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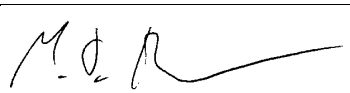
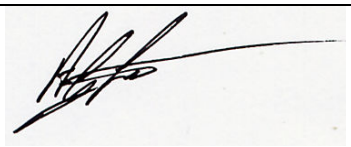
Test Report for a65, a67 and a68 Marine Multifunction Displays

To 47 CFR Part 15 Subpart C and RSS 210

Model Number	E70076. E70077, E70200		
Product Description	a65, a67 and a68 Marine Multifunction Displays		
Report Number	TP/808/1055b		
Report Author Mike Thompson EMC Engineer		Date	5th August 2013
Approval Andrew Little Compliance Manager		Date	5th August 2013

Test Date Range	19th October 2012-26th October 2012 9th and 10th July 2013 (a68)

Product Status	PASS

The test data and results contained within this report relate only to the items tested.

1 47 CFR Part 15 and RSS-210 Test Summary

	CFR 47 Part 15	RSS-210	Section	Result
Hopping Sequence	15.247(a)		5.4	Pass
Peak Output Power	15.247(b)	A8.4(2)	5.3	Pass
Carrier Frequency Seperation	15.247(a)	A8.1(b)	5.4	Pass
Frequency Band Edges	15.247(d)		5.8	Pass
20dB Bandwidth	15.247(a)(1)	A8.1(a)	5.7	Pass
Radiated Emissions	15.209(a)	RSS-GEN 7.5.2	5.9	Pass
Spurious Emissions	15.247(d)	A8.5	5.9	Pass
Number of Channels	15,247(a)(1)	A8.1(d)	5.4	Pass
Directional antenna with >6dBi	15.247(c)		5.2 Antenna<6dBi	N/A
Dwell Time	15.247(a)	A8.1(d)	5.4	Pass
6dB Bandwidth		A8.2(a)		N/A (FHSS)
Power Spectral Density		A8.2(b)		N/A (FHSS)

2 Attestations

This equipment has been tested in accordance with the standards identified in this report. To the best of *my* knowledge and belief, these tests were performed using the measurement procedures described in these reports.
All measuring instruments used to determine the status of the product's compliance to the identified standards are calibrated regularly in accordance with UKAS requirements.
A comprehensive system of traceable calibration in accordance with ISO9001 is maintained.

Name/Position	Signature	Date
Mike Thompson EMC Engineer		5th Aug 2013

I attest that the necessary measurements were made, under my supervision at:

Raymarine UK Ltd, Marine House, Cartwright Drive, Fareham, Hampshire, PO15 5RJ

Andy Little
Compliance Manager

Date: 5th August 2013

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3 Version control

Report 808-1055b updated to include a68 display

4 Test Information

4.1 Test Facilities

Site 1	9m x 6m x 5.5m Semi Anechoic Chamber	FCC ID IC Certification	183727 4069B-2
Site 5	3m x 2m x 2.5m Screened Room		

4.2 Overall Test Conditions

Work Area	Relative Humidity (%)	Air Pressure (mbar)	Ambient Temperature (°C)
Site 1-5	42	1005	18.9
Sites 6-10	43	1015	21.1

July 2013

Work Area	Relative Humidity (%)	Air Pressure (mbar)	Ambient Temperature (°C)
Site 1	28-38	995-1005	19-21

4.3 Test Methods

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth and WIFI,2.4GHz ISM band radiators) for the EUT FCC ID Certification and RSS-210 for the Industry Canada certification:

Number	Standard Number	Document Title
1	47 CFR Part 15 (10-01-09 Edition)	Radio Frequency Devices
2	RSS-210 Issue 8 December 2010	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

4.3.1 Deviations from Test Methods

None

5 EUT Information

5.1 Test Rationale

Full compliance

Additional units covered by this report

FCC ID	PJ5-WFBT4
IC ID	4069B-WFBT4
Unique Type Identification:	E70076 / a65
	E70200 / a68

5.2 Description of Equipment under Test (EUT)

Date of Receipt:	18-10-2012
Client:	Raymarine UK Ltd
Brand Name:	a67
Product Range:	Multifunction Display with Sonar
Country of Manufacture:	China
Operational voltage range:	10.8V to 15.6V

Unit 1

Model Name or Number:	a67
FCC ID	PJ5-WFBT4
IC ID	4069B-WFBT4
Unique Type Identification:	E70077
Serial Number:	EMC121026A
CCT Diagram Number(s) & Issue:	**Chartplotter Only Variant** CPU 1001511 Issue 6 GPS 1001651 Issue 3 Keyboard 1001671 Issue 1 Chart Reader 1001661 Issue 1 **Chartplotter + Sonar Variant** CPU 1001511 Issue 6 Sonar 1001521 Issue 3 GPS 1001651 Issue 3 Keyboard 1001671 Issue 1 Chart Reader 1001661 Issue 1

PCB Assembly Number(s) & Issue:	**Chartplotter Only Variant** CPU 1001510 Issue 5 GPS 1001650 Issue 3 Keyboard 1001670 Issue 1 Chart Reader 1001660 Issue 1 **Chartplotter + Sonar Variant** CPU 1001510 Issue 5 Sonar 1001520 Issue 3 GPS 1001650 Issue 3 Keyboard 1001670 Issue 1 Chart Reader 1001660 Issue 1
Software Version:	Platform Application
Modifications to Unit:	

Unit 2

Model Name or Number:	A68
Unique Type Identification:	E70200
Serial Number:	EMC130122a
CCT Diagram Number(s) & Issue:	CPU 1002515-10 Sonar 1002573-2 Keyboard 1001673-1 GPS 1001653-5 Chart 1001663-1
PCB Assembly Number(s) & Issue:	CPU 1002516-10 Sonar 1002574-2 Modified under deviation D-13-0184 v3 Keyboard 1001674-1 GPS 1001654-5 Chart 1001664-1
Software Version:	Boot 7.26-00132 Kernel 3.4.41-rm Application 7.30-00616
Modifications to Unit:	

5.3 Additional information

This test report is also applicable to E70076 a65 Multifunction Display.
The only difference between the a65 & a67 is the a65 does not have a built-in sonar. All other functionality & features are the same.

