

A RADIO TEST REPORT

FOR

SIMOCO EMEA LTD

ON

SPD650 and SPD660

DOCUMENT NO. TRA-009125-03-47-00-A

HULL

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TRaC Wireless Test Report : TRA-009125-03-47-00-A

Applicant : Simoco EMEA Ltd

Apparatus : SPD650 and SPD660

Specification(s) : CFR47 Part 90 & RSS119

Purpose of Test : Certification

FCCID : STZSDP600TU

IC Unique Product number : 7068A-SDP600TU

Authorised by

:



:Radio Product Manager

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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.

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1.2 Tests Requested By

This testing in this report was requested by :

Simoco EMEA Ltd
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1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 13th February 2013 – 22nd April 2013

SPD650 and SPD660

The SPD650 and SPD660 are multi-mode PMR/ DMR Portable Handset Radios operating with 12.5 kHz channel spacing with the following emissions:

11k0F3E – Analogue speech

7k60FXE – DMR 4FSK 9600 bps TDMA digital speech and data

7k60FXD – DMR 4FSK 9600 bps TDMA digital data

The SPD650 and SPD660 are DMR Portable Handset Radios capable of operating with 12.5 kHz channel spacing in analogue mode and 12.5 kHz in Digital Mode.

The SPD660 model offers full keypad functionality for telephony, complex groups, advanced data messaging and a total of 12 programmable function keys. The SPD650 model offers seven function keys but no keypad.

1.5 Test Result Summary

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

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

Test Type	FCC Part	RSS Part	Appendix in Report	Pass/ Fail
RF Power Output	90.205	RSS-119 5.4	A1	Pass
Emission Mask	90.210	RSS-119 5.5	A2	Pass
Occupied Bandwidth	90.210	RSS-119 5.5	A3	Pass
Spurious Emissions at Antenna Terminals	90.210	RSS-119 5.8	A4	Pass
Field Strength of Spurious Emissions	90.210	RSS-119 5.8	A5	Pass
Frequency Stability	90.213	RSS-119 5.3	A6	Pass
Transient behaviour	90.214	RSS-119 5.9	A7	Pass
AC Powerline Conducted Emissions	15.107	RSS-GEN 5.5	A8	Pass
Field Strength of Un-Intentional Spurious Emissions	15.109	RSS-GEN 6.0	A9	Pass
Audio Frequency Response	2.1047	RSS-119 5.5	A10	Pass
Modulation Limiting	2.1047	RSS-119 5.5	A10	Pass

Abbreviations used in the above table:

FCC : Federal Communications Commission
CFR : Code of Federal Regulations

RSS : Radio Standards Specification

1.6 Standard References

47 CFR 2	Code of Federal Regulations, Title 47, Part 2, "Frequency allocations and Radio Telemetry Matters; General Rules and Regulations"
47 CFR 90	Code of Federal Regulations, Title 47, Part 90, "Land Mobile Radio Service"
47 CFR 15	Code of Federal Regulations, Title 47, Part 15, "Radio Frequency Devices" Subpart B, "Unintentional Radiators"
C63.4	American National Standards Institute (ANSI), "Methods of Measurement of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz"
RSS-GEN	Radio Standards Specification "General Requirements and Information for the Certification of Radio Apparatus"
RSS-119	Radio Standards Specification "Radio transmitters and receivers operating in the land mobile and fixed services in the frequency range 27.41-960MHz"

1.6 Notes Relating To 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).

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

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

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

This assessment has been performed in accordance with the requirements of 47 CFR Part 2.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

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

For the test data recorded the following measurement uncertainty was calculated:

Radio Testing – General Uncertainty Schedule

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 (Power Meter) = **1.08dB**

Uncertainty in test result (Spectrum Analyser) = **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 (Power Meter) = **0.113ppm**

Uncertainty in test result (Spectrum Analyser) = **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 – Up to 8.1GHz = **3.31dB**

Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result – 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%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

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

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] 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, in addition to those listed in section 1.5

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

A1 RF Output Power

Test Details:	
FCC Regulation	Title 47 of the CFR: Part 90.205, RSS-119 Section 5.4
Measurement standard	Title 47 of the CFR: Part 2.1046, RSS-GEN Section 4.8
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
Temperature	21
Humidity	50
EUT set up	Refer to Appendix C

SPD650					
Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Variation (dB)	Limit	Verdict
412.950	36.30	37.00	-0.70	±1dB	Pass
459.075	36.30	37.00	-0.70	±1dB	Pass

SPD660					
Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Variation (dB)	Limit	Verdict
412.950	36.80	37.00	-0.20	±1dB	Pass
459.075	36.80	37.00	-0.30	±1dB	Pass

Both variants utilise the same RF paths therefore conducted testing is performed on the highest power unit

Limit

The output power shall be within ±1dB of the manufacturers rated output power

Result

The SPD650 and SPD660 were found to comply with the limits

A2 Emissions Mask

Test Details:	
Regulation	Title 47 of the CFR: Part 90.210, RSS-119 Section 5.5
Measurement standard	Title 47 of the CFR: Part 2.1051
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Both variants utilise the same RF paths, testing was performed on the highest power unit, the SPD660.

Limit**Mask D – 12.5 kHz channels with audio filter**

On any frequency removed from the centre of the authorised bandwidth (f_o) by the following frequency offsets

± 0 kHz	-	5.625 kHz	0	dB
± 5.625 kHz	-	12.5 kHz	$7.27 (f_d - 2.88 \text{ kHz})$	dB
$> \pm 12.5$ kHz	-		$50 + 10 \text{ Log } P$ or 70^*	dB
$> \pm 50$ kHz			$43 + 10 \text{ Log } P$	dB [#]

Notes:

$(10 \log P_{\text{watts}}) - (43 + 10 \text{ Log } (P_{\text{watts}} * 1000)) = \text{LIMIT} = -13 \text{ dBm}$

$(10 \log P_{\text{watts}}) - (50 + 10 \text{ Log } (P_{\text{watts}} * 1000)) = \text{LIMIT} = -20 \text{ dBm}$

* whichever is the lesser attenuation

[#] Not applicable for RSS-119

Results

The SPD660 was found to comply with the limits

See plots in Appendix B.

A3 Occupied Bandwidth

Test Details:	
Regulation	Title 47 of the CFR: Part 90.210, RSS-119 Section 5.5
Measurement standard	Title 47 of the CFR: Part 2.1049, RSS-GEN Section 4.6
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Both variants utilise the same RF paths, testing was performed on the highest power unit, the SPD660.

Frequency Of Operation (MHz)	Channel Spacing	
	12.5 kHz Analogue	12.5 kHz Digital
412.950	5.1923 kHz	7.2436 kHz
459.075	5.1923 kHz	6.9872 kHz

Note 1 Measurements on 12.5 kHz channels made with 100Hz RBW
Figures may be rounded up/down.

Limit

Channel Spacing	Bandwidth Limitation
12.5 kHz	11.25 kHz

Result

The SPD660 was found to comply with the limits

A4 Spurious Emissions at Antenna Terminals

Test Details:	
Regulation	Title 47 of the CFR: Part 90.210
Measurement standard	Title 47 of the CFR: Part 2.1051
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Operating Frequency – 412.950 MHz					
Frequency Range (MHz)	Freq. of Emission (MHz)	Measured Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit dBm
9 kHz - 16GHz	350.703	-67.73	36.45	-31.7	-13
	475.202	-68.39	36.45	-32.4	-13
	825.890	-48.16	10.94	-37.6	-13
	1238.850	-59.20	19.18	-40.5	-13

Operating Frequency – 459.075 MHz					
Frequency Range (MHz)	Freq. of Emission (MHz)	Measured Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit dBm
9 kHz - 16GHz	442.942	-66.90	36.45	-30.90	-13
	475.198	-66.36	36.45	-30.40	-13
	918.147	-54.76	11.93	-43.30	-13
	1377.225	-54.40	12.43	-42.50	-13

Note Emissions checked upto 16GHz, 10 x the GPS operating frequency.

Limit

Limit is determined by the outermost step of the emissions mask and is calculated as follows:

At least $43 + 10 \log P_{\text{dB}}$

$$(10 \log P_{\text{watts}}) - (43 + 10 \log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -13 \text{ dBm}$$

Limit reduces to $(10 \log P_{\text{watts}}) - (50 + 10 \log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -20 \text{ dBm}$ for RSS-119 Mask D

Result

The SPD660 was found to comply with the limits

A5 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to all spurious emissions.

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

3m open area test site : ☐

3m alternative test site : ☒

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

Test Details: SPD 650	
Regulation	Title 47 of the CFR: Part 90.210, RSS-119 Section 5.8
Measurement standard	Title 47 of the CFR: Part 2.1053, RSS-GEN Section 4.9
Frequency range	30 MHz – 16 GHz
EUT sample number	S02 & S04
Modification state	0
SE in test environment	S01, S08, S12, Mic/Speaker Handset
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	1 & 2

Operating Frequency – 412.950MHz			
FREQUENCY RANGE	FREQ. (MHz)	ERP/EIRP (dBm)	LIMIT (dBm)
30 MHz – 16 GHz	No significant Emissions Within 20 dB of the limit		-13

Operating Frequency – 459.075 MHz			
FREQUENCY RANGE	FREQ. (MHz)	ERP/EIRP (dBm)	LIMIT (dBm)
30 MHz – 16 GHz	No significant Emissions Within 20 dB of the limit		-13

Result

The SPD650 was found to comply with the limits

Test Details: SPD 660	
Regulation	Title 47 of the CFR: Part 90.210, RSS-119 Section 5.8
Measurement standard	Title 47 of the CFR: Part 2.1053, RSS-GEN Section 4.9
Frequency range	30 MHz – 16 GHz
EUT sample number	S02 & S04
Modification state	0
SE in test environment	S01, S08, S12, Mic/Speaker Handset
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	1 & 2

Operating Frequency – 412.950MHz			
FREQUENCY RANGE	FREQ. (MHz)	ERP/EIRP (dBm)	LIMIT (dBm)
30 MHz – 16 GHz	No significant Emissions Within 20 dB of the limit		-13

Operating Frequency – 459.075 MHz			
FREQUENCY RANGE	FREQ. (MHz)	ERP/EIRP (dBm)	LIMIT (dBm)
30 MHz – 16 GHz	No significant Emissions Within 20 dB of the limit		-13

Result

The SPD660 was found to comply with the limits

Notes:

1. Emissions Checked up to a minimum of 10 times F_c , this is extended if significant emissions are detected. Emissions Checked up to 10 times the highest frequency used within the EUT, in the case of the SPD650 and SPD660 this is the GPS receiver.
2. The unit was mounted on a turntable and rotated through 360° and in 3 orthogonal planes to find the worst case emission.
3. For Frequencies below 1 GHz, RBW = 120 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 = $\geq$ RBW

4. Limit is determined as the outermost step of the emissions mask and is calculated as follows.

At least $43 + 10 \log P$ dB

$$(10 \log P_{\text{watts}}) - (43 + 10 \log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -13 \text{ dBm}$$

Limit reduces to $(10 \log P_{\text{watts}}) - (50 + 10 \log (P_{\text{watts}} * 1000)) = \text{LIMIT} = -20 \text{ dBm}$ for RSS-119 Mask D

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 2.1057.

- (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:

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

- (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				

A6 Frequency Stability

Test Details:	
Regulation	Title 47 of the CFR: Part 90.213, RSS-119 Section 5.3
Measurement standard	Title 47 of the CFR: Part 2.1055, RSS-GEN Section 4.7
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Voltage Variation					
Temperature °C	Vnom (Vdc)	Measured Frequency (MHz)	Frequency Difference (Hz)	ppm	Pass/Fail
+20	7.2	412.95020	0.20	0.48	Pass [*]
+20	85%	412.95018	-0.02	-0.05	Pass
+20	115%	412.95023	0.03	0.07	Pass
Temperature Variation					
Temperature °C	Vnom (Vdc)	Measured Frequency (MHz)	Frequency Difference (Hz)	ppm	Pass/Fail
-30	7.2	412.94977	-0.43	-1.04	Pass
-20	7.2	412.94984	-0.36	-0.87	Pass
-10	7.2	412.94994	-0.26	-0.63	Pass
0	7.2	412.94997	-0.23	-0.56	Pass
10	7.2	412.95010	-0.10	-0.24	Pass
20	7.2	412.95020	0.20	0.48	Pass [*]
30	7.2	412.95017	-0.03	-0.07	Pass
40	7.2	412.94995	-0.25	-0.61	Pass
50	7.2	412.95005	-0.15	-0.36	Pass

^{*} Measured f_c at Tnom Vnom used compared to declared operating frequency for drift.

^{*} Measured f_c at Tnom Vnom used as reference frequency drift calculations of measured f_c at extreme voltage / temperature.

Limit

±1.5 ppm (tightest applicable limit)

Result

The SPD660 was found to comply with the limits

Test Details:	
Regulation	Title 47 of the CFR: Part 90.213, RSS-119 Section 5.3
Measurement standard	Title 47 of the CFR: Part 2.1055, RSS-GEN Section 4.7
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Voltage Variation					
Temperature °C	Vnom (Vdc)	Measured Frequency (MHz)	Frequency Difference (Hz)	ppm	Pass/Fail
+20	7.2	459.07521	0.21	0.46	Pass [*]
+20	85%	459.07520	-0.01	-0.02	Pass
+20	115%	459.07518	-0.03	-0.07	Pass
Temperature Variation					
Temperature °C	Vnom (Vdc)	Measured Frequency (MHz)	Frequency Difference (Hz)	ppm	Pass/Fail
-30	7.2	459.07447	-0.74	-1.61	Pass
-20	7.2	459.07496	-0.25	-0.54	Pass
-10	7.2	459.07503	-0.18	-0.39	Pass
0	7.2	459.07508	-0.13	-0.28	Pass
10	7.2	459.07508	-0.13	-0.28	Pass
20	7.2	459.07521	0.21	0.46	Pass [*]
30	7.2	459.07519	-0.02	-0.04	Pass
40	7.2	459.07496	-0.25	-0.54	Pass
50	7.2	459.07504	-0.17	-0.37	Pass

^{*} Measured f_c at Tnom Vnom used compared to declared operating frequency for drift.

^{*} Measured f_c at Tnom Vnom used as reference frequency drift calculations of measured f_c at extreme voltage / temperature.

Limit

±1.5 ppm (tightest applicable limit)

Result

The SPD660 was found to comply with the limits

A7 Transient Behaviour

Test Details:	
Regulation	Title 47 of the CFR: Part 90.214, RSS-119 Section 5.9
Measurement standard	Title 47 of the CFR: Part 2.1055,
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel	412.950 MHz	459.075 MHz
Time, t1	Compliant	Compliant
Time, t2	Compliant	Compliant
Time, t3	Compliant	Compliant

Limit

Time interval	Maximum Frequency Difference	All Equipment	
		150 – 174 MHz	421 – 512 MHz
12.5 kHz channels			
t1	±12.5 kHz	5.0 ms	10.0 ms
t2	±6.25 kHz	20.0 ms	25.0 ms
t3	±12.5 kHz	5.0 ms	10.0 ms

Result

The SPD660 was found to comply with the limits

A8 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak & average 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 an average and/or quasi peak detector.

Test Details:	
Regulation	Title 47 of the CFR: Part 15.107, RSS-GEN Section 5.5
Measurement standard	ANSI C63.10:2003
Frequency range	150kHz to 30MHz
EUT sample number	S02 & S04
Modification state	0
SE in test environment	S01, S08, S12, Mic/Speaker Handset
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	3

The EUT was operated in standby mode. The worst-case power line conducted emission measurements are listed below:

Results measured using the average detector compared to the average limit

SPD650						
Ref No.	Freq (MHz)	Result (dBuV)	Conductor	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.27	32.12	Live	51.27	19.15	Pass
2	0.40	29.97	Live	47.96	17.99	Pass
3	0.40	29.41	Live	47.85	18.44	Pass
4	0.53	29.78	Live	46.00	16.22	Pass
5	0.60	29.13	Live	46.00	16.87	Pass
6	0.66	26.42	Neutral	46.00	19.58	Pass
7	0.80	29.53	Live	46.00	16.47	Pass
8	0.86	27.44	Neutral	46.00	18.56	Pass
9	1.00	27.50	Live	46.00	18.50	Pass
10	1.06	26.49	Live	46.00	19.51	Pass
11	1.13	26.99	Neutral	46.00	19.01	Pass
12	4.44	27.65	Live	46.00	18.35	Pass
13	4.97	32.31	Live	46.00	13.69	Pass
14	5.17	35.40	Live	50.00	14.60	Pass
15	5.23	34.59	Live	50.00	15.41	Pass
16	5.63	32.75	Live	50.00	17.25	Pass
17	16.23	30.53	Neutral	50.00	19.47	Pass

Results measured using the quasi-peak detector compared to the quasi-peak limit

SPD650						
Ref No.	Freq (MHz)	Result (dBuV)	Conductor	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.20	46.75	Live	63.61	16.86	Pass
2	4.97	37.19	Neutral	56.00	18.81	Pass
3	15.70	41.42	Neutral	60.00	18.58	Pass
4	15.96	41.61	Neutral	60.00	18.39	Pass

Results measured using the average detector compared to the average limit

SPD660						
Ref No.	Freq (MHz)	Result (dBuV)	Conductor	Spec Limit (dBuV)	Margin (dB)	Result Summary
No Significant Emissions Within 20 dB of Limit						

Results measured using the quasi-peak detector compared to the quasi-peak limit

SPD660						
Ref No.	Freq (MHz)	Result (dBuV)	Conductor	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.2	47.03	Live	63.61	16.58	Pass

Specification limits:

Conducted disturbance at the mains port Limits.

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 ²	56 to 46 ²
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				

A9 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in a transmit standby / receive mode.

