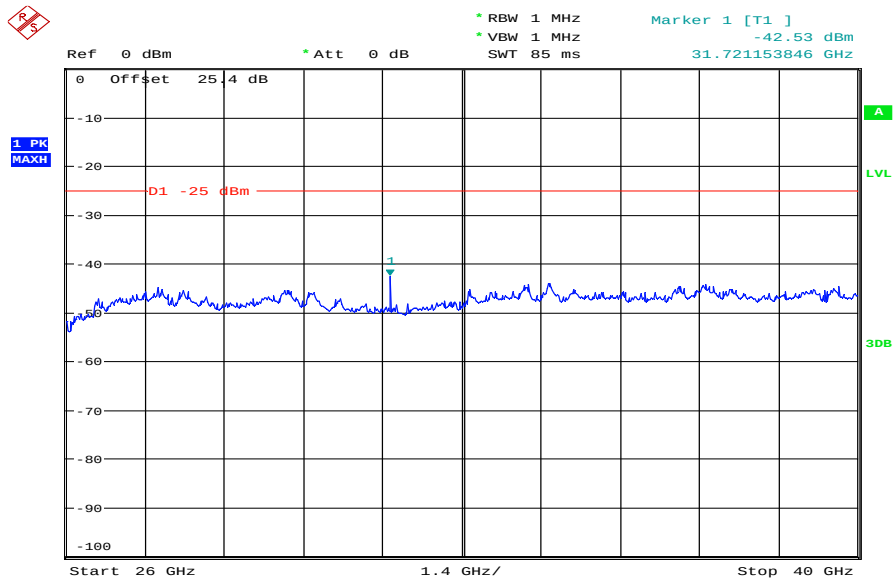
Plot 64: Port 2, 5905 MHz, 18 GHz – 26 GHz, horizontal + vertical

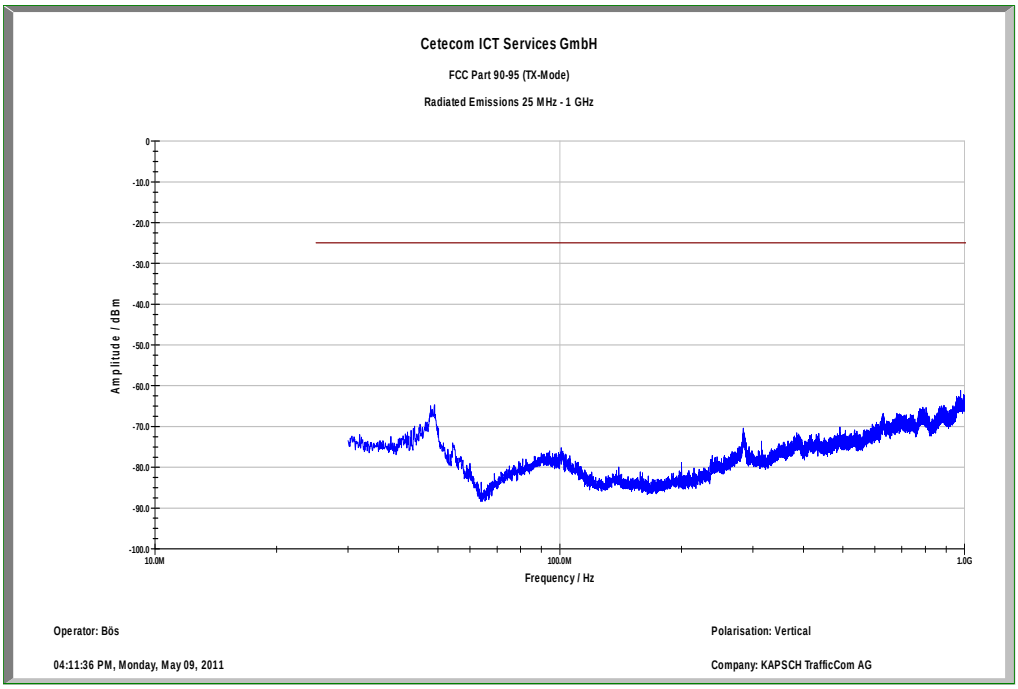


Date: 11.MAY.2011 09:13:20

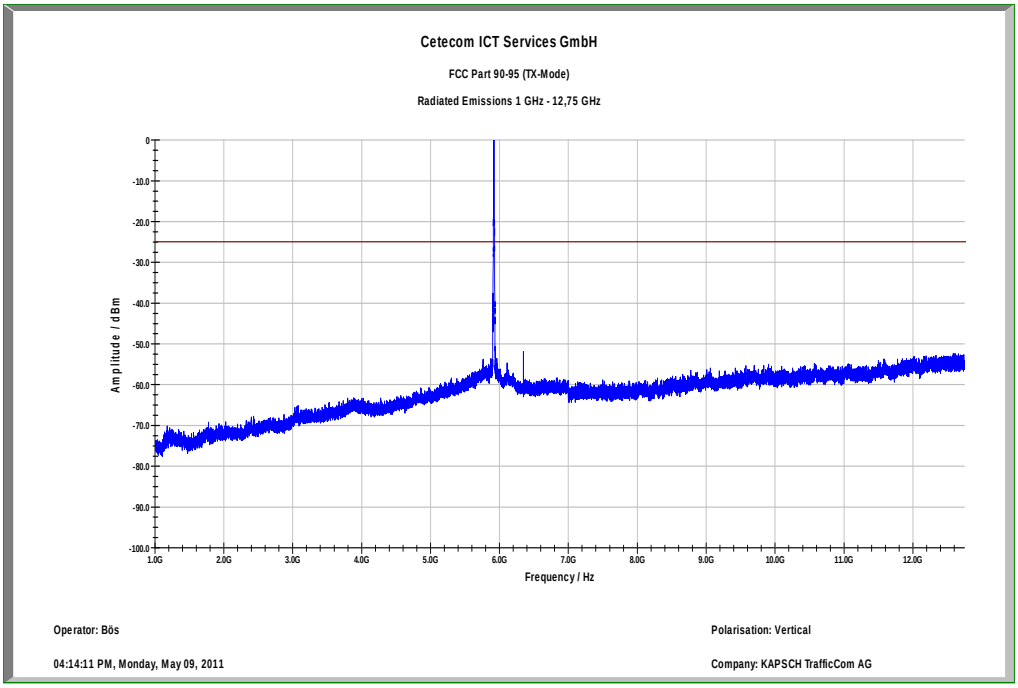
Plot 65: Port 2, 5905 MHz, 26 GHz – 40 GHz, horizontal + vertical



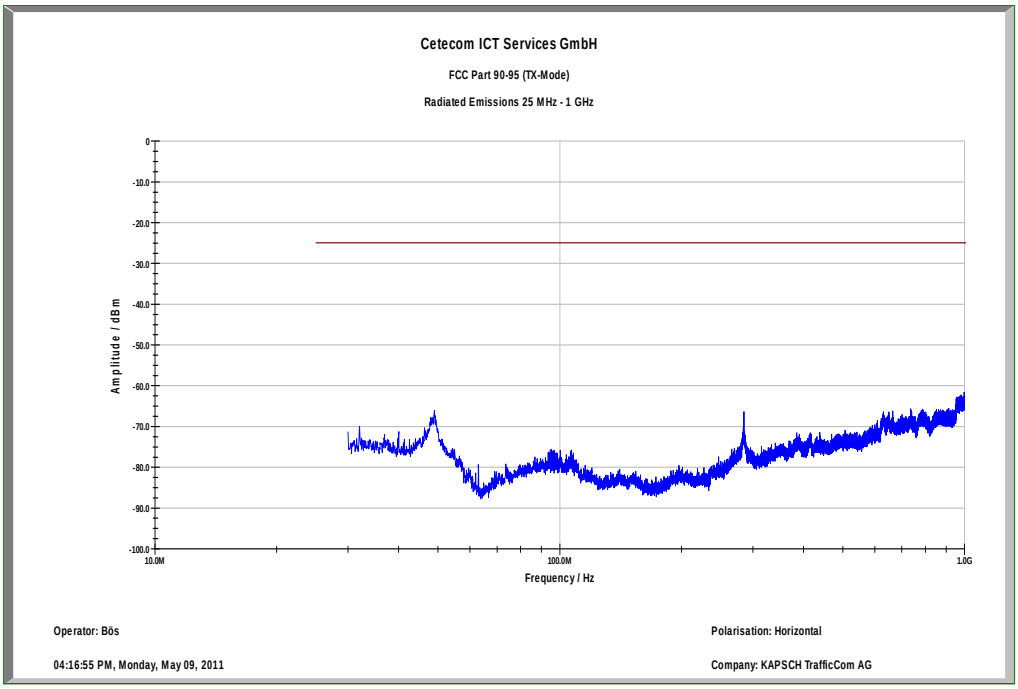
Plot 66: Port 2, 5920 MHz, 30 MHz – 1 GHz, Antenna vertical