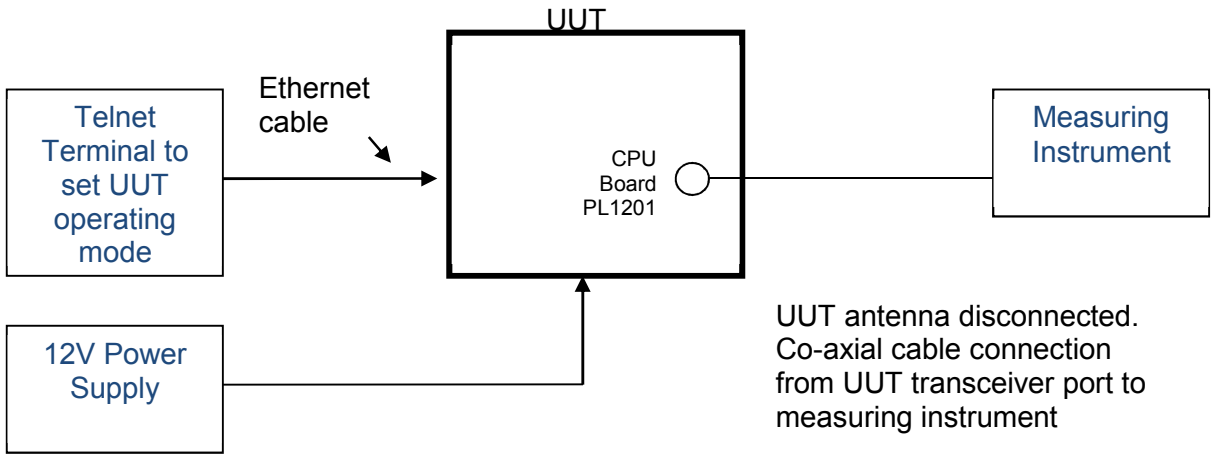
Addition of a68 display.
Experience in testing these displays has shown that the emissions from the all displays below 2GHz are due to the electronics associated with the display and not the RF chip set. Testing a a68 Bluetooth version will give identical results to a a68 WiFi version below 2GHz. All emissions above 2GHz are associated with the RF module which is identical on a65, a67 and a68 displays

5.4 Description of Auxiliary Equipment

Product Type	Part Number	Serial Number
none		

5.5 Test Configurations

5.5.1 Maximum Power, EIRP Spectral Density and Frequency Range tests



5.5.2 Photos

5.6 Operating Modes

5.6.1 Peak Output Power and Frequency Range

The tests performed with the UUT in continuously transmitting 1Mbps Bluetooth GFSK, fixed frequency @ 9.5dBm nominal

6 Test Results

6.1 Transmit Duty Cycle, “x”

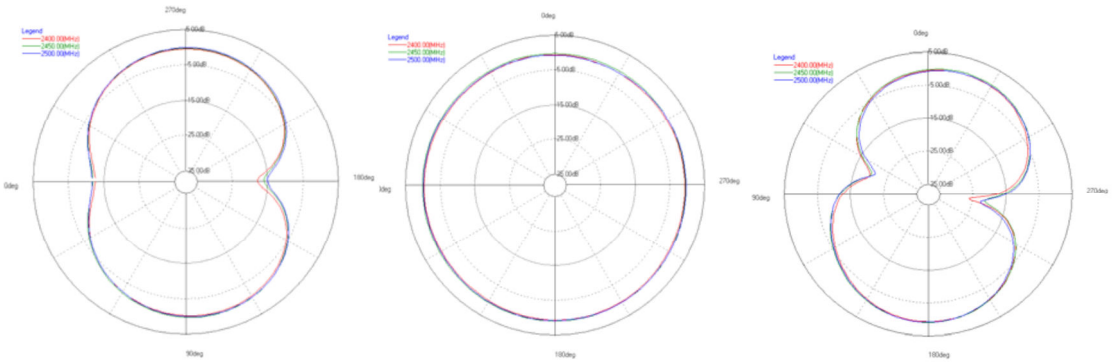
Transmit duty cycle (symbol “x”) is required for the calculations relating average power (measured) to EIRP for Maximum Transmit Power, Maximum EIRP Spectral Density and Frequency Range tests.

UUT Operating Mode	Period (ms)	Transmit On (ms)	Transmit Duty Cycle, x
1Mbps Bluetooth GFSK 9.5dBm nominal	1.0000	1.0000	1.0000

6.2 UUT Antenna Gain, “G”

Antenna gain (symbol “G”) is required for the calculations relating average power (measured) to EIRP for Maximum Transmit Power, Maximum EIRP Spectral Density and Frequency Range tests.

UUT Max Antenna Gain (dBi)
+0.8



6.3 Peak Output Power

Conducted measurements as specified in 15.247(b)(1).

6.3.1 Normal Test Conditions; 22°C,12.0V

Operating Mode (Modulation)	Channel \ Frequency (No.\ MHZ)	Power Measured A (dBm)	Tx Duty Cycle x	Peak Power (mW)	Limit max. (mW)	Pass/Fail
1Mbps Bluetooth GFSK 9.5dBm nominal	1 \ 2402	1.35	1.0000	1.36	125	Pass
	48 \ 2440	4.54	1.0000	2.844	125	Pass
	79 \ 2480	6.36	1.0000	4.33	125	Pass

6.4 Frequency Hopping Requirements

UUT frequency hopping characteristics are as defined by the Bluetooth system specification

47 CFR 15.247(a)		Bluetooth	Pass / Fail
Technical Specification	**Limit**		
Dwell Time 15.247(a)	0.4s	0.38s Based on 79 Channels	**Pass**
Channel Separation 15.247(a)	Channels non-overlapping, 1MHz separation measured at 20dB below peak power	Complies with this requirement	**Pass**
Hopping Sequence 15.247(a)	Non-adaptive hopping uses 15 channels min. Adaptive hopping uses 90% min. of 2.4000 to 2.4835 band Adaptive hopping uses 20 channels min. Each channel occupied at least once during period T = 4 x dwell time x no. of channels	79 N/A N/A The Bluetooth channel hopping sequence is designed to visit each1 MHz channel spacing frequency regularly and with roughly equal probability	**Pass**