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

3m open area test site :

☐

3m alternative test site :

☒

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

Test Details:	
Regulation	Title 47 of the CFR, Part 15.109, RSS-GEN 6.0
Measurement standard	ANSI C63.10:2003
Frequency range	30 MHz – 16.3GHz
EUT sample number	S02, S04
Modification state	0
SE in test environment	S01, S08, S12, Mic/Speaker Handset
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs	See Appendix F

The worst case radiated emission measurements for spurious emissions are listed overleaf:

SPD650									
Ref No.	FREQ. (MHz)	MEAS Rx (dBμV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBμV/m)	EXTRAP FACT (dB)	FIELD ST'GH (μV/m)	LIMIT (μV/m)
1	31.85	7.00	0.5	16.9	-	24.4	-	16.60	100
2	34.40	6.80	0.6	15.6	-	22.9	-	13.96	100
3	35.60	9.00	0.6	14.9	-	24.5	-	16.79	100
4	36.25	10.20	0.6	14.6	-	25.4	-	18.62	100
5	36.80	14.50	0.6	14.2	-	29.3	-	29.17	100
6	37.05	14.20	0.6	14.1	-	28.9	-	27.86	100
Bottom operating channel specific emissions									
7	367.95	15.40	2.4	14.7	-	32.50	-	42.17	200
8	2207.68 _{PK}	58.67	2.8	27.8	36.0	53.27	-9.54	153.60	5000
9	2207.68 _{AV}	55.86	2.8	27.8	36.0	50.46	-9.54	111.14	500
10	2575.65 _{PK}	58.09	3.1	28.7	36.0	53.89	-9.54	164.96	5000
11	2575.65 _{AV}	54.89	3.1	28.7	36.0	50.69	-9.54	114.12	500
12	2943.59 _{PK}	55.96	3.5	29.6	36.0	53.06	-9.54	149.93	5000
13	2943.59 _{AV}	52.23	3.5	29.6	36.0	49.33	-9.54	97.58	500
14	3311.55 _{PK}	54.35	3.2	31.0	35.8	52.75	-9.54	144.67	5000
15	3311.55 _{AV}	49.78	3.2	31.0	35.8	48.18	-9.54	85.48	500
16	3679.49 _{PK}	51.80	3.4	31.8	35.6	51.40	-9.54	123.85	5000
17	3679.49 _{AV}	46.54	3.4	31.8	35.6	46.14	-9.54	67.59	500
18	4047.41 _{PK}	52.16	3.6	32.0	35.5	52.26	-9.54	136.73	5000
19	4047.41 _{AV}	47.23	3.6	32.0	35.5	47.33	-9.54	77.51	500
Top operating channel specific emissions									
20	414.10	16.80	2.6	16.6	-	36.0	-	63.10	200
21	2484.44 _{PK}	54.78	3.1	28.5	36.0	50.38	-9.54	110.12	5000
22	2484.44 _{AV}	49.76	3.1	28.5	36.0	45.36	-9.54	61.78	500
23	2898.48 _{PK}	55.77	3.5	29.4	36.0	52.67	-9.54	143.34	5000
24	2898.48 _{AV}	52.53	3.5	29.4	36.0	49.43	-9.54	98.71	500
25	3312.60 _{PK}	55.03	3.2	31.0	35.8	53.43	-9.54	156.45	5000
26	3312.60 _{AV}	51.02	3.2	31.0	35.8	49.42	-9.54	98.60	500

SPD660									
Ref No.	FREQ. (MHz)	MEAS Rx (dBμV)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dBμV/m)	EXTRAP FACT (dB)	FIELD ST'GH (μV/m)	LIMIT (μV/m)
1	34.40	12.6	0.6	17.1	-	30.2	-	32.36	100
2	34.95	13.9	0.6	16.7	-	31.2	-	36.31	100
3	35.35	14.4	0.6	16.5	-	31.5	-	37.58	100
4	37.35	15.3	0.6	15.4	-	31.3	-	36.73	100
5	37.45	15.1	0.6	15.4	-	31.1	-	35.89	100
6	37.70	14.9	0.6	15.3	-	30.7	-	34.28	100
7	37.85	14.8	0.6	15.2	-	30.5	-	33.50	100
8	39.85	12.3	0.6	14.1	-	27.0	-	22.39	100
9	42.60	12	0.7	12.6	-	25.3	-	18.41	100
10	49.85	6.3	0.8	8.9	-	16.0	-	6.31	100
Bottom operating channel specific emissions									
11	367.95	10.00	2.4	14.7	-	26.70	-	42.17	200
12	2575.65 _{PK}	53.55	3.1	28.7	36.0	49.35	-9.54	97.81	5000
13	2575.65 _{AV}	51.51	3.1	28.7	36.0	47.31	-9.54	77.34	500
14	2943.59 _{PK}	50.3	3.5	29.6	36.0	47.40	-9.54	78.14	5000
15	2943.59 _{AV}	47.75	3.5	29.6	36.0	44.85	-9.54	58.26	500
Top operating channel specific emissions									
16	414.10	9.40	2.6	16.6	-	28.10	-	63.10	200
17	2898.48 _{PK}	51.01	3.5	29.4	36.0	47.91	-9.54	82.87	5000
18	2898.48 _{AV}	48.38	3.5	29.4	36.0	45.28	-9.54	61.22	500
19	3312.60 _{PK}	50.36	3.2	31.0	35.8	48.76	-9.54	91.39	5000
20	3312.60 _{AV}	46.75	3.2	31.0	35.8	45.15	-9.54	60.31	500

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1. For emissions below 30MHz the cable losses are assumed to be negligible.
- 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 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.
- 4 For Frequencies below 1 GHz, RBW = 120 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 RBW=VBW= 1MHz
Average RBW=VBW= 1MHz

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

Radiated emission limits for all emissions:

Frequency of emission (MHz)	Field strength $\mu\text{V/m}$	Measurement Distance m	Field strength $\text{dB}\mu\text{V/m}$
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

- (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:

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

- (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				

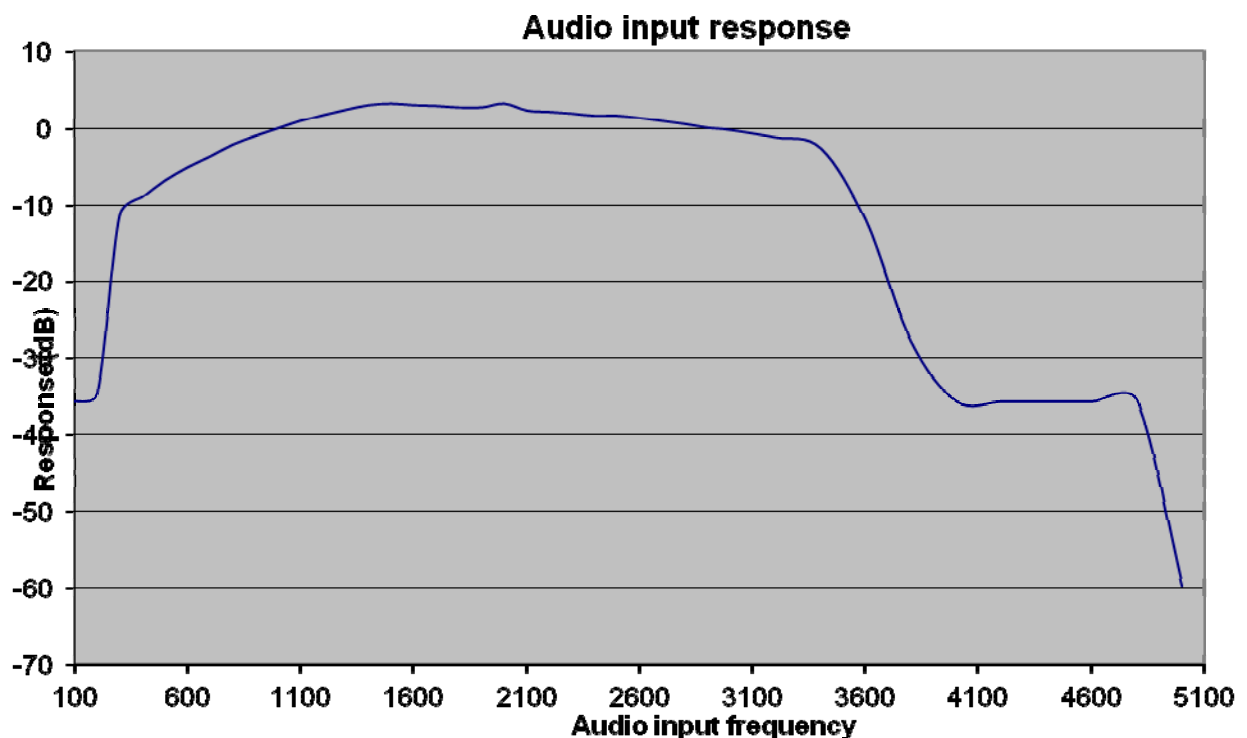
A10 Modulation Characteristics

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1047, RSS-119 Section 5.5
EUT sample number	S02 & S04
Modification state	0
SE in test environment	Interface / Control PCB
SE isolated from EUT	None
EUT set up	Refer to Appendix C

The transmitter was tested whilst operating under the following conditions:

- 1) A signal generator was connected into the AF input and the audio frequency was then varied between 100Hz and 5kHz.
- 2) A 1kHz audio signal was applied which was used as a 0dB response reference.

The following plot shows the audio response of the transmitter.

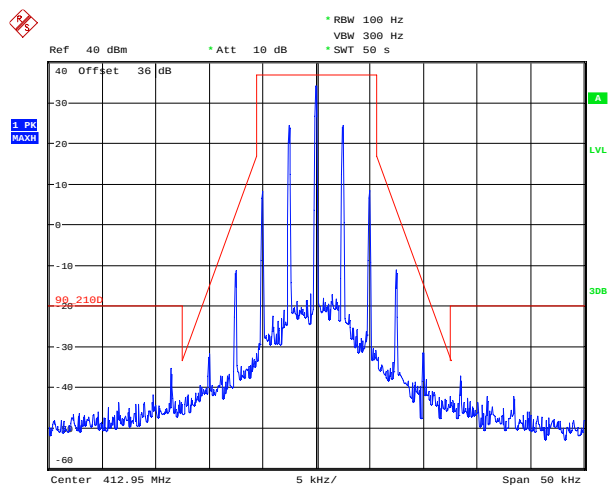


Appendix B:**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

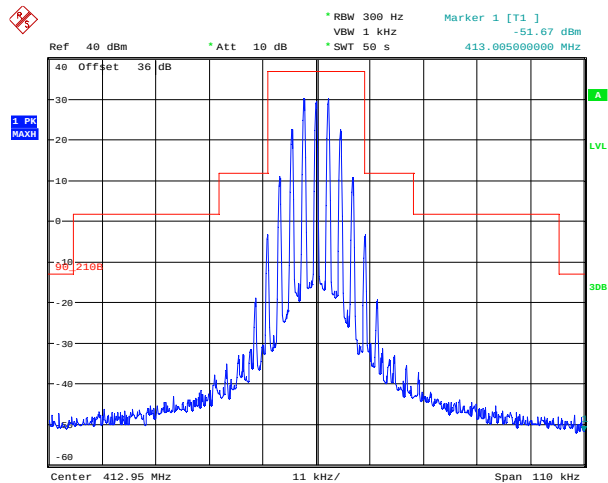
Notes:

- (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.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.
- (d) Appendix C details the numbering system used to identify the sample and its modification state.
- (e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.



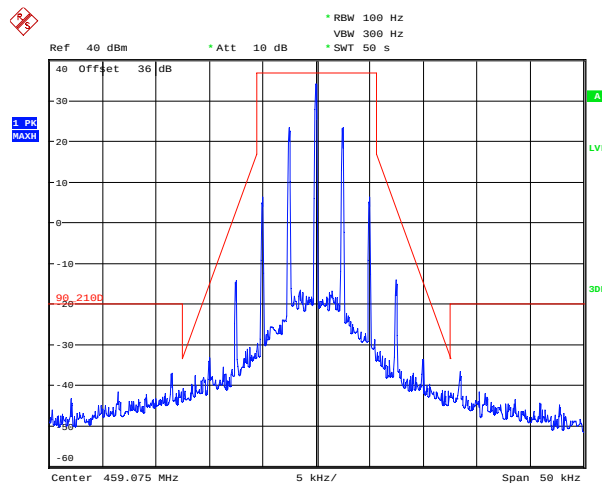
Date: 28.MAR.2013 13:05:42

412.950 MHz Mask D – 12.5 kHz Analogue Modulation



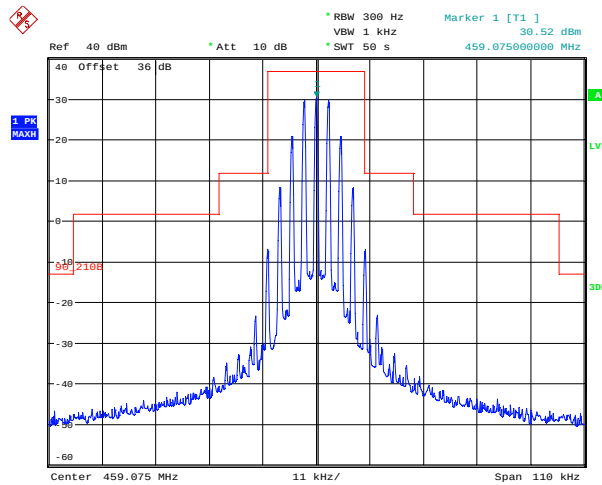
Date: 28.MAR.2013 13:02:58

412.950 MHz Mask D – 12.5 kHz Digital Modulation



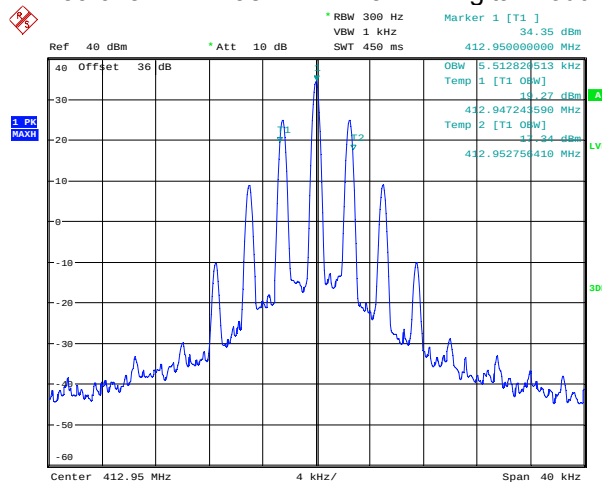
Date: 28.MAR.2013 13:08:05

459.075 MHz Mask D – 12.5 kHz Analogue Modulation



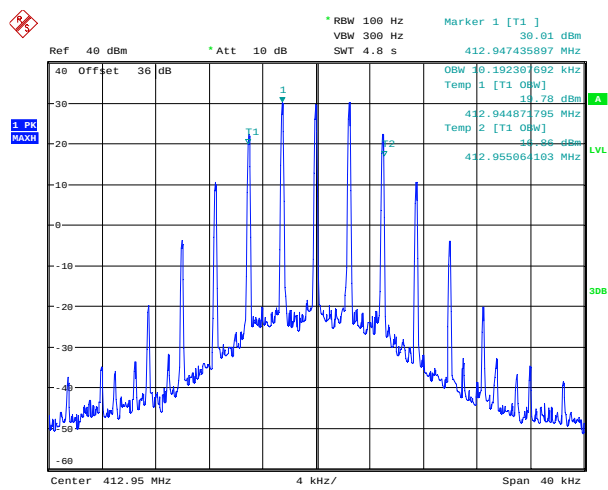
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459.075 MHz Mask D – 12.5 kHz Digital Modulation



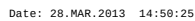
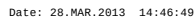
Date: 28.MAR.2013 14:45:38