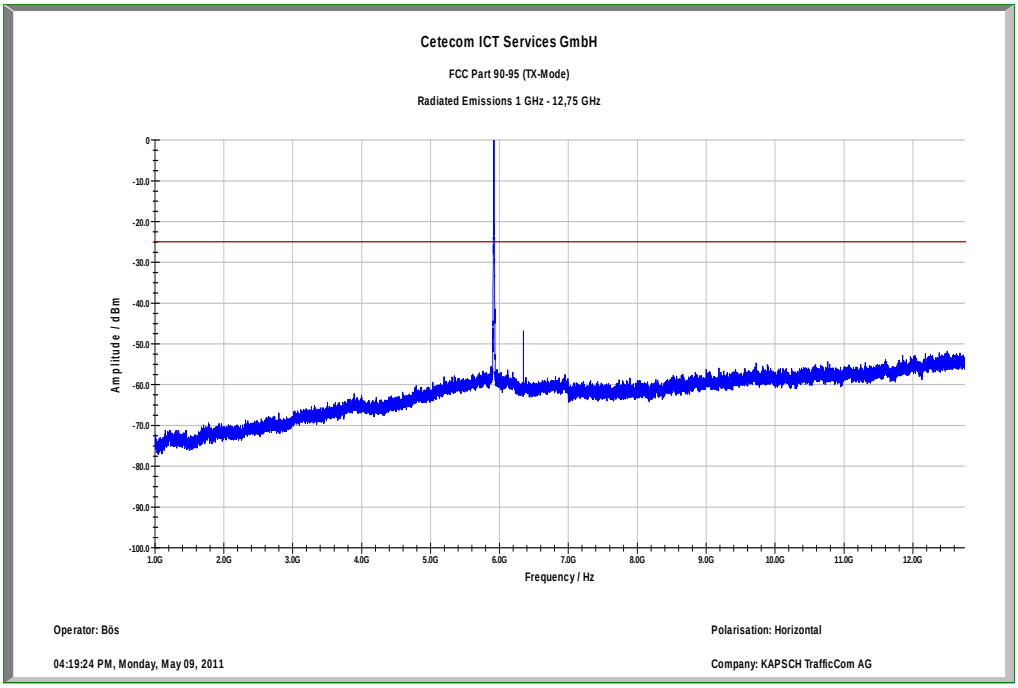
Plot 67: Port 2, 5920 MHz, 1 GHz – 12,75 GHz, Antenna vertical



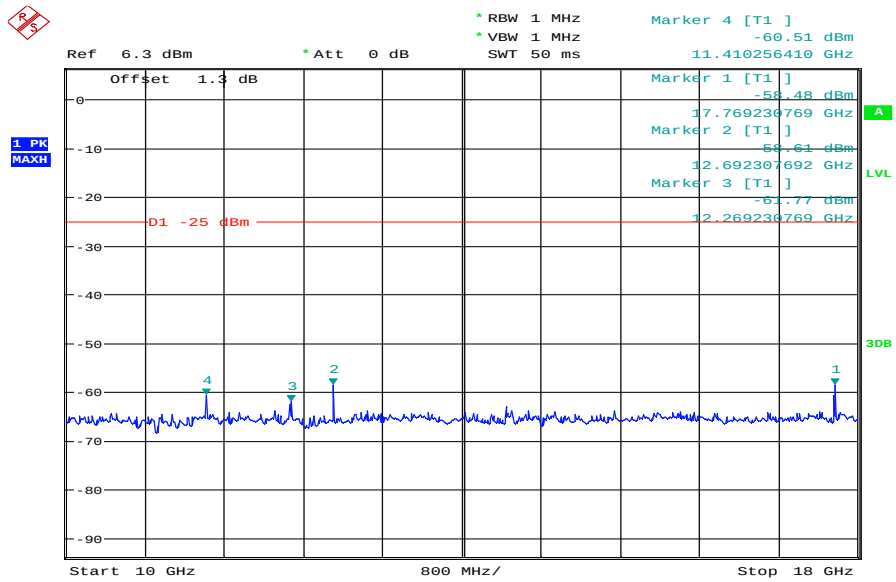
Plot 68: Port 2, 5920 MHz, 30 MHz – 1 GHz, Antenna horizontal



Plot 69: Port 2, 5920 MHz, 1 GHz – 12,75 GHz, Antenna horizontal



Plot 70: Port 2, 5920 MHz, 12 GHz – 18 GHz, horizontal + vertical



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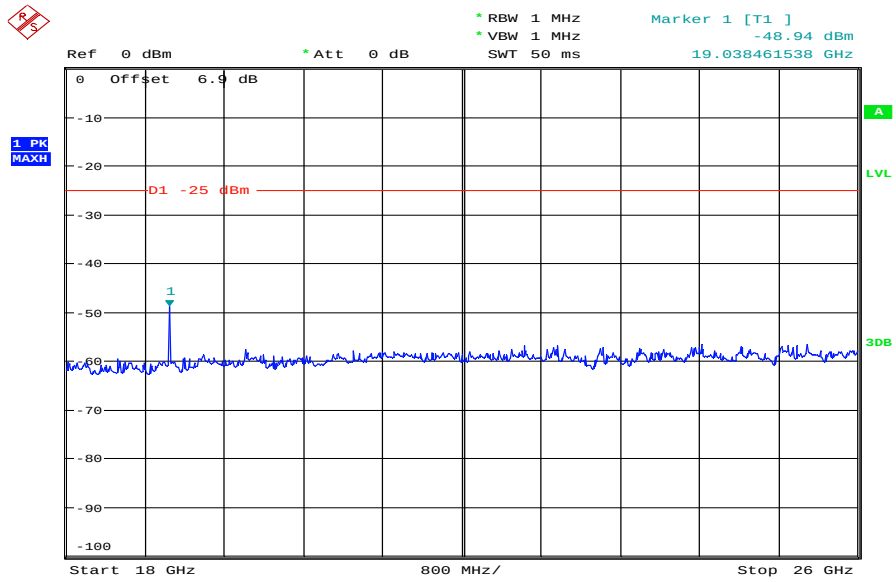
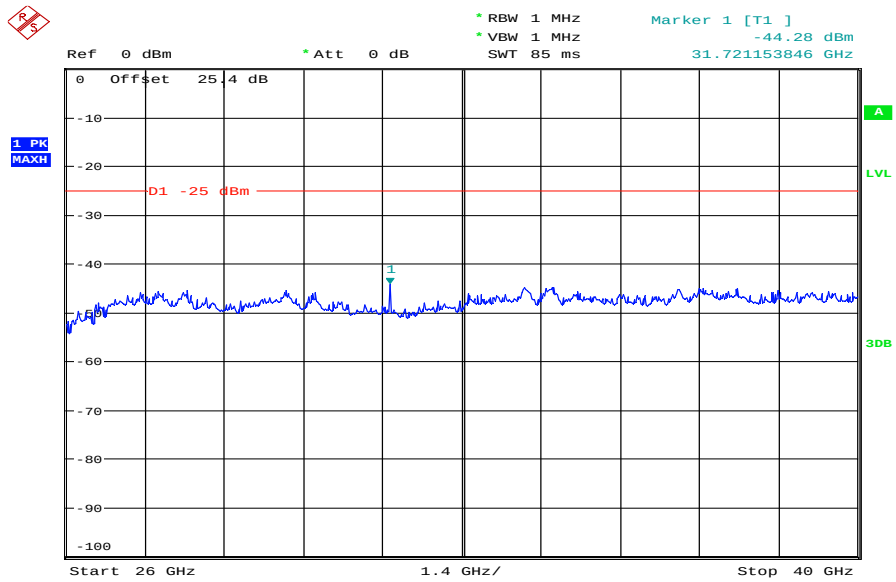
Plot 71: Port 2, 5920 MHz, 18 GHz – 26 GHz, horizontal + vertical



Date: 11.MAY.2011 09:04:02

Plot 72: Port 2, 5920 MHz, 26 GHz – 40 GHz, horizontal + vertical



10 Test equipment and ancillaries used for tests

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, rf-generating and signalling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Labor/Item).

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	45	Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368	g		
2	50	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2920A04466	300000580	ne		
3	n. a.	software	SPS_PHE 1.4f	Spitzberger & Spieß	B5981; 5D1081;B5979	300000210	ne		
4	n. a.	EMI Test Receiver	ESCI 1166.5950.03	R&S	100083	300003312	k	05.01.2011	05.01.2013
5	n. a.	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	k	31.07.2009	31.07.2011
6	n. a.	Amplifier	JS42-00502650-28-5A	MITEQ	1084532	300003379	ev		
7	n. a.	Antenna Tower	Model 2175	ETS-LINDGREN	64762	300003745	izw		
8	n. a.	Positioning Controller	Model 2090	ETS-LINDGREN	64672	300003746	izw		
9	n. a.	Turntable Interface-Box	Model 105637	ETS-LINDGREN	44583	300003747	izw		
10	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	01.04.2010	01.04.2012
11	n. a.	Spectrum-Analyzer	FSU26	R&S	200809	300003874	k	10.01.2011	10.01.2013
12	n. a.	Isolating Transformer	RT5A	Grundig	8041	300001626	g		
13	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2818A03450	300001040	Ve	08.01.2009	08.01.2012
14	n. a.	Coaxial Attenuator 30dB/500W	8325	Bird	1530	300001595	ev		
15	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	05.03.2009	05.09.2011
16	n. a.	Active Loop Antenna	6502	EMCO	2210	300001015	ne		
17	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996		23.03.2009	
18	Spec.A. 2_2e	System rack for EMI measurement solution	85900	HP I.V.	*	300000222	ne		
19	9	Artificial Mains 9 kHz to 30 MHz	ESH3-Z5	R&S	828576/020	300001210	Ve	06.01.2010	06.01.2012
20	n. a.	Relais Matrix	3488A	HP Meßtechnik	2719A15013	300001156	ne		
21	n. a.	Relais Matrix	PSU	R&S	890167/024	300001168	ne		
22	n. a.	Isolating Transformer	RT5A	Grundig	9242	300001263	ne		
23	n. a.	Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997	ne		

