

**TRaC Radio Test Report** : TTR-002152WUS1

**Applicant** : Promethean Ltd

**Apparatus** : ActivBoard Model Number PRM-AB487-01

**FCC ID** : QAM016

**Authorised by** :



: Radio Product Manager

**Issue Date** : 6<sup>th</sup> December 2010

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**Section 1:**

**Introduction**

**1.1 General**

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

Tests performed by: S Hodgkinson, Radio Test Engineer

TRaC Telecoms & Radio  
Unit 1, Pendle Place  
Skelmersdale,  
West Lancs,  
WN8 9PN, UK

Telephone: +44 (0) 1695 556666  
Fax: +44 (0) 1695 577077

Email: [test@tracglobal.com](mailto:test@tracglobal.com)  
Web site: <http://www.tracglobal.com>

Tests performed by: S Hodgkinson, Radio Test Engineer

Report author: S Hodgkinson, Radio Test Engineer

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## 1.2 Tests Requested By

This testing in this report was requested by :

Promethean Ltd  
Promethean House  
Lower Philips Road  
Blackburn  
Lancashire  
BB1 5TH

## 1.3 Manufacturer

Promethean Ltd  
Promethean House  
Lower Philips Road  
Blackburn  
Lancashire  
BB1 5TH

## 1.4 Apparatus Assessed

The following apparatus was assessed between: 12<sup>th</sup> – 20<sup>th</sup> October 2010

The equipment was an ActivBoard Model Number PRM-AB487-01

FCC ID: QAM016

The Promethean, 87" ActivBoard Model Number PRM-AB487-01 has the following features:

Stereo Amplifier  
Stereo Loudspeakers  
USB Hub  
USB Port  
2.4GHz Radio Link  
2 Pen Frequencies  
18.0Vdc Power supply unit, model number DPS-90GB - A

The cables for the Loudspeakers are pre installed into the outer case of the boards.

The Michelangelo wipeboard, testing was carried out with the audio amplifier and USB Hub and USB port exercised, and connected to the PC via a USB lead.

When required the testing was carried out with all of the boards connected to the PC via the 2.4GHz radio link.

## 1.5 EXAMINATIONS REQUIRED

Full details of test results are contained within Appendix A. The following table summarises the assessment.

### EQUIPMENT TEST / EXAMINATIONS REQUIRED

TEST/EXAMINATION	RULE PART	DETECTOR	APPLICABILITY
Intentional Emission Frequency:	15.247	Peak	Yes
Intentional Emission Field Strength:	-	-	No
Intentional Emission Band Occupancy:	15.247(a)1	Peak	Yes
Intentional Emission EIRP (mW):	15.247(b)1	Peak	Yes
Spurious Emissions – Conducted:	-	-	No
Spurious Emissions – Conducted:	15.247	Peak	Yes
Spurious Emissions – Radiated <1000MHz:	15.209 ,15.247	Quasi Peak	Yes
Spurious Emissions – Radiated >1000MHz:	15.247 15.209	Peak average	Yes
Transmitter Carrier Frequency Separation:	15.247(a)(1)	Peak	Yes
Transmitter Maximum Peak Power Output Power:	15.247(b)(1)	Peak	Yes
Transmitter Band Edge Conducted Emissions:	15.247(c)	Peak	Yes
Transmitter Band Edge Radiated Emission:	15.247(c)	Peak	Yes
Extrapolation Factor:	15.31(f)	-	Yes
Maximum Frequency of Search:	15.33	-	Yes
Antenna Arrangements Integral:	15.203	-	Yes
Antenna Arrangements External Connector:	15.204	-	Yes
Restricted Bands:	15.205	-	Yes

Mod : Modification  
 CFR : Code of Federal Regulations  
 REFE : Radiated Electric Field Emissions

ANSI : American National Standards Institution  
 PLCE : Power Line Conducted Emissions

## **1.6 Notes Relating To The Assessment**

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, "Pass" indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 18 to 20 °C
Humidity	: 48 to 55 %

All dates used in this report are in the format dd/mm/yy.

## **1.7 Deviations from Test Standards**

There were no deviations from the standards tested to.

**Section 2:****Measurement Uncertainty****2.1 Measurement Uncertainty Values**

The following page contains the measurement uncertainties for measurements

*All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.*

**[1] Adjacent Channel Power**

Uncertainty in test result = **1.86dB**

**[2] Carrier Power**

Uncertainty in test result (Equipment - TRLUH120) = **2.18dB**

Uncertainty in test result (Equipment – TRL05) = **1.08dB**

Uncertainty in test result (Equipment – TRL479) = **2.48dB**

**[3] Effective Radiated Power**

Uncertainty in test result = **4.71dB**

**[4] Spurious Emissions**

Uncertainty in test result = **4.75dB**

**[5] Maximum frequency error**

Uncertainty in test result (Equipment - TRLUH120) = **119ppm**

Uncertainty in test result (Equipment – TRL05) = **0.113ppm**

Uncertainty in test result (Equipment – TRL479) = **0.265ppm**

**[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field**

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,

Uncertainty in test result (1GHz-18GHz) = **4.7dB**

**[7] Frequency deviation**

Uncertainty in test result = **3.2%**

**[8] Magnetic Field Emissions**

Uncertainty in test result = **2.3dB**

**[9] Conducted Spurious**

Uncertainty in test result (Equipment TRL479) Up to 8.1GHz = **3.31dB**

Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result (Equipment TRLUH120) Up to 26GHz = **3.14dB**

**[10] Channel Bandwidth**

Uncertainty in test result = **15.5%**

**[11] Amplitude and Time Measurement – Oscilloscope**

Uncertainty in overall test level = **2.1dB**, Uncertainty in time measurement = **0.59%**, Uncertainty in Amplitude measurement = **0.82%**

**[11] Power Line Conduction**

Uncertainty in test result = **3.4dB**

**[12] Spectrum Mask Measurements**

Uncertainty in test result = **2.59% (frequency)**  
Uncertainty in test result = **1.32dB (amplitude)**

**[13] Adjacent Sub Band Selectivity**

Uncertainty in test result = **1.24dB**

**[14] Receiver Blocking – Listen Mode, Radiated**

Uncertainty in test result = **3.42dB**

**[15] Receiver Blocking – Talk Mode, Radiated**

Uncertainty in test result = **3.36dB**

**[16] Receiver Blocking – Talk Mode, Conducted**

Uncertainty in test result = **1.24dB**

**[17] Receiver Threshold**

Uncertainty in test result = **3.23dB**

**[18] Transmission Time Measurement**

Uncertainty in test result = **7.98%**



**Section 3:**

**Modifications**

**3.1 Modifications Performed During Assessment**

No modifications were performed during the assessment

## Appendix A:

## Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
EUT	: Equipment Under Test	ATS	: Alternative Test Site
SE	: Support Equipment		
		Ref	: Reference
		Freq	: Frequency
		MD	: Measurement Distance
L	: Live Power Line	SD	: Spec Distance
N	: Neutral Power Line		
E	: Earth Power Line	Pol	: Polarisation
		H	: Horizontal Polarisation
Pk	: Peak Detector	V	: Vertical Polarisation
QP	: Quasi-Peak Detector		
Av	: Average Detector	CDN	: Coupling & decoupling network

**A1 Conducted Fundamental Carrier Power**

The EUT transmitting on its lowest channel centre and highest carrier frequency in turn.

Test Details:	
Regulation	CFR 47 2008, Part15 Subpart (c) 15.247(b)(1)
EUT sample number	S01
Modification state	0
SE in test environment	S02

Channel No	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (dBm)	Measured Peak Conducted Carrier Power (mW)	Limit (W)	Result
02	2401	5.61dBm	3.63	0.125	Pass
46	2440	5.23dBm	3.33		Pass
92	2480	5.38dBm	3.45		Pass

Note: Channel 02 is the lowest operating frequency, and channel 92 is the highest operating frequency.

For battery-operated equipment, the test was performed using a new battery as required by 15.31(e).

## A2 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 100kHz and the VBW>RBW. Frequencies were scanned up through to the 10th harmonic with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details CH02/CH46/CH92	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02

The worst case conducted emission measurements at the antenna port are listed below:

Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
<i>No significant emissions within 20 dB of the limit</i>						

### Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in CFR 47 Part 15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance 15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.

The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

$$\text{The limit in 100 kHz RBW} = (\text{Maximum Peak Conducted Carrier}) - 20\text{dB}$$

**A3 Radiated Electric Field Emissions Within The Restricted Band 15.205**

Preliminary emission testing was performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to :

10m open area test site :       3m alternative test site :

The effect of the EUT set-up on the measurements is summarised in note (c) below.

<b>Test Details CH02 Connected to Laptop</b>	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209. For other frequencies that do not fall into the restricted bands of operation that are  $\geq 1$  GHz the required Limit is 20dBc below the fundamental output power.

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
1.	35.85	33.33	0.6	16.30	27.53	22.70	N/A	13.64	100
2.	37.35	39.82	0.6	14.60	27.52	27.50	N/A	23.71	100
3.	42.20	42.22	0.7	11.60	27.52	27.00	N/A	22.38	100
4.	44.15	42.42	0.7	10.20	27.52	25.80	N/A	19.49	100
5.	45.40	41.62	0.7	10.20	27.52	25.00	N/A	17.78	100
6.	48.05	50.16	0.7	8.70	27.56	32.00	N/A	39.81	100
7.	51.00	47.17	0.7	7.30	27.57	27.60	N/A	23.98	100
8.	51.75	48.57	0.7	7.30	27.57	29.00	N/A	28.18	100
9.	54.00	48.61	0.7	6.30	27.61	28.00	N/A	25.11	100
10.	60.05	51.91	0.8	5.00	27.61	30.00	N/A	31.62	100
11.	64.50	46.93	0.8	5.40	27.63	25.50	N/A	18.83	100
12.	65.85	46.38	0.8	5.45	27.63	25.00	N/A	17.78	100
13.	72.00	57.84	0.9	5.60	27.64	36.70	N/A	68.39	100
14.	82.20	41.05	0.9	7.70	27.65	22.00	N/A	12.58	100
15.	83.90	42.75	0.9	7.70	27.65	23.70	N/A	15.31	100
16.	86.15	46.99	0.9	7.80	27.69	28.00	N/A	25.11	100
17.	88.10	46.60	0.9	8.20	27.70	28.00	N/A	25.11	150
18.	89.65	44.71	1.0	8.50	27.71	26.50	N/A	21.13	150
19.	91.20	45.70	1.0	9.00	27.70	28.00	N/A	25.11	150
20.	105.35	44.38	1.1	10.40	27.68	28.20	N/A	25.70	150
21.	108.00	52.28	1.1	10.50	27.68	36.20	N/A	64.56	150
22.	110.45	44.18	1.1	10.90	27.68	28.50	N/A	26.60	150
23.	111.75	45.63	1.1	10.95	27.68	30.00	N/A	31.62	150
24.	120.00	54.58	1.1	11.00	27.68	39.00	N/A	89.12	150
25.	132.05	47.18	1.3	11.20	27.68	32.00	N/A	39.81	150
26.	135.85	41.79	1.3	11.40	27.69	26.80	N/A	21.87	150
27.	139.85	40.90	1.3	11.20	27.70	25.70	N/A	19.27	150
28.	144.00	50.02	1.3	11.10	27.72	34.70	N/A	54.32	150
29.	150.15	43.52	1.3	10.50	27.52	27.80	N/A	24.54	150
30.	155.10	44.24	1.3	10.50	27.54	28.50	N/A	26.60	150

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
31.	156.50	44.63	1.3	10.30	27.73	28.50	N/A	26.60	150
32.	159.00	45.23	1.3	10.20	27.73	29.00	N/A	28.14	150
33.	161.50	44.94	1.3	10.00	27.74	28.50	N/A	26.60	150
34.	170.35	43.86	1.3	9.10	27.76	26.50	N/A	21.13	150
35.	185.15	41.15	1.5	8.60	27.75	23.50	N/A	14.96	150
36.	185.60	46.16	1.5	8.60	27.76	28.50	N/A	26.60	150
37.	191.00	46.67	1.5	8.00	27.77	28.40	N/A	26.30	150
38.	192.00	45.79	1.5	7.90	27.79	27.40	N/A	23.44	150
39.	204.80	48.08	1.6	8.10	27.78	30.00	N/A	31.62	150
40.	215.10	48.38	1.6	8.80	27.78	31.00	N/A	35.48	150
41.	227.95	47.28	1.6	9.50	27.78	30.60	N/A	33.88	200
42.	230.40	48.48	1.6	9.50	27.78	31.80	N/A	38.90	200
43.	233.85	47.68	1.6	9.70	27.78	31.20	N/A	36.30	200
44.	240.00	51.47	1.7	10.40	27.77	35.80	N/A	61.66	200
45.	242.00	47.26	1.7	10.80	27.76	32.00	N/A	39.81	200
46.	250.15	45.94	1.7	12.10	27.74	32.00	N/A	39.81	200
47.	251.40	45.54	1.7	12.30	27.74	31.80	N/A	38.90	200
48.	360.00	43.04	2.0	14.50	27.54	32.00	N/A	39.81	200
49.	576.00	38.92	2.7	19.90	27.52	34.00	N/A	50.11	200
50.	720.00	36.56	3.0	22.40	27.76	34.20	N/A	51.28	200
51.	864.00	33.53	3.2	23.50	28.23	32.00	N/A	39.81	200
52.	930.05	29.45	3.3	24.70	27.95	29.50	N/A	29.85	200
53.	959.95	38.56	3.5	24.70	27.76	39.00	N/A	89.12	200
54.	4805.6(r)	53.54 51.95	2.35 2.35	33.65 33.65	36.45 36.45	53.00pk 51.50Av	N/A	446.68pk 375.83Av	5011pk 500Av
55.	7208.4	48.91 39.43	2.70 2.70	38.30 38.30	36.25 36.25	53.66pk 44.18Av	N/A	481.94pk 161.80Av	20dBc
56.	9611.3	51.75 42.34	2.40 2.40	38.50 38.50	37.00 37.00	55.65pk 46.24Av	N/A	606.03pk 205.11Av	20dBc

**Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:**

Preliminary emission testing was performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to :

10m open area test site :

3m alternative test site :

The effect of the EUT set-up on the measurements is summarised in note (c) below.

<b>Test Details CH46 Connected to Laptop</b>	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209. For other frequencies that do not fall into the restricted bands of operation that are  $\geq 1$  GHz the required Limit is 20dBc below the fundamental output power.



Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
1.	35.85	33.33	0.6	16.30	27.53	22.70	N/A	13.64	100
2.	37.35	39.82	0.6	14.60	27.52	27.50	N/A	23.71	100
3.	42.20	42.22	0.7	11.60	27.52	27.00	N/A	22.38	100
4.	44.15	42.42	0.7	10.20	27.52	25.80	N/A	19.49	100
5.	45.40	41.62	0.7	10.20	27.52	25.00	N/A	17.78	100
6.	48.05	50.16	0.7	8.70	27.56	32.00	N/A	39.81	100
7.	51.00	47.17	0.7	7.30	27.57	27.60	N/A	23.98	100
8.	51.75	48.57	0.7	7.30	27.57	29.00	N/A	28.18	100
9.	54.00	48.61	0.7	6.30	27.61	28.00	N/A	25.11	100
10.	60.05	51.91	0.8	5.00	27.61	30.00	N/A	31.62	100
11.	64.50	46.93	0.8	5.40	27.63	25.50	N/A	18.83	100
12.	65.85	46.38	0.8	5.45	27.63	25.00	N/A	17.78	100
13.	72.00	57.84	0.9	5.60	27.64	36.70	N/A	68.39	100
14.	82.20	41.05	0.9	7.70	27.65	22.00	N/A	12.58	100
15.	83.90	42.75	0.9	7.70	27.65	23.70	N/A	15.31	100
16.	86.15	46.99	0.9	7.80	27.69	28.00	N/A	25.11	100
17.	88.10	46.60	0.9	8.20	27.70	28.00	N/A	25.11	150
18.	89.65	44.71	1.0	8.50	27.71	26.50	N/A	21.13	150
19.	91.20	45.70	1.0	9.00	27.70	28.00	N/A	25.11	150
20.	105.35	44.38	1.1	10.40	27.68	28.20	N/A	25.70	150
21.	108.00	52.28	1.1	10.50	27.68	36.20	N/A	64.56	150
22.	110.45	44.18	1.1	10.90	27.68	28.50	N/A	26.60	150
23.	111.75	45.63	1.1	10.95	27.68	30.00	N/A	31.62	150
24.	120.00	54.58	1.1	11.00	27.68	39.00	N/A	89.12	150
25.	132.05	47.18	1.3	11.20	27.68	32.00	N/A	39.81	150
26.	135.85	41.79	1.3	11.40	27.69	26.80	N/A	21.87	150
27.	139.85	40.90	1.3	11.20	27.70	25.70	N/A	19.27	150
28.	144.00	50.02	1.3	11.10	27.72	34.70	N/A	54.32	150
29.	150.15	43.52	1.3	10.50	27.52	27.80	N/A	24.54	150
30.	155.10	44.24	1.3	10.50	27.54	28.50	N/A	26.60	150

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
31.	156.50	44.63	1.3	10.30	27.73	28.50	N/A	26.60	150
32.	159.00	45.23	1.3	10.20	27.73	29.00	N/A	28.14	150
33.	161.50	44.94	1.3	10.00	27.74	28.50	N/A	26.60	150
34.	170.35	43.86	1.3	9.10	27.76	26.50	N/A	21.13	150
35.	185.15	41.15	1.5	8.60	27.75	23.50	N/A	14.96	150
36.	185.60	46.16	1.5	8.60	27.76	28.50	N/A	26.60	150
37.	191.00	46.67	1.5	8.00	27.77	28.40	N/A	26.30	150
38.	192.00	45.79	1.5	7.90	27.79	27.40	N/A	23.44	150
39.	204.80	48.08	1.6	8.10	27.78	30.00	N/A	31.62	150
40.	215.10	48.38	1.6	8.80	27.78	31.00	N/A	35.48	150
41.	227.95	47.28	1.6	9.50	27.78	30.60	N/A	33.88	200
42.	230.40	48.48	1.6	9.50	27.78	31.80	N/A	38.90	200
43.	233.85	47.68	1.6	9.70	27.78	31.20	N/A	36.30	200
44.	240.00	51.47	1.7	10.40	27.77	35.80	N/A	61.66	200
45.	242.00	47.26	1.7	10.80	27.76	32.00	N/A	39.81	200
46.	250.15	45.94	1.7	12.10	27.74	32.00	N/A	39.81	200
47.	251.40	45.54	1.7	12.30	27.74	31.80	N/A	38.90	200
48.	360.00	43.04	2.0	14.50	27.54	32.00	N/A	39.81	200
49.	576.00	38.92	2.7	19.90	27.52	34.00	N/A	50.11	200
50.	720.00	36.56	3.0	22.40	27.76	34.20	N/A	51.28	200
51.	864.00	33.53	3.2	23.50	28.23	32.00	N/A	39.81	200
52.	930.05	29.45	3.3	24.70	27.95	29.50	N/A	29.85	200
53.	959.95	38.56	3.5	24.70	27.76	39.00	N/A	89.12	200
54.	4881.39(r)	55.41 49.44	2.35 2.35	33.65 33.65	36.50 36.50	54.91pk 48.94Av	N/A	556.54pk 279.89Av	5011.0pk 500Av
55.	7322.38(r)	51.90 44.45	2.70 2.70	38.30 38.30	36.30 36.30	56.60pk 49.15Av	N/A	676.08pk 286.74Av	5011.0pk 500Av
56.	9763.00	52.52 44.20	2.40 2.40	38.50 38.50	37.05 37.05	56.37pk 48.05Av	N/A	658.41pk 252.63Av	20dBc

**Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:**

Preliminary emission testing was performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to :

10m open area test site :       3m alternative test site :

The effect of the EUT set-up on the measurements is summarised in note (c) below.

<b>Test Details CH92 Connected to Laptop</b>	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below and designated with (r).

Note: For radiated emissions that fall within 30MHz -1GHz the required limits are as part 15.209. For other frequencies that do not fall into the restricted bands of operation that are  $\geq 1$  GHz the required Limit is 20dBc below the fundamental output power.

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
1.	35.85	33.33	0.6	16.30	27.53	22.70	N/A	13.64	100
2.	37.35	39.82	0.6	14.60	27.52	27.50	N/A	23.71	100
3.	42.20	42.22	0.7	11.60	27.52	27.00	N/A	22.38	100
4.	44.15	42.42	0.7	10.20	27.52	25.80	N/A	19.49	100
5.	45.40	41.62	0.7	10.20	27.52	25.00	N/A	17.78	100
6.	48.05	50.16	0.7	8.70	27.56	32.00	N/A	39.81	100
7.	51.00	47.17	0.7	7.30	27.57	27.60	N/A	23.98	100
8.	51.75	48.57	0.7	7.30	27.57	29.00	N/A	28.18	100
9.	54.00	48.61	0.7	6.30	27.61	28.00	N/A	25.11	100
10.	60.05	51.91	0.8	5.00	27.61	30.00	N/A	31.62	100
11.	64.50	46.93	0.8	5.40	27.63	25.50	N/A	18.83	100
12.	65.85	46.38	0.8	5.45	27.63	25.00	N/A	17.78	100
13.	72.00	57.84	0.9	5.60	27.64	36.70	N/A	68.39	100
14.	82.20	41.05	0.9	7.70	27.65	22.00	N/A	12.58	100
15.	83.90	42.75	0.9	7.70	27.65	23.70	N/A	15.31	100
16.	86.15	46.99	0.9	7.80	27.69	28.00	N/A	25.11	100
17.	88.10	46.60	0.9	8.20	27.70	28.00	N/A	25.11	150
18.	89.65	44.71	1.0	8.50	27.71	26.50	N/A	21.13	150
19.	91.20	45.70	1.0	9.00	27.70	28.00	N/A	25.11	150
20.	105.35	44.38	1.1	10.40	27.68	28.20	N/A	25.70	150
21.	108.00	52.28	1.1	10.50	27.68	36.20	N/A	64.56	150
22.	110.45	44.18	1.1	10.90	27.68	28.50	N/A	26.60	150
23.	111.75	45.63	1.1	10.95	27.68	30.00	N/A	31.62	150
24.	120.00	54.58	1.1	11.00	27.68	39.00	N/A	89.12	150
25.	132.05	47.18	1.3	11.20	27.68	32.00	N/A	39.81	150
26.	135.85	41.79	1.3	11.40	27.69	26.80	N/A	21.87	150
27.	139.85	40.90	1.3	11.20	27.70	25.70	N/A	19.27	150
28.	144.00	50.02	1.3	11.10	27.72	34.70	N/A	54.32	150
29.	150.15	43.52	1.3	10.50	27.52	27.80	N/A	24.54	150
30.	155.10	44.24	1.3	10.50	27.54	28.50	N/A	26.60	150

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
31.	156.50	44.63	1.3	10.30	27.73	28.50	N/A	26.60	150
32.	159.00	45.23	1.3	10.20	27.73	29.00	N/A	28.14	150
33.	161.50	44.94	1.3	10.00	27.74	28.50	N/A	26.60	150
34.	170.35	43.86	1.3	9.10	27.76	26.50	N/A	21.13	150
35.	185.15	41.15	1.5	8.60	27.75	23.50	N/A	14.96	150
36.	185.60	46.16	1.5	8.60	27.76	28.50	N/A	26.60	150
37.	191.00	46.67	1.5	8.00	27.77	28.40	N/A	26.30	150
38.	192.00	45.79	1.5	7.90	27.79	27.40	N/A	23.44	150
39.	204.80	48.08	1.6	8.10	27.78	30.00	N/A	31.62	150
40.	215.10	48.38	1.6	8.80	27.78	31.00	N/A	35.48	150
41.	227.95	47.28	1.6	9.50	27.78	30.60	N/A	33.88	200
42.	230.40	48.48	1.6	9.50	27.78	31.80	N/A	38.90	200
43.	233.85	47.68	1.6	9.70	27.78	31.20	N/A	36.30	200
44.	240.00	51.47	1.7	10.40	27.77	35.80	N/A	61.66	200
45.	242.00	47.26	1.7	10.80	27.76	32.00	N/A	39.81	200
46.	250.15	45.94	1.7	12.10	27.74	32.00	N/A	39.81	200
47.	251.40	45.54	1.7	12.30	27.74	31.80	N/A	38.90	200
48.	360.00	43.04	2.0	14.50	27.54	32.00	N/A	39.81	200
49.	576.00	38.92	2.7	19.90	27.52	34.00	N/A	50.11	200
50.	720.00	36.56	3.0	22.40	27.76	34.20	N/A	51.28	200
51.	864.00	33.53	3.2	23.50	28.23	32.00	N/A	39.81	200
52.	930.05	29.45	3.3	24.70	27.95	29.50	N/A	29.85	200
53.	959.95	38.56	3.5	24.70	27.76	39.00	N/A	89.12	200
54.	4960.90	51.47 43.32	2.35 2.35	33.65 33.65	36.60 36.60	50.87pk 42.72Av	N/A	349.54pk 136.77Av	5011.0pk 500Av
55.	7441.00	54.17 47.21	2.70 2.70	38.30 38.30	36.10 36.10	59.07pk 52.11Av	N/A	898.46pk 403.18Av	5011.0pk 500Av
56.	9922.20	54.68 45.57	2.40 2.40	38.50 38.50	37.20 37.20	58.38pk 49.27Av	N/A	829.85pk 290.73Av	20dBc

**Notes:**

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.4: 2003 section 8.2.1.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 The measurements 2483.5 MHz was made to ensure band edge compliance.
- 4 Demonstration of band edge compliance at 2.4GHz (which lies outside the restricted bands as defined in section CFR47Part 15.205(a) is contained in section A2, RF Antenna Conducted Spurious Emissions and Appendix B of this test report.
- 5 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 6 For Frequencies Below 1 GHz, RBW= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak Detector	RBW= 1MHz, VBW ≥ RBW
Average Detector	RBW= 1MHz, VBW ≥ RBW

These settings as per ANSI C63.4 and DA 00-705.

- 7 In accordance with DA 00-705, the average level of the spurious radiated emission may be reduced by the duty cycle correction factor. If the dwell time per channel (refer to the measured channel occupancy time, section A7 of this test report) of the hopping signal is less than 100ms then the average measurement may be further adjusted by the duty cycle correction factor which is derived from

$$20\log_{10}\left(\frac{\text{dwell time}}{100\text{ms}}\right)$$

The upper and lower frequency of the measurement range was decided according to CFR 47 Part 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (CFR 47 Part 15:2008 Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength $\mu\text{V}/\text{m}$	Measurement Distance m	Field strength $\text{dB}\mu\text{V}/\text{m}$
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz)
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

**Notes:**

- (a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation (dB)} = 20 \log_{10} \left( \frac{\text{measurement distance}}{\text{specification distance}} \right)$$

The results displayed take into account applicable antenna factors and cable losses.

- (b) The levels may have been rounded for display purposes.
- (c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels	✓			
(i) Parameter defined by standard and / or single possible, refer to Appendix D (ii) Parameter defined by client and / or single possible, refer to Appendix D (iii) Parameter had a negligible effect on emission levels, refer to Appendix D (iv) Worst case determined by initial measurement, refer to Appendix D				

#### A4 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room.

The effect of the EUT set-up on the measurements is summarised in note (b).

Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

The worst-case power line conducted emission measurements are listed below:

Test Details: 2.441 GHz	
Regulation	CFR 47 2008, Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.4:2003
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	0
SE in test environment	S02 Dell Laptop
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

The worst case power line conducted emission measurements are listed below:

The worst case was using the 87" ActivBoard Model Number is PRM-AB487-01 connected via the Laptop and USB cable.

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Detector	Spec Limit (dBuV)	Margin (dB)	Result
1	0.16	Live	48.08	QP	65.46	17.38	Pass
2	0.165	Neutral	39.67	AV	55.21	15.54	Pass
3	0.195	Live	34.12	AV	53.82	19.70	Pass



**Specification limits :**

Conducted emission limits (CFR 47 2008 :Clause 15.207).

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dB $\mu$ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 <sup>2</sup>	56 to 46 <sup>2</sup>
0.5 to 5	56	46
5 to 30	60	50

Notes:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

- (a) The levels may have been rounded for display purposes.
- (b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			

(i) Parameter defined by standard and / or single possible, refer to Appendix C  
(ii) Parameter defined by client and / or single possible, refer to Appendix C  
(iii) Parameter had a negligible effect on emission levels, refer to Appendix C  
(iv) Worst case determined by initial measurement, refer to Appendix C

**A5 20 dB Bandwidth and Channel Spacing**

Title 47 of the CFR: 2002, Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel spacing shall be a minimum of 25 kHz or the 20 dB bandwidth, whichever is the greater. The formal measurements are detailed below:

<b>Test Details:</b>	
Regulation	CFR 47 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	S02

Hopping	F <sub>l</sub> (GHz)	F <sub>h</sub> (MHz)	Measured 20 dB Bandwidth (MHz)	Limit	Result
2.404GHz	2.403756410	2.405230769	1.4743	≥500kHz	Pass

Plots of the 20 dB bandwidth and channel spacing are contained in Appendix B of this test report.

**A6 Hopping frequencies**

Hopping frequencies were verified using a spectrum analyser set to 85 MHz spans, displaying a set of the hopping channels in turn, while the EUT was operating in its normal frequency hopping mode.

<b>Test Details:</b>	
Regulation	CFR 47 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	S02 S03 S04
SE isolated from EUT	None

No. of Hopping Channels	Requirement	Result
46	0.125mW 2.400GHz – 2.4835GHz	Pass

Plots showing the hopping channels are contained in Appendix B

**A7 Channel Occupancy**

Channel occupancy time was verified using a spectrum analyser in zero span mode, centred on the middle hopping channel frequency (2441 MHz), while the EUT was operating in its normal frequency hopping mode. The other channels were then verified to ensure that the channel occupancy was identical for all channels.

<b>Test Details:</b>	
Regulation	CFR 47 2008, Part15 Subpart (c) 15.247(a)(1)
EUT sample number	S01
Modification state	0
SE in test environment	S02 S03

Measured Channel Occupancy Time (ms)	Average Channel Occupancy Time Limit (ms)	Result
0.552564	400	Pass

Plots showing the channel occupancy time and time between successive transmissions are contained in Appendix B of this test report.

**A8 Antenna Gain**

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 0 dBi.

**Appendix B:**

**Supporting Graphical Data**

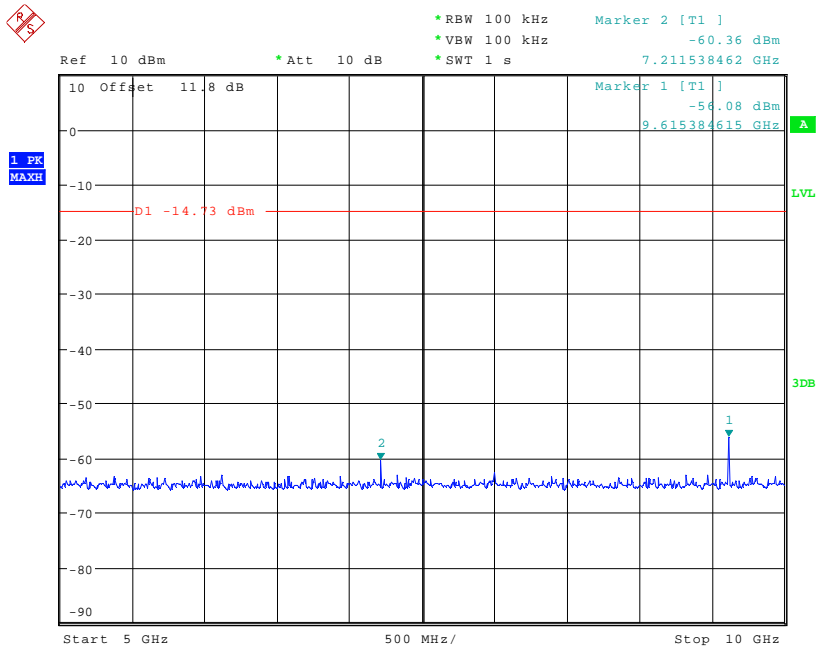
This appendix contains graphical data obtained during testing.