412.950 MHz 99% Bandwidth – 12.5 kHz Analogue Modulation



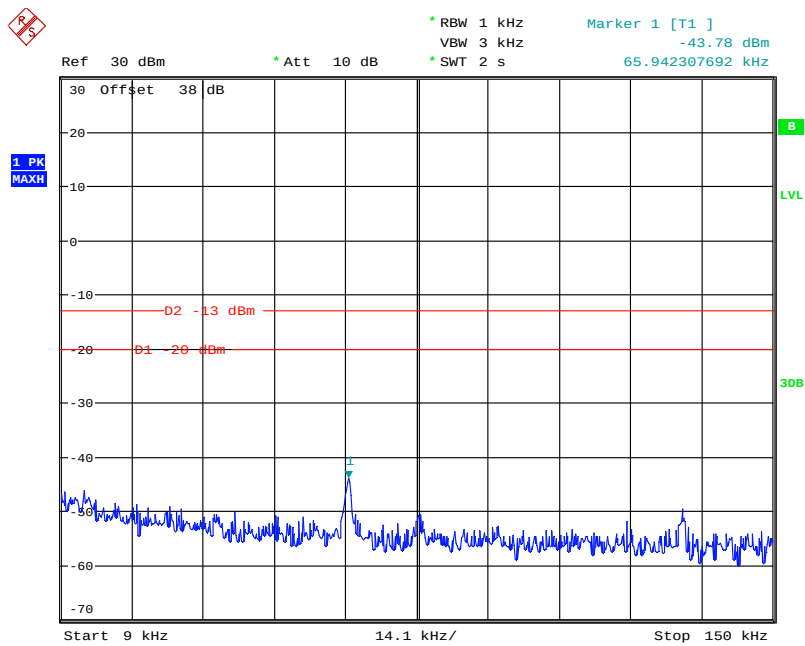
Date: 28.MAR.2013 14:54:32

412.950 MHz 99% Bandwidth – 12.5 kHz Digital Modulation



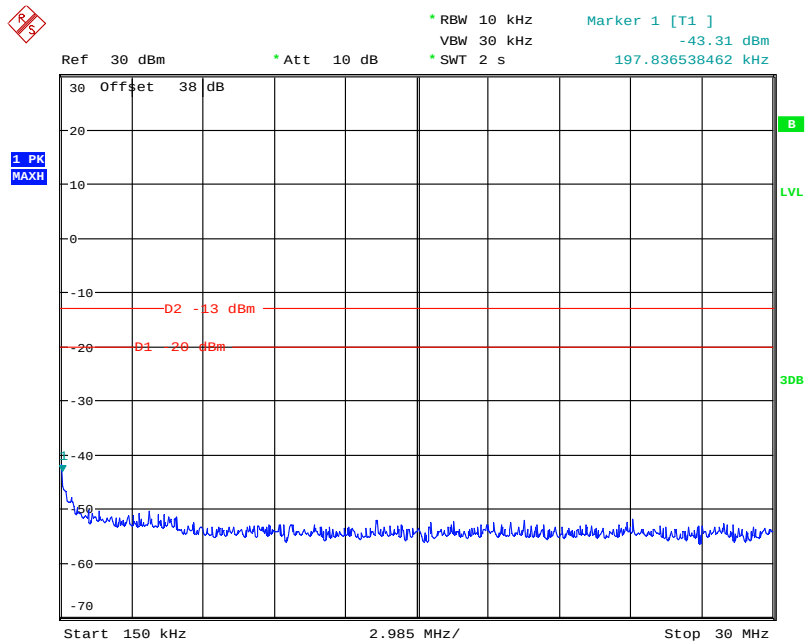
Spurious Emissions at antenna Terminals

412.950 MHz



Date: 11.FEB.2013 13:23:30

9 kHz – 150 kHz

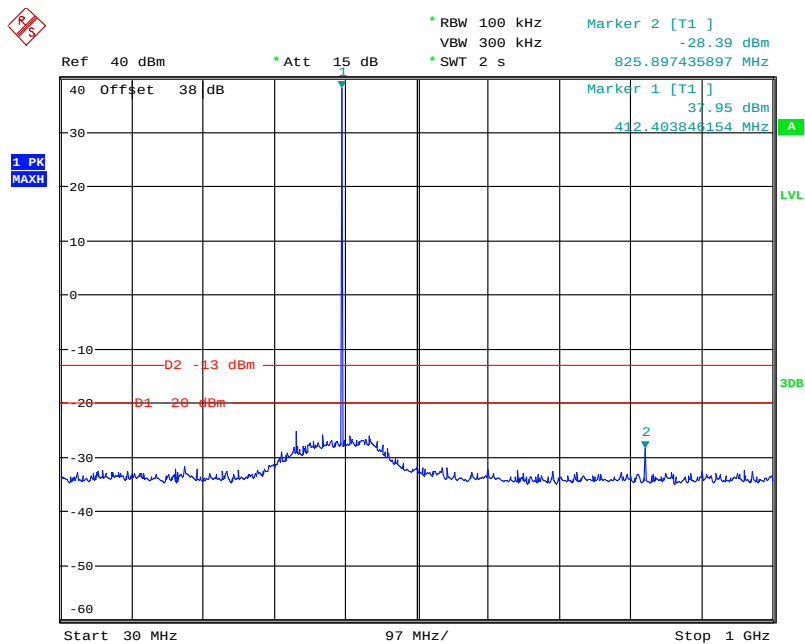


Date: 11.FEB.2013 13:24:13

150 kHz – 30 MHz

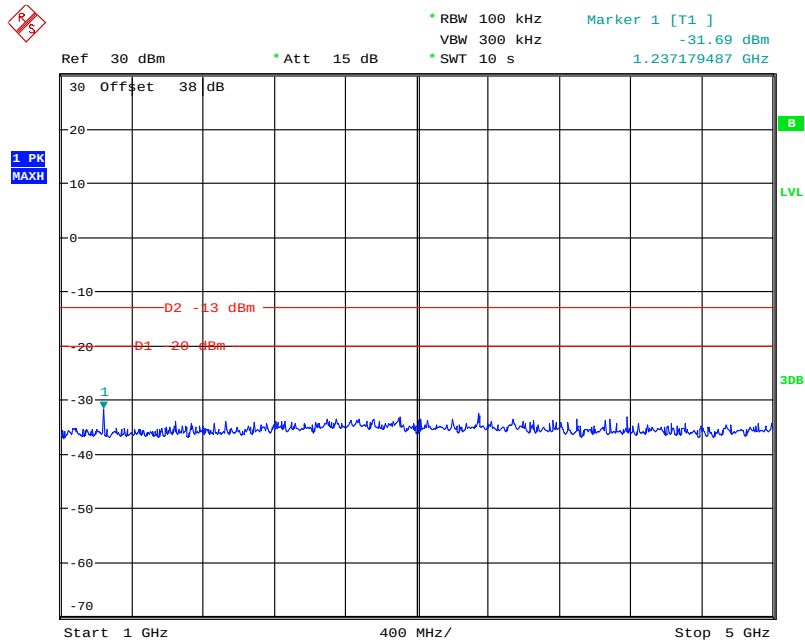
Spurious Emissions at antenna Terminals

412.950 MHz



Date: 28.MAR.2013 12:34:43

30MHz – 1GHz

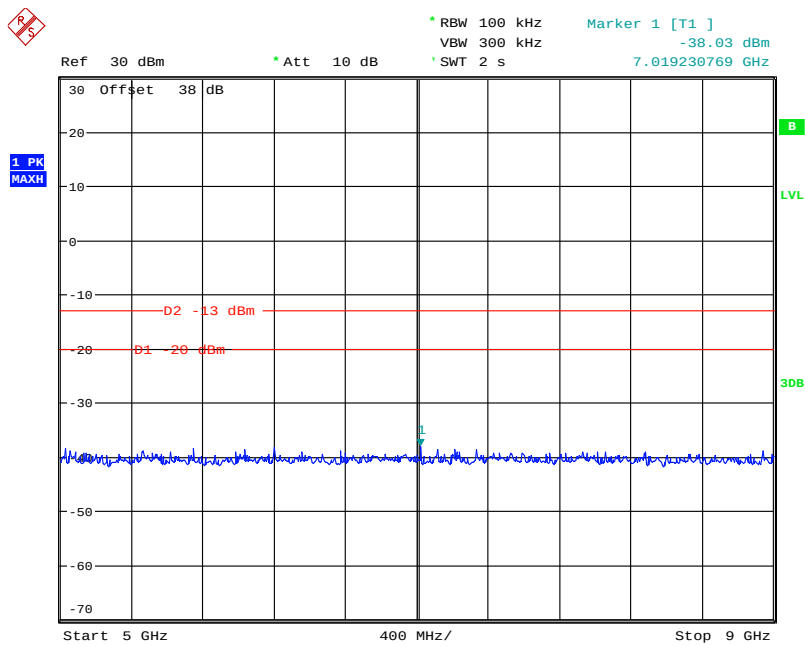


Date: 11.FEB.2013 13:20:41

1GHz – 5GHz

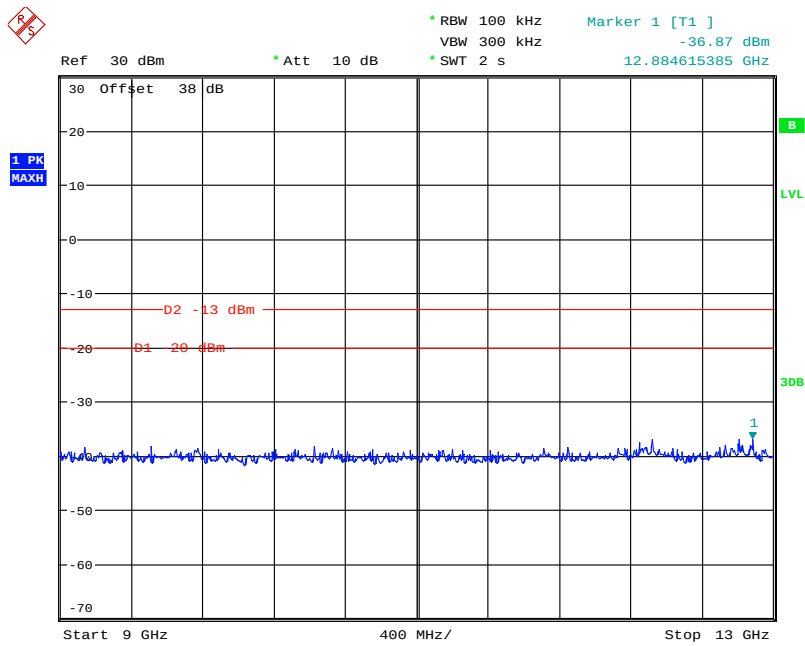
Spurious Emissions at antenna Terminals

412.950 MHz



Date: 11.FEB.2013 13:22:33

5GHz – 9GHz

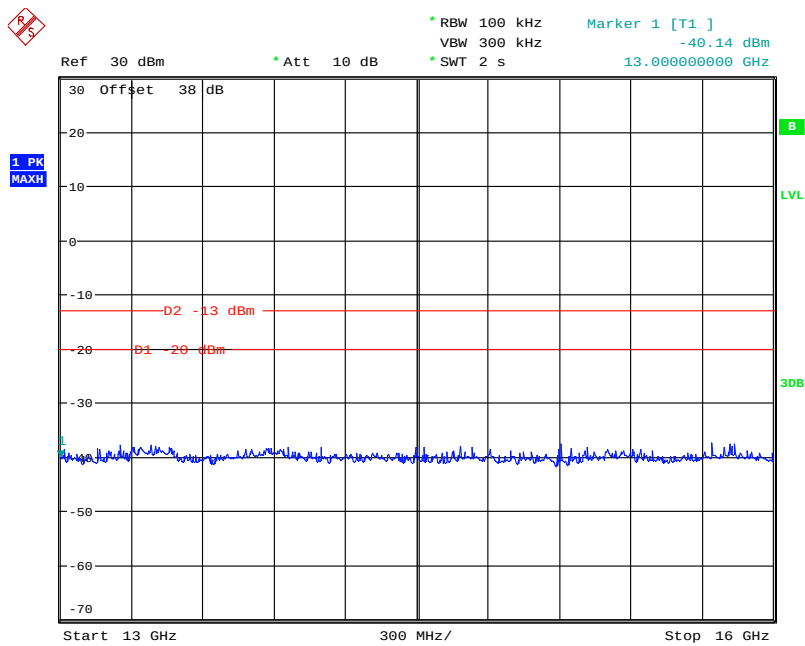


Date: 11.FEB.2013 13:22:50

9GHz – 13GHz

Spurious Emissions at antenna Terminals

412.950 MHz

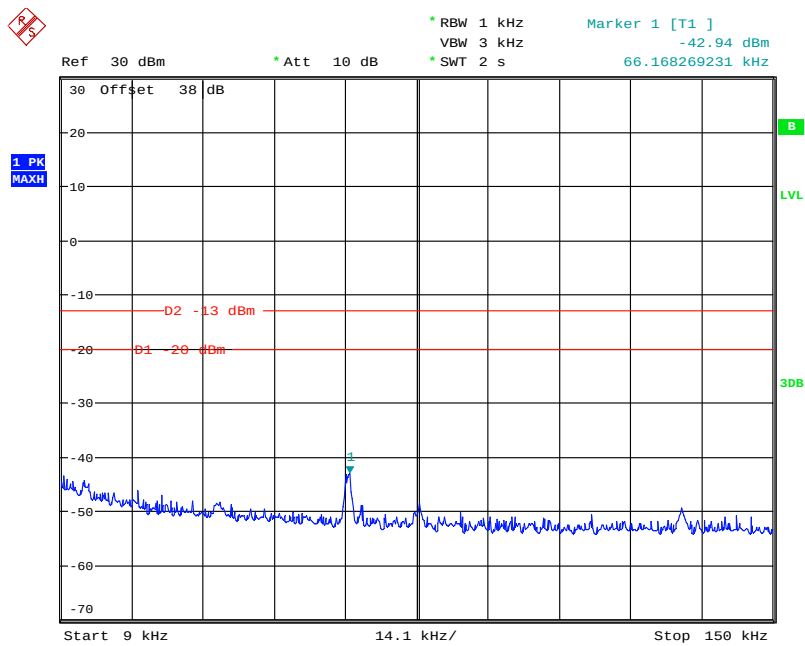


Date: 11.FEB.2013 13:23:05

13GHz – 16GHz

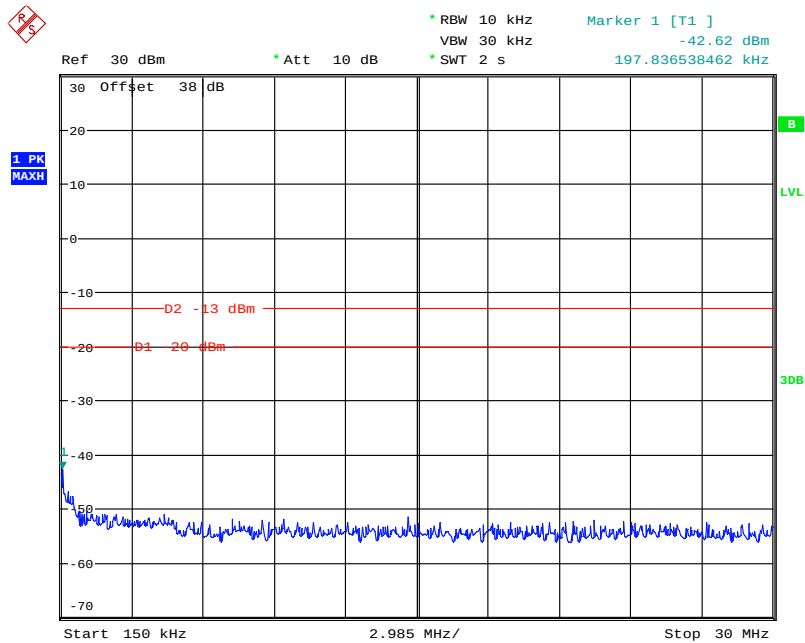
Spurious Emissions at antenna Terminals

459.075 MHz



Date: 11.FEB.2013 13:30:46

9 kHz – 150 kHz