6.5 Frequency Range

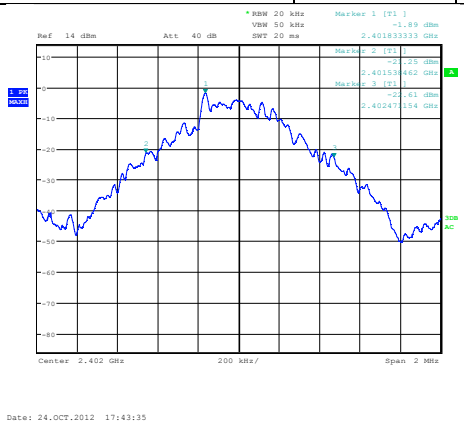
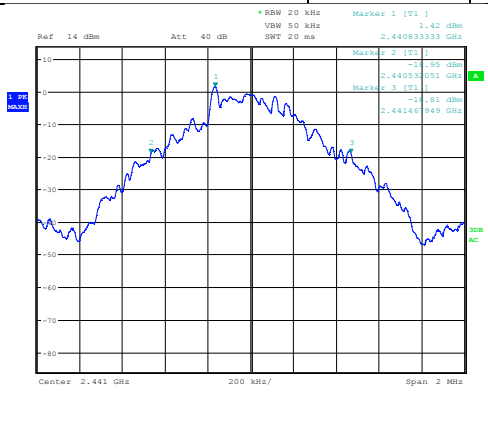
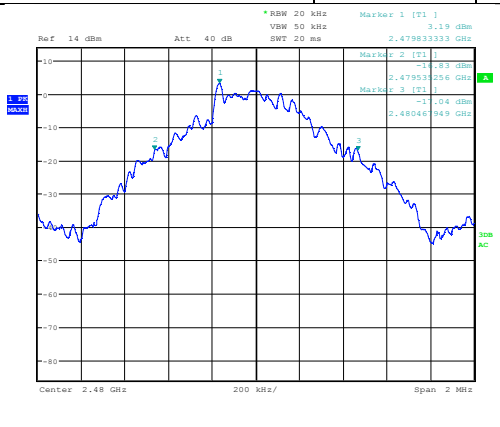
Conducted measurements as specified in EN 300 328 V1.7.1 (2006-10) clause 5.7.4.1 were used.

Operating Mode (Modulation)	Spectral Power Density Threshold relative to EIRP (dBm, RBW = 100kHz)	Max Antenna Gain, G (dBi)	Tx Duty Cycle, x	Attenuator, Z (dB)	Spectral Power Density Threshold (relative to measued average power) = Threshold relative EIRP - G - 10log(1/x) - Z (dBm, RBW = 100kHz)	Ch1 \ 2.402GHz	fL limit min. (GHz)	Pass if fL > fL limit?	Ch79 \ 2.480GHz	fH limit max. (GHz)	Pass if fH < fH limit?	fH - fL (GHz)
1Mbps Bluetooth GFSK 9.5dBm nominal	-30.0000	-1.0000	1.0000	0	-31.0000	**2.4018**	2.4000	Pass	**2.4802**	2.4835	Pass	0.0784

6.6 Medium Access Protocol

Technical Specification	Requirement	UUT
Medium Access Protocol	A medium access protocol shall be implemented by the equipment	The UUT implements medium access protocols defined by Bluetooth

6.7 20dB Channel Bandwidth

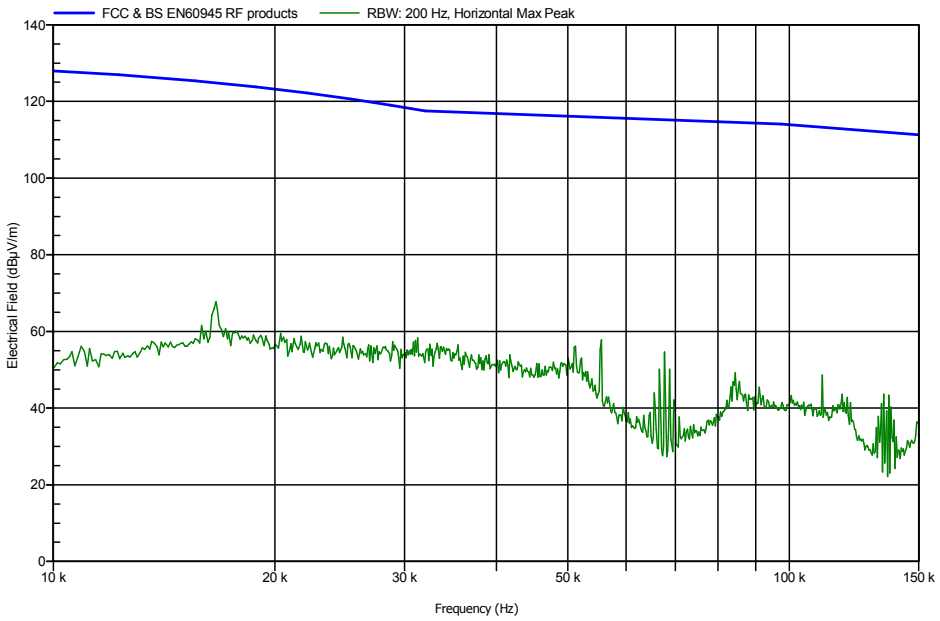
Modulation	-20dBC frequencies		-20dB BW
	fL (GHz)	fH (GHz)	fH - fL (MHz)
Ch1 \ 2.402GHz	2.40154	2.40247	0.93
			
Ch40 \ 2.441GHz	2.44053	2.44147	0.94
			
Ch79 \ 2.480GHz	2.47954	2.48047	0.93
			

6.8 Frequency Band Edges

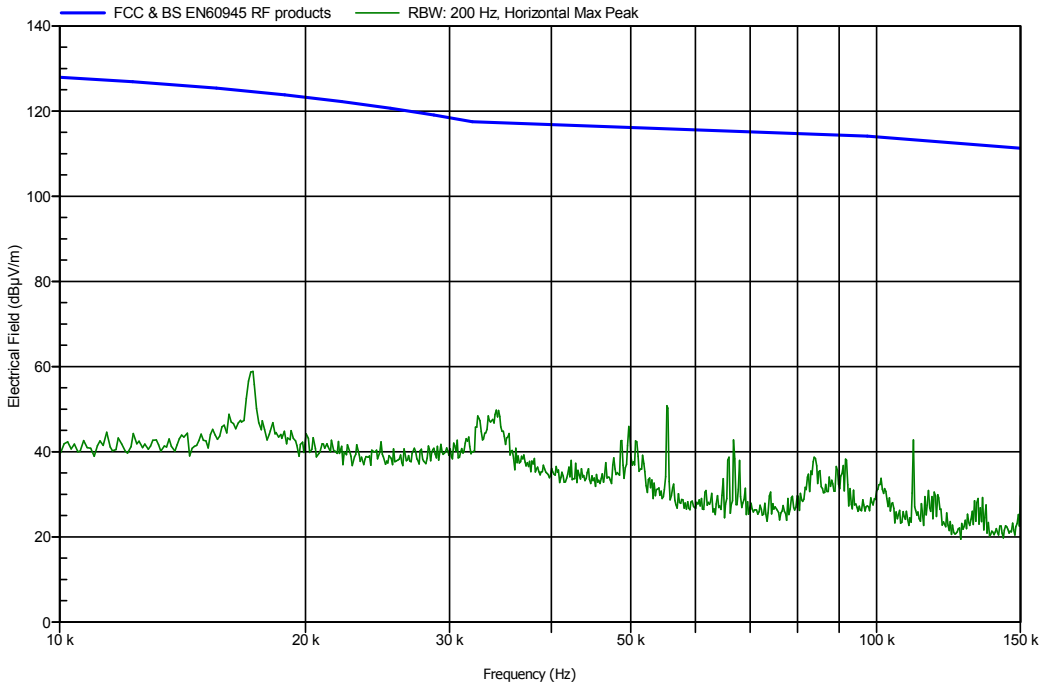
Modulation	-20dBC frequencies	
	fL (GHz)	fH (GHz)
1Mbps Bluetooth GFSK 9.5dBm nominal		
Lower Band Edge Ch1 \ 2.402GHz	2.40154	
Upper Band Edge Ch79 \ 2.480GHz		2.48047