Notes:

- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

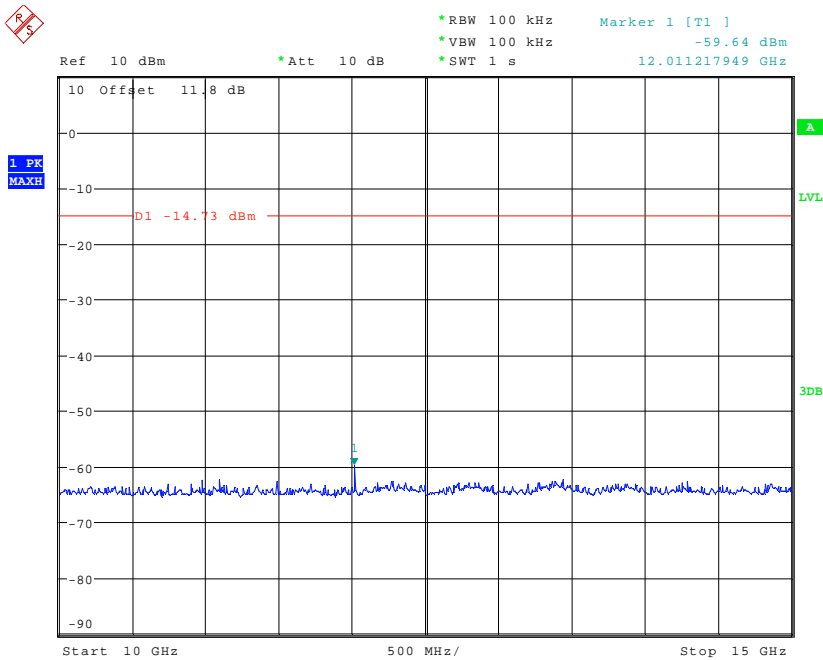


Bottom Channel Conducted emissions 5GHz – 10GHz



Date: 19.OCT.2010 14:17:51

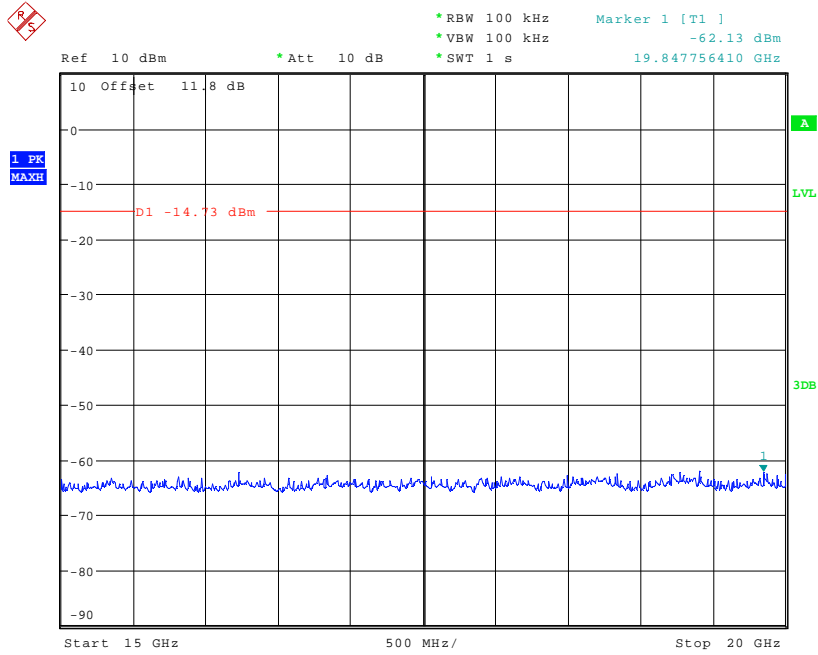
Bottom Channel Conducted emissions 10GHz -15GHz



Date: 19.OCT.2010 14:19:25

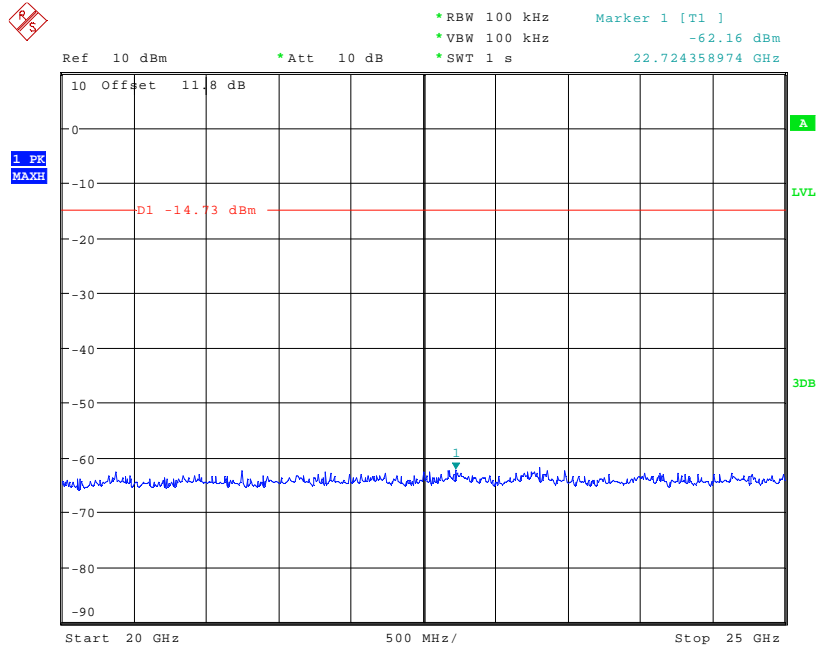


Bottom Channel Conducted emissions 15GHz -20GHz



Date: 19.OCT.2010 14:19:54

Bottom Channel Conducted emissions 20GHz -25GHz

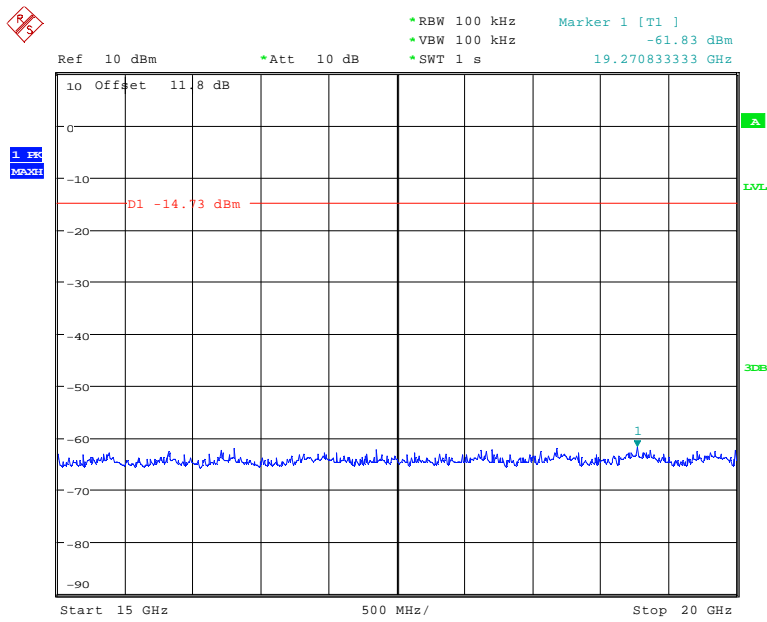


Date: 19.OCT.2010 14:20:27



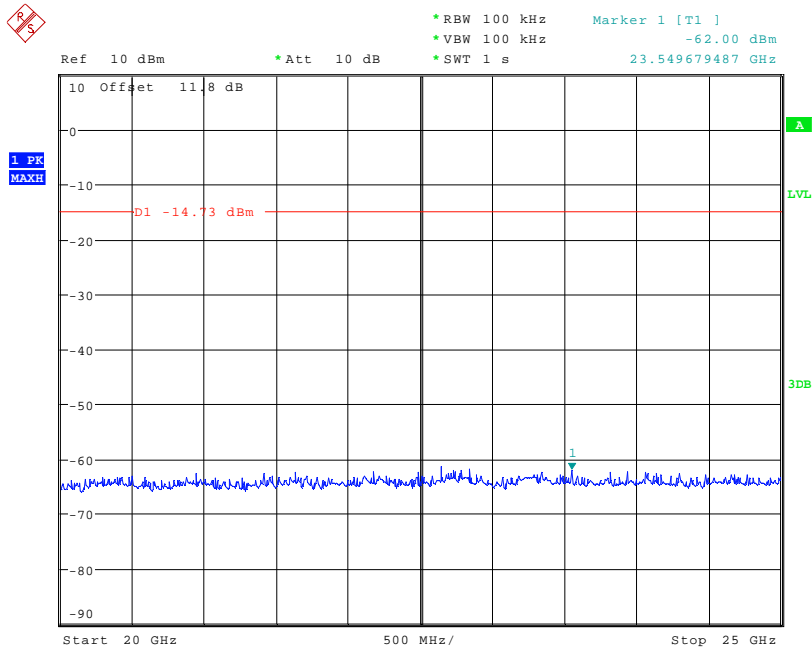


Middle Channel Conducted emissions 15GHz – 20GHz



Date: 19.OCT.2010 14:27:39

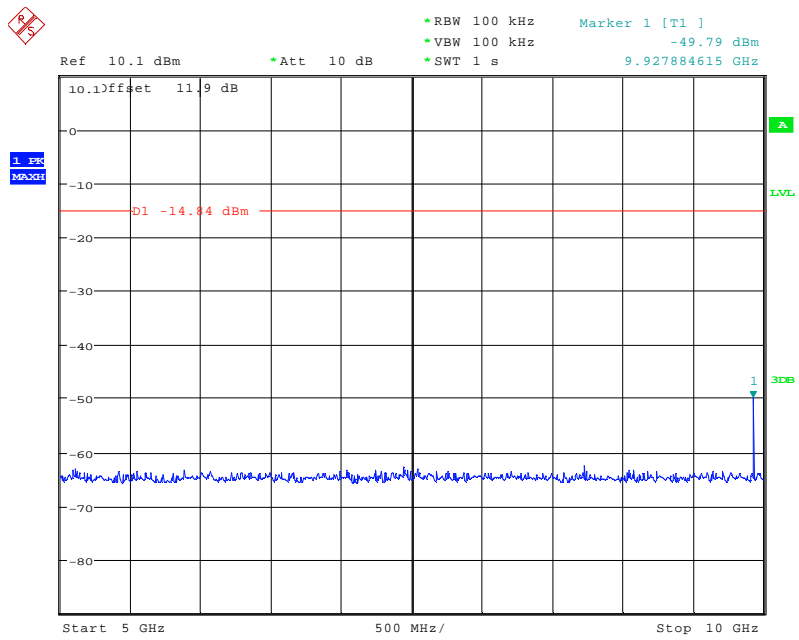
Middle Channel Conducted emissions 20GHz – 25GHz



Date: 19.OCT.2010 14:28:10

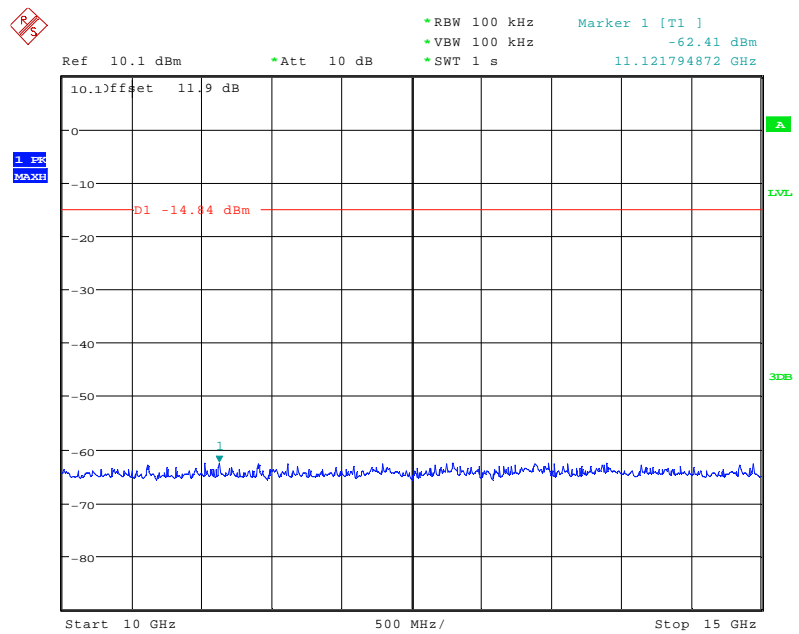


Top Channel Conducted emissions 5GHz – 10GHz



Date: 19.OCT.2010 14:32:46

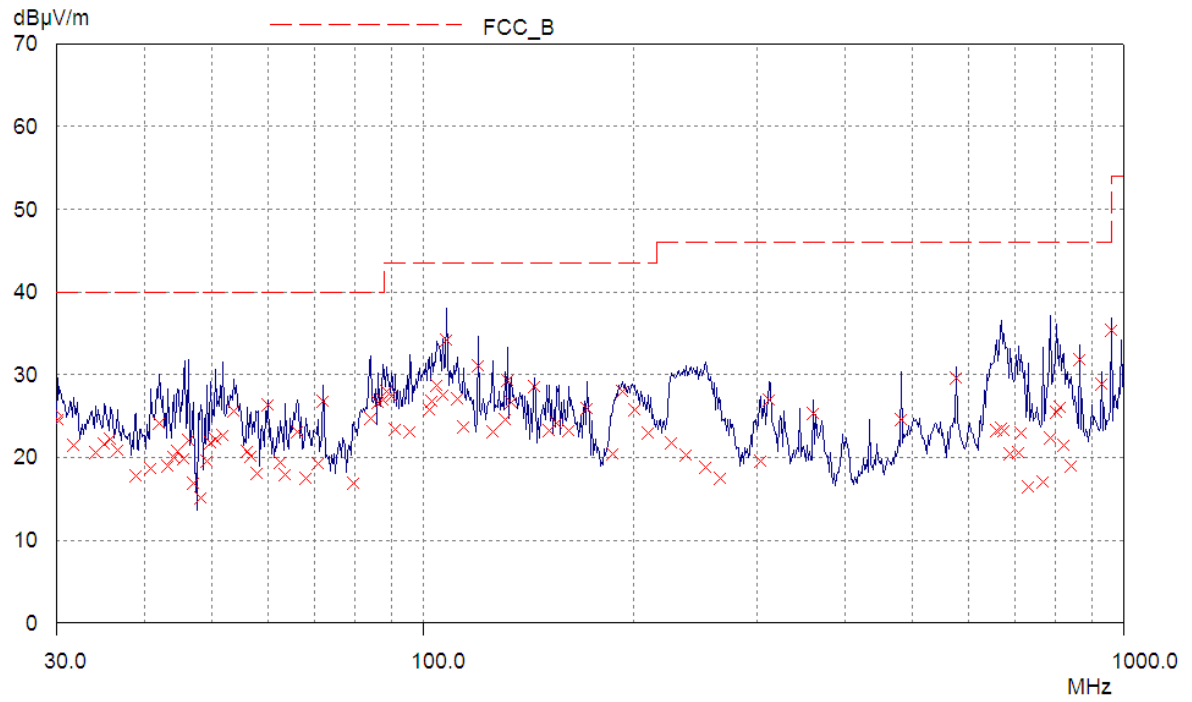
Top Channel Conducted emissions 10GHz – 15GHz