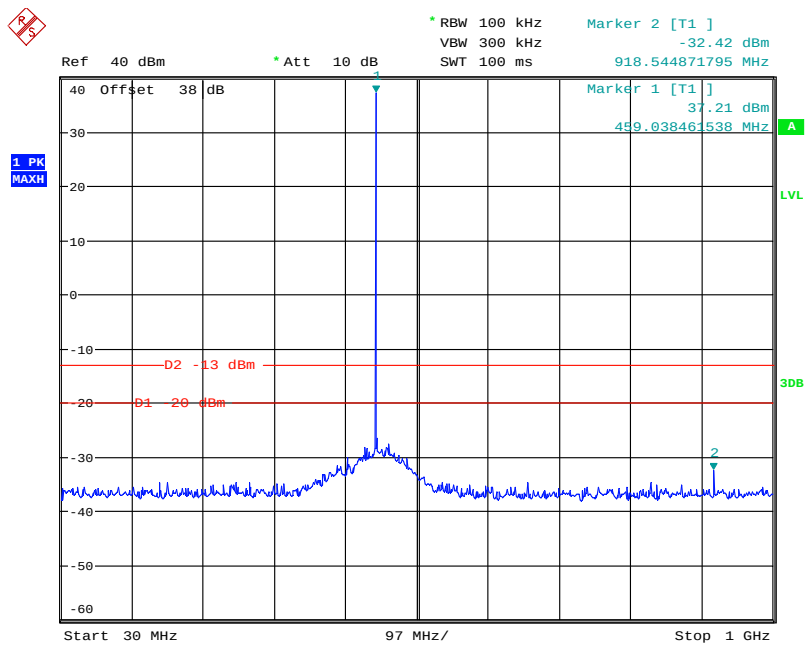


Date: 11.FEB.2013 13:24:54

150 kHz – 30 MHz

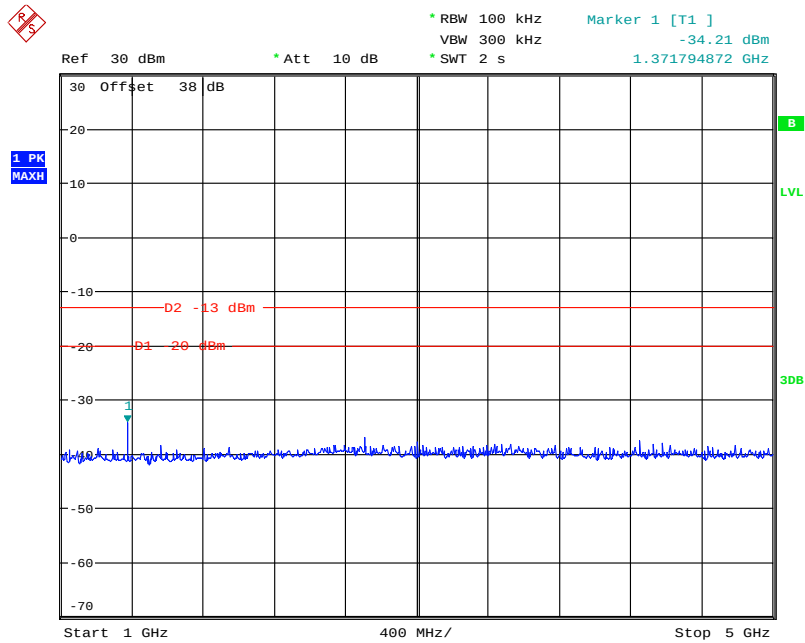
Spurious Emissions at antenna Terminals

459.075 MHz



Date: 28.MAR.2013 12:41:05

30MHz – 1GHz

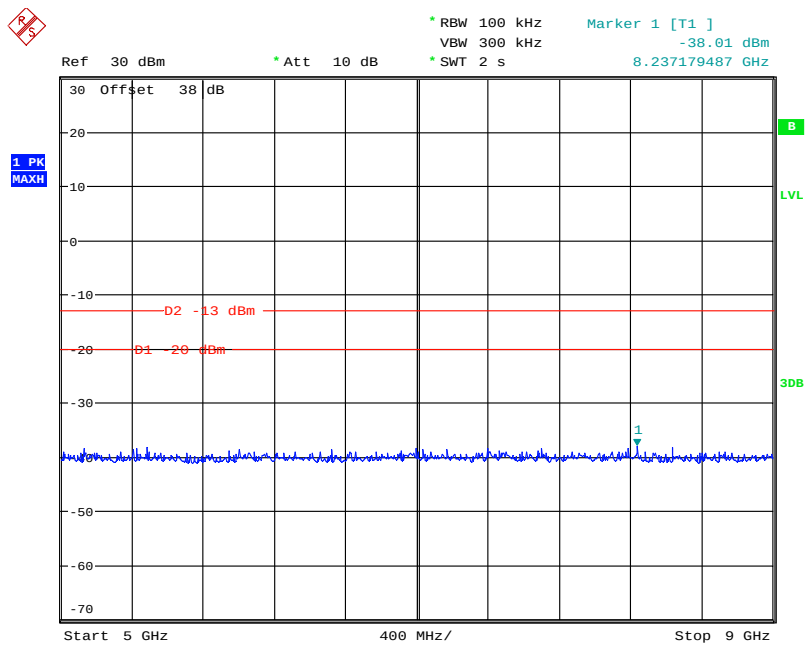


Date: 11.FEB.2013 13:31:43

1GHz – 5GHz

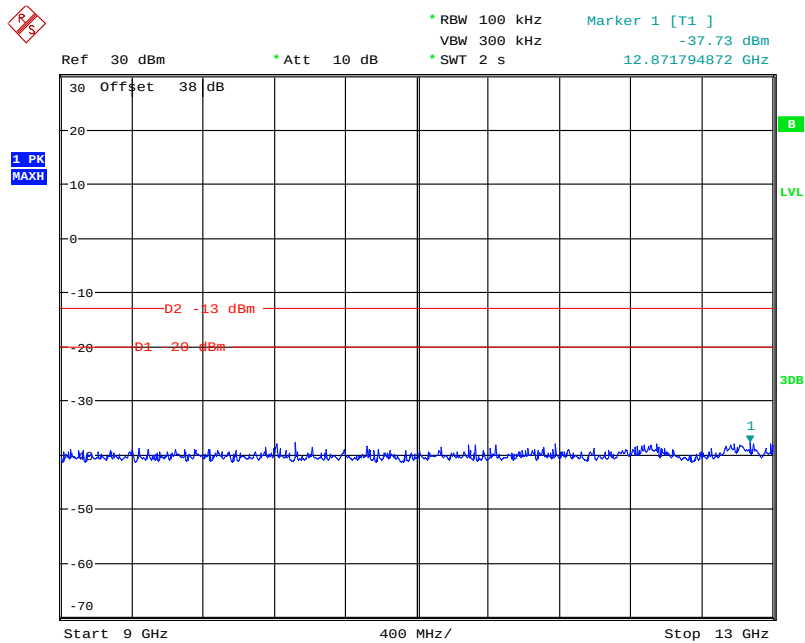
Spurious Emissions at antenna Terminals

459.075 MHz



Date: 11.FEB.2013 13:32:15

5GHz – 9GHz

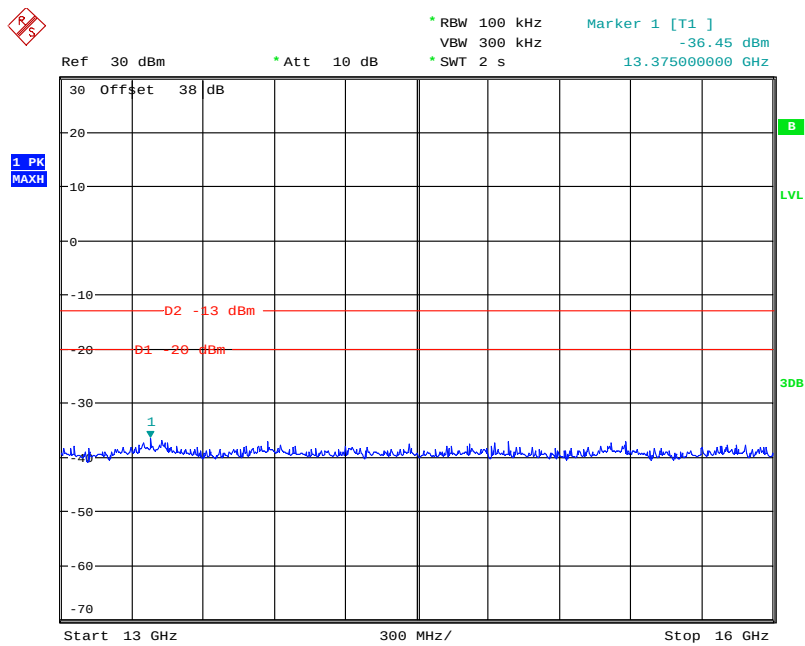


Date: 11.FEB.2013 13:32:33

9GHz – 13GHz

Spurious Emissions at antenna Terminals

459.075 MHz

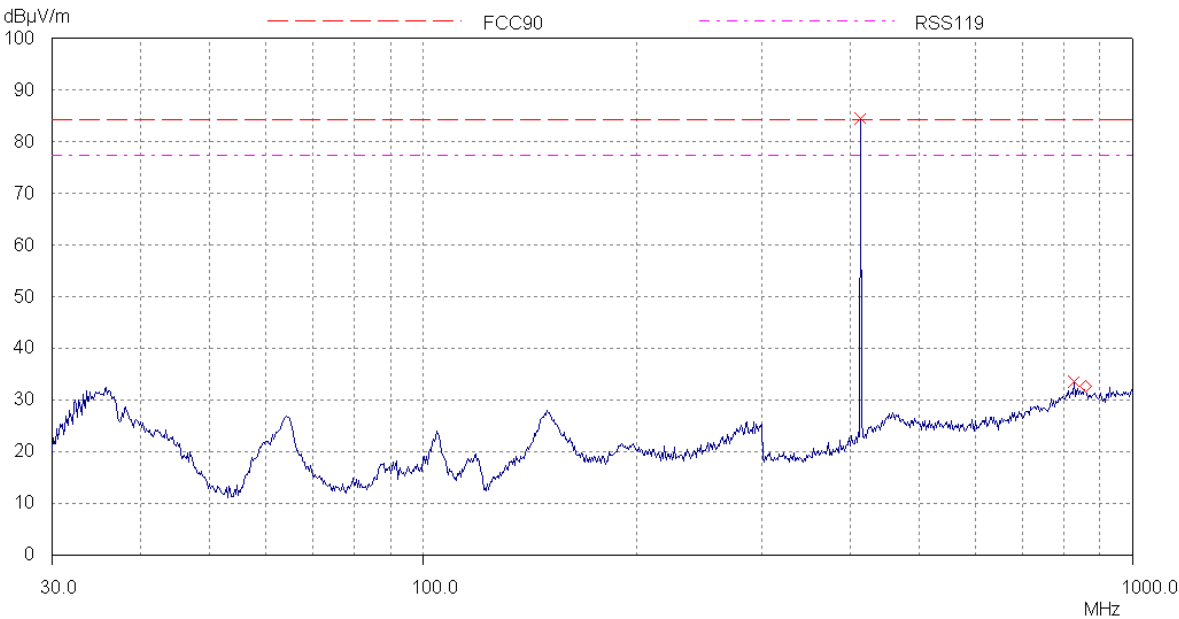


Date: 11.FEB.2013 13:33:24

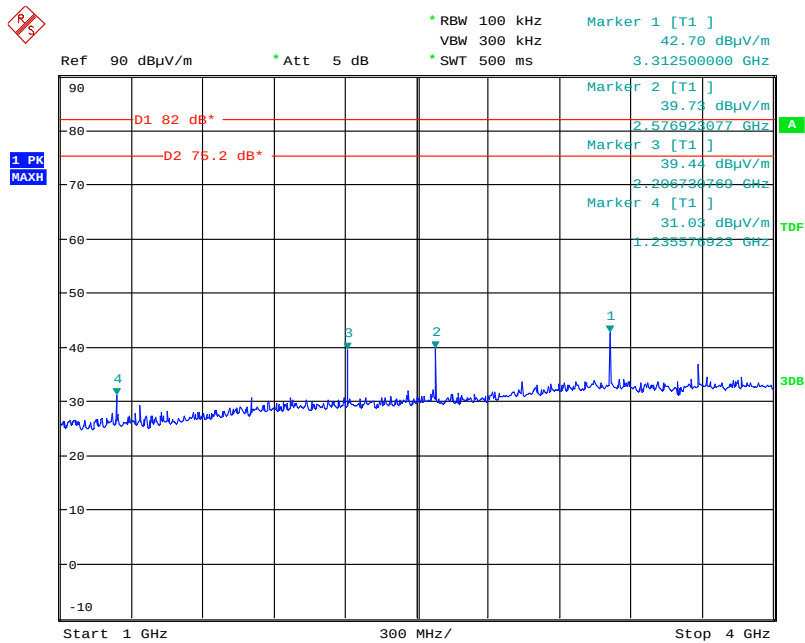
13GHz – 16GHz

Field Strength of Spurious Emissions

SPD650 - 412.950 MHz



30MHz – 1 GHz

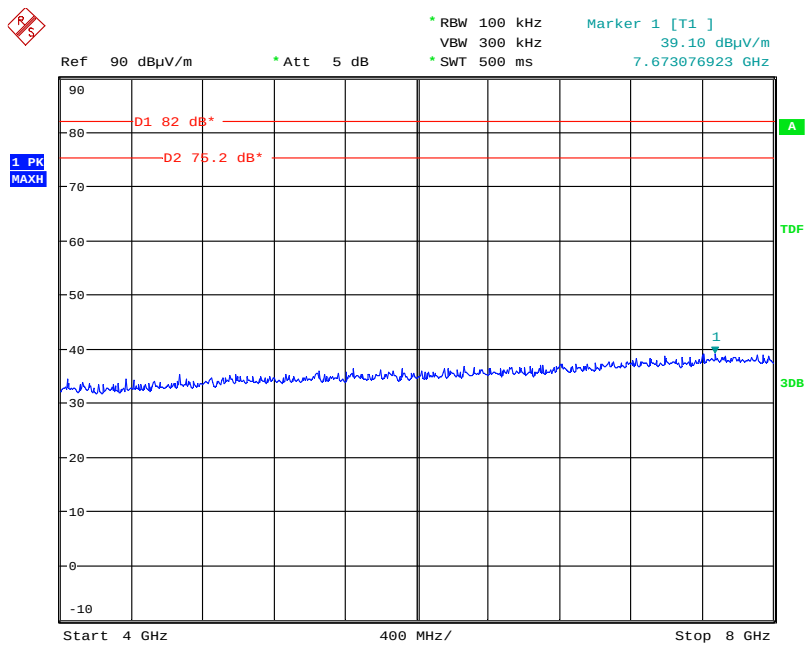


Date: 5.APR.2013 10:55:05

1 GHz – 4 GHz

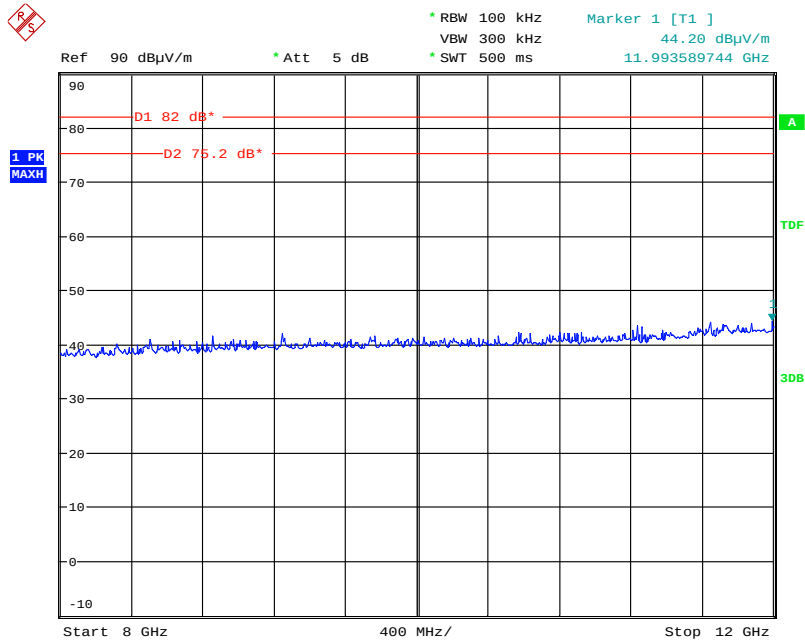
Field Strength of Spurious Emissions

SPD650 - 412.950 MHz



Date: 5.APR.2013 10:56:19

4 GHz – 8 GHz

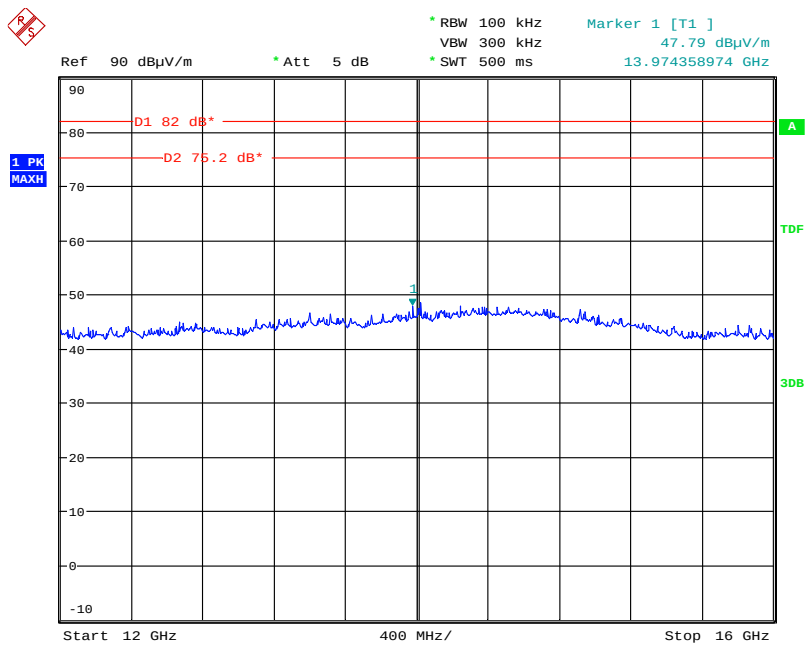


Date: 5.APR.2013 10:58:11

8 GHz – 12 GHz

Field Strength of Spurious Emissions