6.9 Transmitter Spurious Emissions

6.9.1 Radiated Emissions 9kH-150kHz



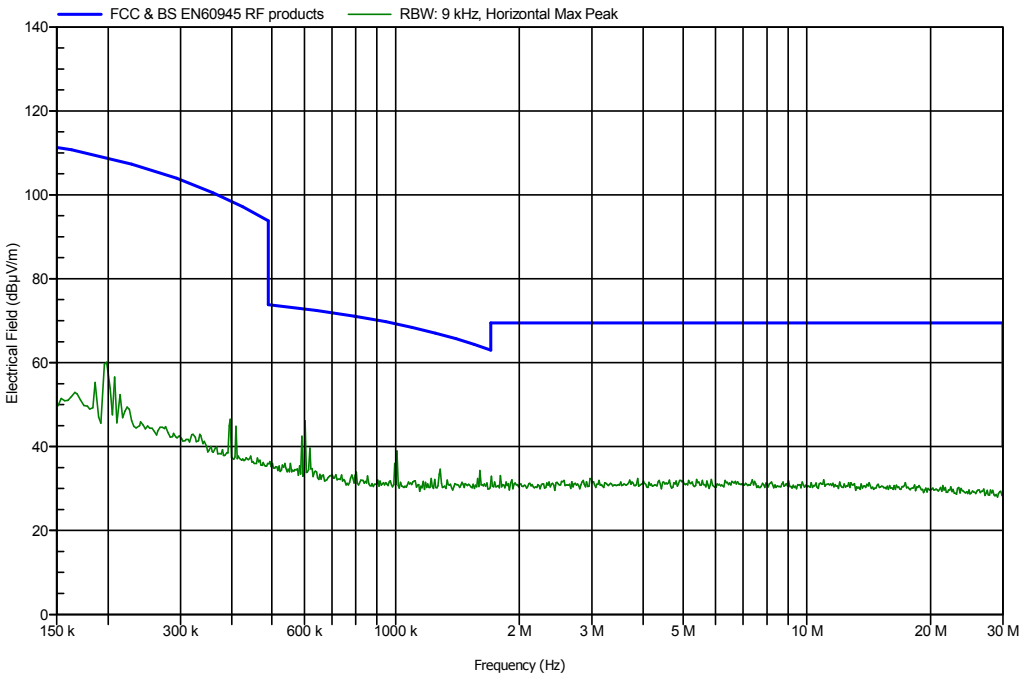
Loop Face On



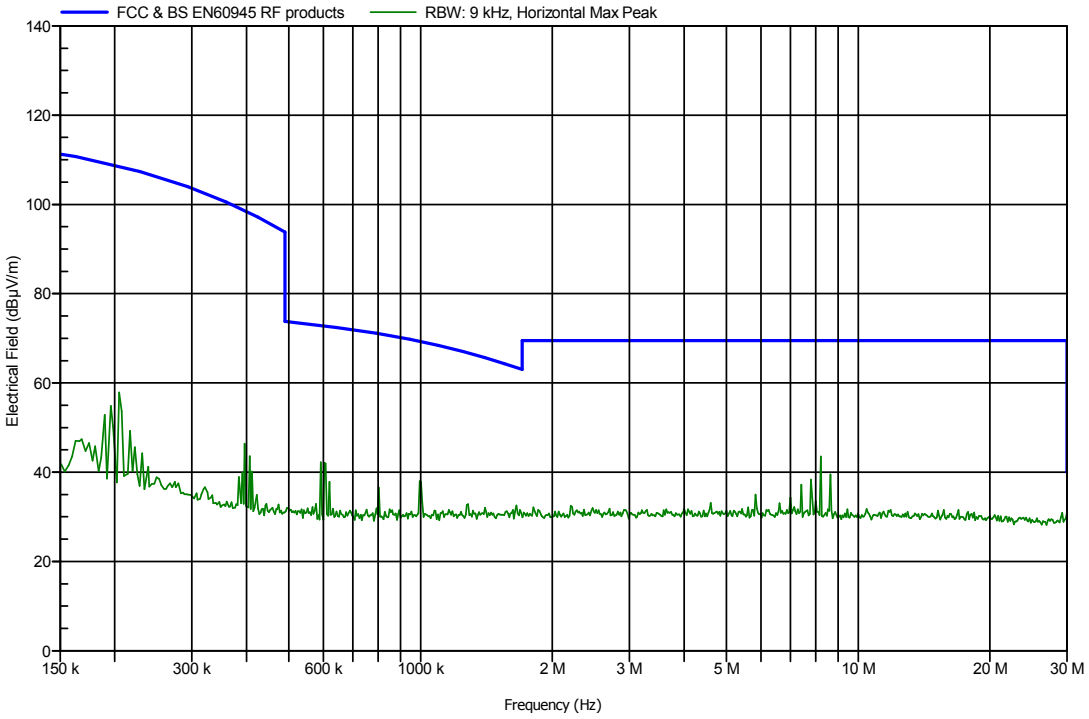
Loop Side On

6.9.2 *Radiated Emissions 150kHz-30MHz*

a67 display



Loop Face On