Date: 19.OCT.2010 14:33:33

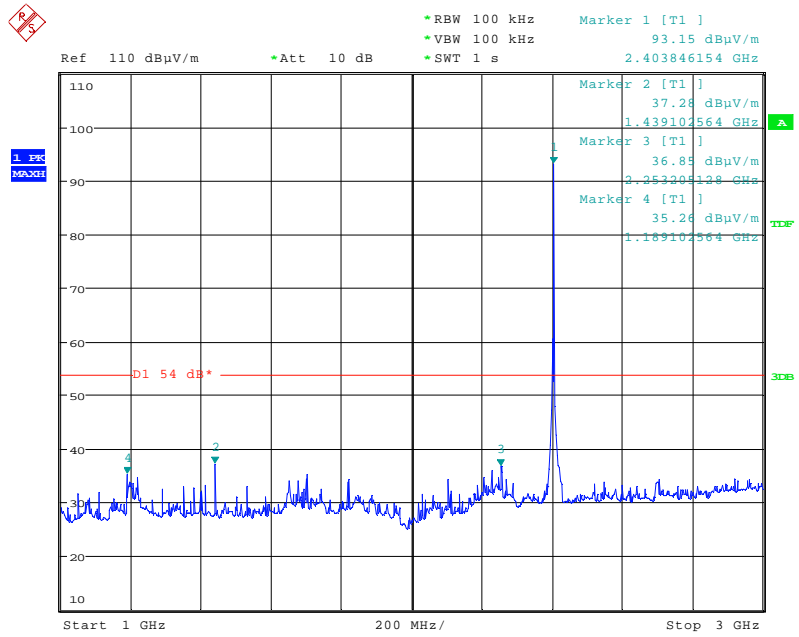


Bottom Channel Radiated emissions 30MHz-1GHz



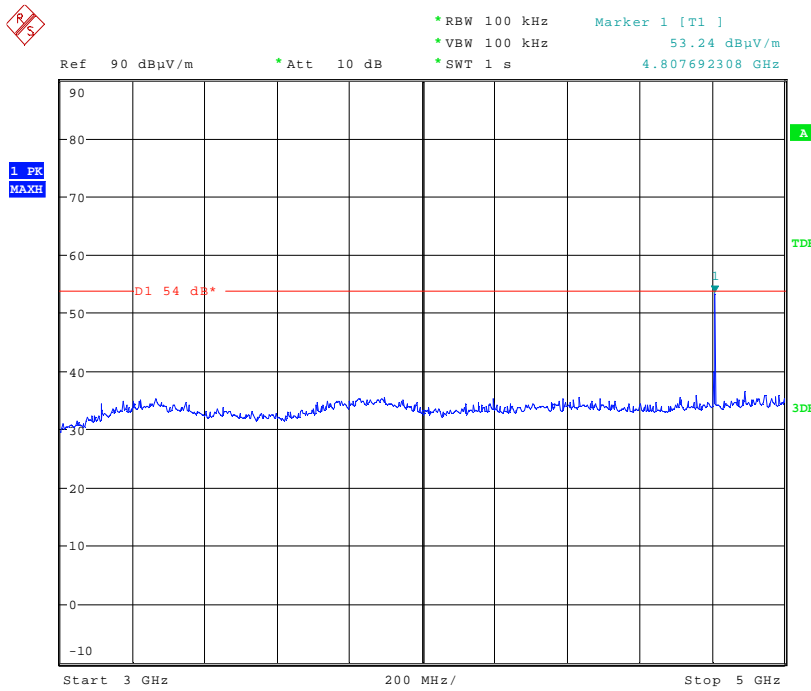


Bottom Channel Radiated emissions Vertical 1GHz – 3GHz



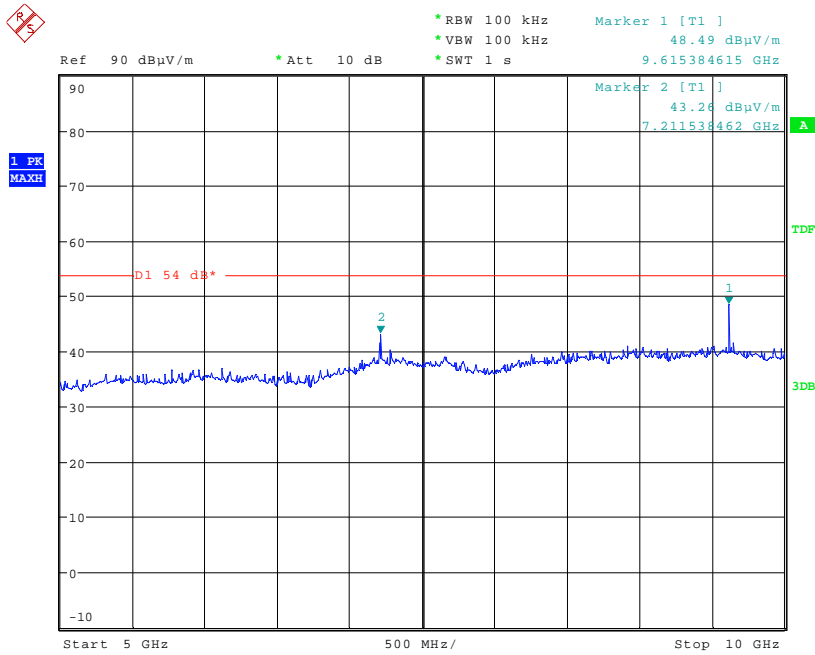
Date: 20.OCT.2010 10:42:54

Bottom Channel Radiated emissions Vertical 3GHz – 5GHz



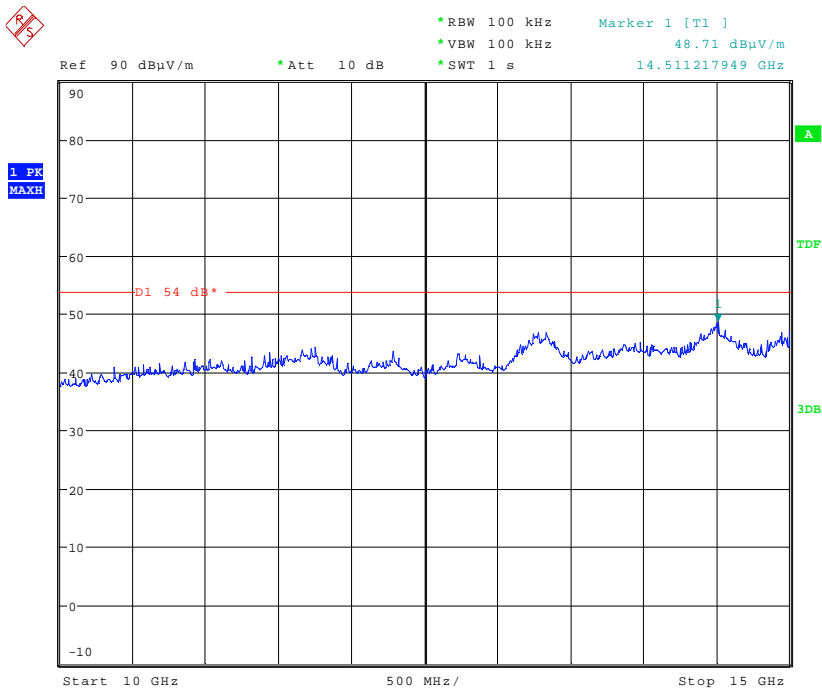
Date: 20.OCT.2010 09:58:58

Bottom Channel Radiated emissions Vertical 5GHz – 10GHz



Date: 20.OCT.2010 10:00:34

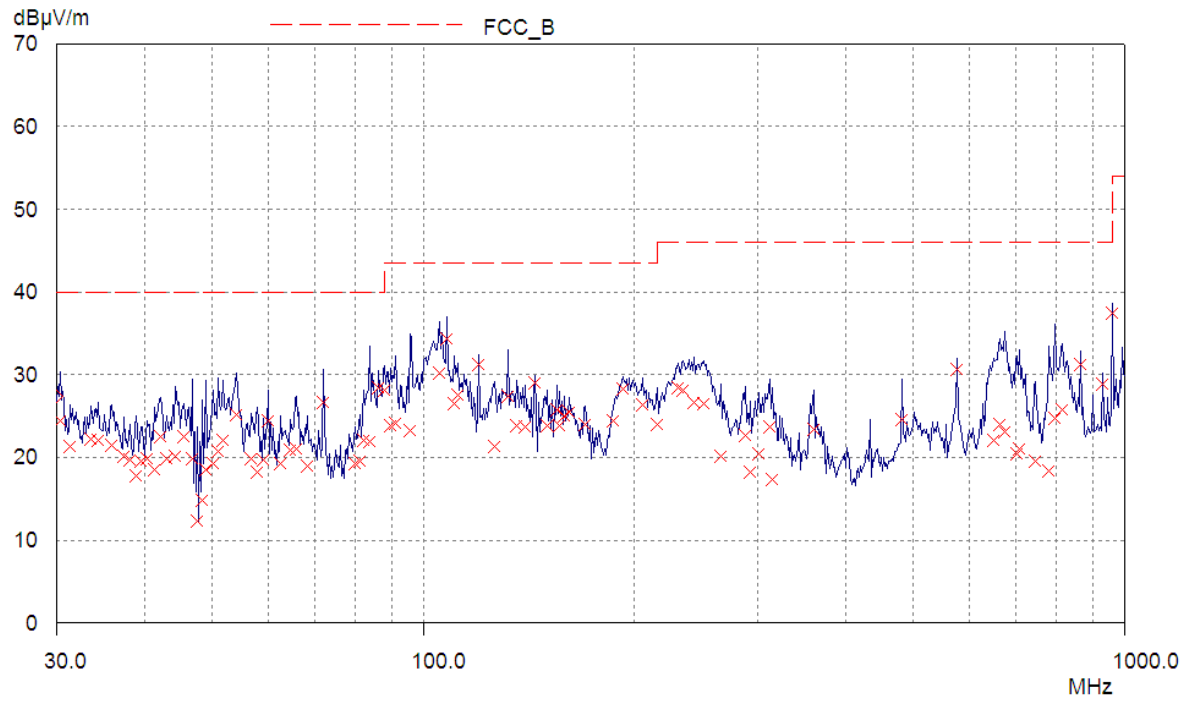
Bottom Channel Radiated emissions Vertical 10GHz – 15GHz