SPD650 - 412.950 MHz

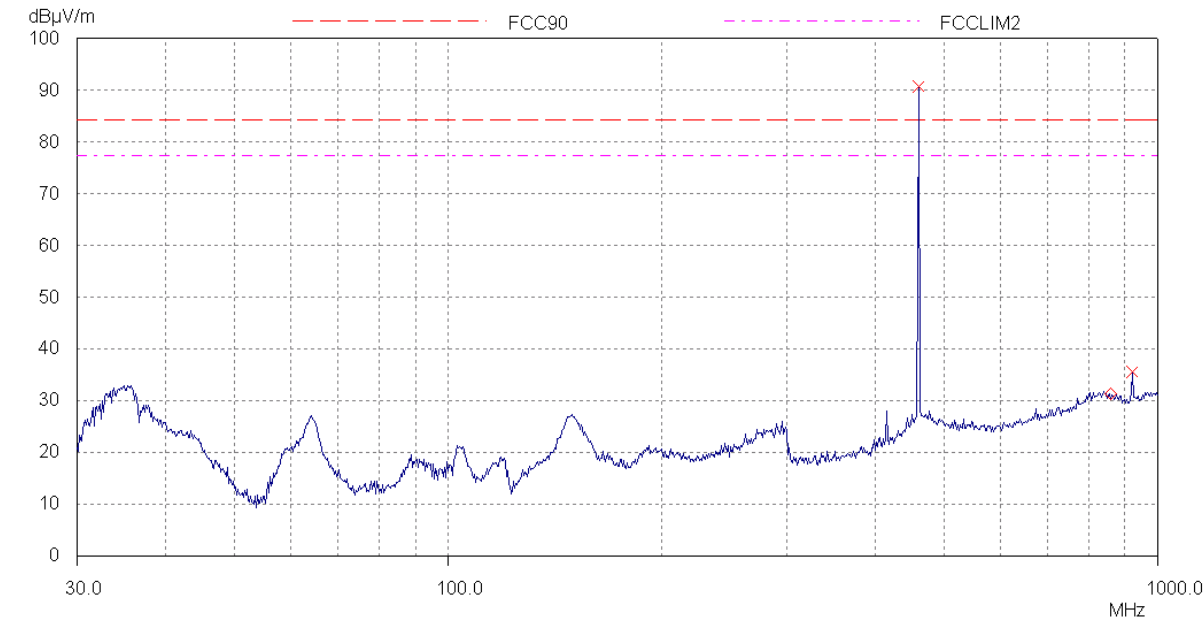


Date: 5.APR.2013 10:59:25

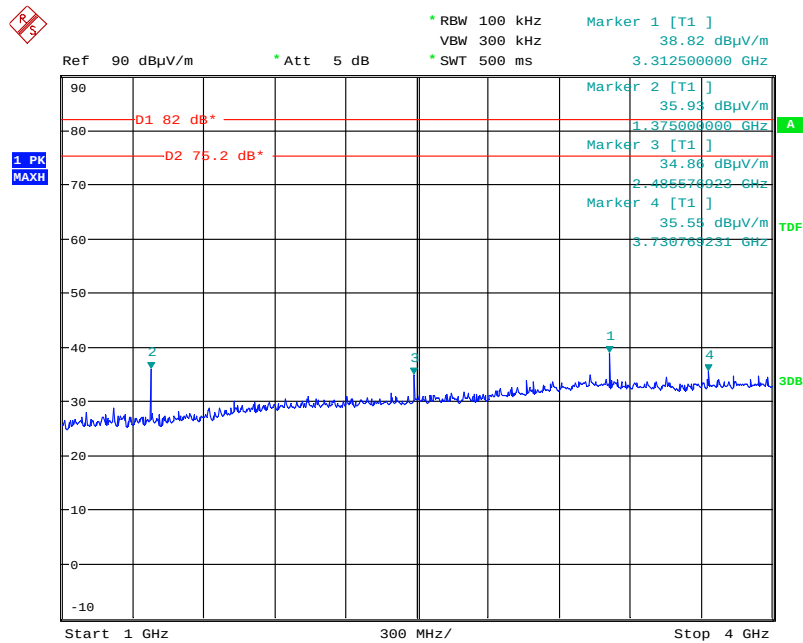
12 GHz – 16 GHz

Field Strength of Spurious Emissions

SPD650 – 459.075MHz



30M Hz – 1 GHz

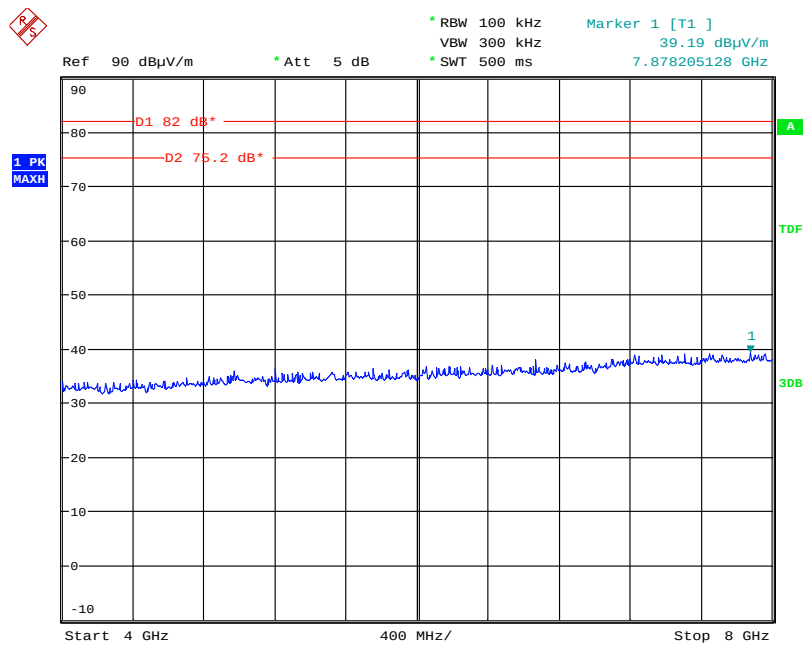


Date: 5.APR.2013 11:33:50

1 GHz – 4 GHz

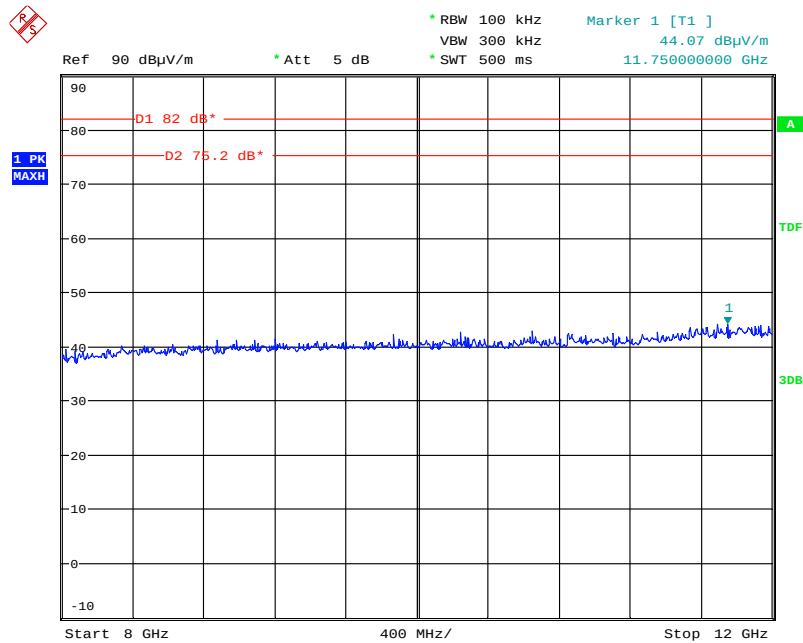
Field Strength of Spurious Emissions

SPD650 – 459.075MHz



Date: 5.APR.2013 11:35:15

4 GHz – 8 GHz

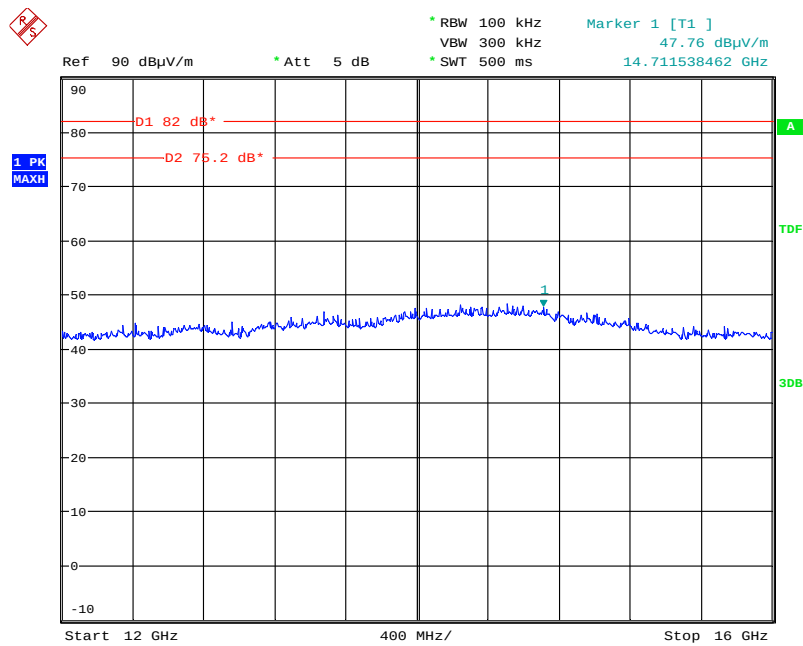


Date: 5.APR.2013 11:36:52

8 GHz – 12 GHz

Field Strength of Spurious Emissions

SPD650 – 459.075MHz

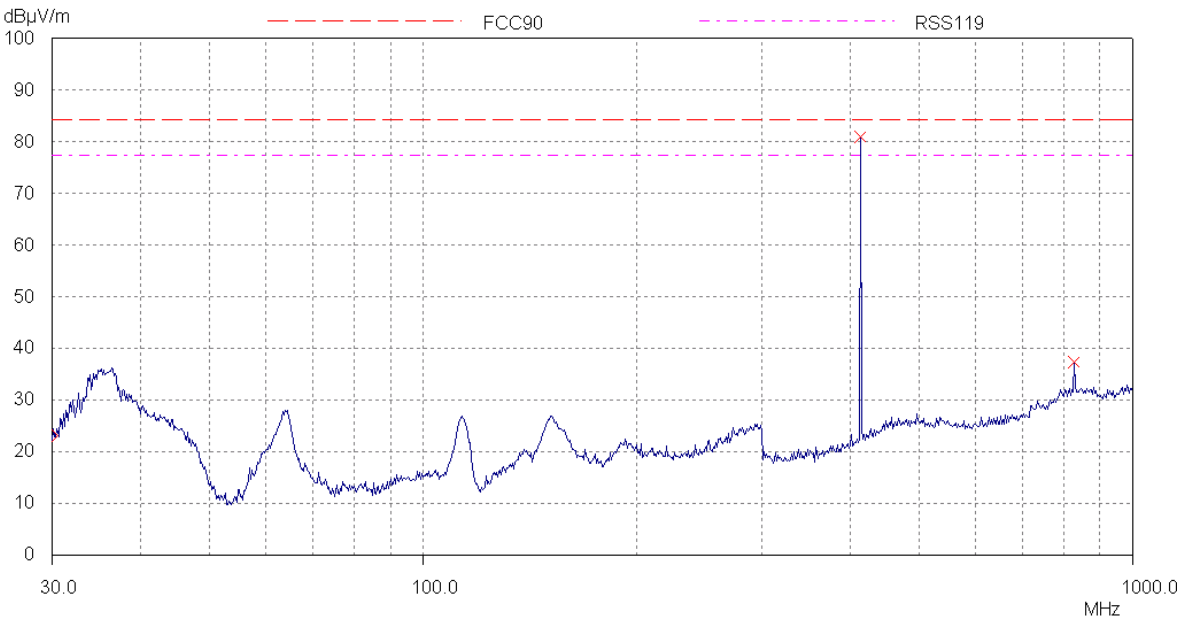


Date: 5.APR.2013 11:37:53

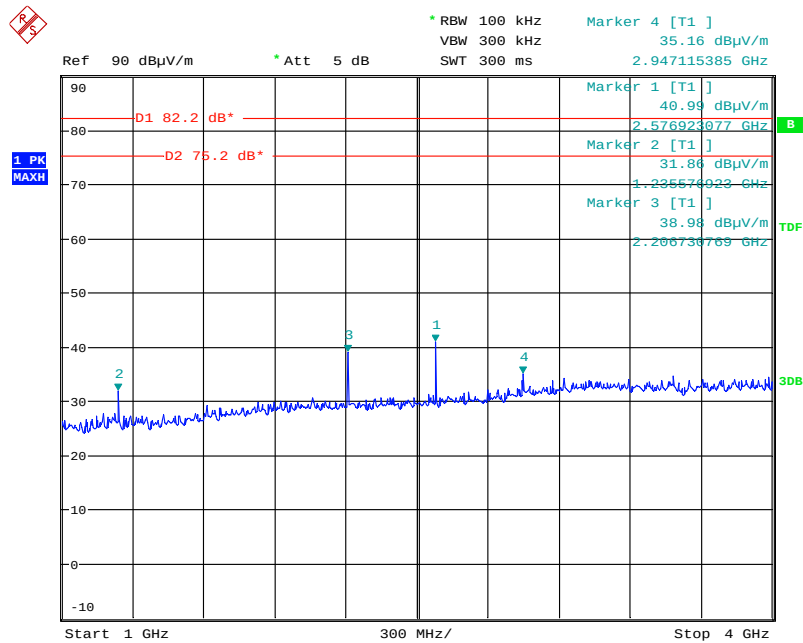
12 GHz – 16 GHz

Field Strength of Spurious Emissions

SPD660 - 412.950 MHz



30MHz – 1 GHz

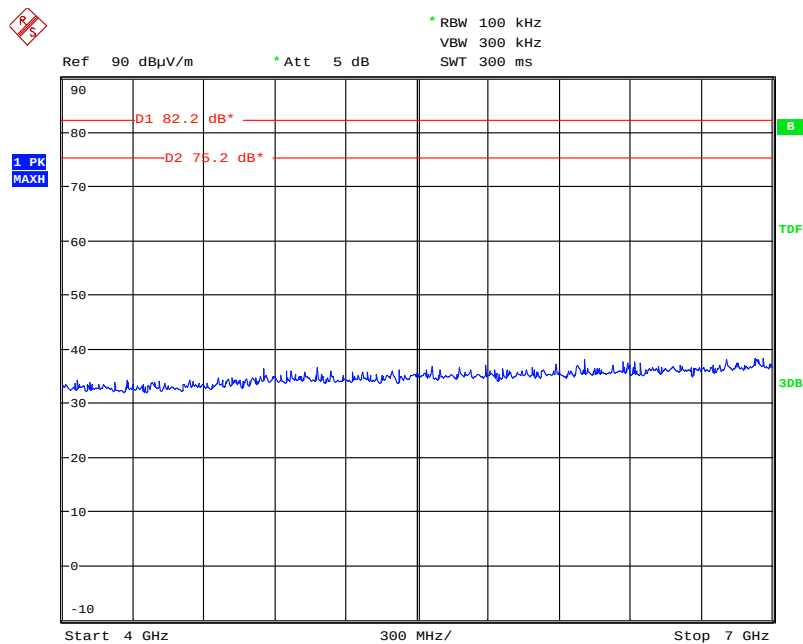


Date: 22.APR.2013 10:04:12

1 GHz – 4 GHz

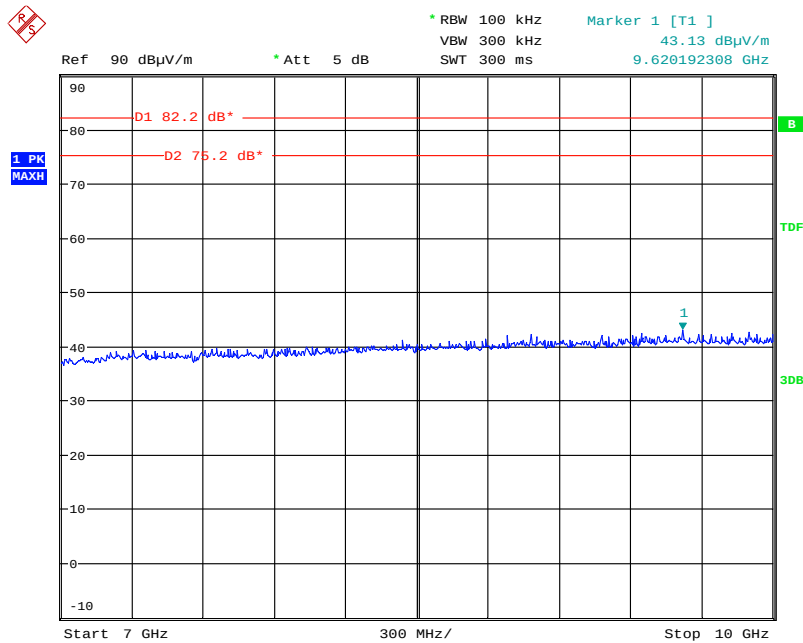
Field Strength of Spurious Emissions

SPD660 - 412.950 MHz



Date: 22.APR.2013 10:05:50

4 GHz – 7 GHz

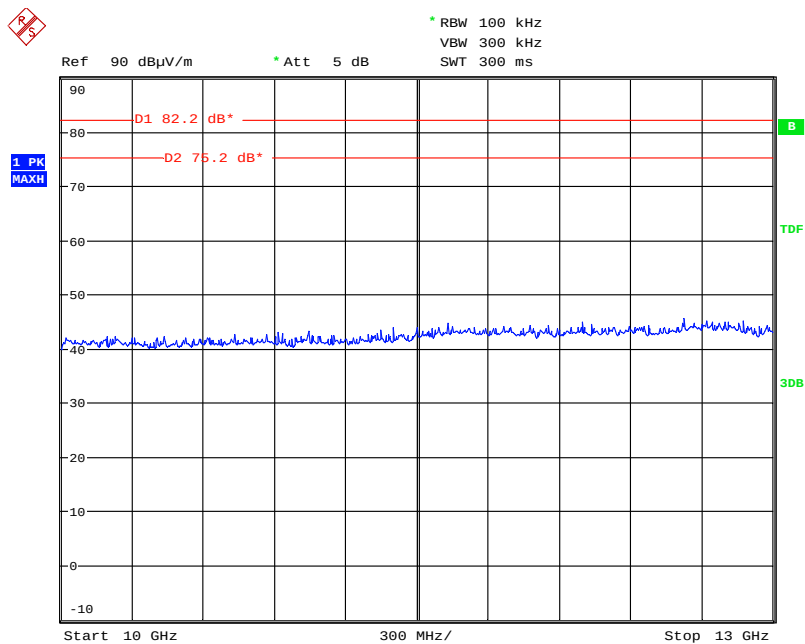


Date: 22.APR.2013 10:09:54

7 GHz – 10 GHz