24	n. a.	Switch / Control Unit	3488A	HP	2605e08770	300001443	ne		
25	n. a.	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
26	n. a.	Band Reject filter	WRCG1855/1910-1835/1925-40/8SS	Wainwright	7	300003350	ev		
27	n. a.	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev		
28	n. a.	TILE-Software Emission	Quantum Change, Modell TILE-ICS/FULL	EMCO	none	300003451	ne		
29	n. a.	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492	ev		
30	n. a.	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev		
31	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne		
32	n. a.	PSA Spectrum Analyzer 3 Hz - 26.5 GHz	E4440A	Agilent Technologies	MY48250080	300003812	k	08.09.2010	08.09.2012
33	n. a.	MXG Microwave Analog Signal Generator	N5183A	Agilent Technologies	MY47420220	300003813	k	13.09.2010	13.09.2012
34	n. a.	RF Filter Section 9kHz - 1GHz	N9039A	Agilent Technologies	MY48260003	300003825	vlKl!	08.09.2010	08.09.2012
35	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vlKl!	17.12.2008	17.12.2011
36	n. a.	EMI Test Receiver 9 kHz - 3 GHz incl. Preselector	ESPI3	R&S	101713	300004059	k	07.09.2010	07.09.2011

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

Annex A Photographs of the test setup

Photo documentation:

Photo 1: chamber F

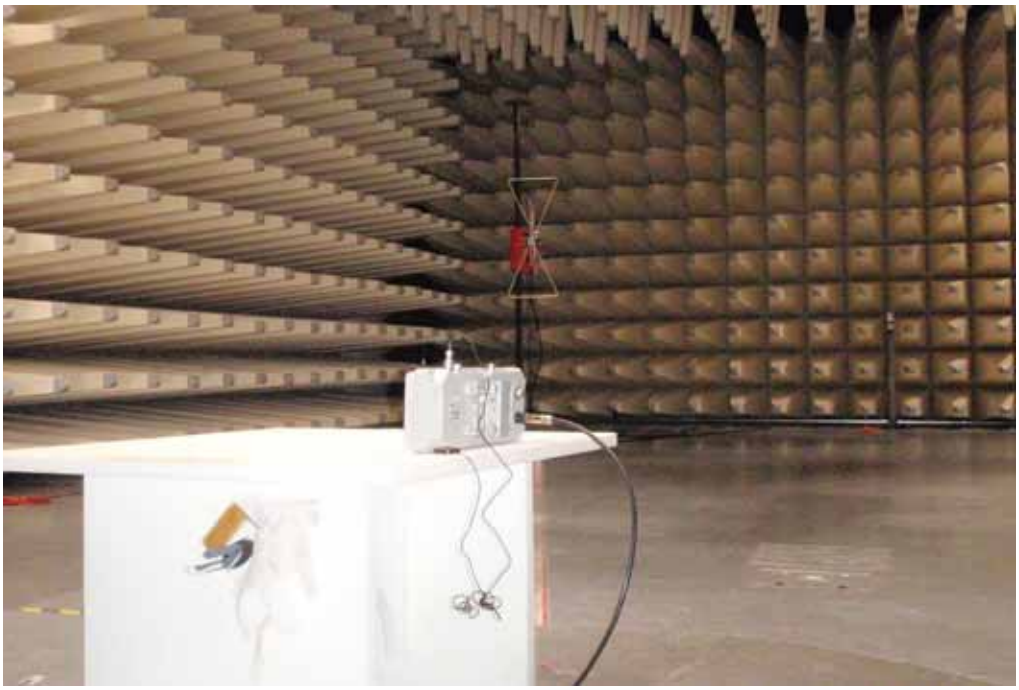


Photo 2: chamber F

Photo 3: chamber C

Photo 4: chamber C

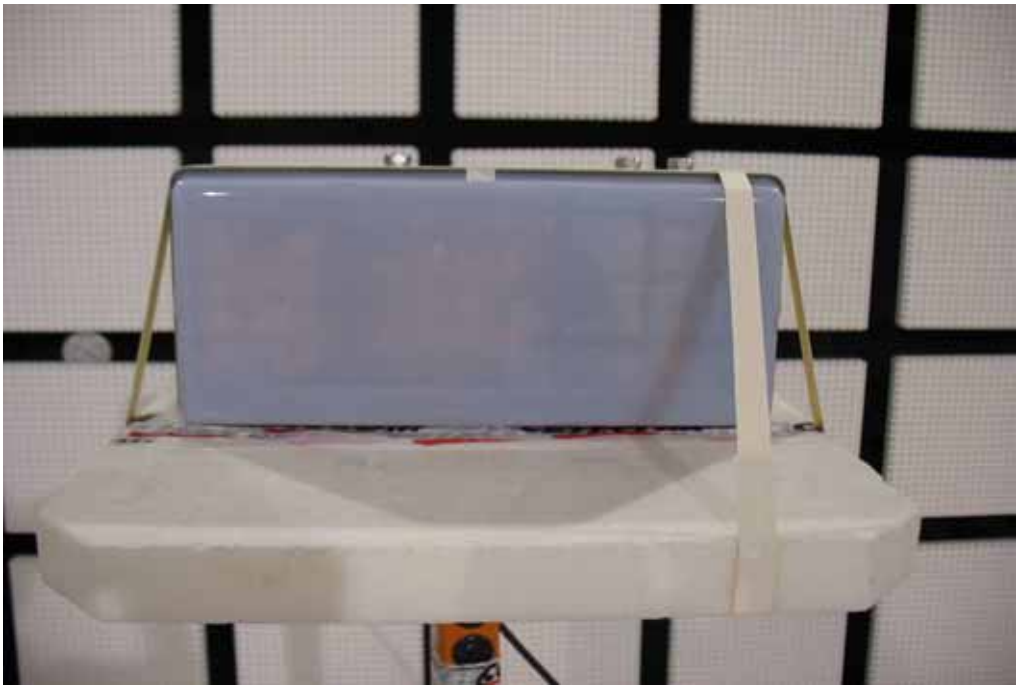


Photo 5: chamber C

Photo 6: chamber C

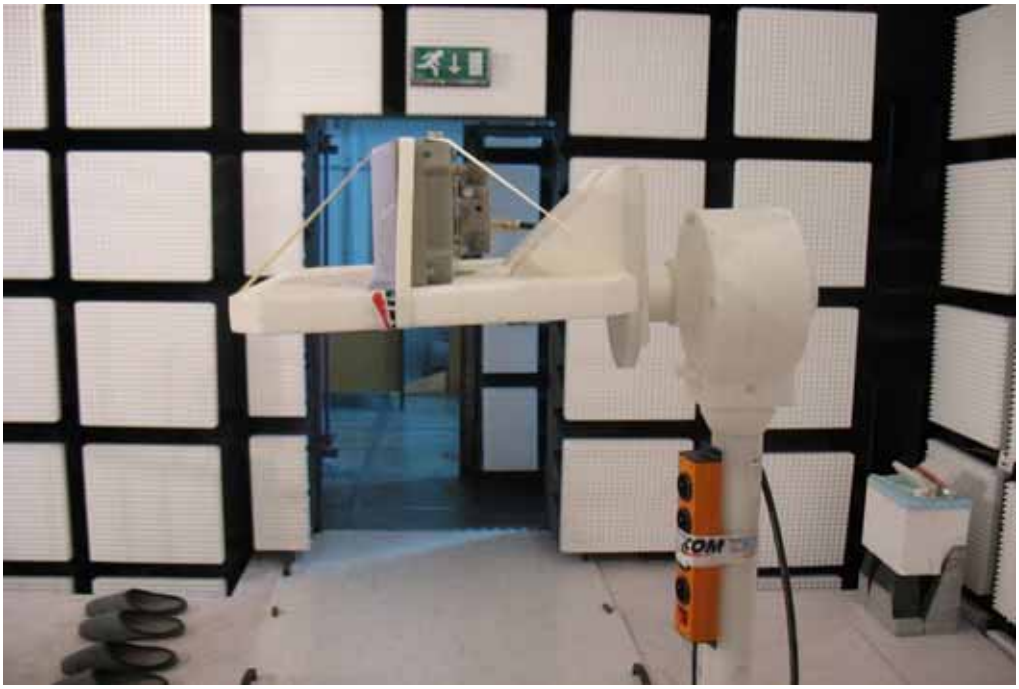


Photo 7: chamber C

Photo 8:

Photo 9:

Photo 10:

Annex B External photographs of the EUT

Photo documentation:

Photo 1:

Photo 2:

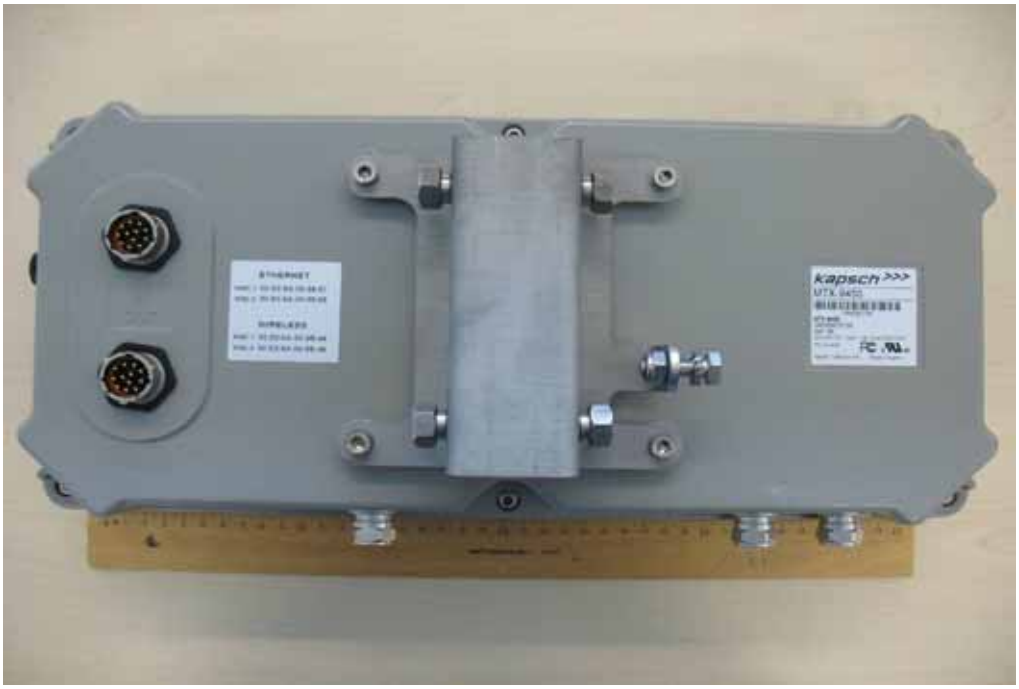


Photo 3:

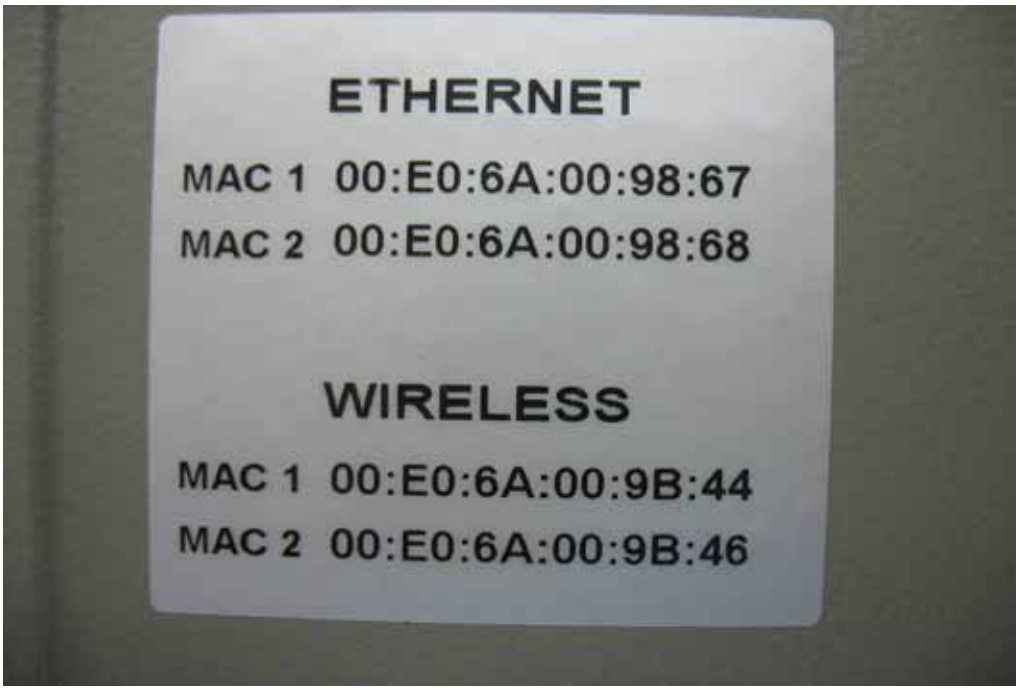


Photo 4:

Photo 5:

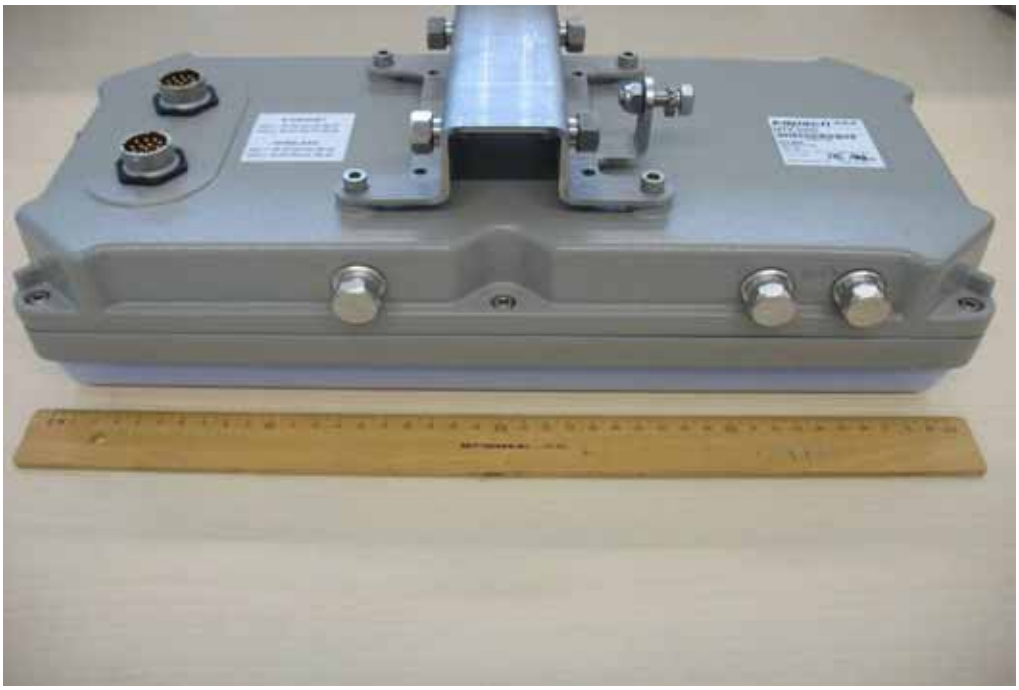


Photo 6:

Photo 7:

Photo 8:

Photo 9:

Photo 10:

Photo 11:

Annex C Internal photographs of the EUT

Photo documentation:

Photo 1:

Photo 2:

Photo 3:

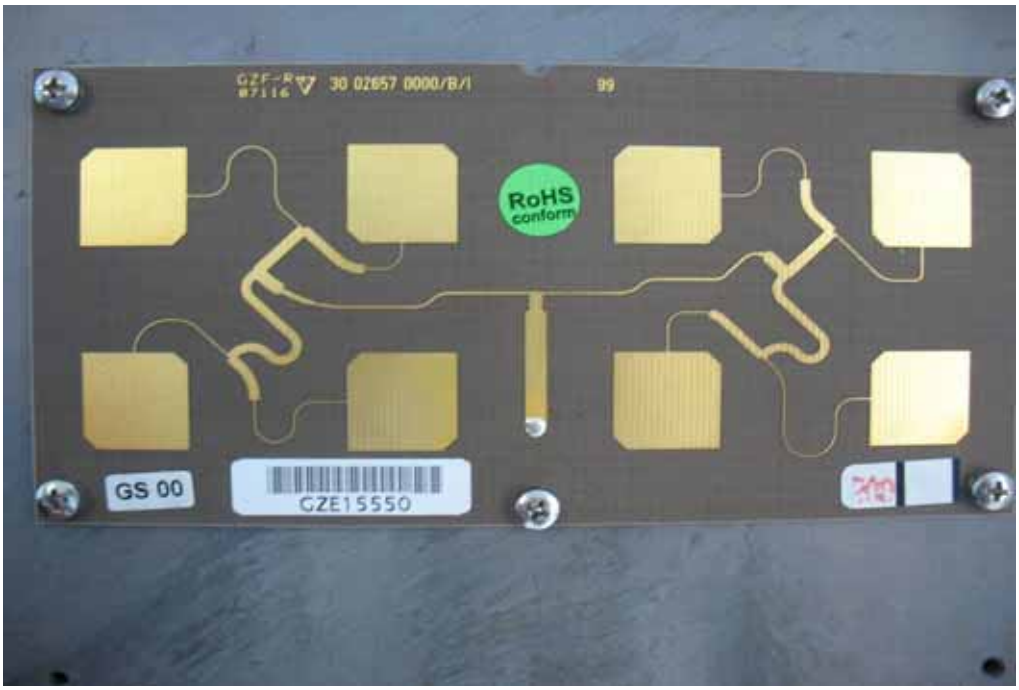


Photo 4:

Photo 5:

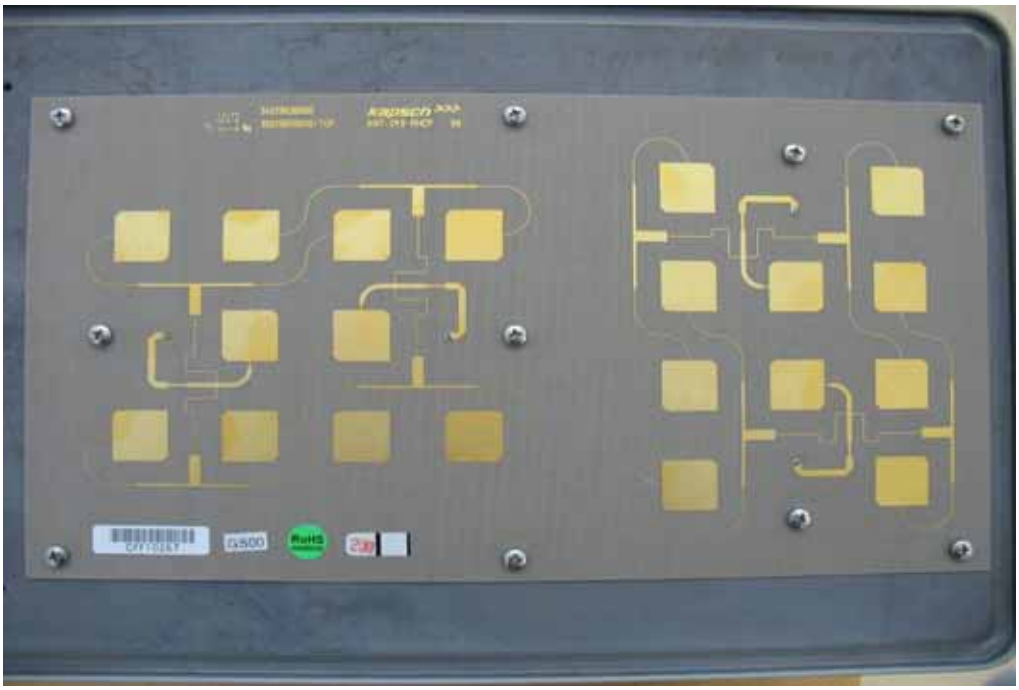


Photo 6:

Photo 7:

Photo 8:

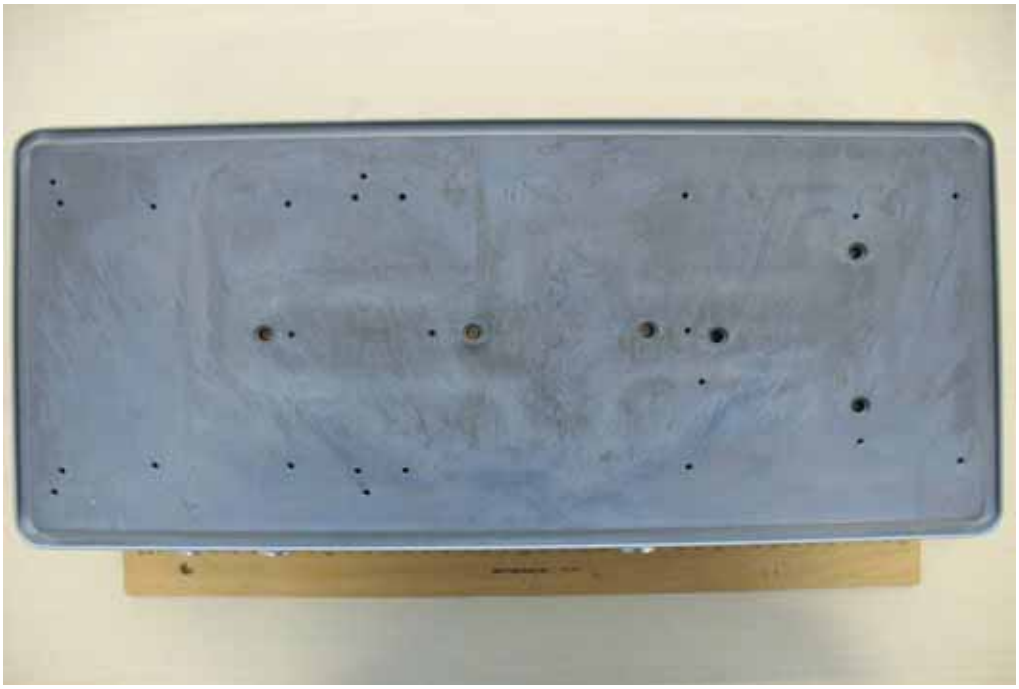


Photo 9:

Photo 10:

Photo 11:

Photo 12:

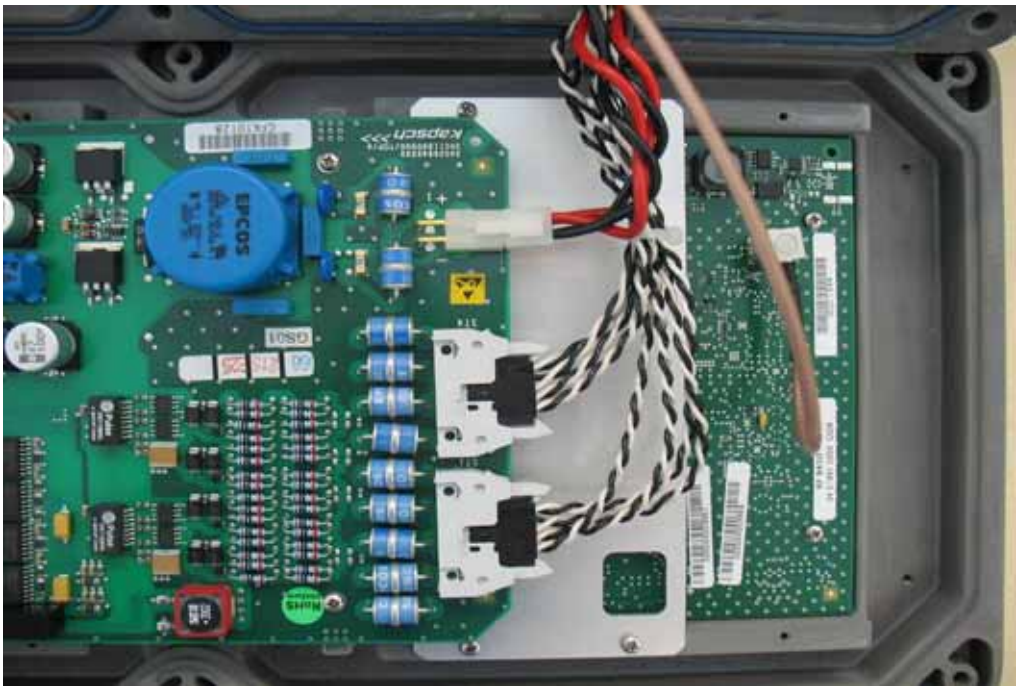


Photo 13:

Photo 14:

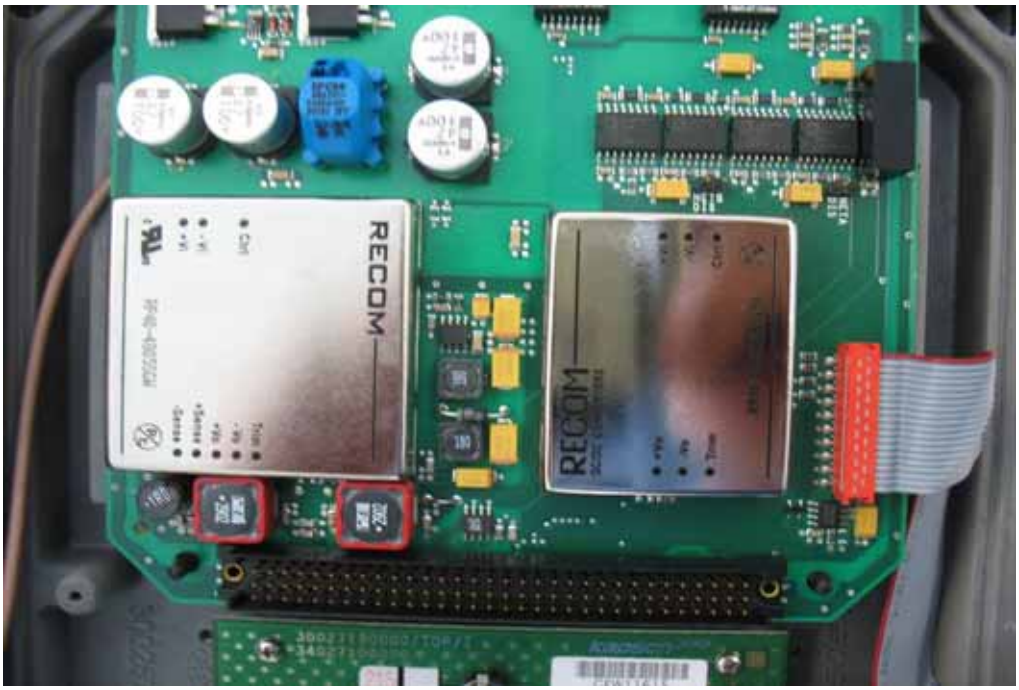
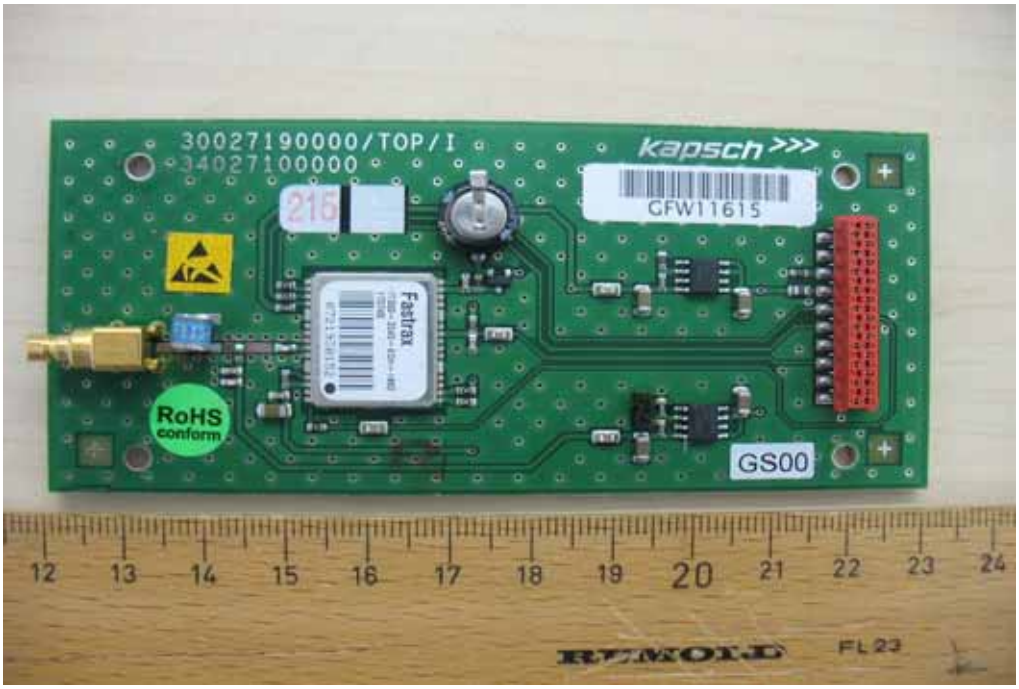


Photo 15:

Photo 16:



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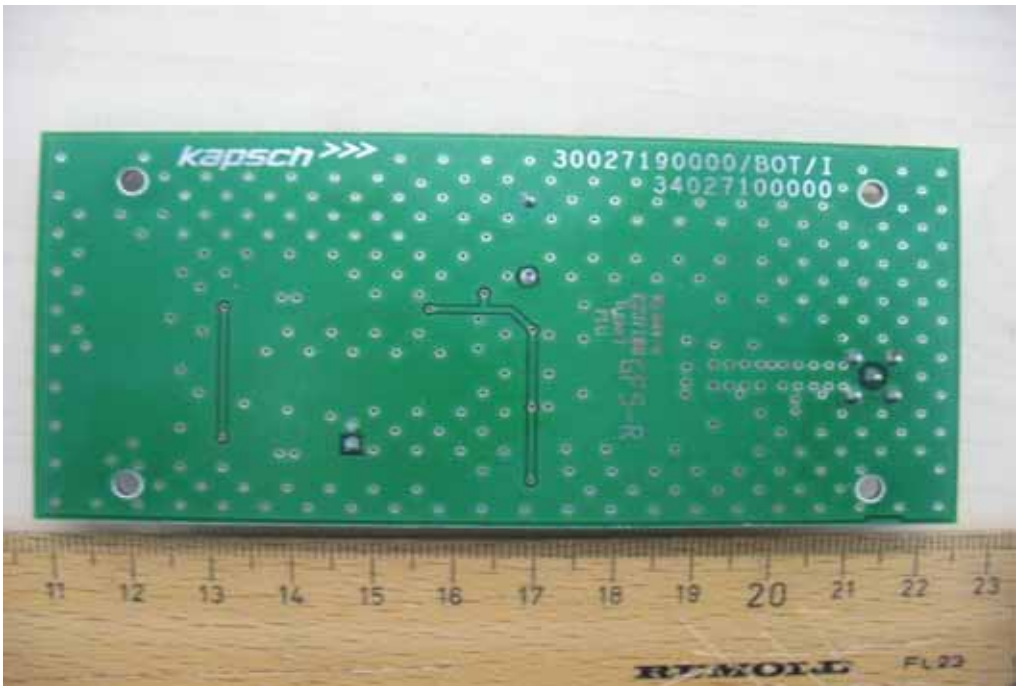


Photo 18:

Photo 19:

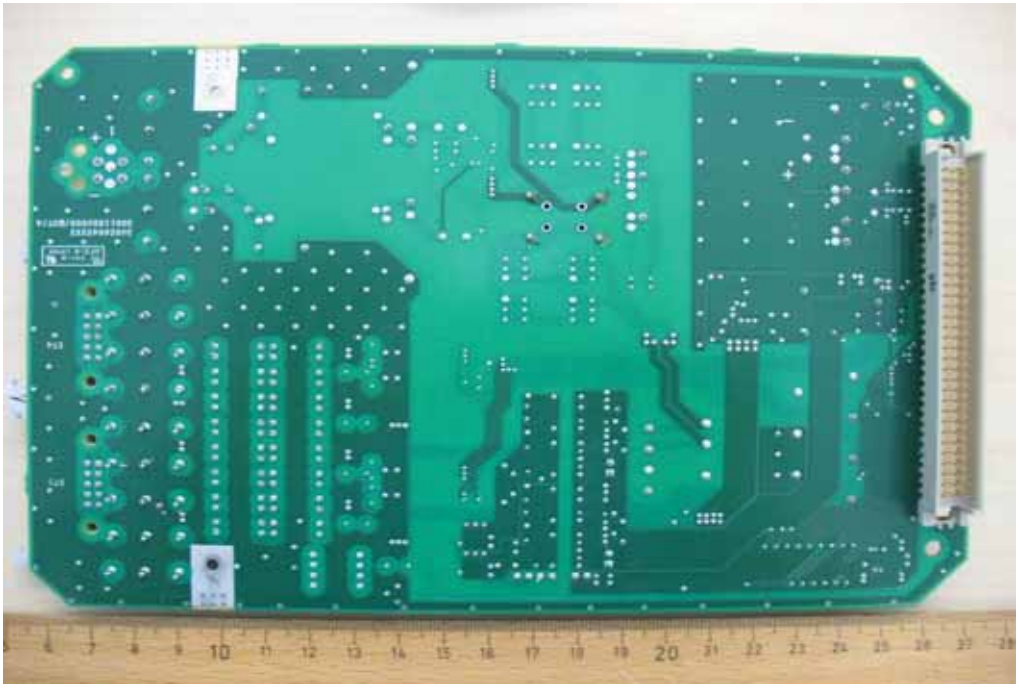


Photo 20:

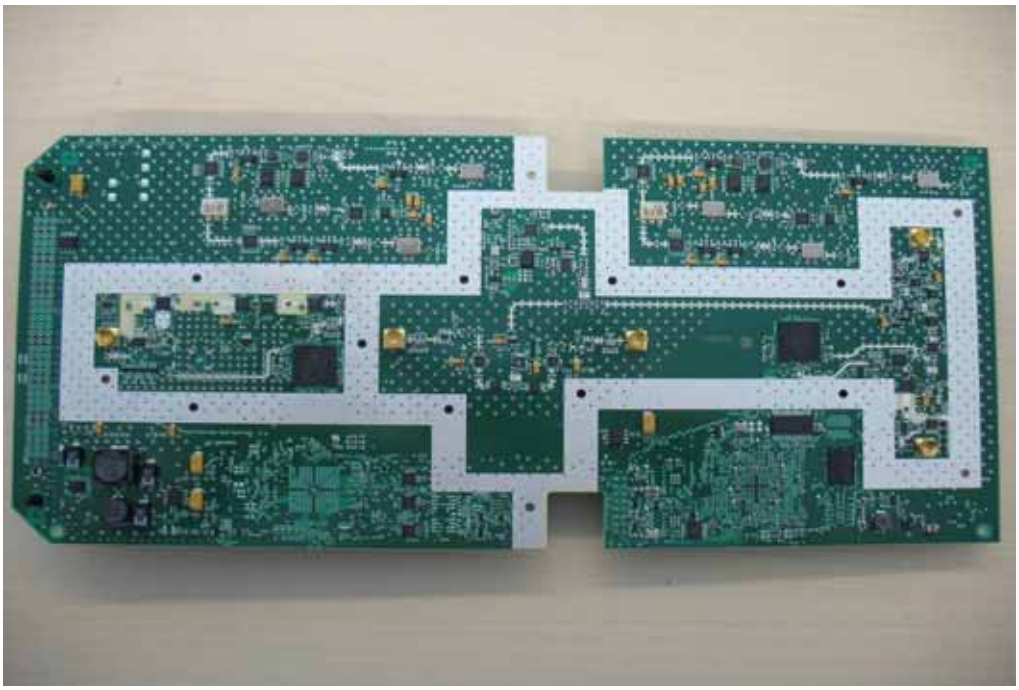
Photo 21:

Photo 22:

Photo 23:

Photo 24:

Photo 25:



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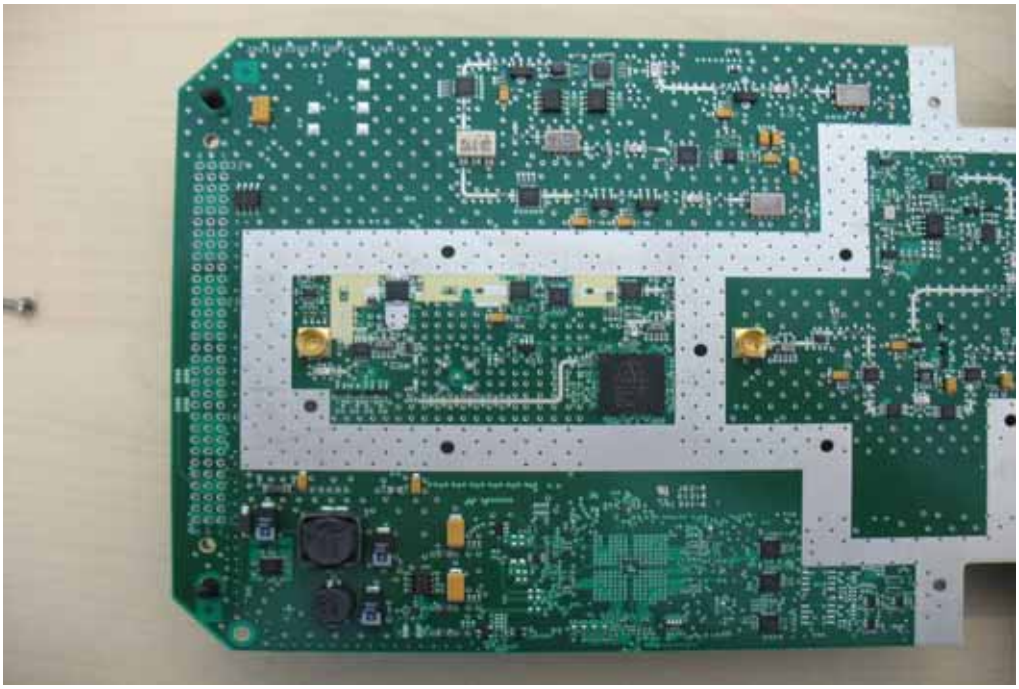

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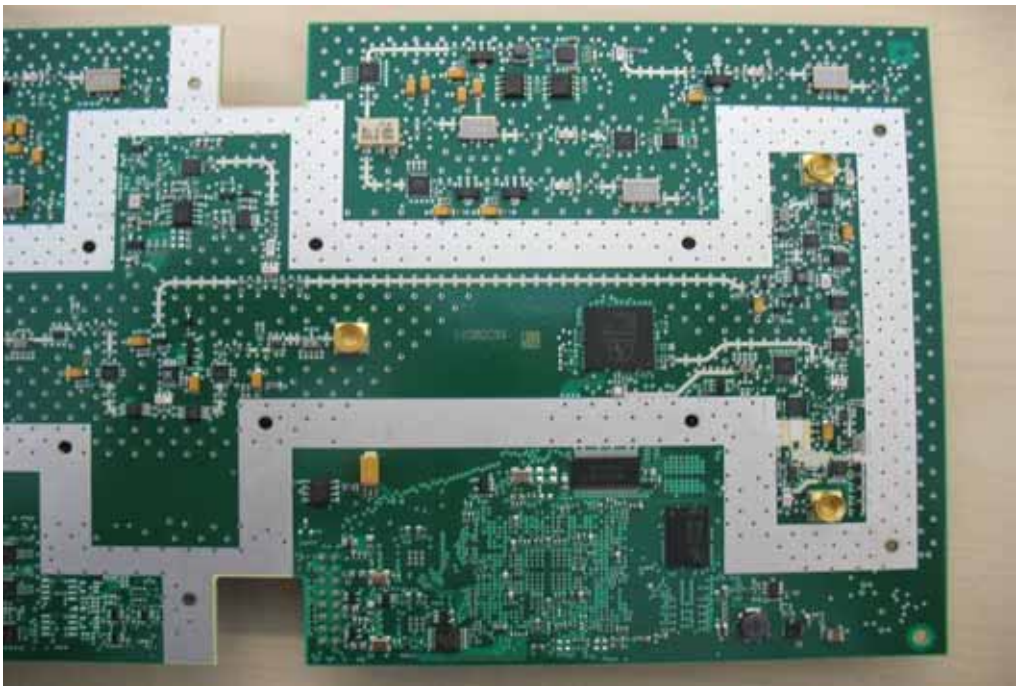

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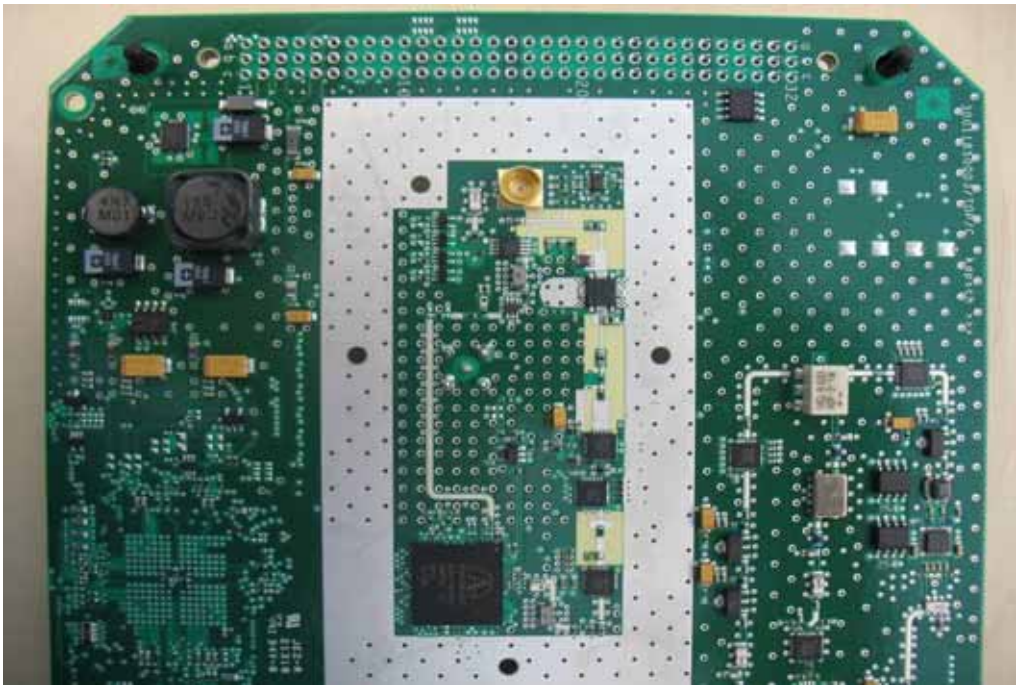

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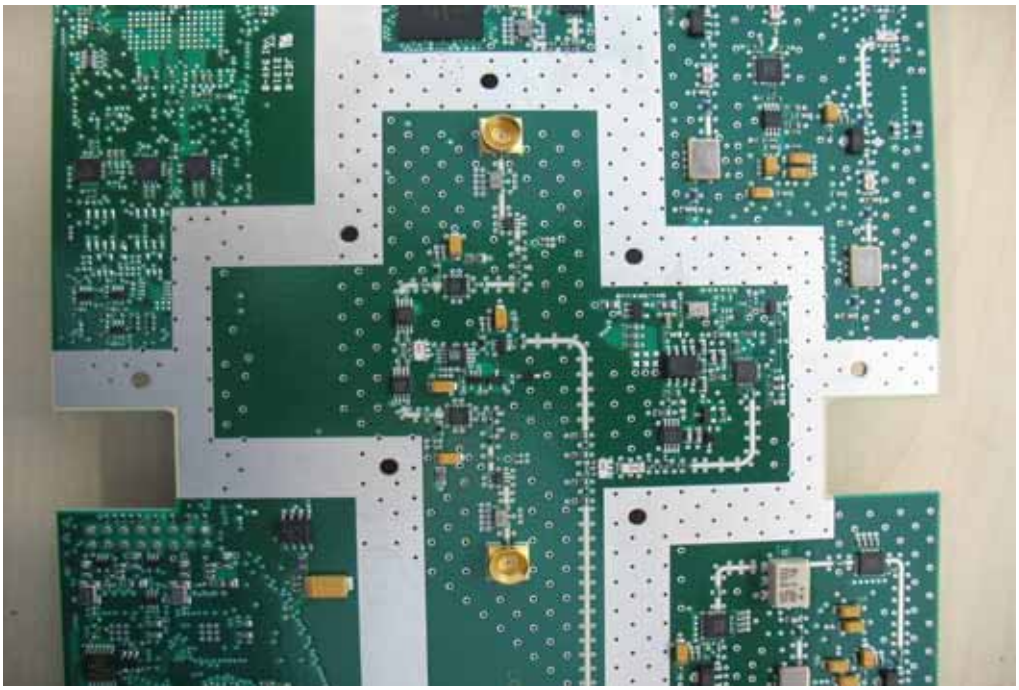