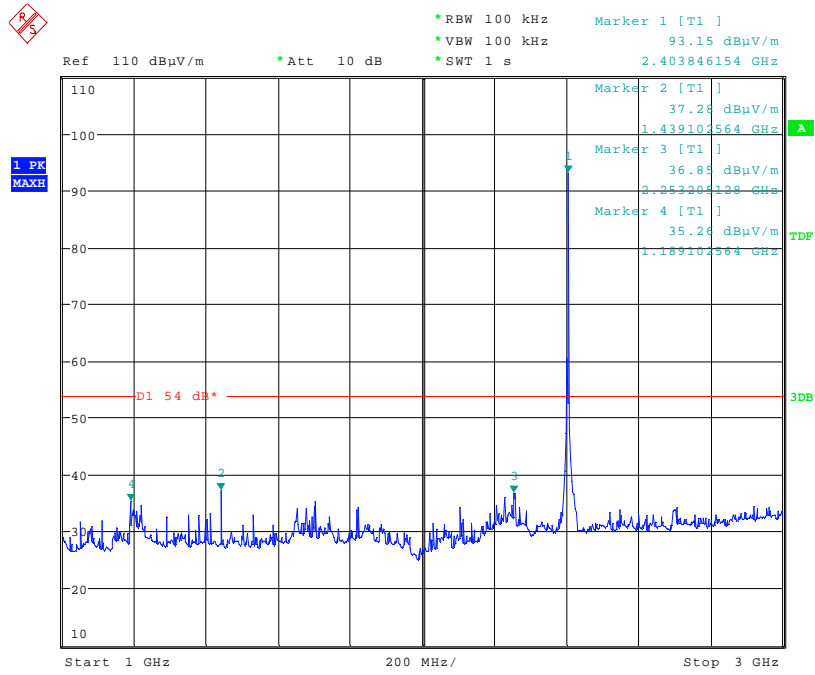
Date: 20.OCT.2010 10:01:32



Middle Channel Radiated emissions Vertical 30MHz-1GHz

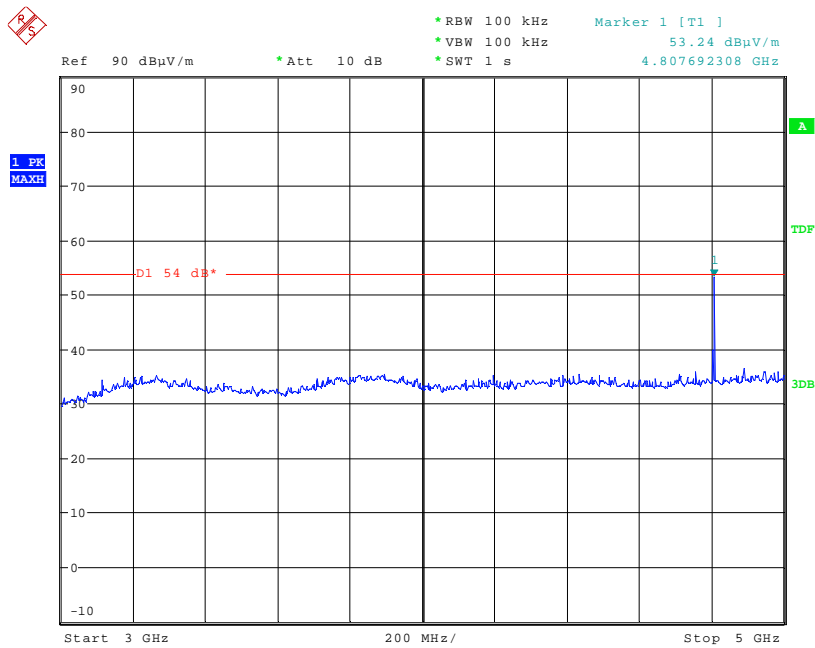


Middle Channel Radiated emissions Vertical 1GHz – 3GHz



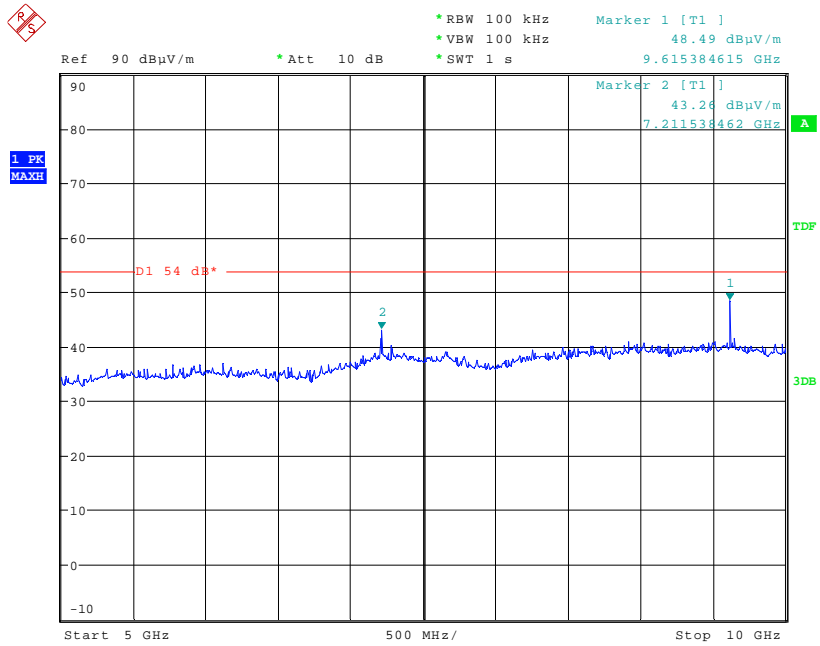
Date: 20.OCT.2010 10:42:54

Middle Channel Radiated emissions Vertical 3GHz- 5GHz



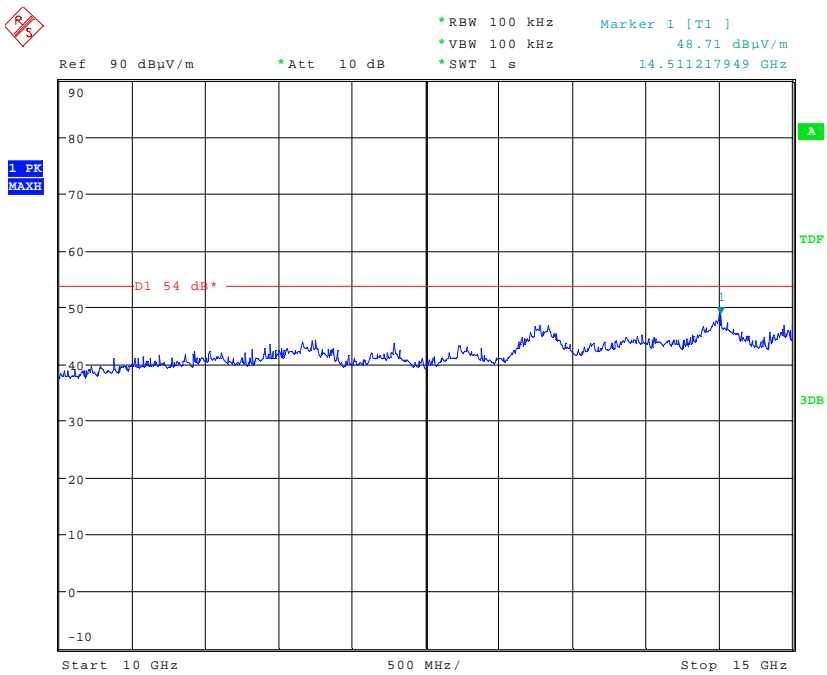
Date: 20.OCT.2010 09:58:58

Middle Channel Radiated emissions Vertical 5GHz- 10GHz



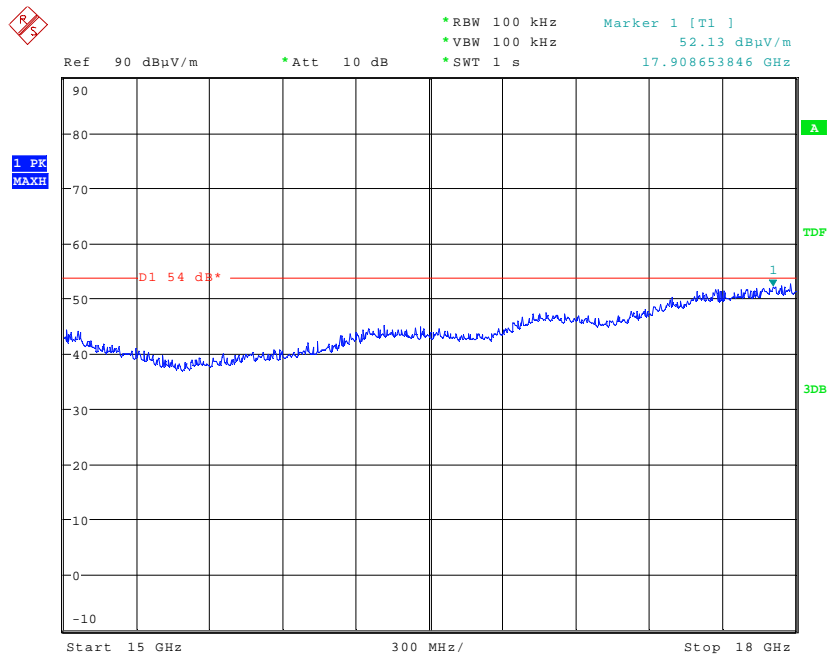
Date: 20.OCT.2010 10:00:34

Middle Channel Radiated emissions Vertical 10GHz- 15GHz



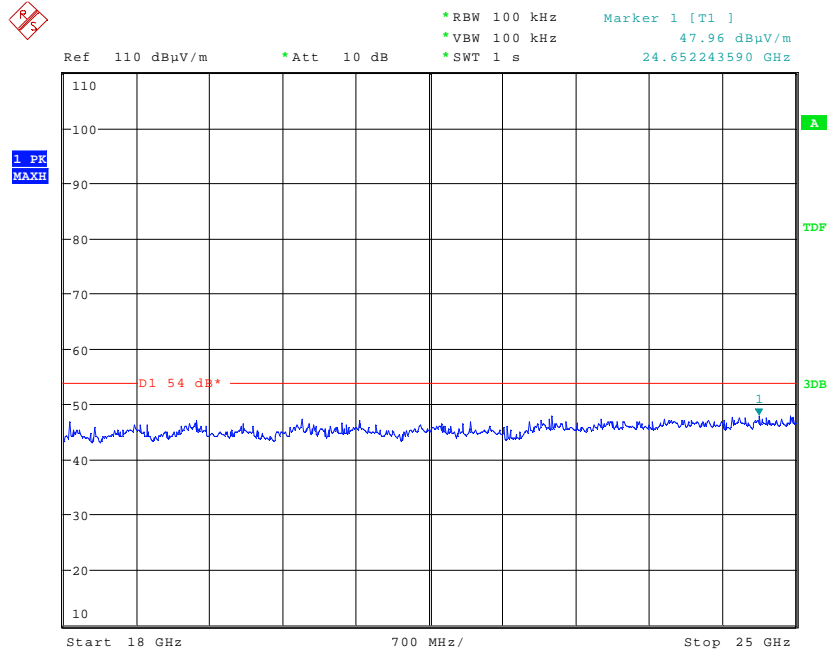
Date: 20.OCT.2010 10:01:32

Middle Channel Radiated emissions Vertical 15GHz- 18GHz



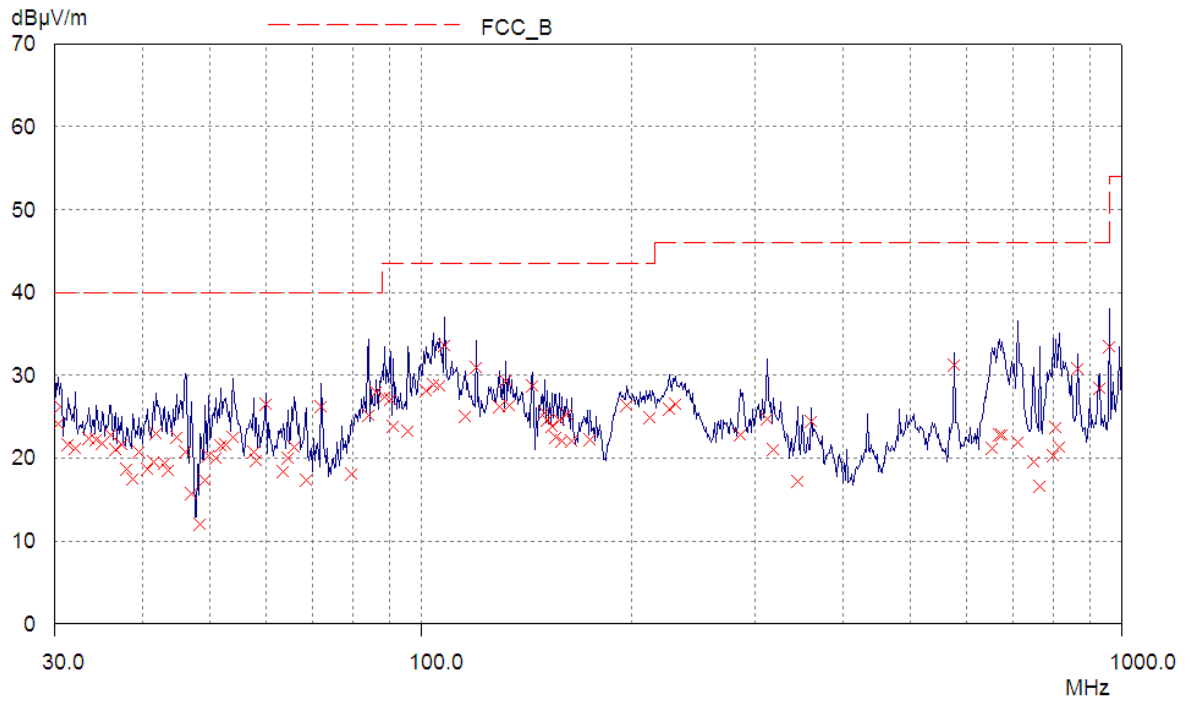
Date: 20.OCT.2010 10:02:21

Middle Channel Radiated emissions Vertical 18GHz- 25GHz



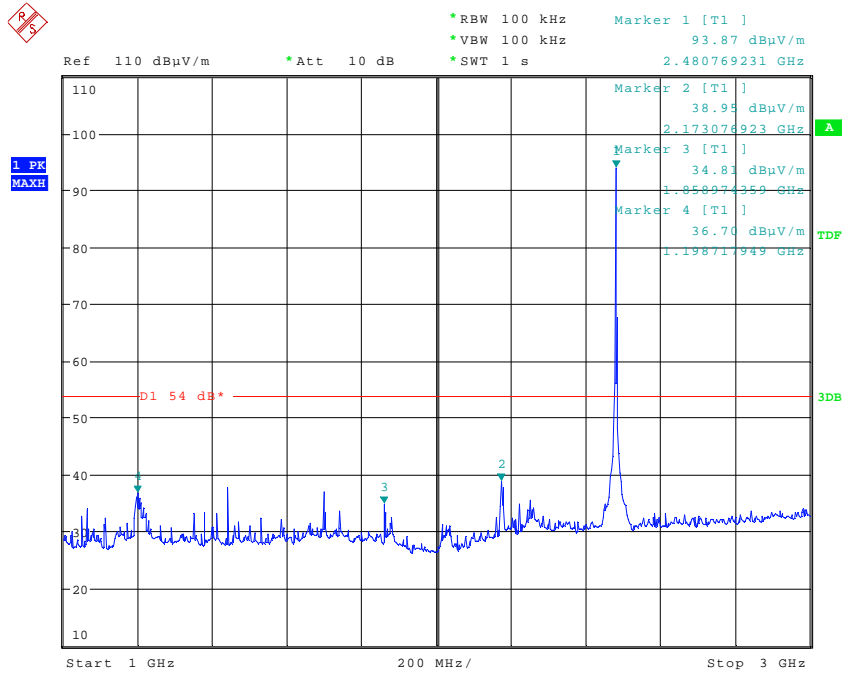
Date: 20.OCT.2010 12:48:26

Top Channel Radiated emissions Vertical 30MHz-1GHz



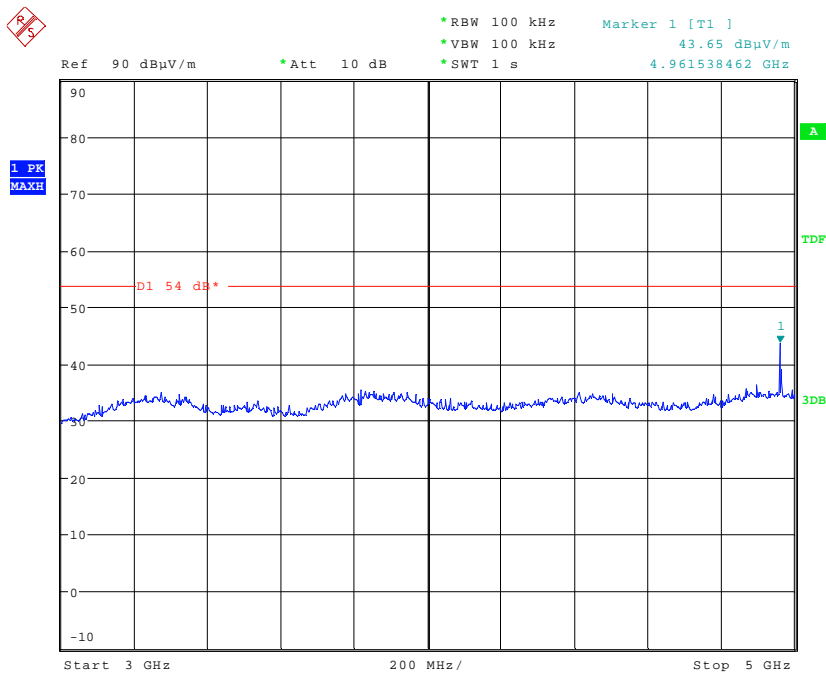


Top Channel Radiated emissions Vertical 1GHz – 3GHz



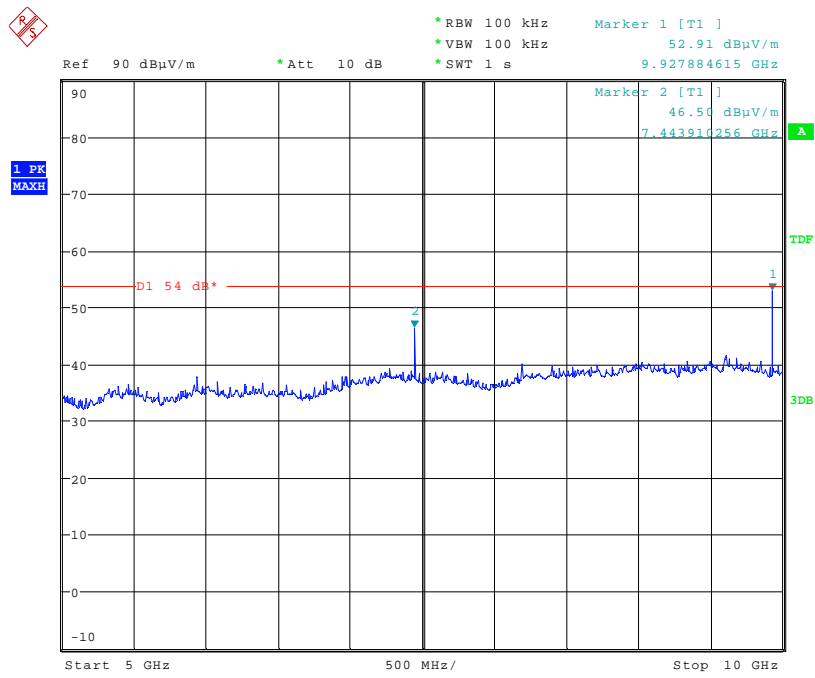
Date: 20.OCT.2010 10:53:20

Top Channel Radiated emissions Vertical 3GHz - 5GHz



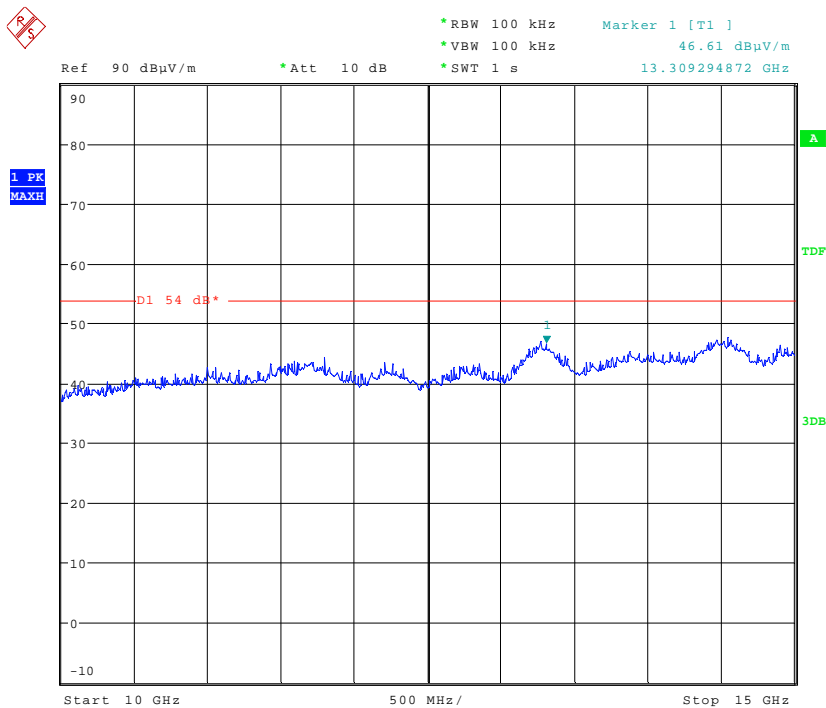