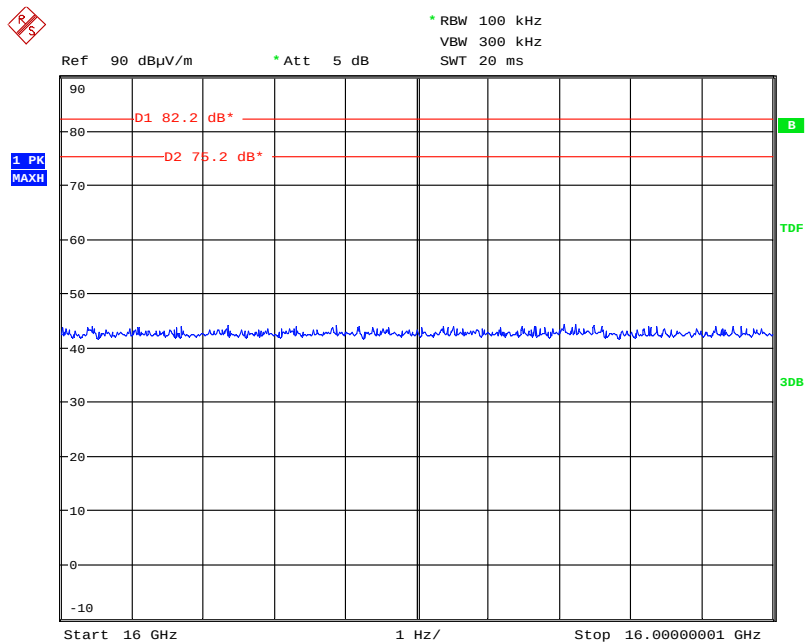
Field Strength of Spurious Emissions

SPD660 - 412.950 MHz



Date: 22.APR.2013 10:11:30

10 GHz – 13 GHz

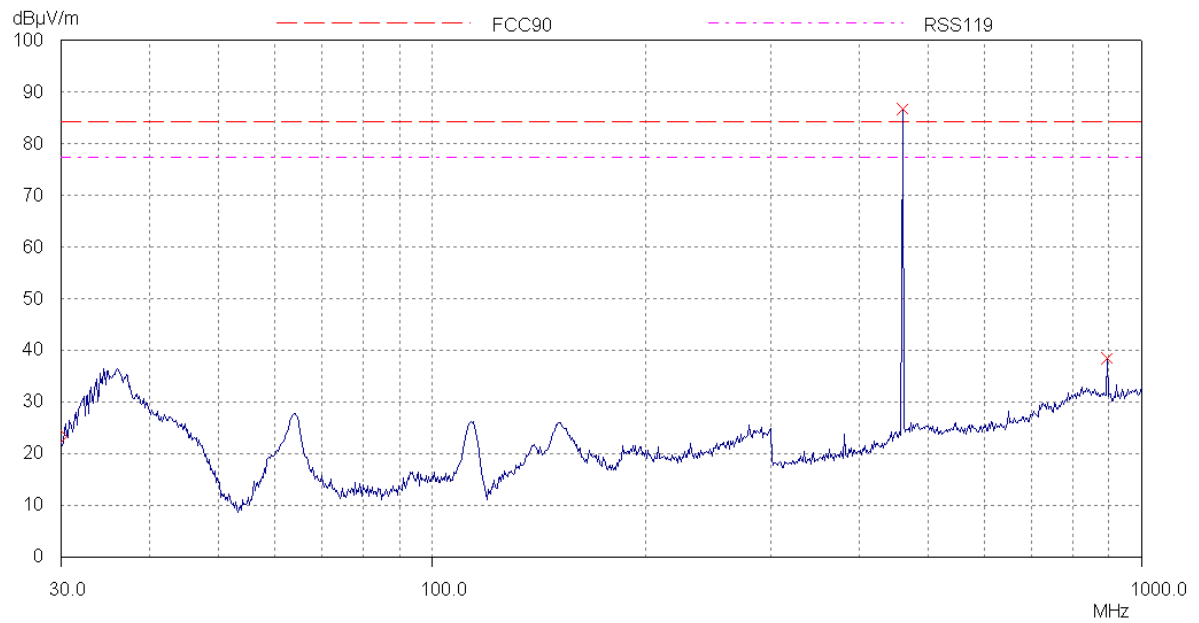


Date: 22.APR.2013 10:15:32

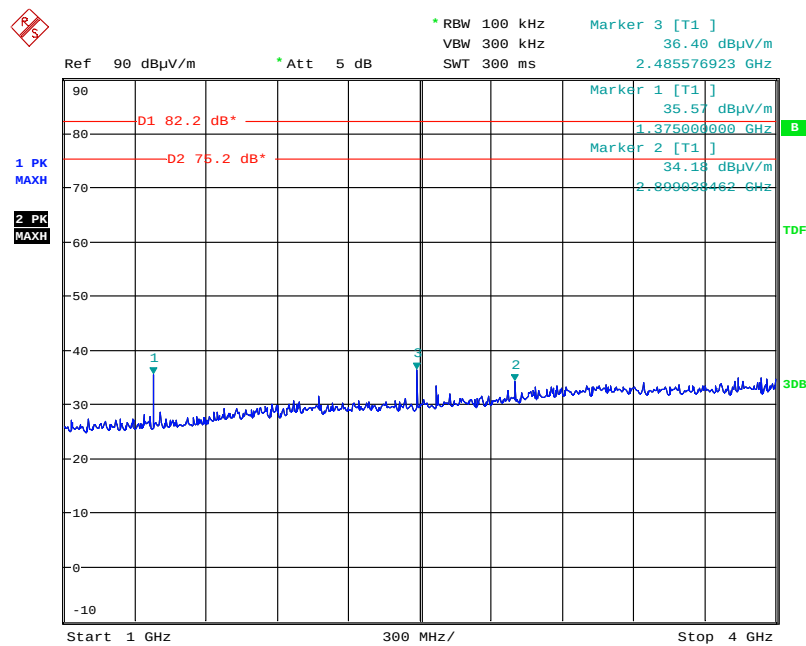
13 GHz – 16 GHz

Field Strength of Spurious Emissions

SPD660 – 459.075MHz



30M Hz – 1 GHz

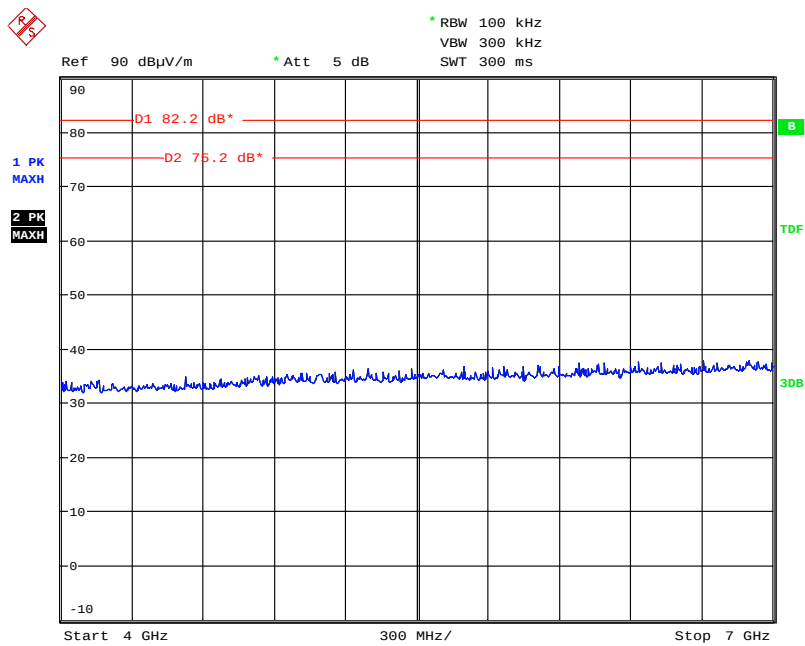


Date: 22.APR.2013 09:44:05

1 GHz – 4 GHz

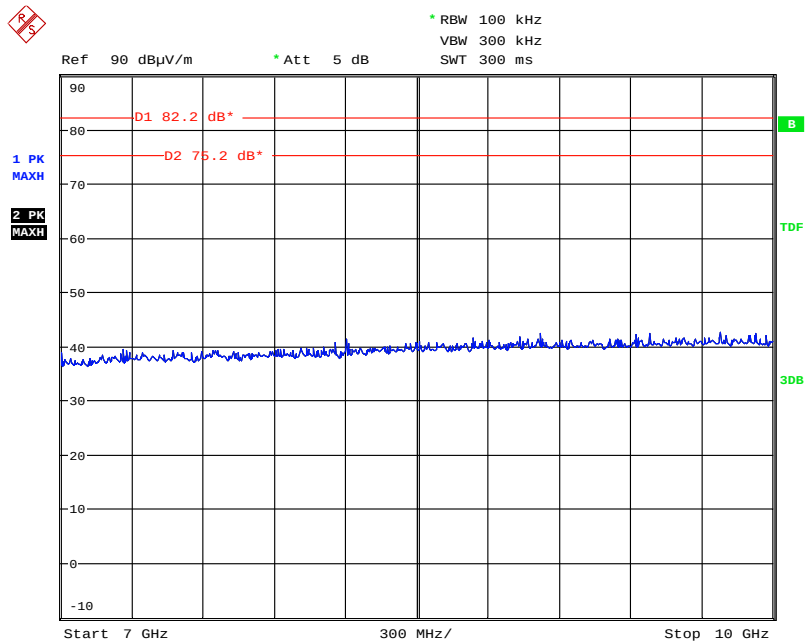
Field Strength of Spurious Emissions

SPD660 – 459.075MHz



Date: 22.APR.2013 09:47:54

4 GHz – 7 GHz

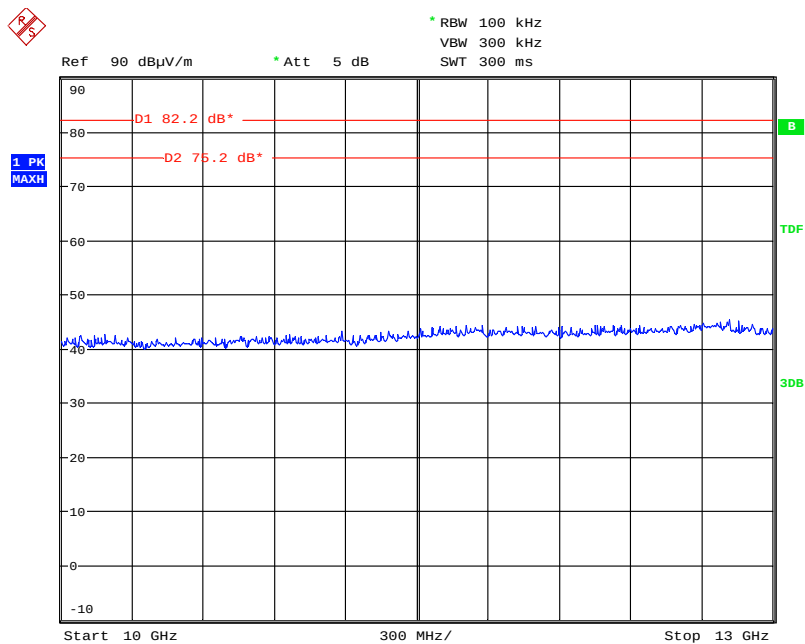


Date: 22.APR.2013 09:49:32

7 GHz – 10 GHz

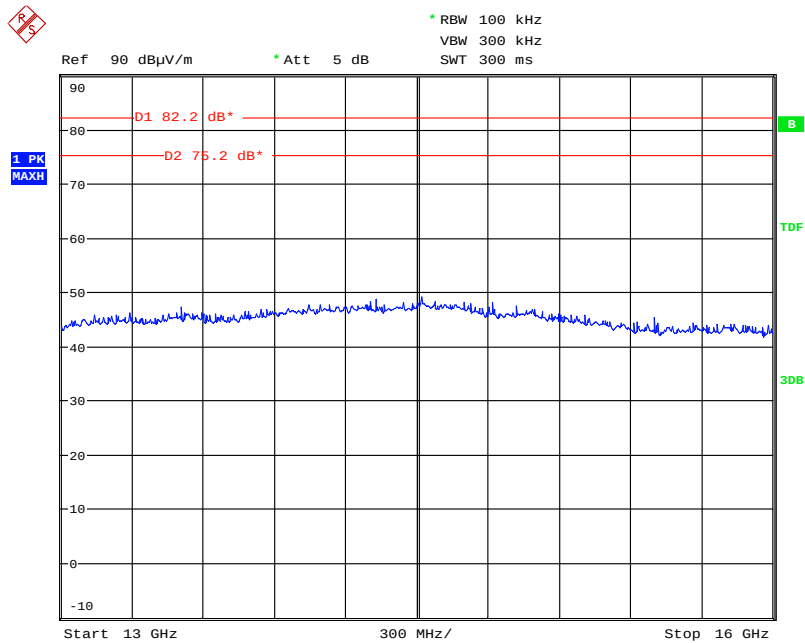
Field Strength of Spurious Emissions

SPD660 – 459.075MHz



Date: 22.APR.2013 09:57:02

10 GHz – 13 GHz

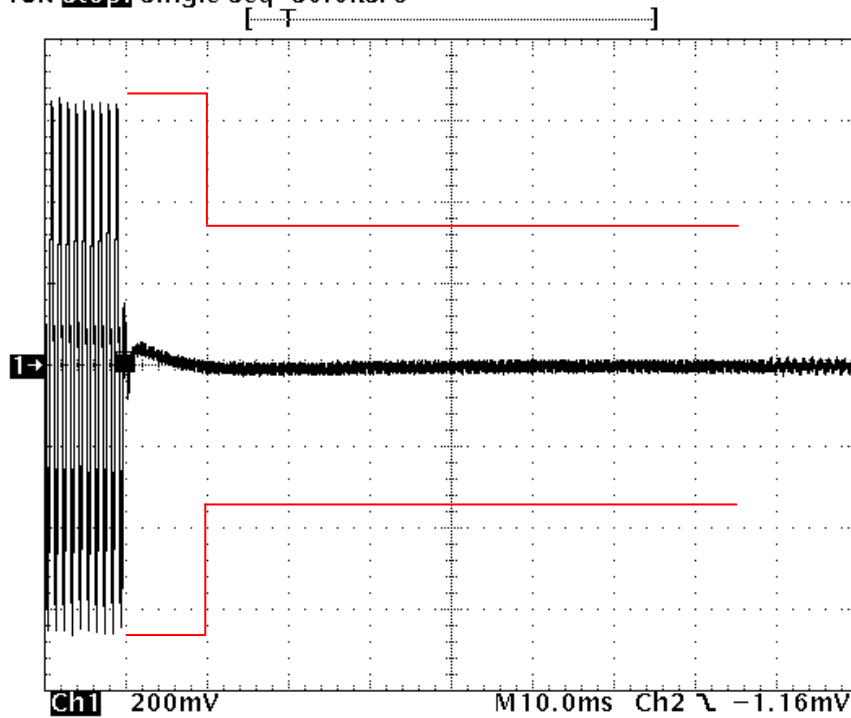


Date: 22.APR.2013 09:58:44

13 GHz – 16 GHz

412.950 MHz On Transient – 12.5 kHz

Tek **Stop**: Single Seq 50.0kS/s



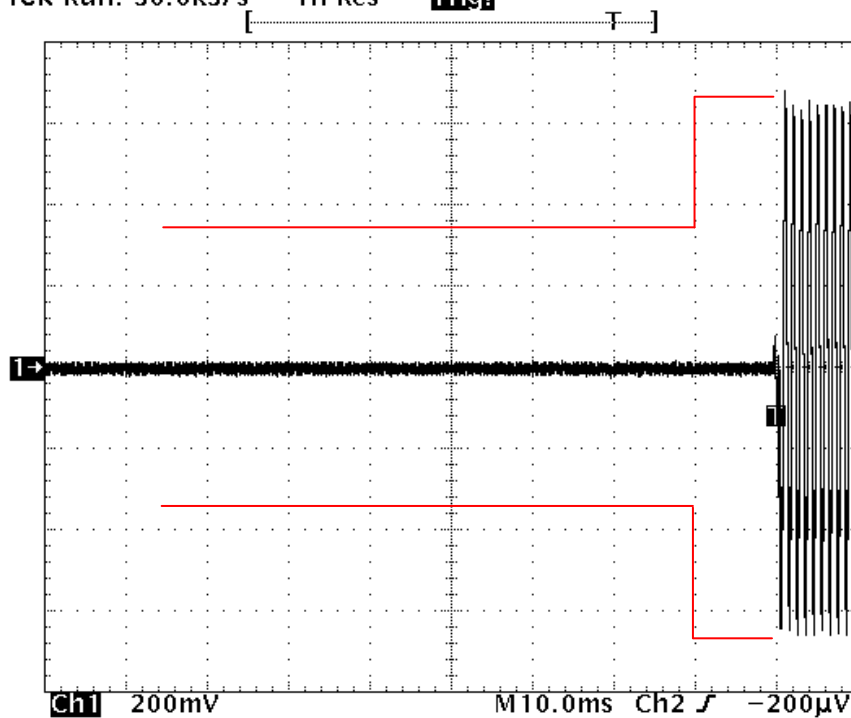
28 Mar 2013
14:21:58

412.950 MHz Off Transient – 12.5 kHz

Tek Run: 50.0kS/s

Hi Res

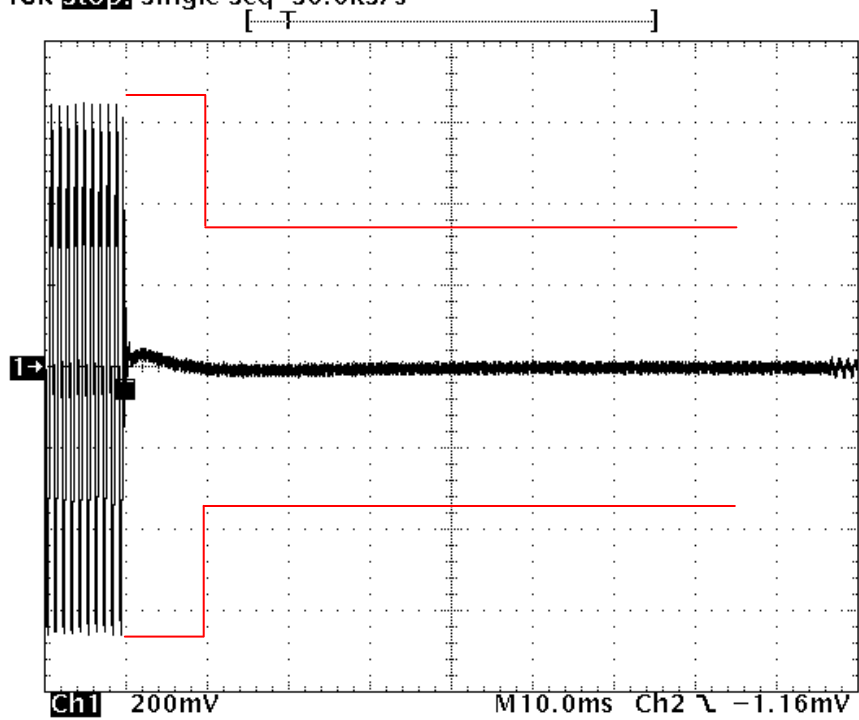
Trig?