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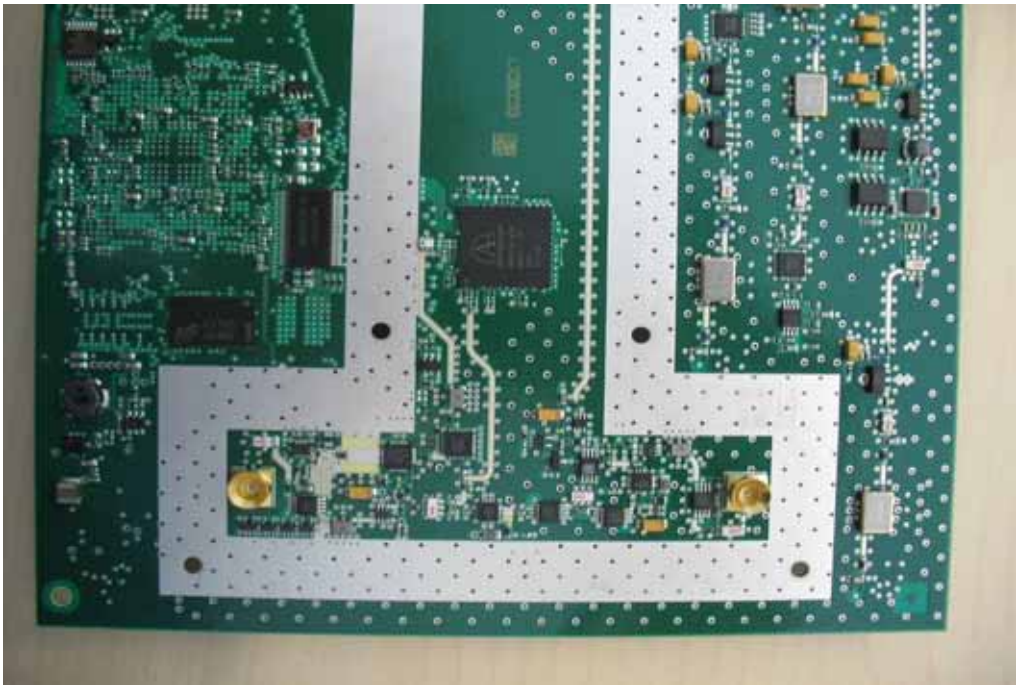
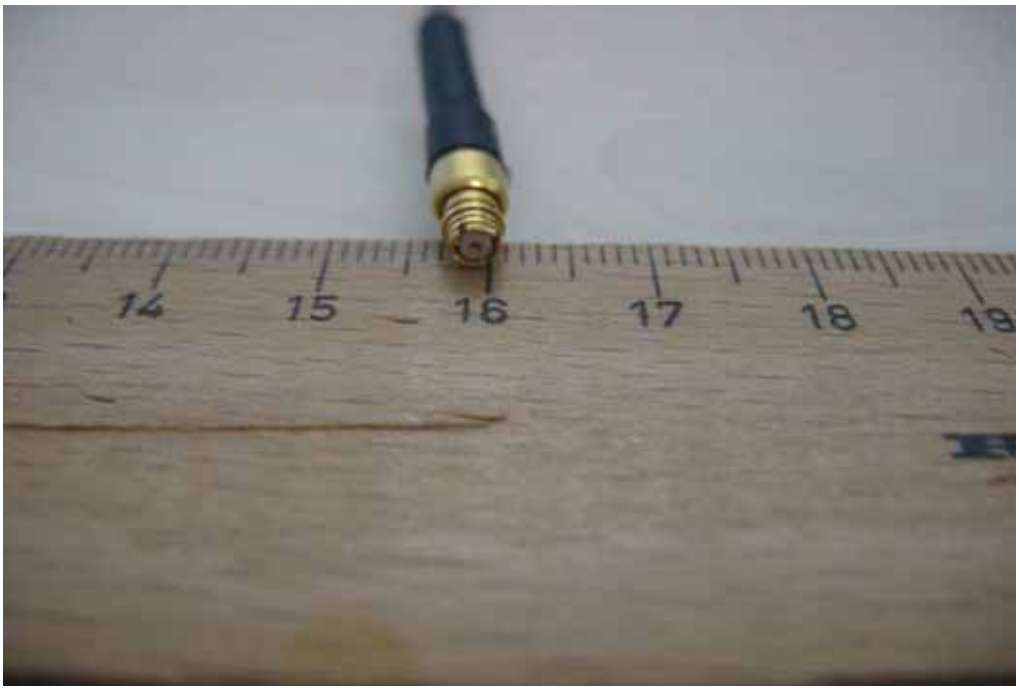


Photo 31: (Adapter)

Photo 32: (Adapter)

Photo 33: (Adapter)



Annex D Document history

Version	Applied changes	Date of release
1.0	Initial release	2011-06-15
-A	Extended temperature range results added at page 11.	2011-07-13
-B	Photo Label @ page 101 changed to actual version and description of the usability if external and internal antennas @ page 124 corrected.	2011-09-15

Annex E Further information

Glossary

DUT	-	Device under Test
EMC	-	Electromagnetic Compatibility
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	not applicable
S/N	-	Serial Number
SW	-	Software

Annex F MPE calculation

Prediction of MPE

This device is designed to be used only for fixed and mobile applications.

It has integrated internal antennas. External connectors are provided which allows connection of external antennas. The output can be switched either to the external antennas or the internal antennas. Simultaneous transmission with both antennas is restricted.

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	Power density (mW/cm^2)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30
1500 – 100.000	1.0	30

Based on the above table the limits are: For 5900 MHz frequency band device: 1 mW/cm^2

§ 2.1091: The limit for 5900 MHz mobile operations, where no routine evaluation is required, is: 3W EIRP

Max permissive power according to §90.377:

Channel No.	Frequency range (MHz)	Max. EIRP [1] (dBm)	Channel use
170	5850–5855	.....	Reserved.
172	5855–5865	33	Service Channel.[2]
174	5865–5875	33	Service Channel.
175	5865–5885	23	Service Channel.[3]
176	5875–5885	33	Service Channel.
178	5885–5895	33/44.8	Control Channel.
180	5895–5905	23	Service Channel.
181	5895–5915	23	Service Channel.[3]
182	5905–5915	23	Service Channel.
184	5915–5925	33/40	Service Channel.[4]

Using the equation from page 19 of OET Bulletin 65, Edition 97-01:

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Compliance with MPE limits can be guaranteed as the calculations below show:

Internal Antennas

Band	Maximum radiated output power (dBm)	Maximum radiated output power (mW)	Duty cycle	Equivalent radiated output power (Maximum radiated output power x duty cycle) (mW)
5860 MHz	32.1	1621.8	100%	1621.8
5875 MHz	22.5	177.8	100%	177.8
5890 MHz	33.2	2089.3	100%	2089.3
5905 MHz	22.5	177.8	100%	177.8
5920 MHz	32.2	1659.6	100%	1659.6

Maximum output power considerations:

$P \times G_1$	Maximum power input to the antenna x Antenna gain (dBi) to comply with MPE limits:	2089.3	mW
R	Distance:	20	cm
S	**MPE limit for uncontrolled exposure:**	**0.42**	**mW/cm^2**

Result: **Internal antenna configuration complies with MPE limits.**

External Antennas

Band	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
5860 MHz	18.9	77.6	100%	77.6
5875 MHz	8.6	7.2	100%	7.2
5890 MHz	18.6	72.4	100%	72.4
5905 MHz	8.5	7.1	100%	7.1
5920 MHz	19.1	81.3	100%	81.3

Maximum output power considerations:

P	Maximum power input to the antenna:	81.3	mW
R	Distance:	20	cm
S	MPE limit for uncontrolled exposure:	1	mW/cm^2
G_1	Antenna gain (dBi) to comply with MPE limits:	**17.9**	**dBi**
EIRP power limit according to §2.1091:		3	W EIRP
G_2	Antenna gain (dBi) to comply with ERP limits: (EIRP = Maximum conducted output power x Antenna gain)	**15.7**	**dBi**
ERP power limit according to §90.377: (low power channels)		0.2	W EIRP
G_3	Antenna gain (dBi) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain)	**14.4**	**dBi**
ERP power limit according to §90.377: (high power channels)		2	W EIRP
G_4	Antenna gain (dBi) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain)	**13.9**	**dBi**
$G_{5900\ MHz\ band}$	**Min (G_1, G_2, G_3, G_4)**	**13.9**	**dBi**

Result:. The maximum antenna gain for mobile operation to comply with MPE and EIRP limits shall not exceed 13.9 dBi.