Date: 20.OCT.2010 10:26:23

Top Channel Radiated emissions Vertical 5GHz – 10GHz



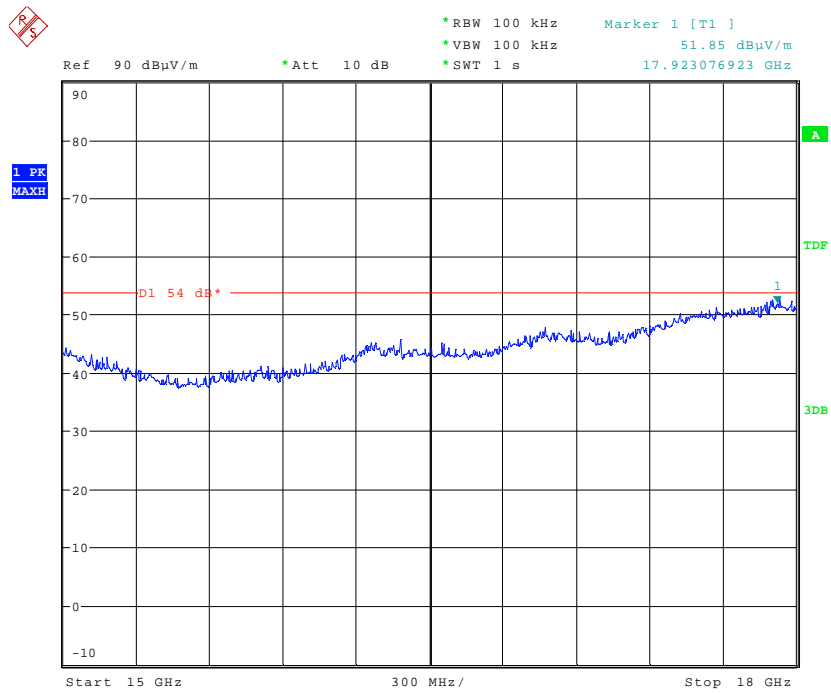
Date: 20.OCT.2010 10:27:19

Top Channel Radiated emissions Vertical 10GHz – 15GHz



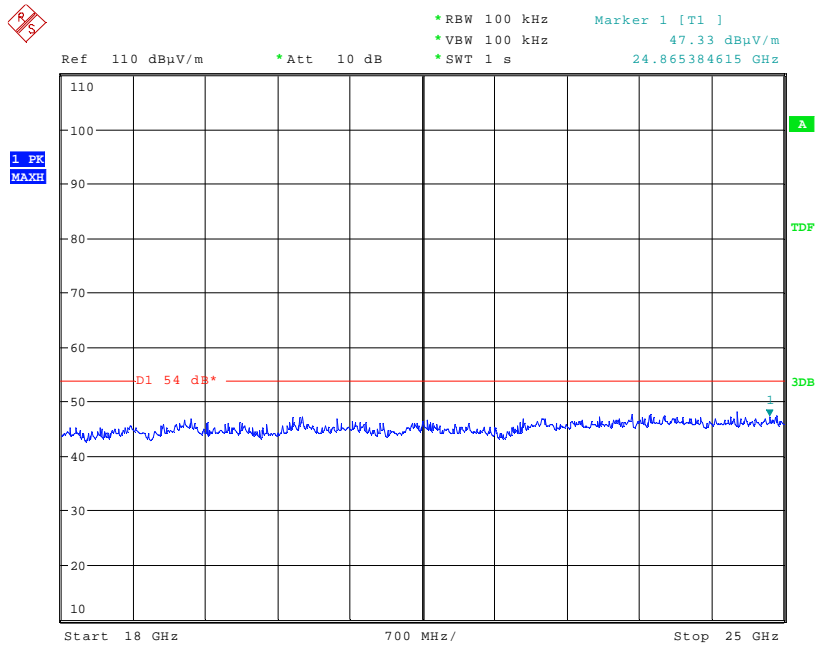
Date: 20.OCT.2010 10:28:20

Top Channel Radiated emissions Vertical 15GHz – 18GHz



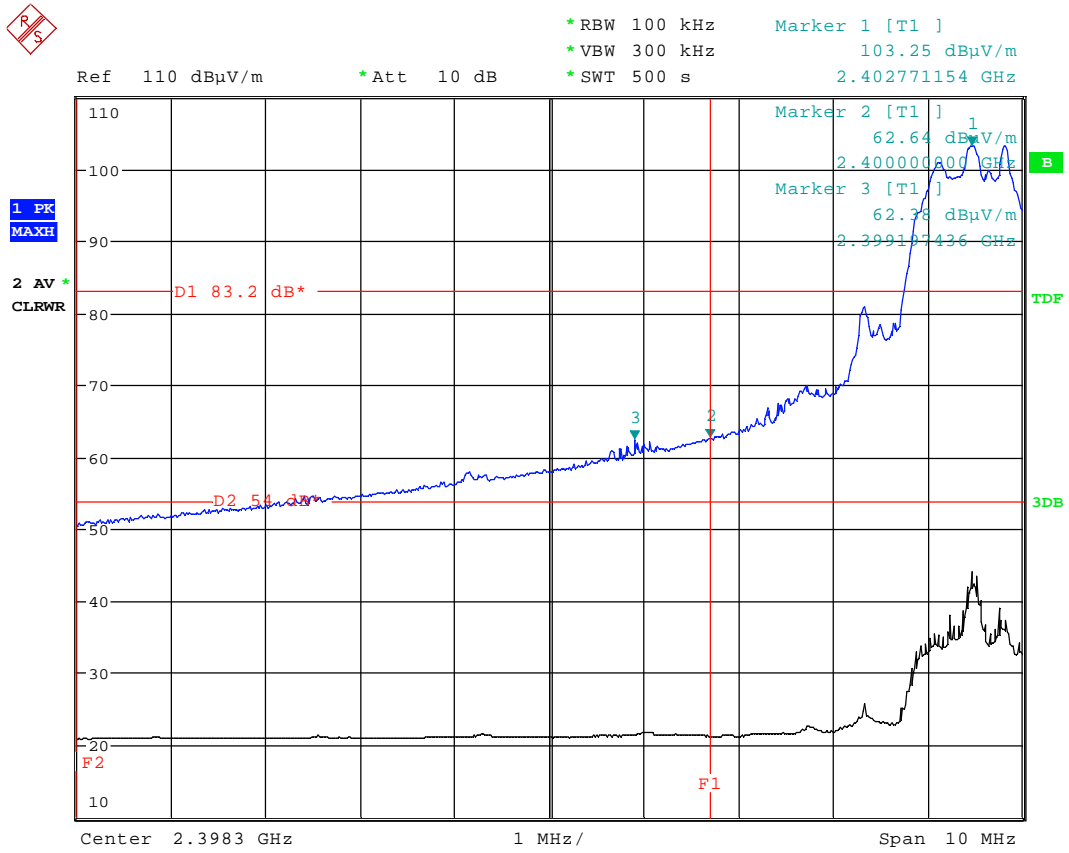
Date: 20.OCT.2010 10:28:54

Top Channel Radiated emissions Vertical 18GHz – 25GHz



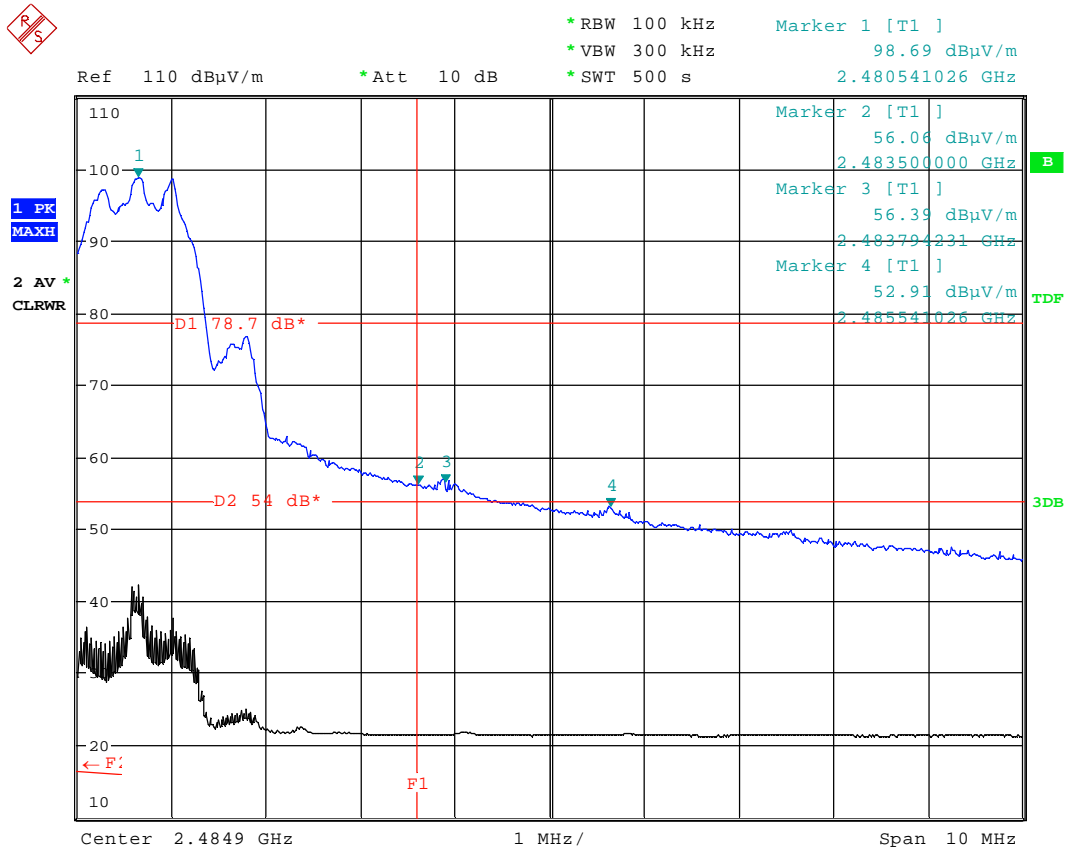
Date: 20.OCT.2010 12:55:50

Lower Band edge compliance



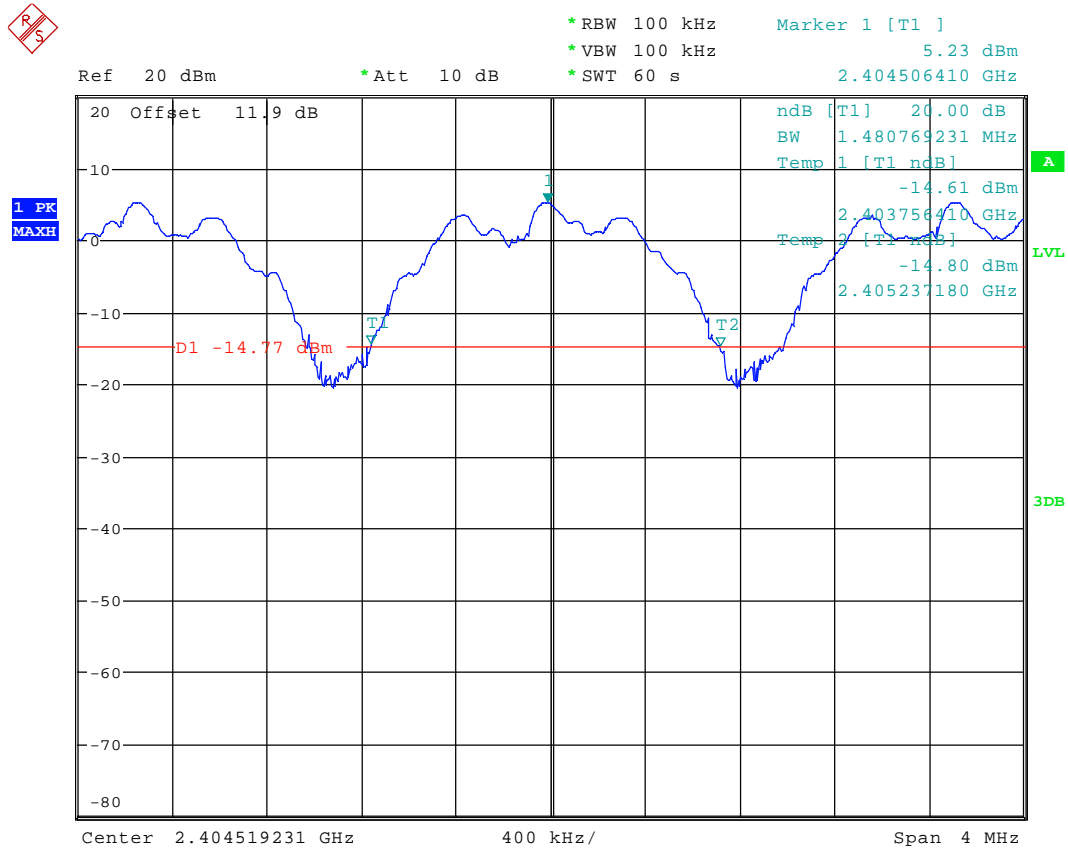
Date: 26.OCT.2010 14:38:41

Upper Band edge compliance



Date: 26.OCT.2010 14:22:57

20dB Occupied Bandwidth

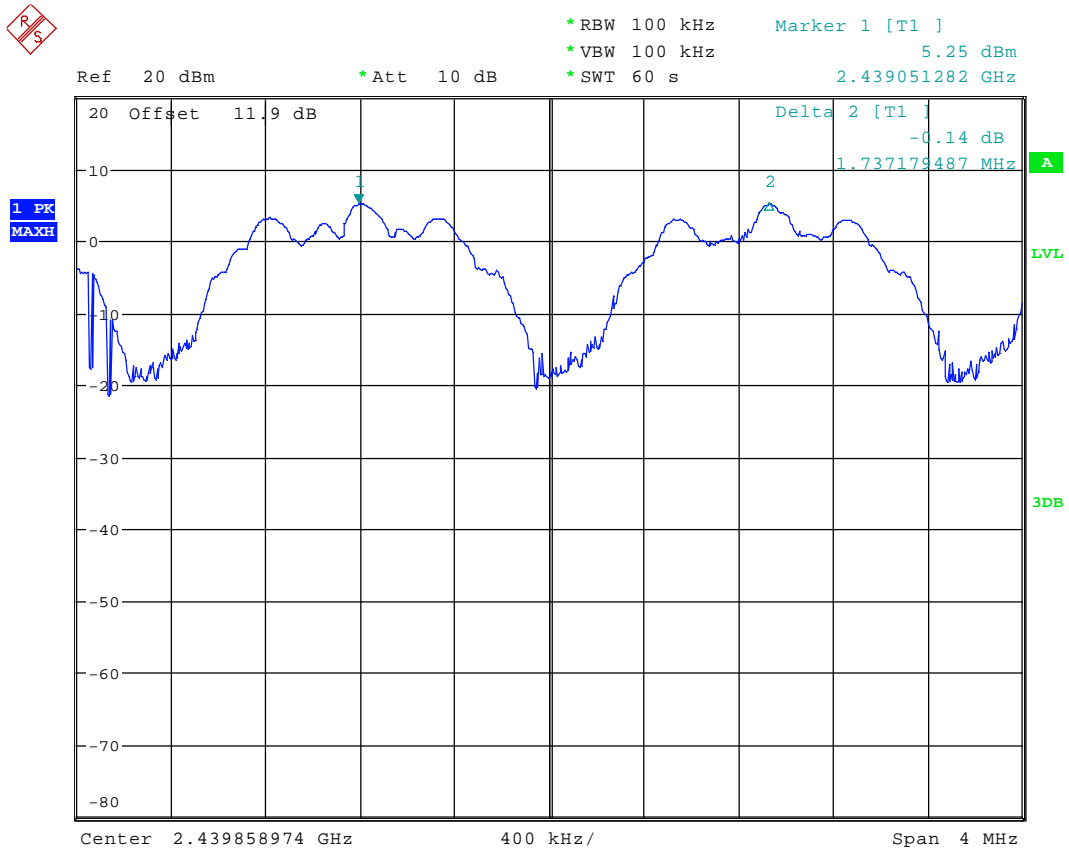


Date: 15.OCT.2010 14:13:05

f<sub>l</sub> = 2403.756MHz  
 f<sub>h</sub> = 2405.237MHz

20dB occupied bandwidth = 1.4807MHz

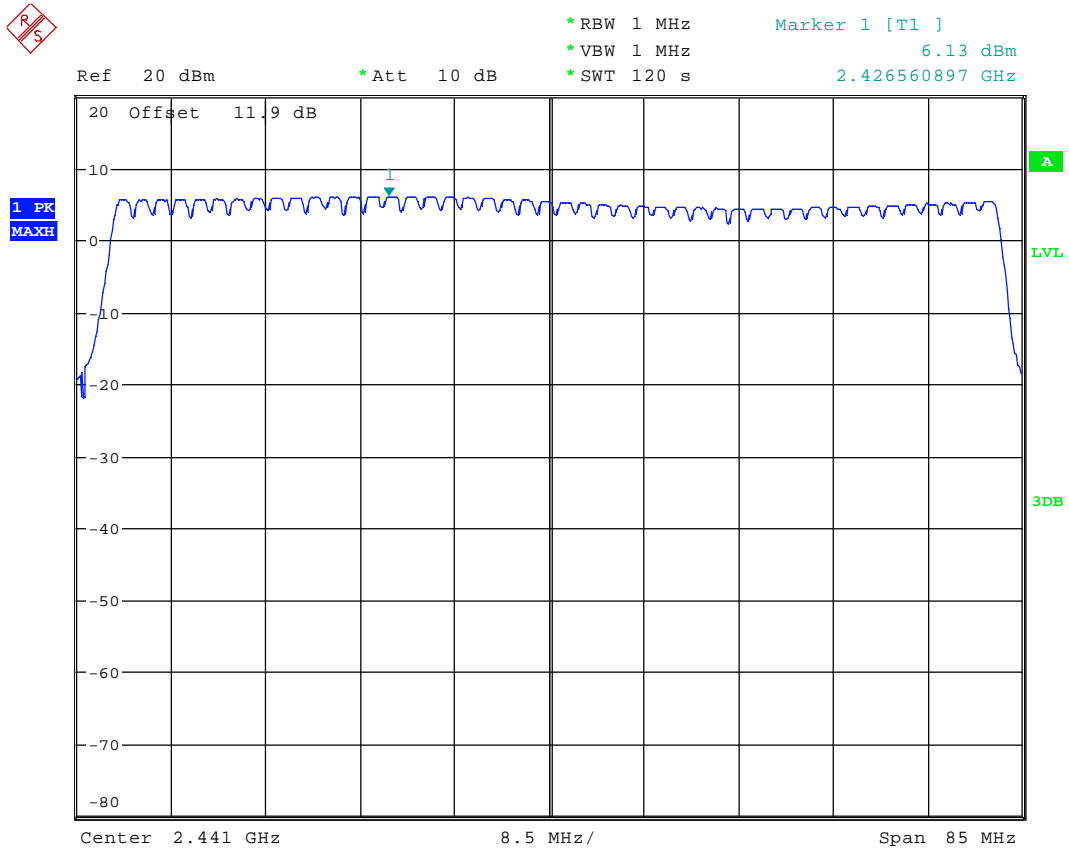
**Carrier Frequency separation**



Date: 15.OCT.2010 14:43:35

Carrier Frequency separation = 1.7371MHz

Number of hopping channels

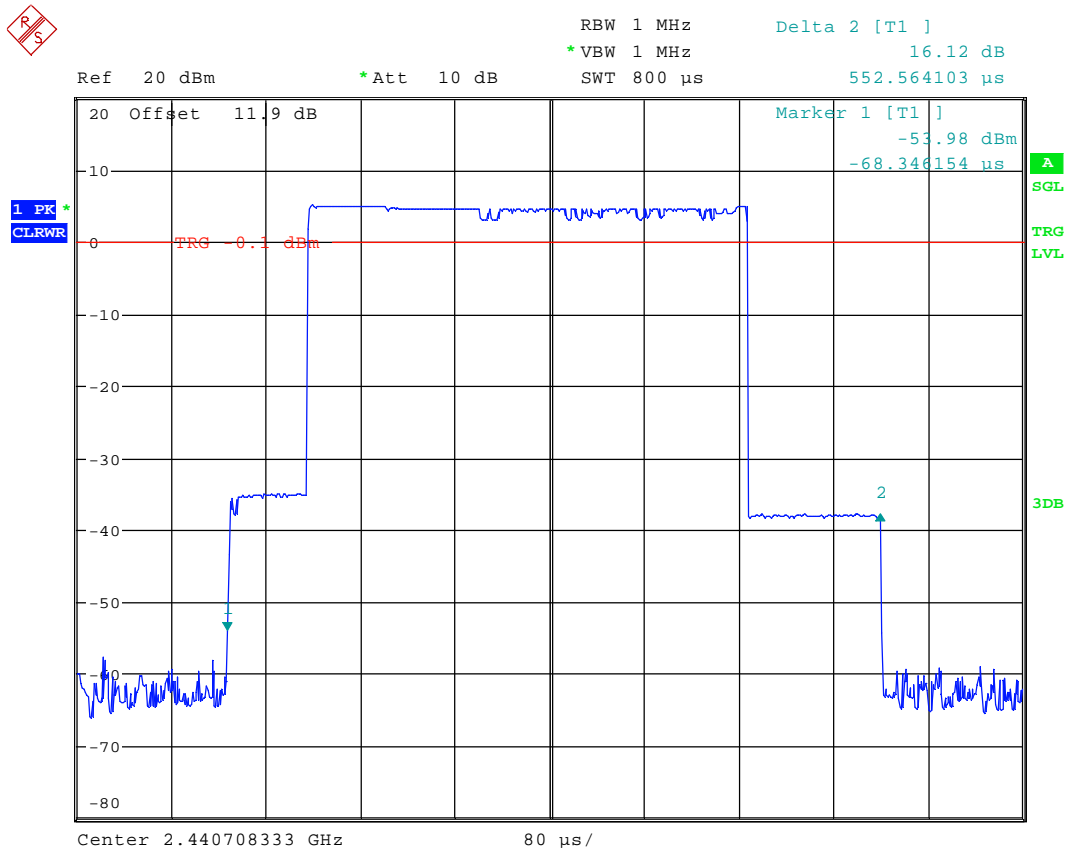


Date: 15.OCT.2010 11:40:59

Number of hopping channels = 46 Channels



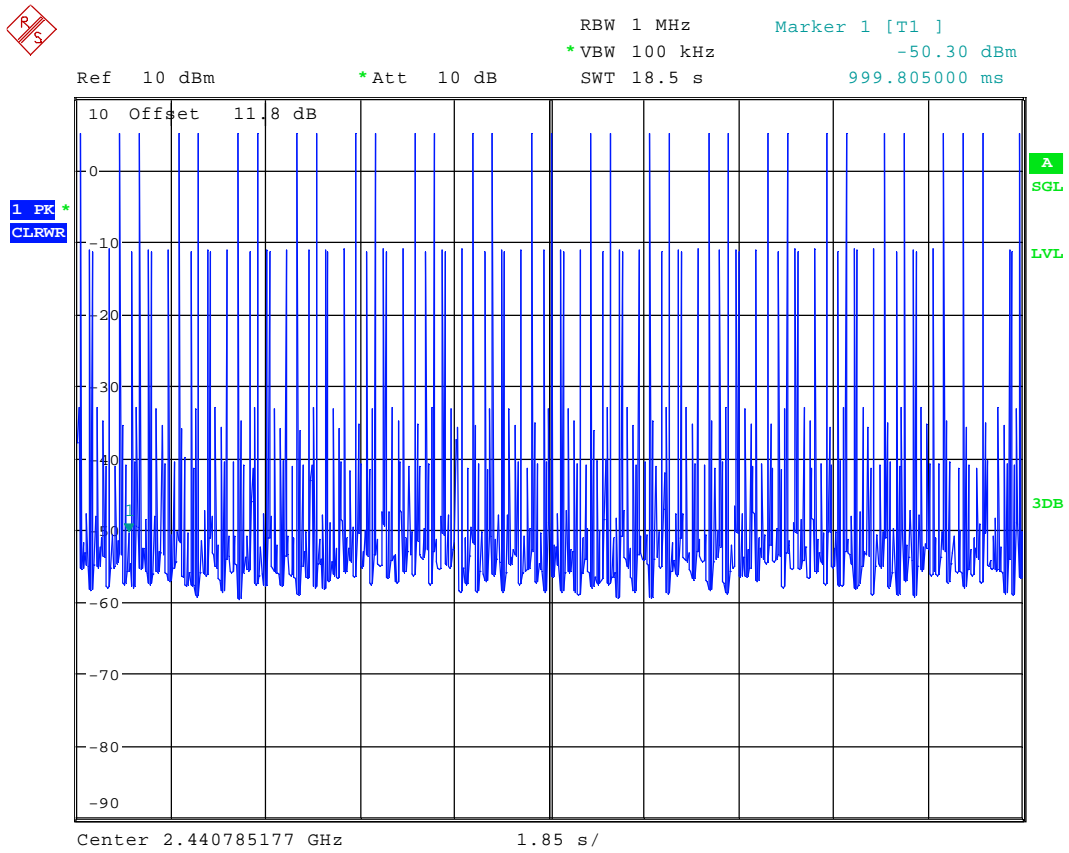
**Channel occupancy**



Date: 18.OCT.2010 08:57:52