28 Mar 2013
14:40:24

459.075 MHz On Transient – 12.5 kHz

Tek **Stop** Single Seq 50.0kS/s



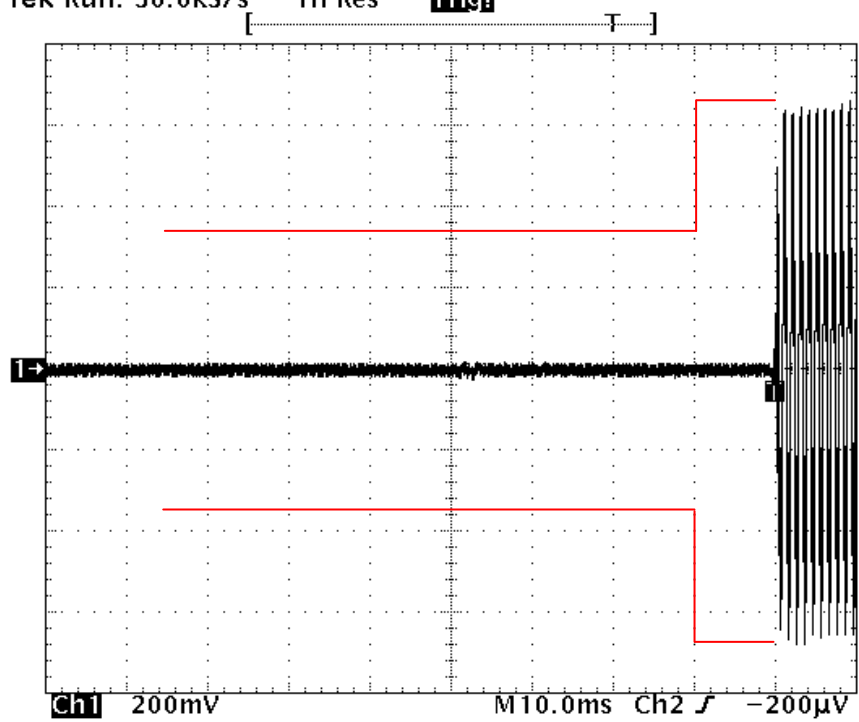
28 Mar 2013
14:22:26

459.075 MHz Off Transient – 12.5 kHz

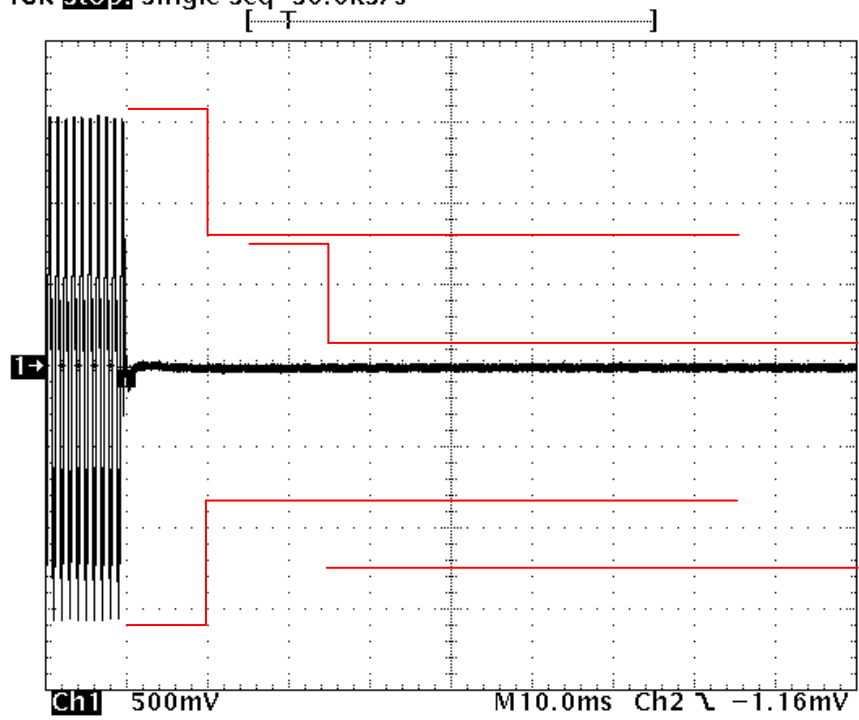
Tek Run: 50.0kS/s

Hi Res

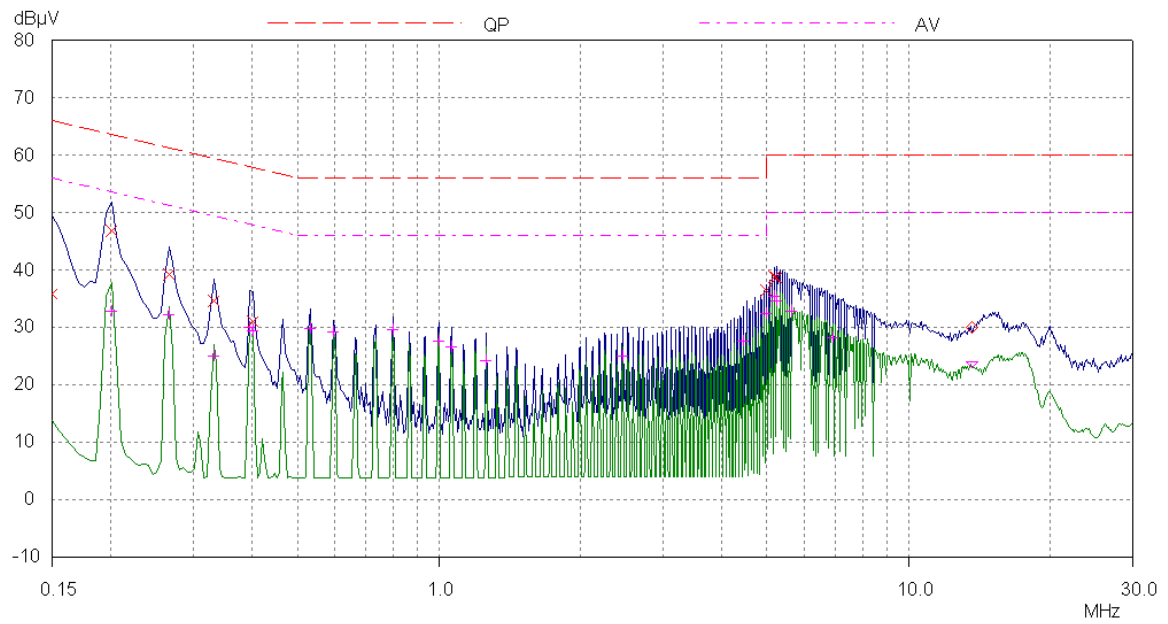
Trig2



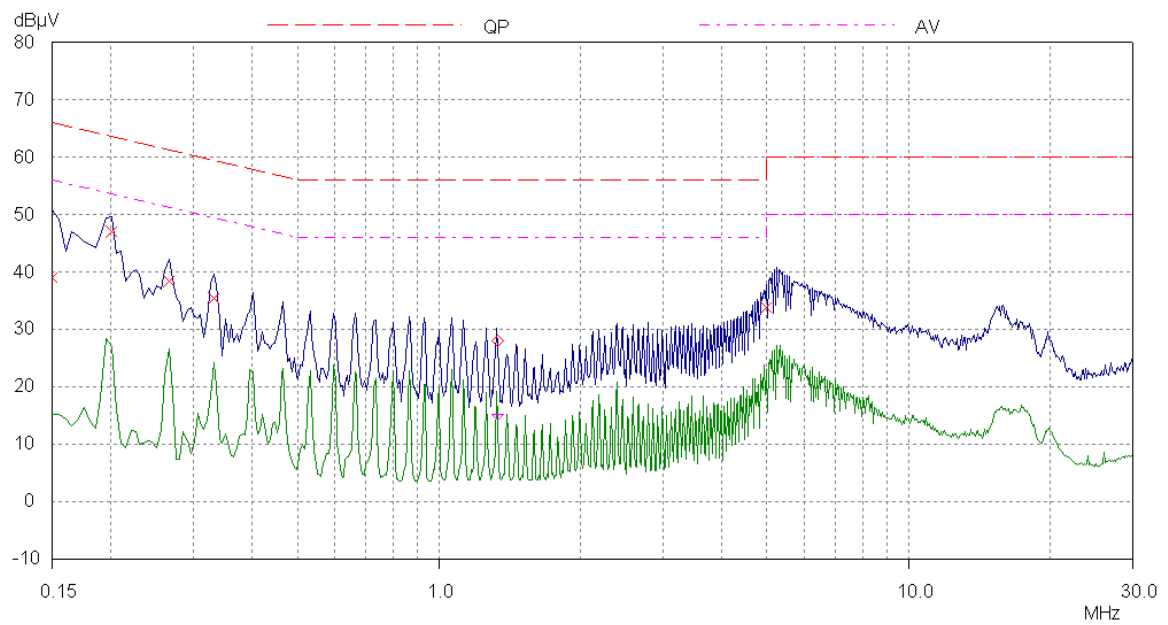
28 Mar 2013
14:39:36

Tek **Stop** Single Seq 50.0kS/s28 Mar 2013
14:27:35

SPD 650 - AC powerline Conducted Emissions EUT in RX mode

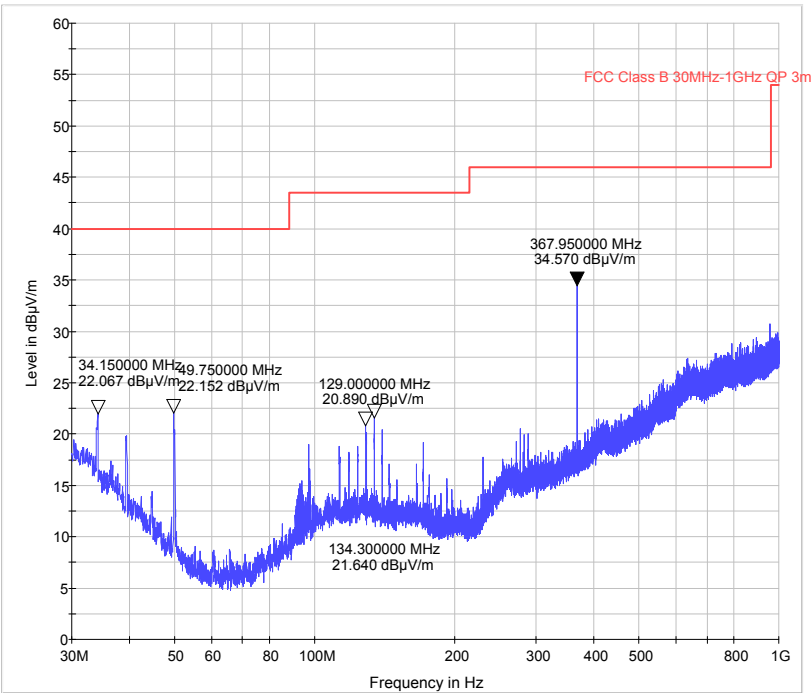


SPD 660 - AC powerline Conducted Emissions EUT in RX mode

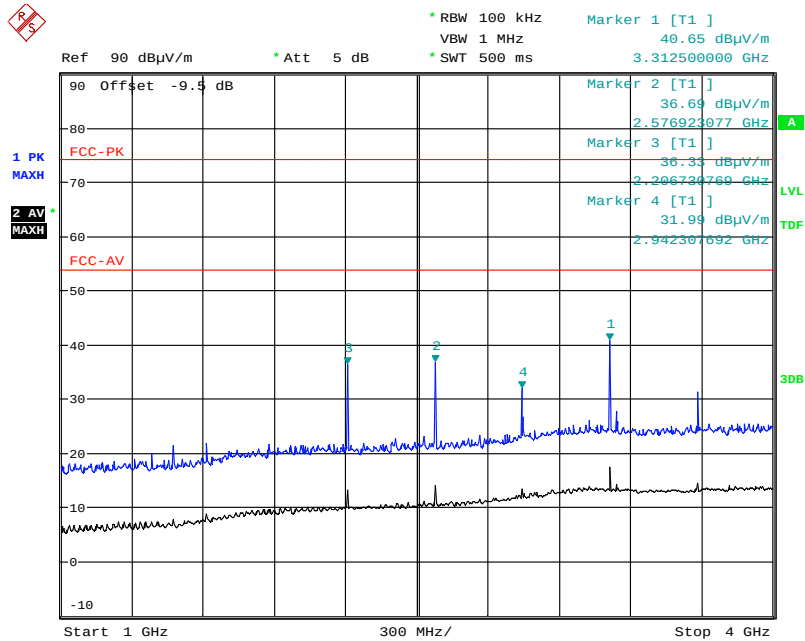


Field Strength of Un-intentional Spurious Emissions

SPD650 - 412.950 MHz



30M Hz – 1 GHz

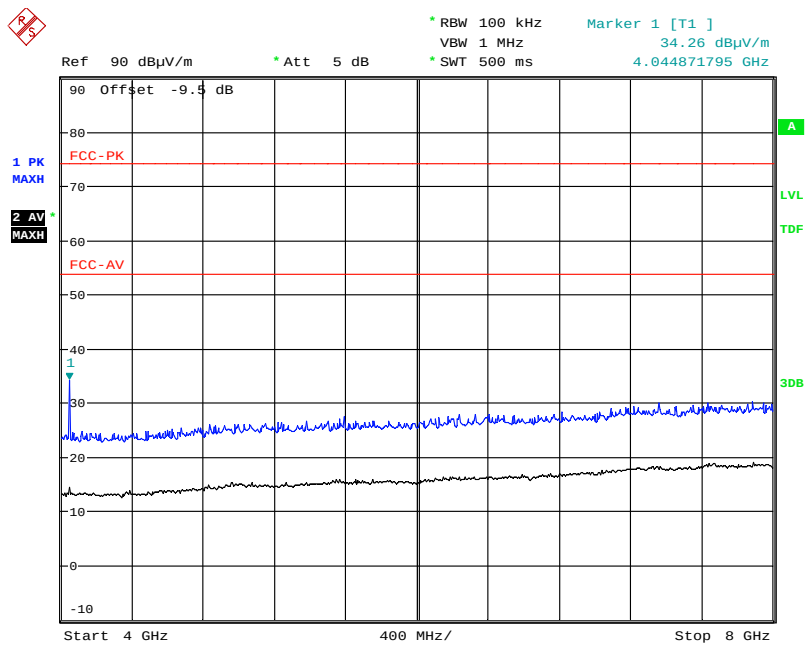


Date: 5.APR.2013 09:27:51

1 GHz –4 GHz

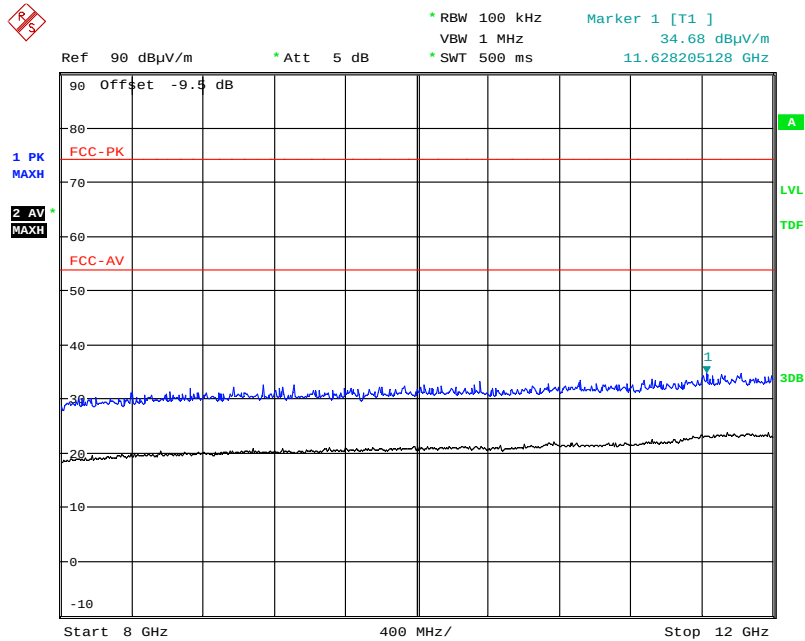
Field Strength of Un-intentional Spurious Emissions

SPD650 - 412.950 MHz



Date: 5.APR.2013 09:29:16

4GHz – 8GHz

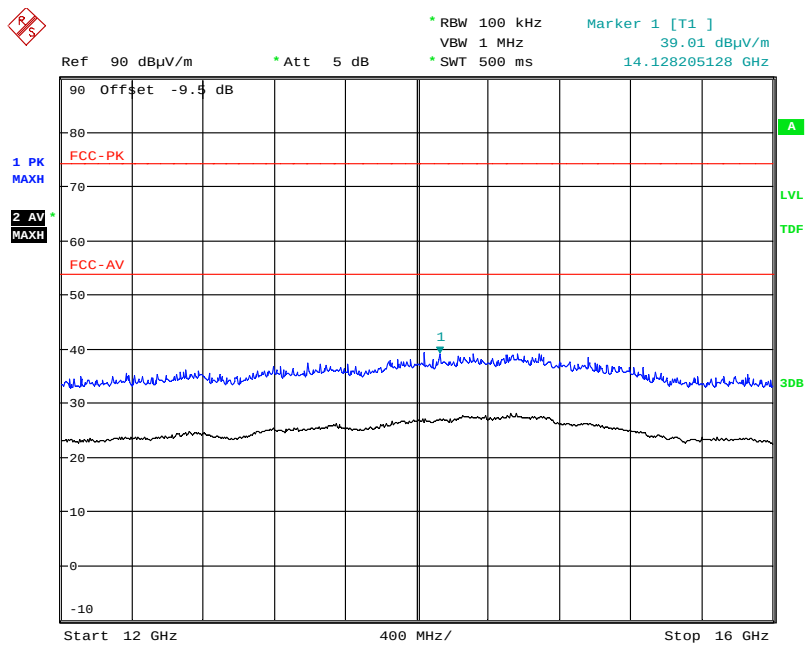


Date: 5.APR.2013 09:30:19

8GHz – 12GHz

Field Strength of Un-intentional Spurious Emissions

SPD650 - 412.950 MHz

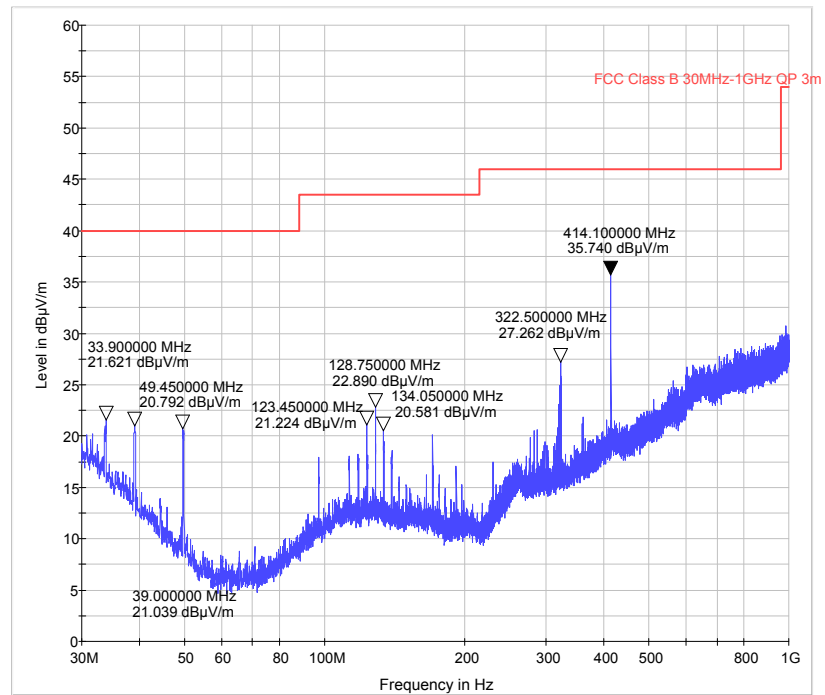


Date: 5.APR.2013 09:32:13

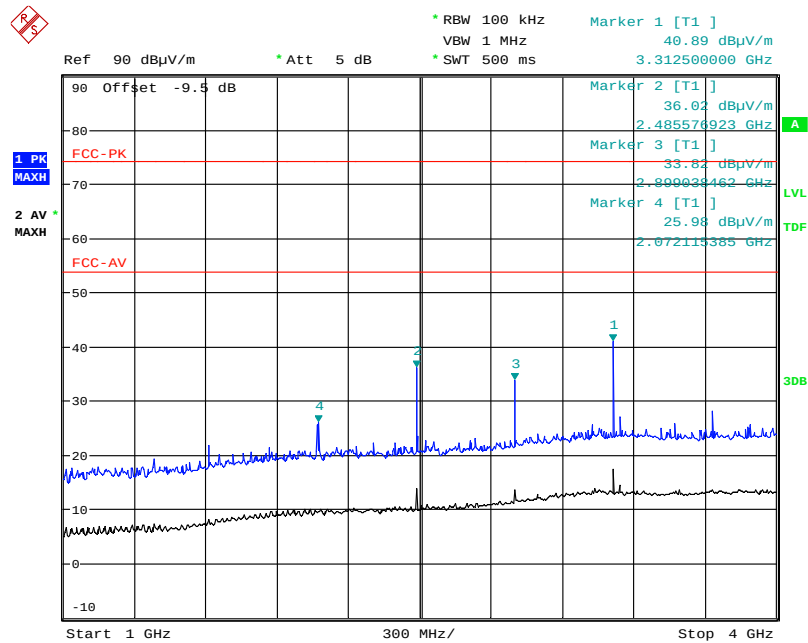
12GHz – 16GHz

Field Strength of Un-intentional Spurious Emissions

SPD650 - 459.075 MHz



30M Hz – 1 GHz

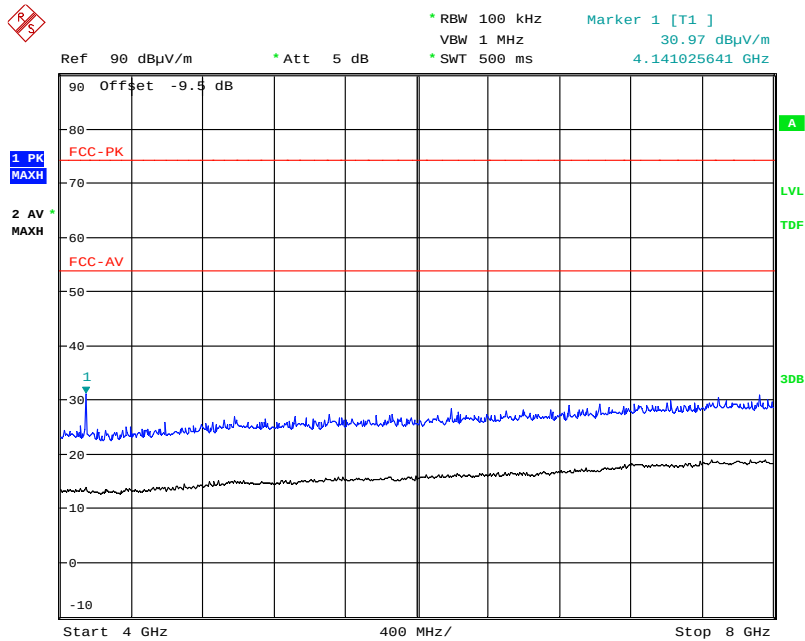


Date: 5.APR.2013 09:45:50

1 GHz – 4 GHz

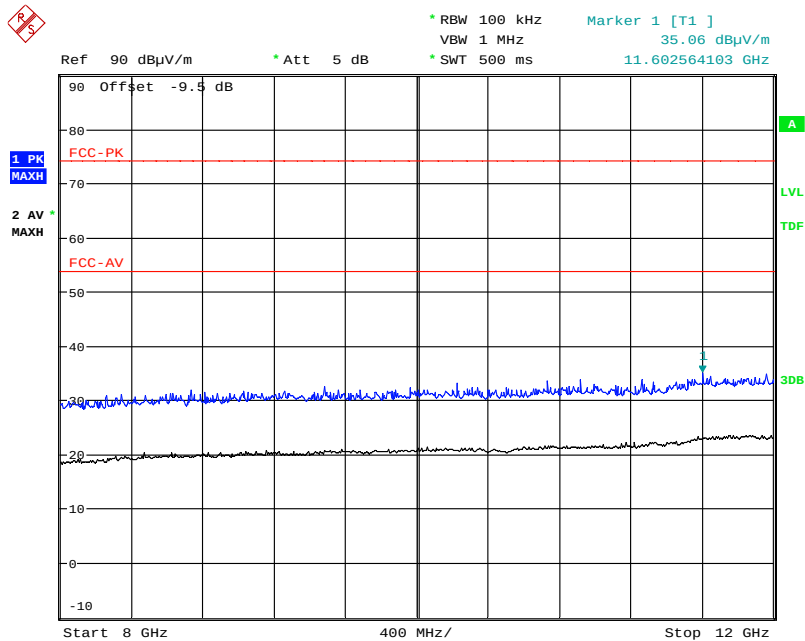
Field Strength of Un-intentional Spurious Emissions

SPD650 - 459.075 MHz



Date: 5.APR.2013 09:47:06

4GHz – 8GHz

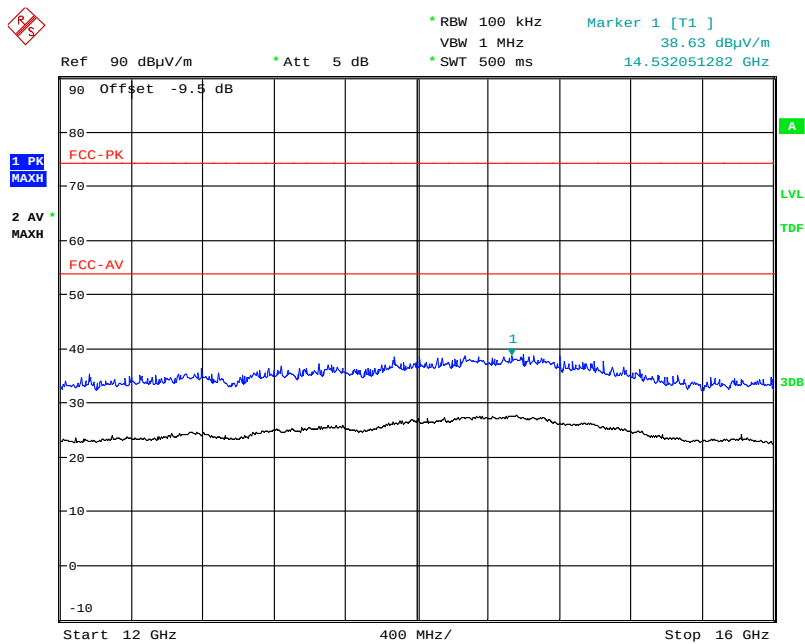


Date: 5.APR.2013 09:48:13

8GHz – 12GHz

Field Strength of Un-intentional Spurious Emissions

SPD650 - 459.075 MHz



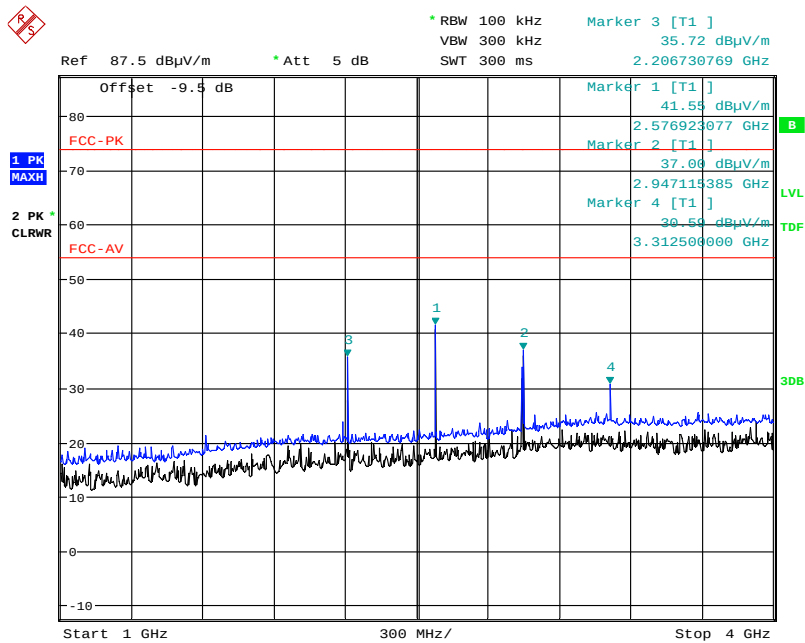
Date: 5.APR.2013 09:49:22

12GHz – 16GHz

Field Strength of Un-intentional Spurious Emissions

SPD660 - 412.950 MHz

30M Hz – 1 GHz

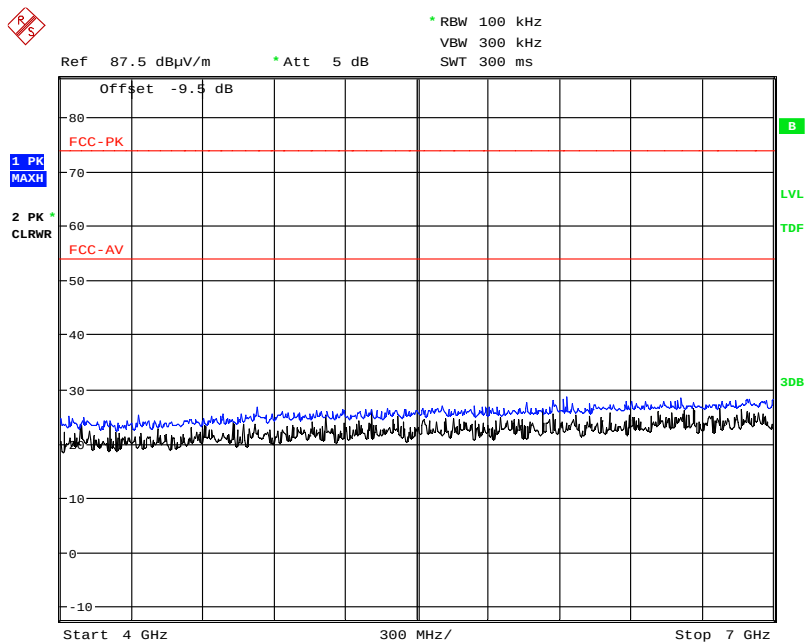


Date: 22.APR.2013 08:47:47

1 GHz –4 GHz

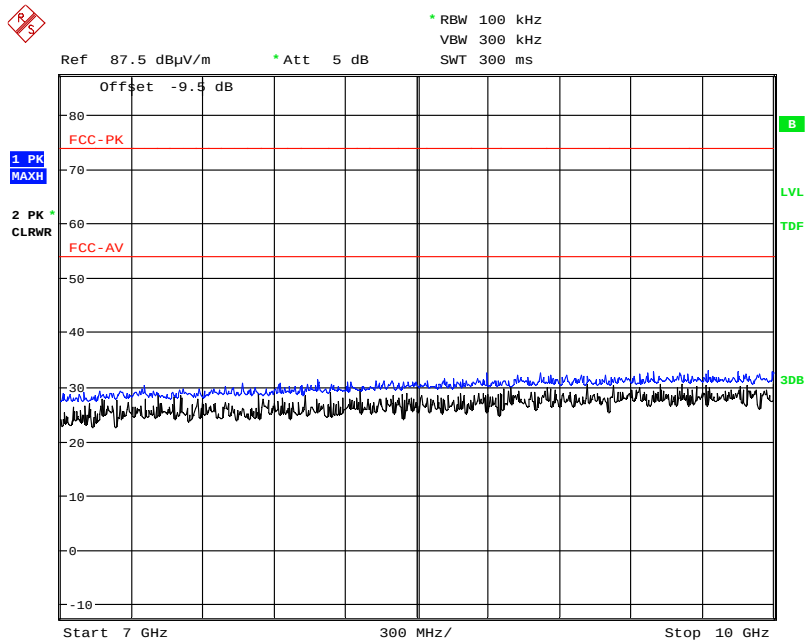
Field Strength of Un-intentional Spurious Emissions