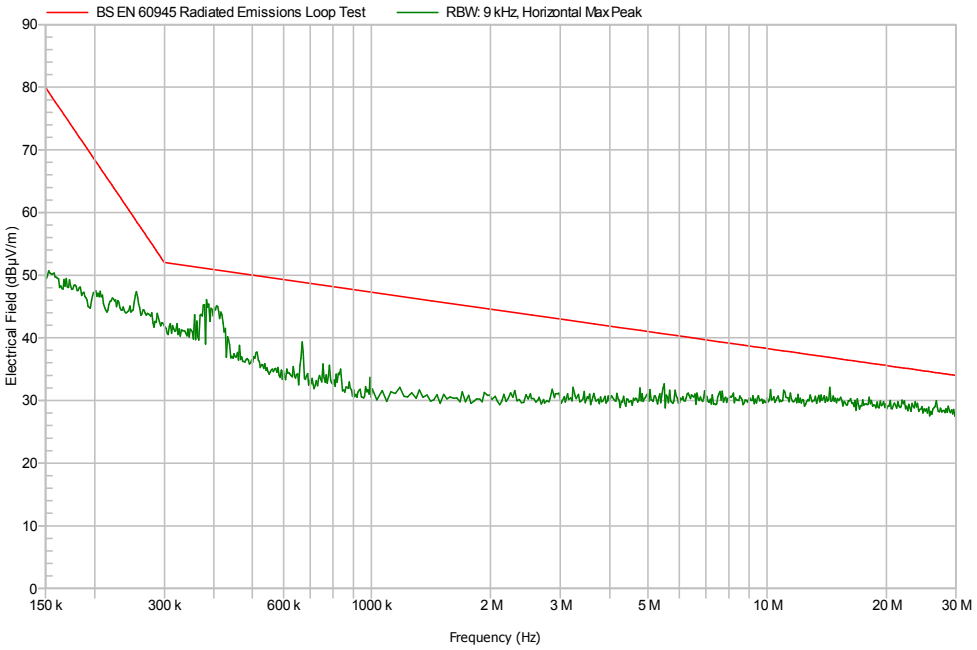


Loop Side On

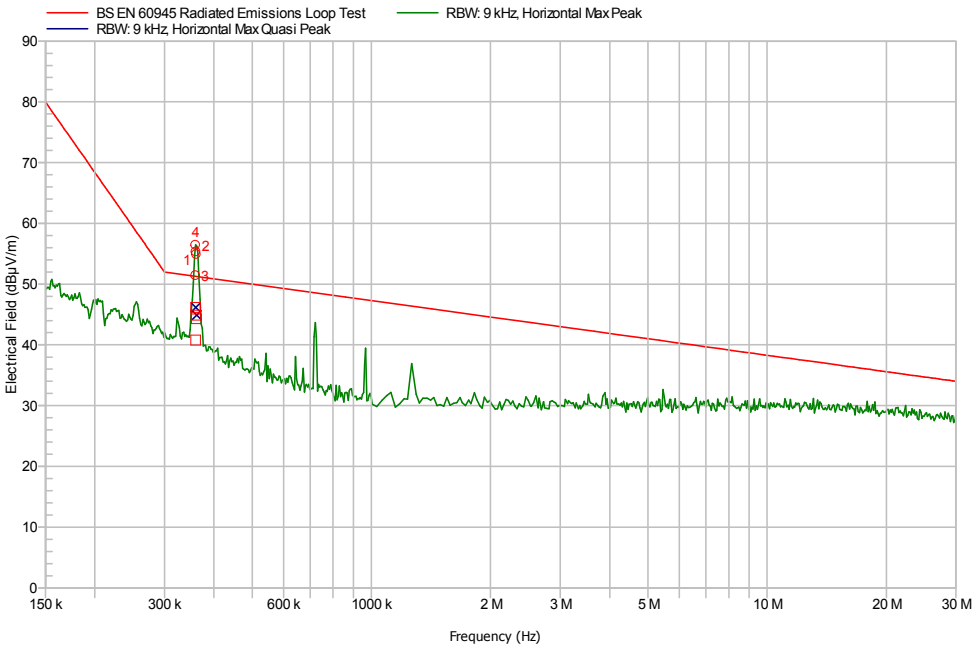
a68 display

X polarity (Face on)

30ft range

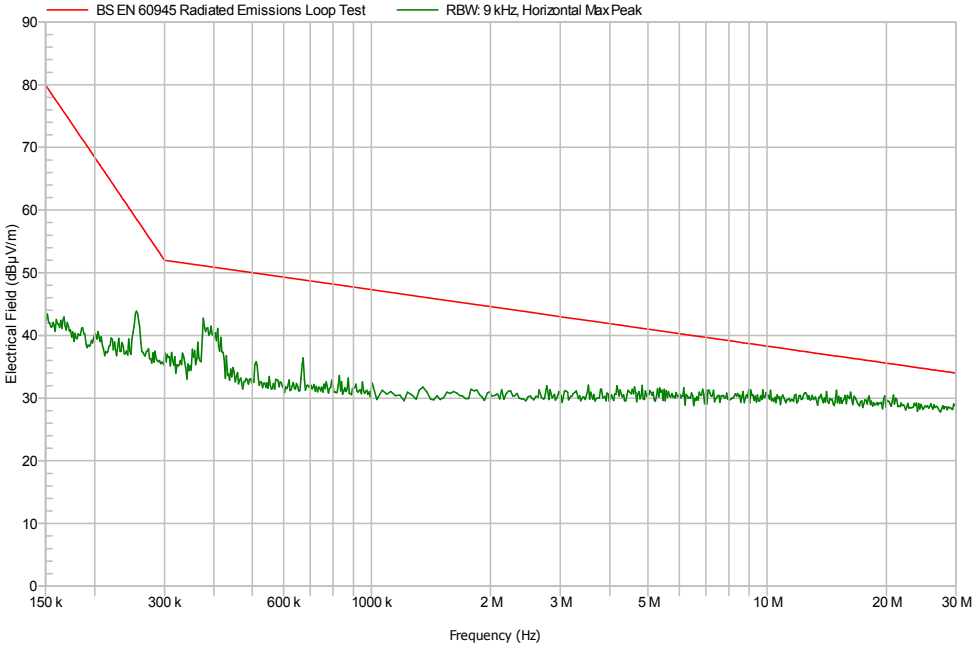


400ft range

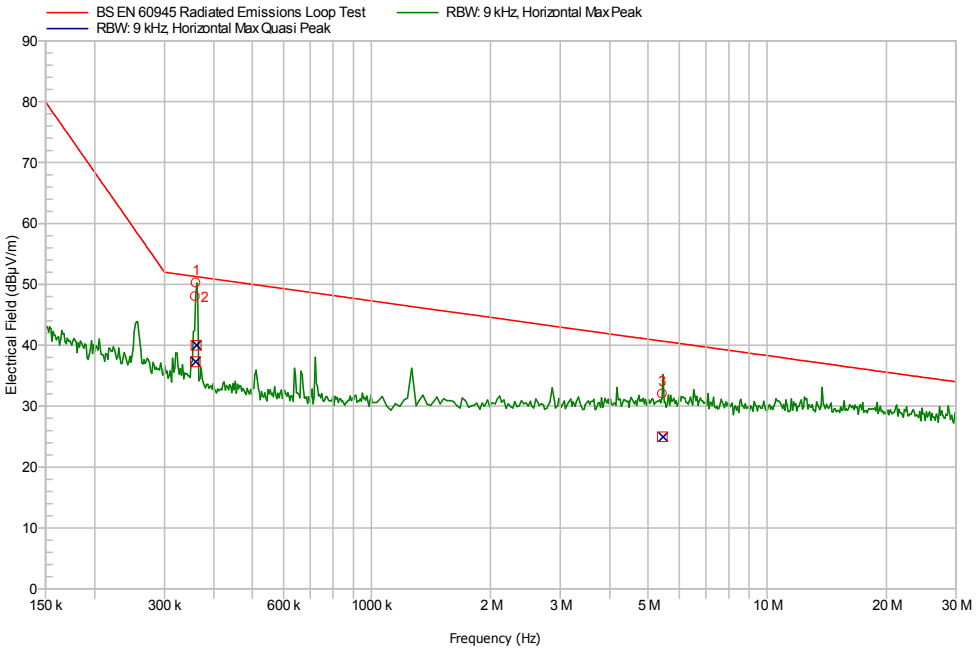


Y polarity (Side on)