Channel occupancy = 552.564μs

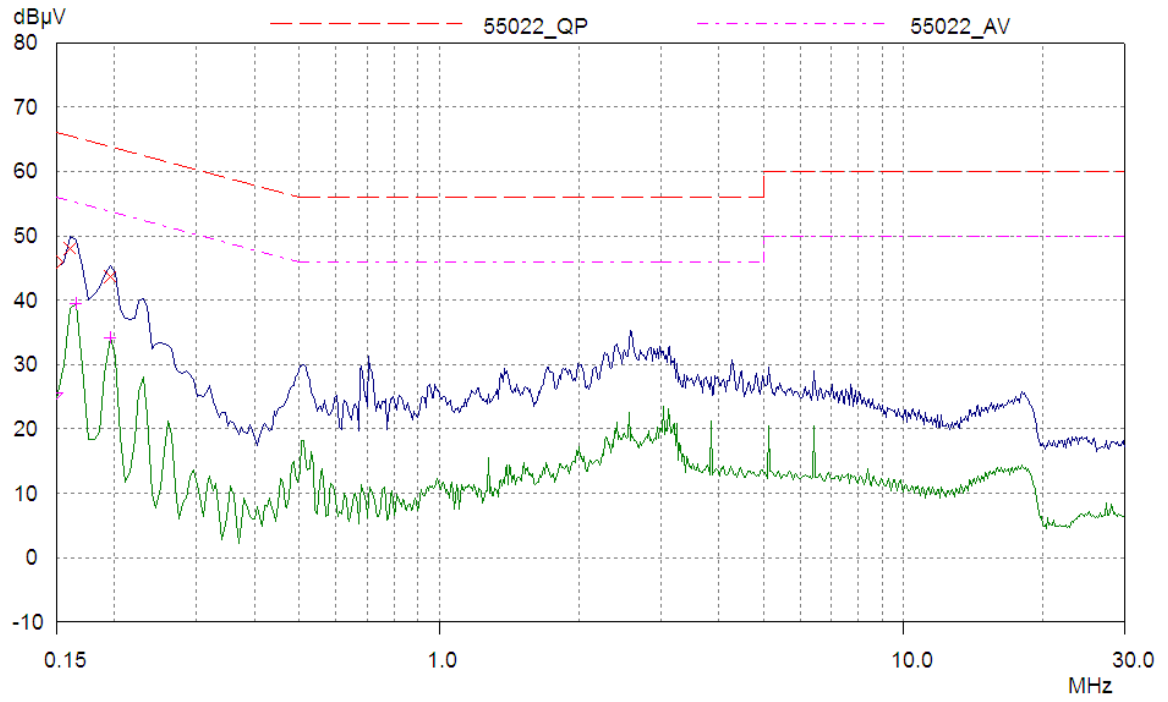
Channel repetition time



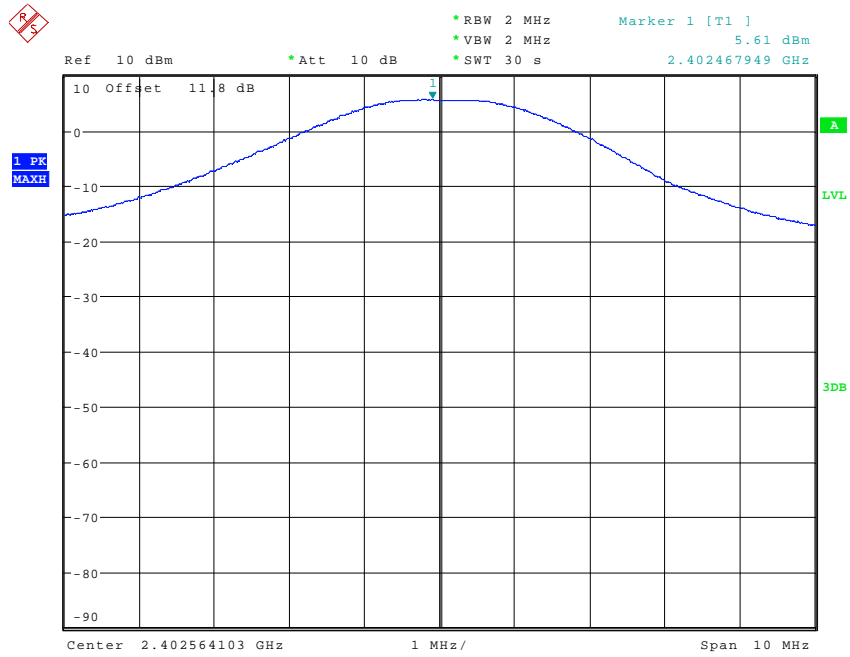
Date: 19.OCT.2010 10:09:09

46 channels X 0.4 seconds = 18.4 seconds

**AC Power Line Emissions hopping 2.4GHz connected via the laptop and USB cable.**

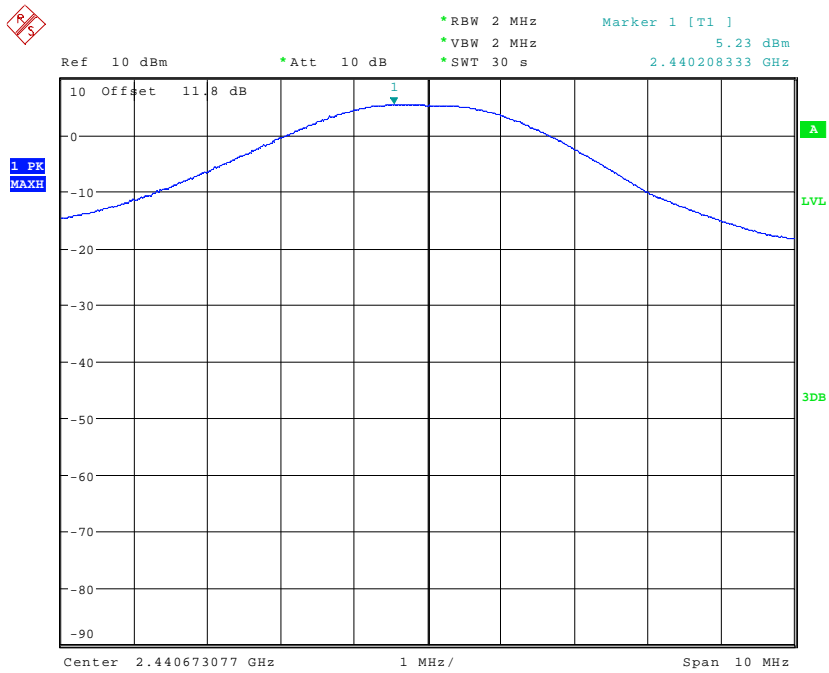


### Conducted carrier power 2402MHz



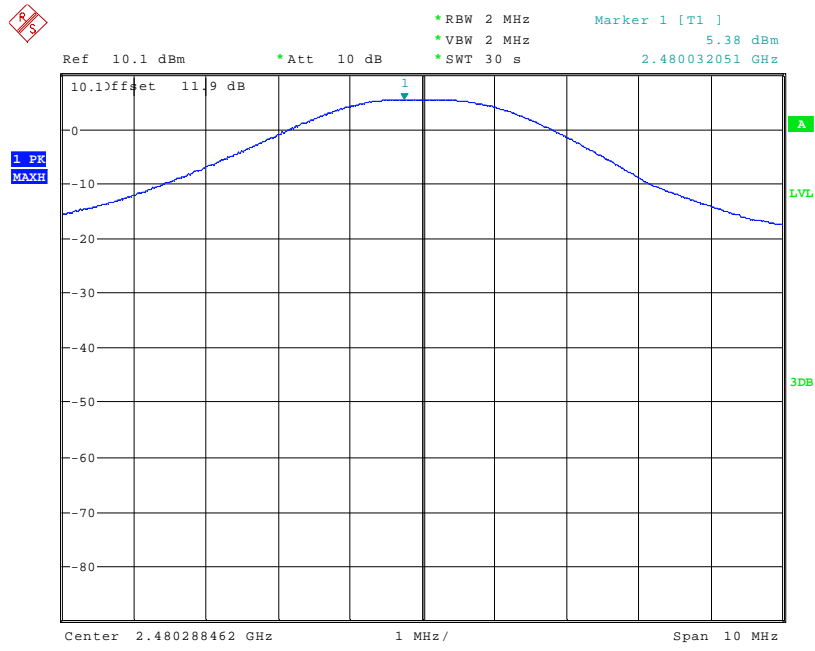
Date: 18.OCT.2010 16:30:06

### Conducted carrier power 2440 MHz



Date: 18.OCT.2010 16:35:07

Conducted carrier power 2480 MHz



Date: 18.OCT.2010 16:41:41

**Appendix C:****Additional Test and Sample Details**

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

**Sample No:** Sxx Mod w

where:

xx	= sample number	eg. S01
w	= modification number	eg. Mod 2

The following terminology is used throughout the test report:

**Support Equipment (SE)** is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

**EUT configuration** refers to the internal set-up of the EUT. It may include for example:

- Positioning of cards in a chassis.
- Setting of any internal switches.
- Circuit board jumper settings.
- Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as "single possible configuration".