SPD660 - 412.950 MHz



Date: 22.APR.2013 08:58:50

4GHz – 7GHz

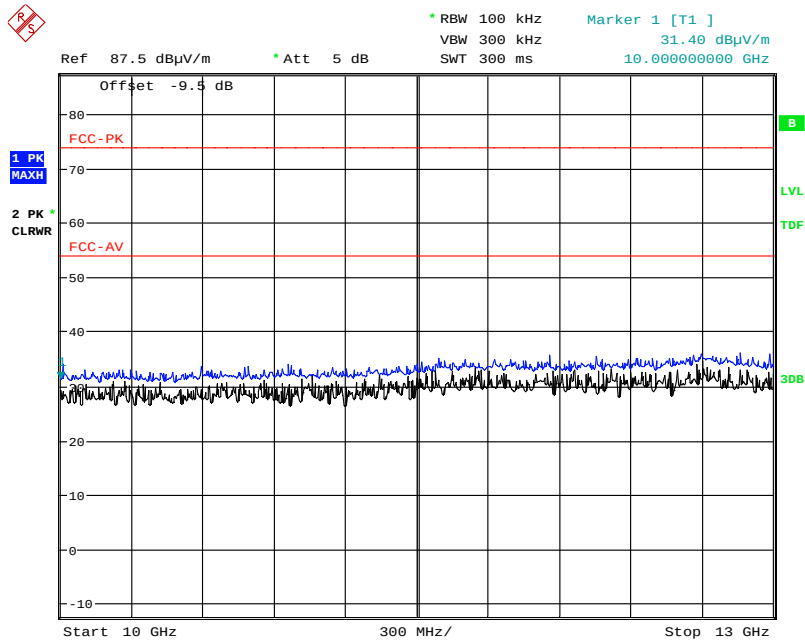


Date: 22.APR.2013 09:00:49

7GHz – 10GHz

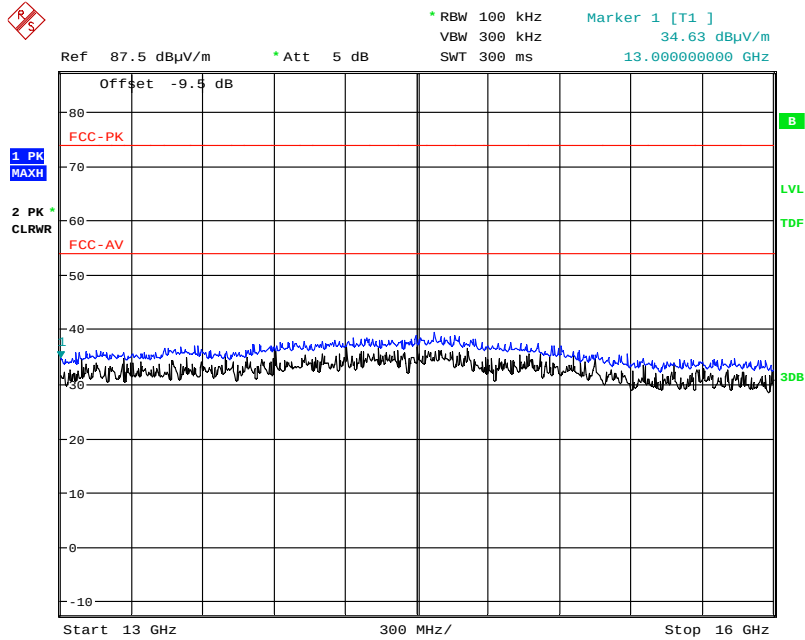
Field Strength of Un-intentional Spurious Emissions

SPD660 - 412.950 MHz



Date: 22.APR.2013 09:06:08

10GHz – 13GHz

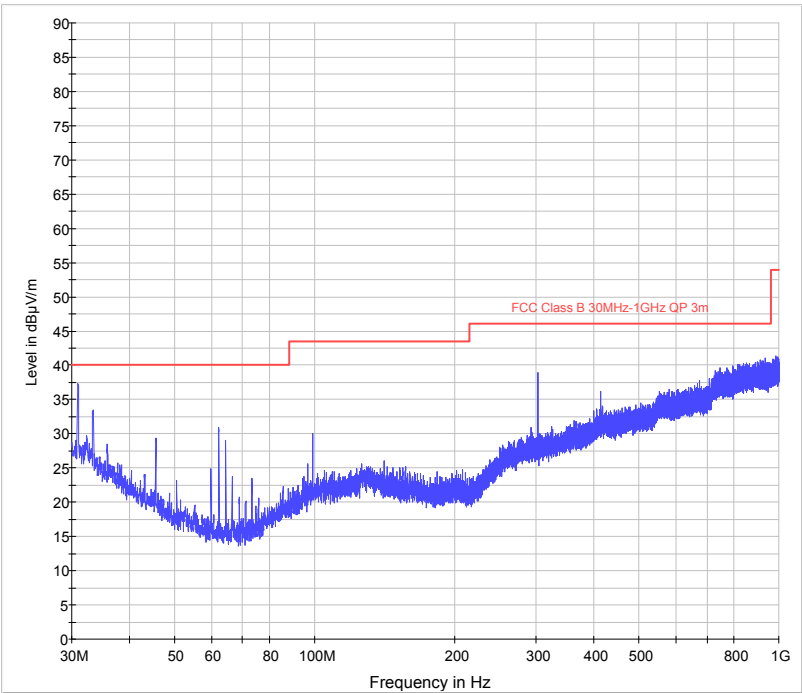


Date: 22.APR.2013 09:08:14

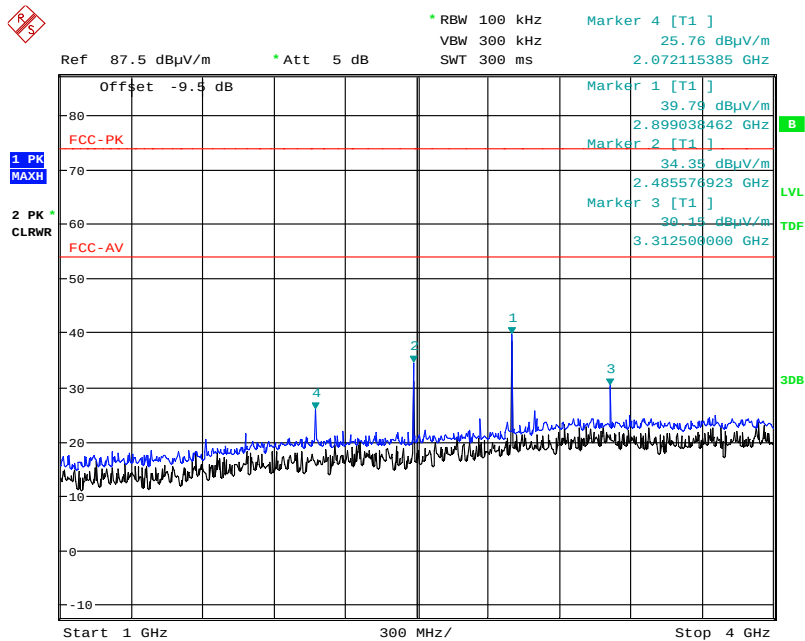
13GHz – 16GHz

Field Strength of Un-intentional Spurious Emissions

SPD660 - 459.075 MHz



30M Hz – 1 GHz

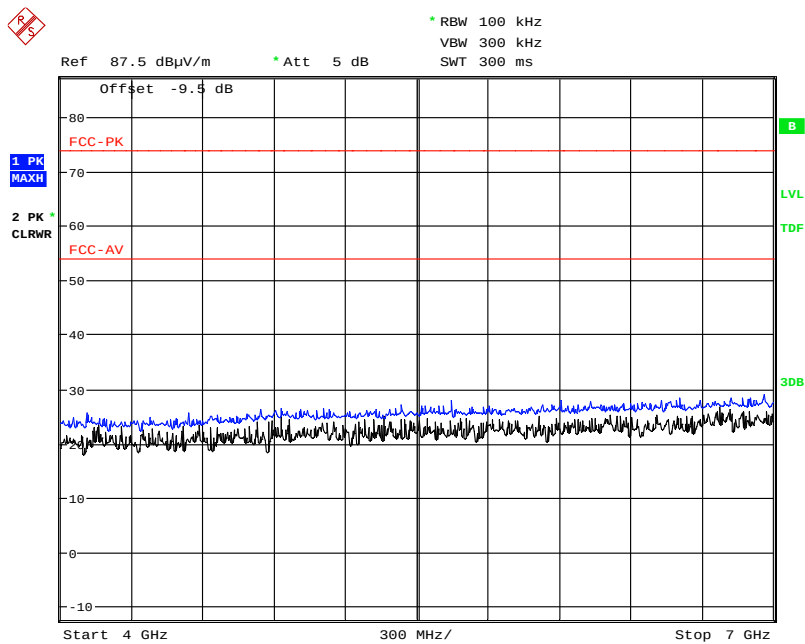


Date: 22.APR.2013 09:14:29

1 GHz –4 GHz

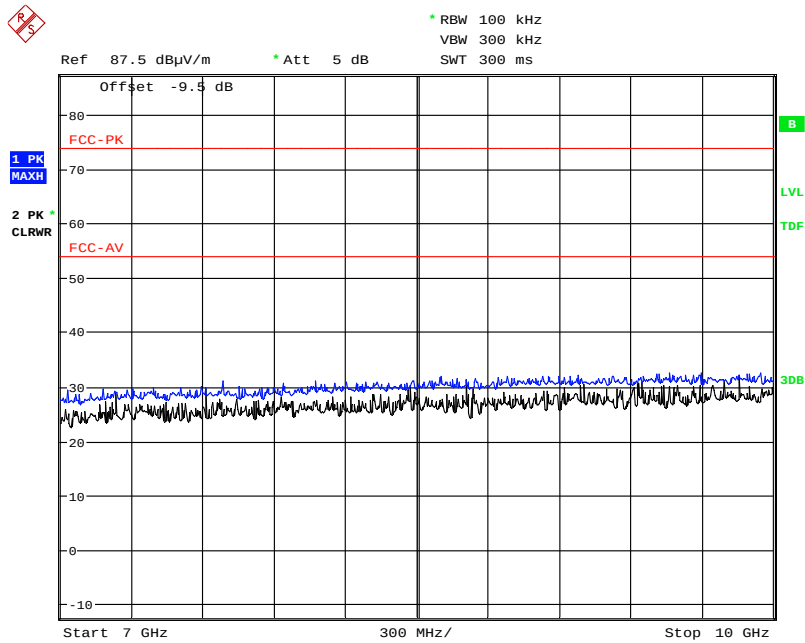
Field Strength of Un-intentional Spurious Emissions

SPD660 - 459.075 MHz



Date: 22.APR.2013 09:16:40

4GHz – 7GHz

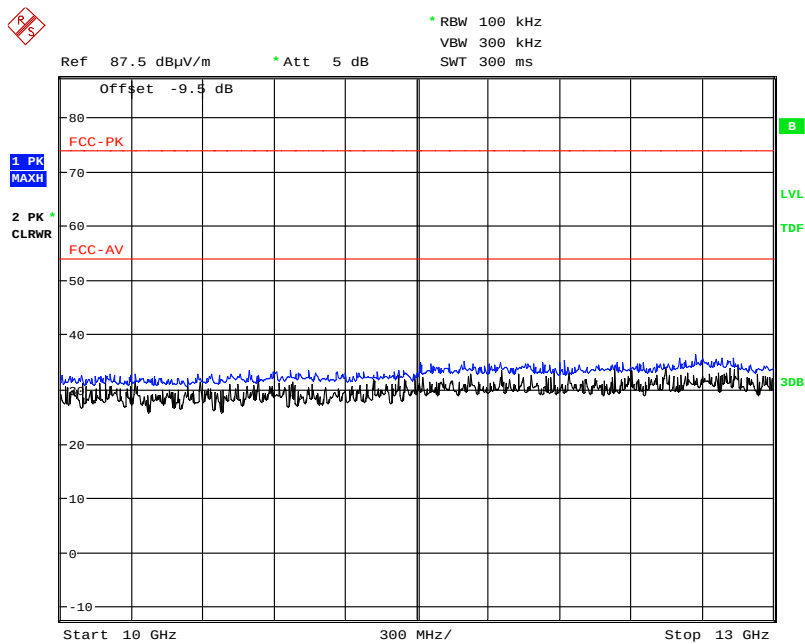


Date: 22.APR.2013 09:21:37

7GHz – 10GHz

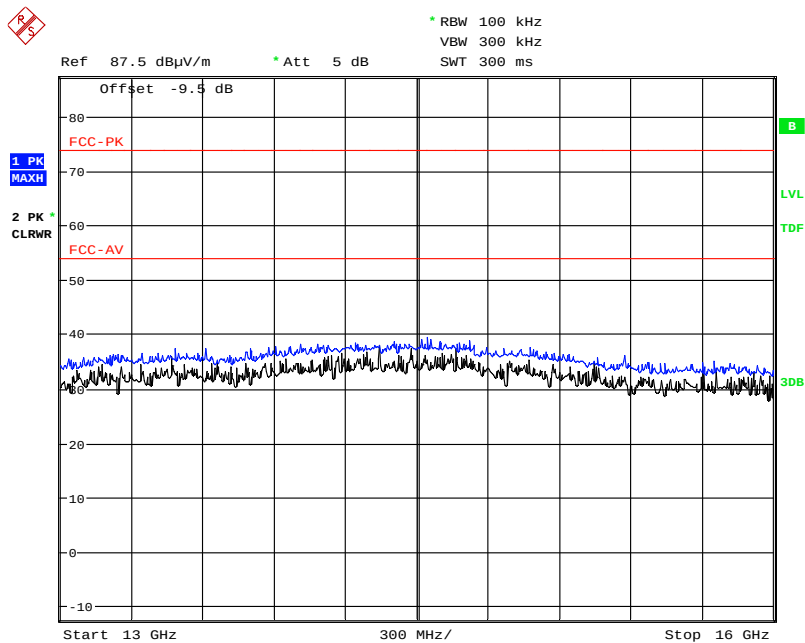
Field Strength of Un-intentional Spurious Emissions

SPD660 - 459.075 MHz



Date: 22.APR.2013 09:23:10

10GHz – 13GHz



Date: 22.APR.2013 09:33:56

13GHz – 16GHz

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.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

C1) Test samples

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

Sample No.	Description	Identification
S02	SPD650	36NTU125100
S04	SPD660	36KTU125100N

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

Sample No.	Description	Identification
S01	Charger	36NTU125100
S08	Antenna	None
S12	AC Adaptor	None
None	Interface / Control PCB	None
None	Mic / Speaker Handset	None

The following samples of apparatus were supplied by TRaC Global as support or drive equipment (auxiliary equipment):

Identification	Description
None	

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	EUT transmitting on the required frequency with / without modulation and set to 12.5 kHz as required

Test	Description of Operating Mode:
Receiver conducted and radiated (ERP) spurious emissions	EUT active but non-transmitting.

Test	Description of Operating Mode:
PLCE	EUT Active but not transmitting

C3) EUT Configuration Information.

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

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S02 & S04
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna Port	Coaxial cable	1m	Measuring setup
Handset port	Multicore cable	1m	Interface / Control PCB

Sample : S02 & S04
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Antenna Port	None	0	50Ω Load (TX Mode)
Antenna Port	None	0	Antenna (RX Mode)
Charging port	None (Seated in charger)	0	S01

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH004	ESVS10	Receiver	R&S	11/02/2013	12	11/02/2014
UH028	UHALP 9108	Log Periodic Ant	Schwarbeck	17/06/2011	24	17/06/2013
UH029	VHBA 9123	Bicone Antenna	Schwarbeck	17/06/2011	24	17/06/2013
UH093	CBL6112B	Bilog	Chase	20/06/2011	24	20/06/2013
UH096	6960B	Power meter	Marconi	04/11/2012	12	04/11/2013
UH122	TDS520B	Oscilloscope	Tektronix	11/04/2012	24	11/04/2014
UH129	6924	Power Sensor	Marconi	03/12/2012	12	03/12/2013
UH187	ESHS10	Receiver	R&S	11/02/2013	12	11/02/2014
UH191	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
UH195	ESH3-Z5.831.5	Lisn	R&S	01/06/2012	12	01/06/2013
UH228	6920	Power Sensor	Marconi	03/12/2012	12	03/12/2013
UH281	FSU46	Spectrum Analyser	R&S	06/03/2013	12	06/03/2014
UH385	HL 050	Log Periodic Antenna	R&S	16/07/2012	24	16/07/2014
UH387	ATS	Chamber 1	Rainford EMC	24/06/2012	12	24/06/2013
UH388	ATS	Chamber 2	Rainford EMC	22/06/2012	12	22/06/2013
UH403	ESCI 7	Recevier	R&S	27/06/2012	12	27/06/2013
UH405	FSU26	Spectrum Analyser	R&S	20/03/2013	12	20/03/2014
UH420	CBL6112	Bilog	Chase	06/07/2012	24	06/07/2014
L005	CMTA52	Communications Analyser	R&S	27/03/2013	12	27/03/2014
L007	hfh2	Loop Antenna	R&S	04/11/2011	24	04/11/2013
L138	3115	1-18GHz Horn	EMCO	08/11/2011	24	08/11/2013
L139	3115	1-18GHz Horn	EMCO	14/09/2011	24	14/09/2013
L176	2042	Signal Generator	Marconi	20/11/2012	12	20/11/2013
L254	2042	Signal Generator	Marconi	19/12/2012	12	19/12/2013
L193	VHA 9103 balu	Bicone Antenna	Chase	19/06/2012	24	19/06/2014
L203	UPA6108	Log Periodic Ant	Chase	19/06/2012	24	19/06/2014
L263/A	20240-20	Horn 18-26GHz	Flann	17/11/2011	24	17/11/2013
L290	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
L300	20240-20	Horn 18-26GHz (&UH330)	Flann	17/11/2011	24	17/11/2013
L317	ESVS10	Receiver	R&S	09/01/2013	12	09/01/2014
L426	52 Series II	Temperature Indicator	Fluke	29/04/2013	12	29/04/2014
L572	8449B	Pre Amp	Agilent	12/12/2012	24	12/12/2014
L654	8563A	Spectrum Analyser	HP	18/10/2012	12	18/10/2013
REF909	FSU26	Spectrum Analyser	R&S	04/02/2013	12	04/02/2014
REF916	SMBV100A	Signal Generator	R&S	23/07/2012	12	23/07/2013
REF940	ATS	Radio Chamber - PP	Rainford EMC	26/06/2012	12	26/06/2013
REF976	34405a	Multimeter	Agilent	26/04/2013	12	26/04/2014
REF977	SH4141	High Pass Filter	BSC	25/02/2013	24	25/02/2015

Appendix D:

Additional Information

No additional information is included within this test report.

Appendix F:

Photographs and Figures

The following photographs were taken of the test samples:

1. SPD650 - Radiated electric field emissions arrangement: Overview.
2. SPD650 - AC Powerline Conducted emissions arrangement: Overview.
3. SPD660 - Radiated electric field emissions arrangement: Overview.
4. SPD660 - AC Powerline Conducted emissions arrangement: Overview.



Photograph 1



Photograph 2



Photograph 3



Photograph 4