30ft range

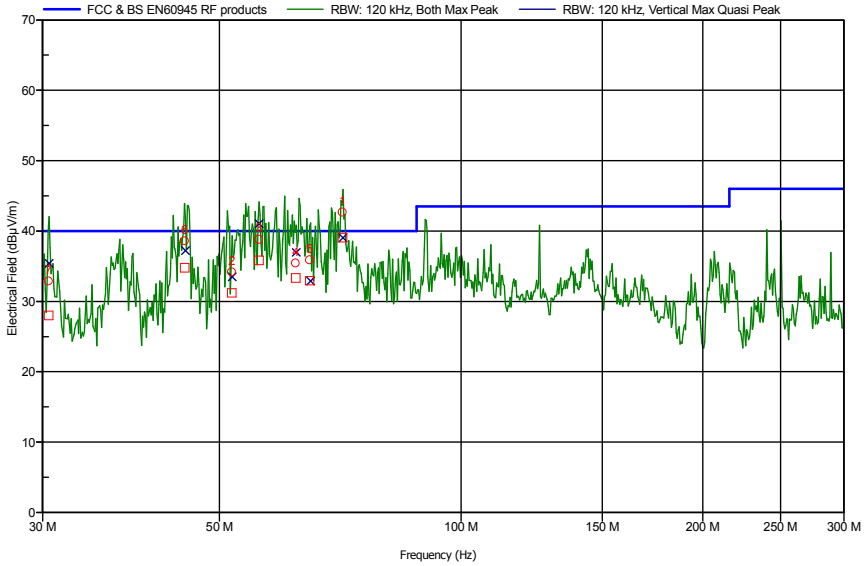


400ft range



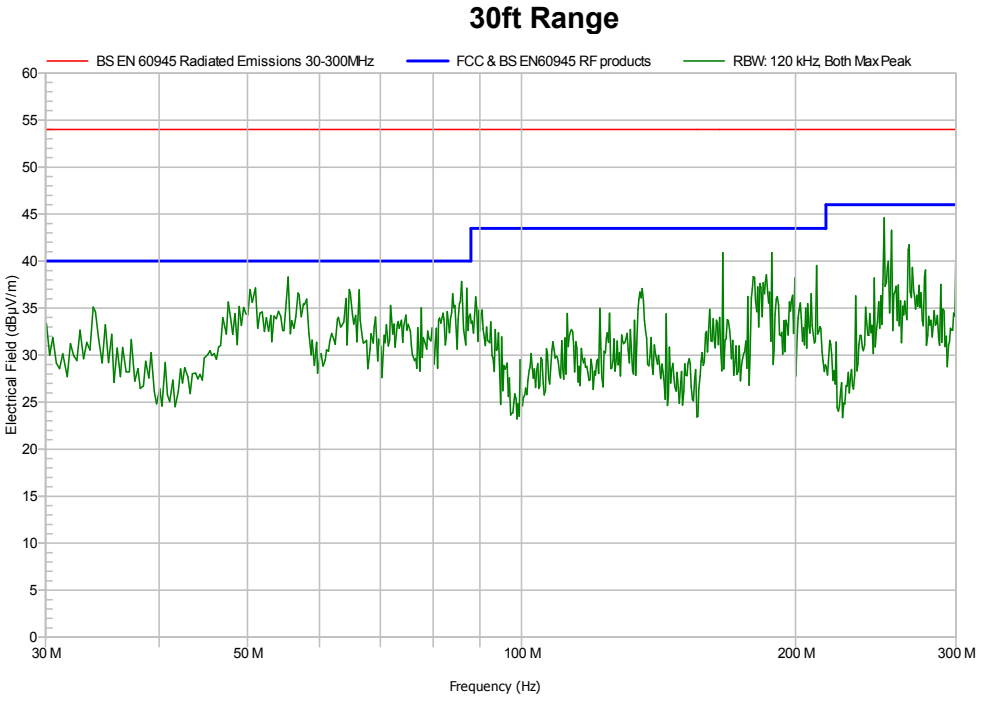
6.9.3 Radiated Emissions 30MHz – 300MHz

a67 display

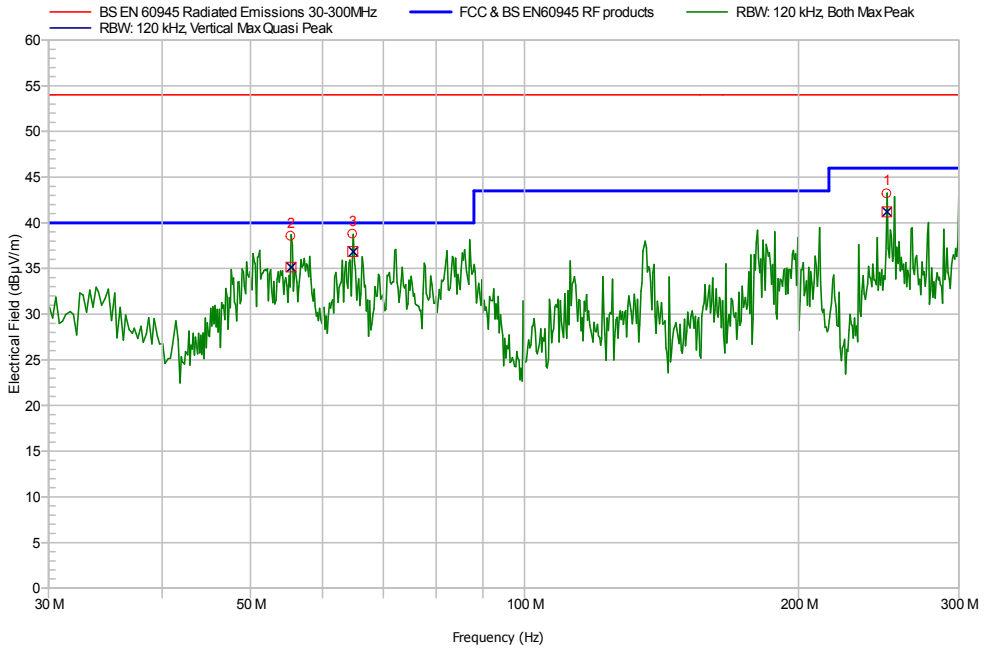


Peak identifier	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
1	71.164 MHz	42.65 dBµV/m	39.07 dBµV/m	40 dBµV/m	-0.93 dB	Pass	254 Degree	1.13 m	Vertical
2	51.808 MHz	34.16 dBµV/m	31.23 dBµV/m	40 dBµV/m	-8.77 dB	Pass	74 Degree	1.01 m	Vertical
3	56.02 MHz	38.79 dBµV/m	35.83 dBµV/m	40 dBµV/m	-4.17 dB	Pass	105 Degree	100 cm	Vertical
4	62.236 MHz	35.41 dBµV/m	33.33 dBµV/m	40 dBµV/m	-6.67 dB	Pass	60 Degree	1.28 m	Vertical
5	64.78 MHz	35.87 dBµV/m	32.95 dBµV/m	40 dBµV/m	-7.05 dB	Pass	82 Degree	1.2 m	Vertical
6	45.268 MHz	38.58 dBµV/m	34.77 dBµV/m	40 dBµV/m	-5.23 dB	Pass	67 Degree	1.03 m	Vertical
7	30.64 MHz	32.87 dBµV/m	28.03 dBµV/m	40 dBµV/m	-11.97 dB	Pass	104 Degree	1.1 m	Vertical