**EUT arrangement** refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

**C1) Test samples**

The following samples of the apparatus were submitted by the client for testing :

Sample No.	Description	Identification
S01	ActivBoard Model Number PRM-AB487-01	N/A

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
S02	Dell Laptop	Service Tag 8Q0314J
S03	Power Supply	DPS-90GB - A
S04	Activhub	N/A

**C2) EUT Operating Mode During Testing.**

During testing, the EUT was exercised as described in the following tables :

Test	Description of Operating Mode:
All tests detailed in this report	<i>EUT transmitting on maximum power using FHSS over 46 channels</i>



**C3) EUT Configuration Information.**

Sample	Internal Configuration Details
S01	Single possible internal configuration

The EUT was submitted for testing in one single possible configuration.

**C4) List of EUT Ports**

The table below describes the termination of EUT ports:

Sample : S01

Port	Description of Cable Attached	Cable length	Equipment Connected
<i>USB</i>	<i>USB</i>	<i>5.0mtr</i>	<i>PC - Activboard</i>
<i>USB</i>	<i>USB</i>	<i>1.5mtr</i>	<i>USB-Hub</i>
<i>USB</i>	<i>USB</i>	<i>0.90mtr</i>	<i>Audio Amp - Hub</i>
<i>Dc</i>	<i>Power supply</i>	<i>0.33mtr</i>	<i>Audio Amp – AC3</i>
<i>Dc</i>	<i>Power supply</i>	<i>1.8 5mtr</i>	<i>Switch mode supply - Audio Amp</i>

Notes on the above:

A photograph showing the termination of EUT ports is contained within Appendix F

**C5 Details of Equipment Used**

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	29/01/2010
TRL138	3115	Horn Antenna	Emco	10/09/2010
TRL139	3115	Horn Antenna	Emco	17/08/2009
TRL572	8449B	Pre amp	Agilent	15/07/2009
TRLUH04	ESVS10	Receiver	Rhode & Schwarz	10/12/2009
TRLUH372	6201-69	Pre amp	Watkins& Johnson	27/11/2009
TRLUH93	CBL6112B	Antenna	Chase	03/06/2009
TRLUH377	ESU	Spectrum Analyser	Rhode & Schwarz	11/06/2010
TRLUH191	CBL611/A	Antenna	York	01/10/2008
TRLUH195	ESH3	Lisn	Rhode & Schwarz	27/01/10

**Appendix D:**

**Additional Information**

No additional information is included within this test report.

**Appendix E: Calculation of the duty cycle correction factor**

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB =  $20 \times (\text{Log}_{10} \text{ Calculated Duty Cycle})$

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle =  $\frac{\text{the sum of the highest average value pulsewidths over 100ms}}{100\text{ms}}$

e.g

$$= \frac{7.459\text{ms}}{100\text{ms}} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) =  $20 \times (\text{Log}_{10} 0.07459) = -22.54\text{dB}$

**OR**

For EUT that uses Zigbee device technology the EUT is designed to be compliant with the requirements of IEEE 802.15.4, which in general assumes a maximum duty cycle of 1%. Therefore in accordance with CFR 47 Part 15.35(c), the emissions may be reduced by a factor of 100 (40 dB). Plots of the duty cycle showing the duty cycle to be less than 1% are contained in Appendix B of this report.

**Appendix F:**

**Photographs and Figures**

The following photographs were taken of the test samples:

- 1: Test Setup
- 2: Power line conducted emissions arrangement.
- 3: Overview / Overview case removed.
- 4: USB Hub and Audio Amplifier.
- 5: Top view PCB'S removed.
- 6: Underside view PCB'S removed.
- 7: RF Section Screening cover removed

Photograph 1

Test Setup



Photograph 2

Test Setup AC powerline



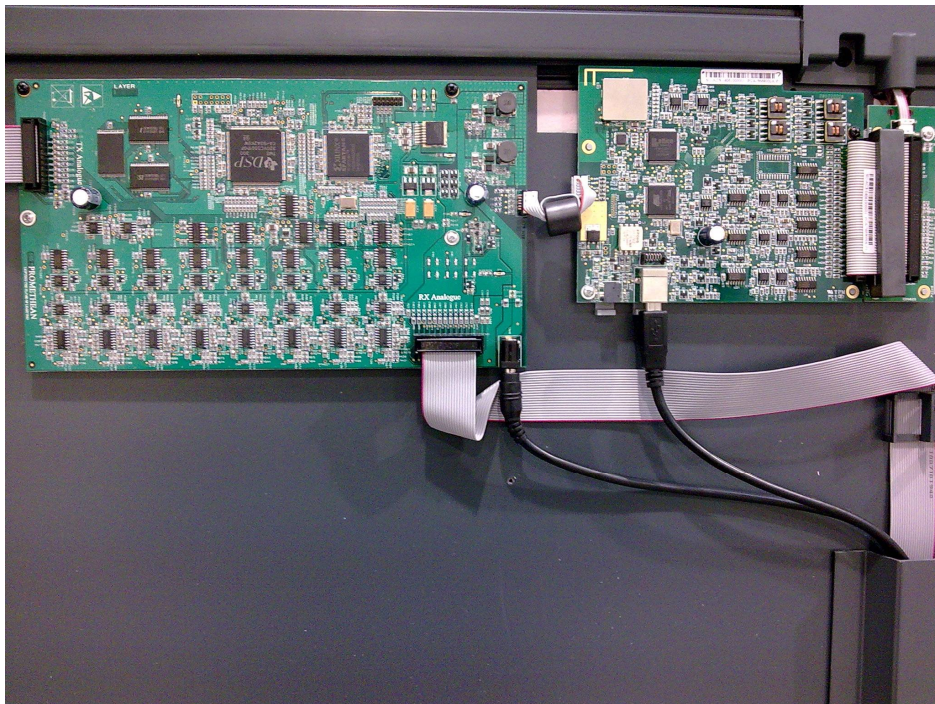


Photograph 3

Overview

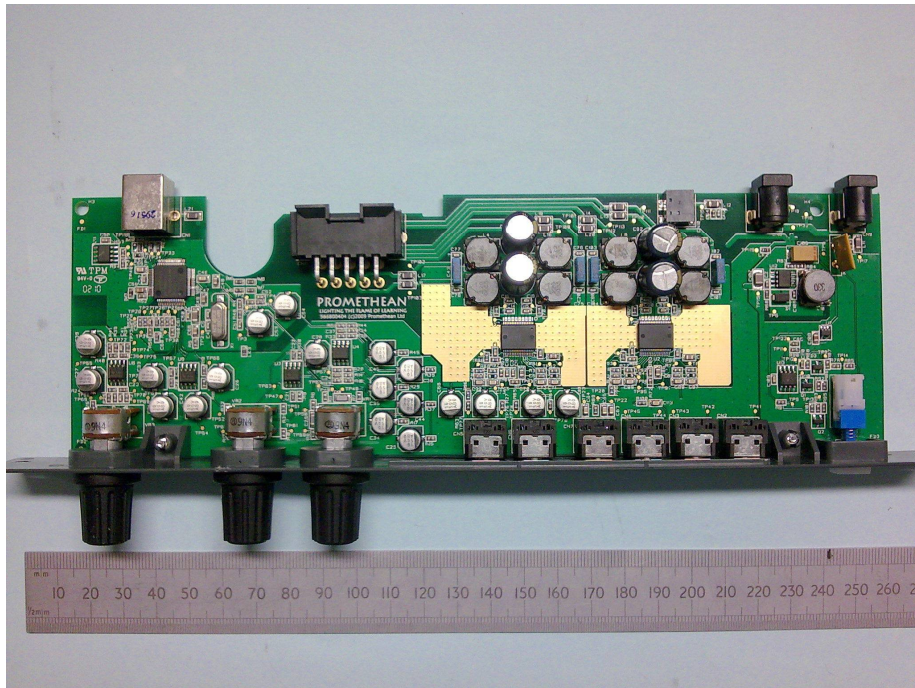


Overview Case removed



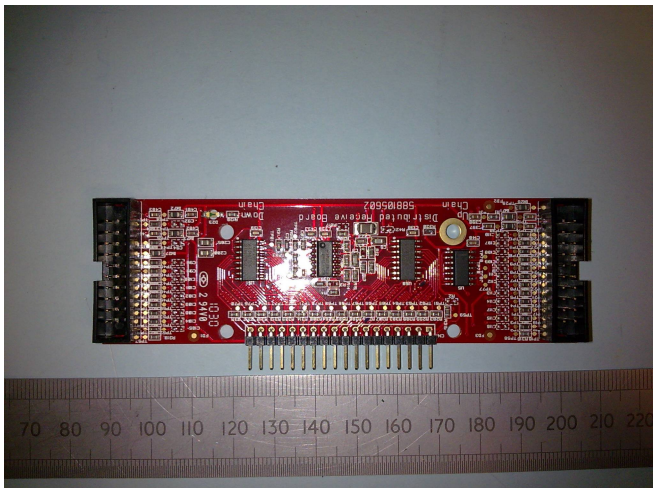
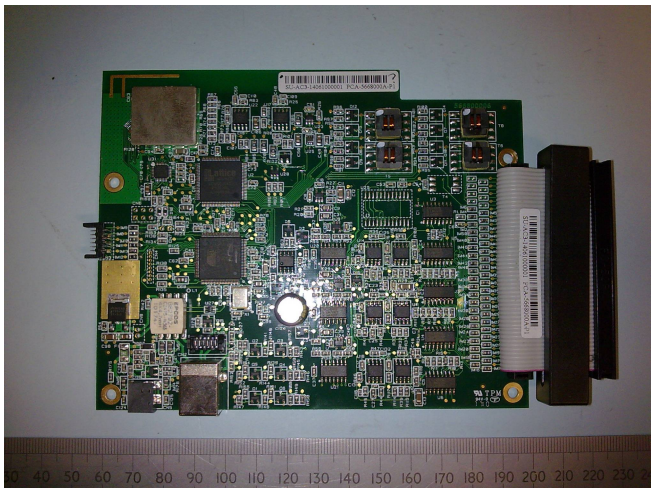
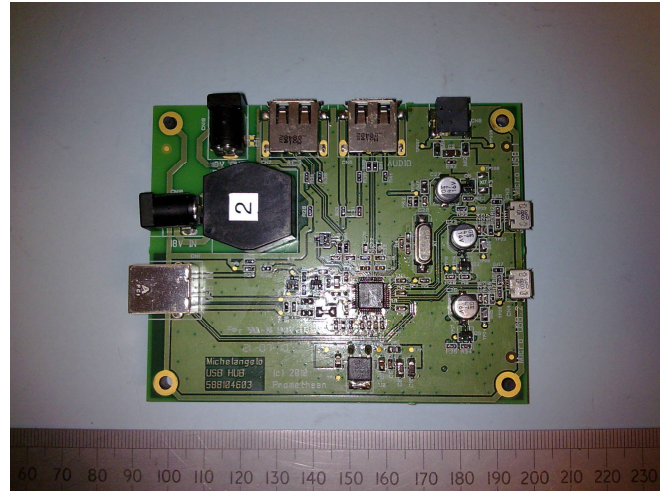
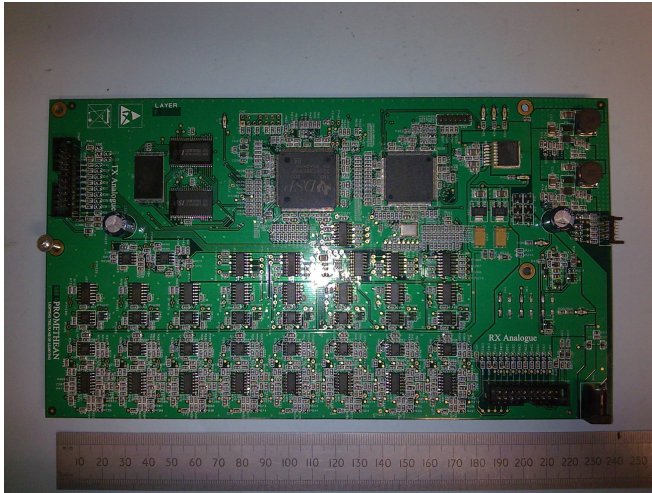
Photograph 4

USB Hub PCB and Audio amplifier



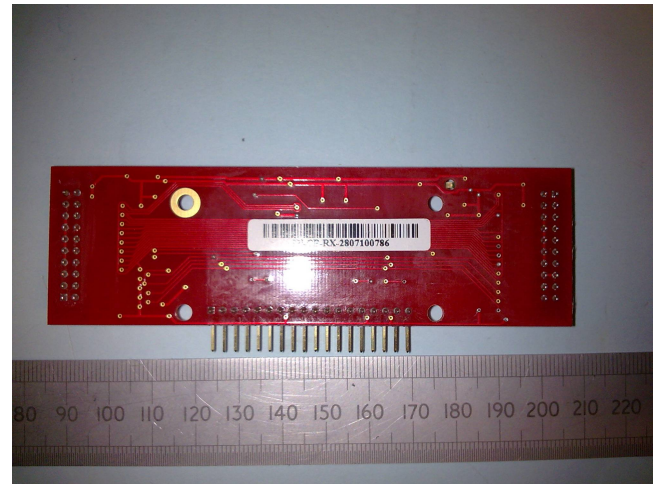
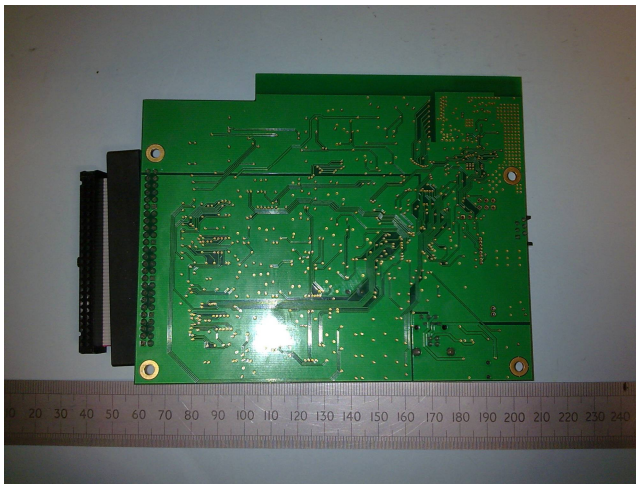
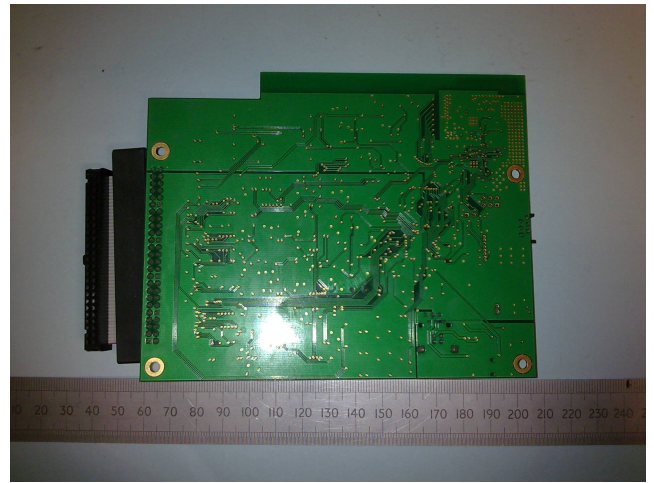
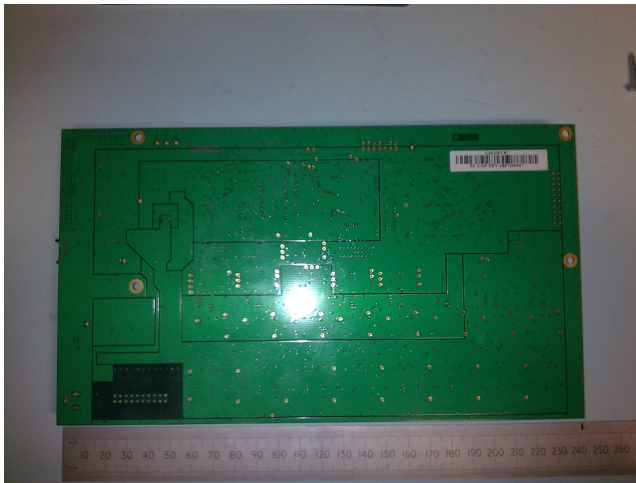
Photograph 5

Top view PCB's removed



Photograph 6

Underside view PCB'S removed







**NORTH WEST**

Unit 1, Pendle Place, Skelmersdale, West Lancashire, WN8 9PN UK.  
T +44 (0)1695 556666 F +44 (0)1695 557077 E test@tracglobal.com  
www.tracglobal.com