a68 display



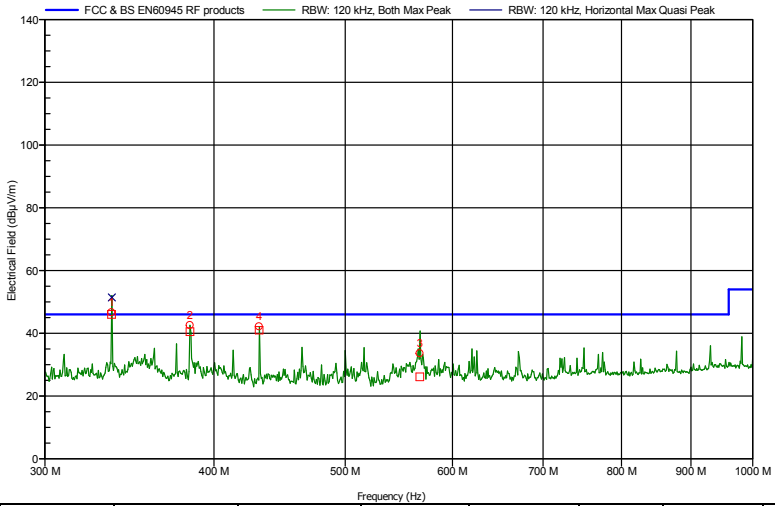
400ft Range



Nr	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status
1	250.006 MHz	43.18 dBµV/m	41.2 dBµV/m	-4.8 dB	Pass
2	55.405 MHz	38.53 dBµV/m	35.16 dBµV/m	-4.84 dB	Pass
3	64.778 MHz	38.75 dBµV/m	36.86 dBµV/m	-3.14 dB	Pass

6.9.4 Radiated Emissions 300MHz-1GHz

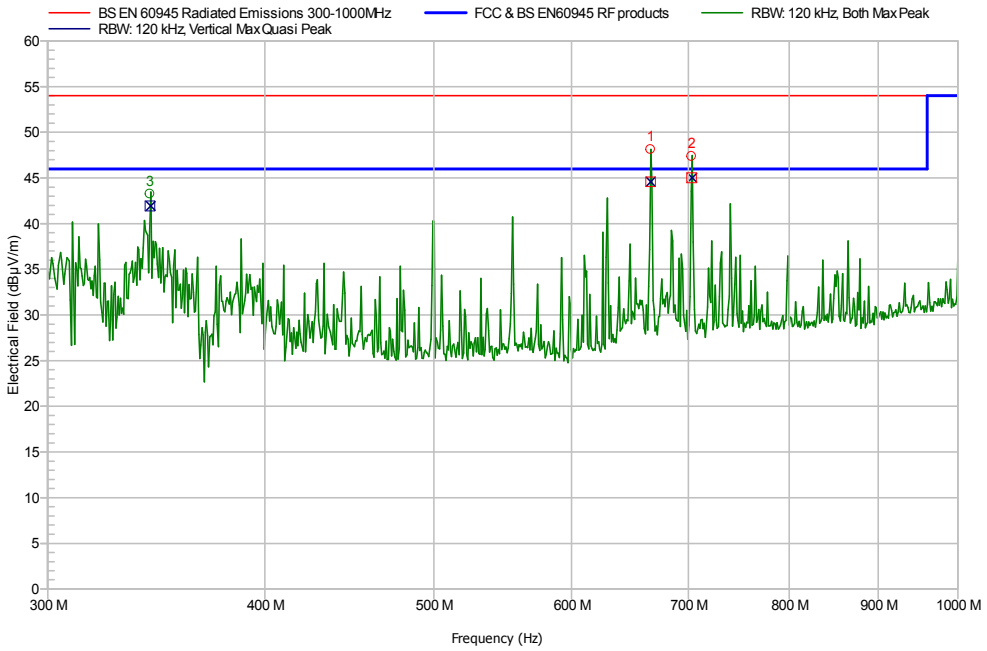
a67 display



Peak identifier	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Peak Status	Angle	Height	Polarization
1	336 MHz	46.67 dBµV/m	45.97 dBµV/m	46 dBµV/m	-0.03 dB	Pass	285 Degree	100 cm	Horizontal
2	383.952 MHz	42.59 dBµV/m	40.54 dBµV/m	46 dBµV/m	-5.46 dB	Pass	45 Degree	1.04 m	Vertical
3	567.72 MHz	33.57 dBµV/m	26.11 dBµV/m	46 dBµV/m	-19.89 dB	Pass	22 Degree	1.2 m	Vertical
4	431.988 MHz	42.12 dBµV/m	40.97 dBµV/m	46 dBµV/m	-5.03 dB	Pass	0 Degree	1.29 m	Vertical

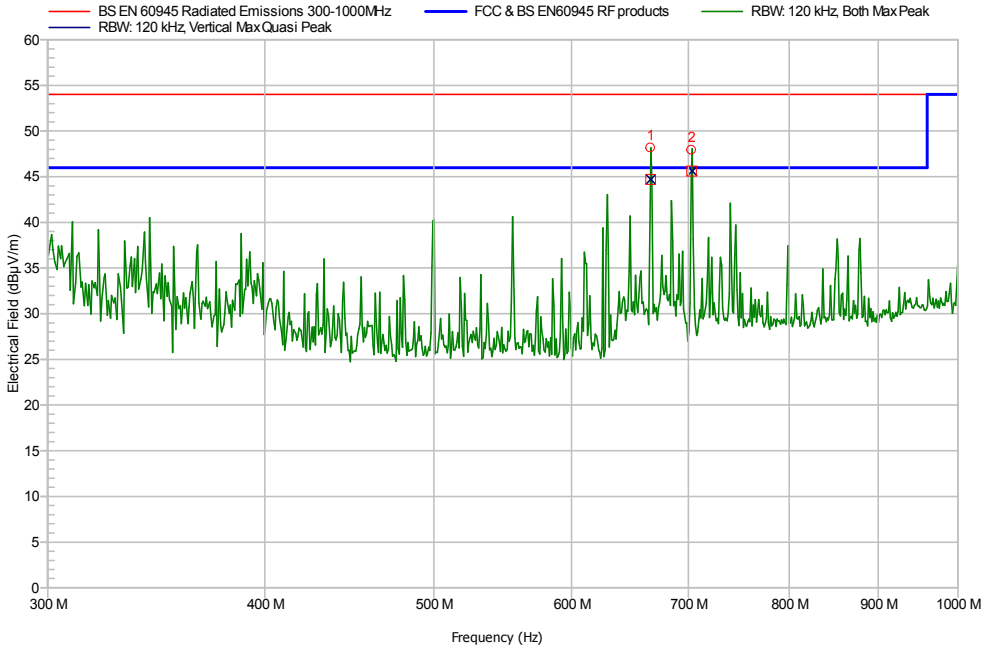
a68 display

30ft Range



Nr	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status
1	666.025 MHz	48.12 dBµV/m	44.58 dBµV/m	-1.42 dB	Pass
2	703.064 MHz	47.36 dBµV/m	45.02 dBµV/m	-0.98 dB	Pass
3	343.59 MHz	43.24 dBµV/m	41.93 dBµV/m	-4.07 dB	Pass

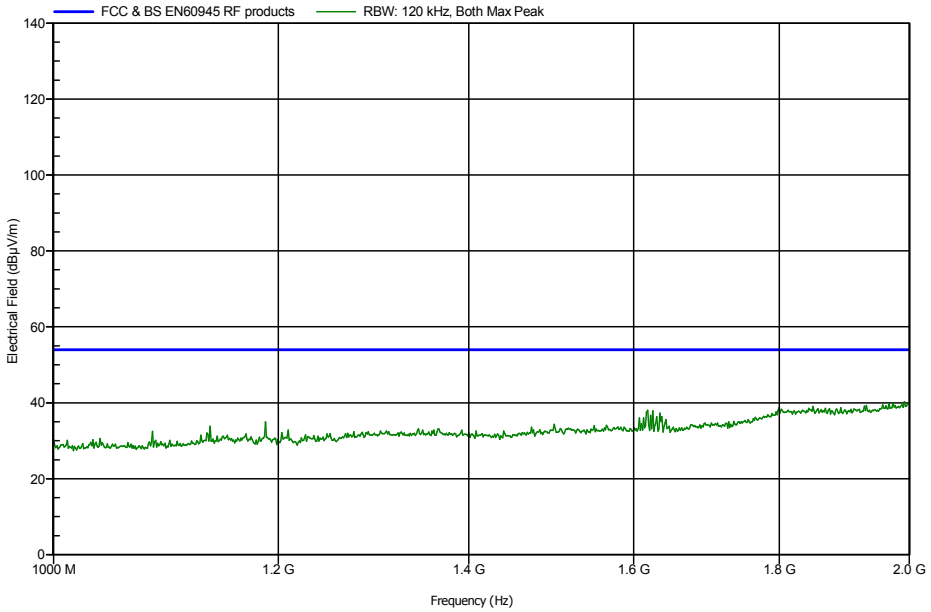
400ft Range



Nr	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status
1	665.998 MHz	48.14 dBµV/m	44.71 dBµV/m	-1.29 dB	Pass
2	703.033 MHz	47.9 dBµV/m	45.61 dBµV/m	-0.39 dB	Pass

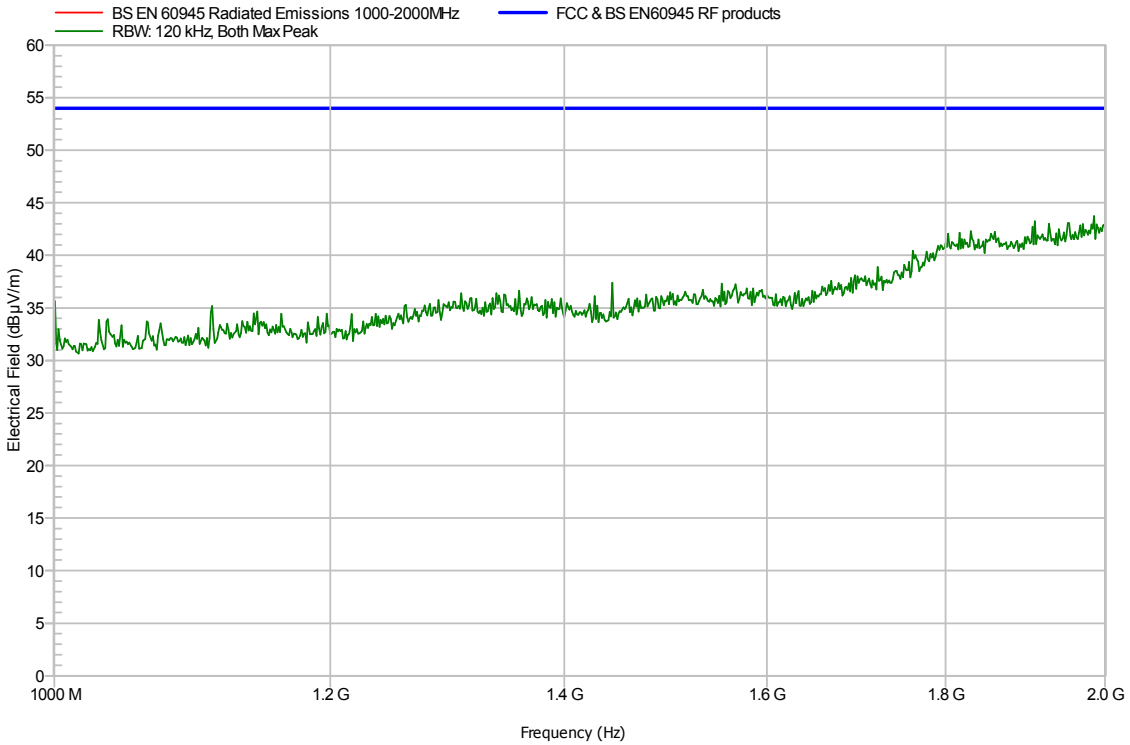
6.9.5 *Radiated Emissions 1GHz-2GHz*

a67 display

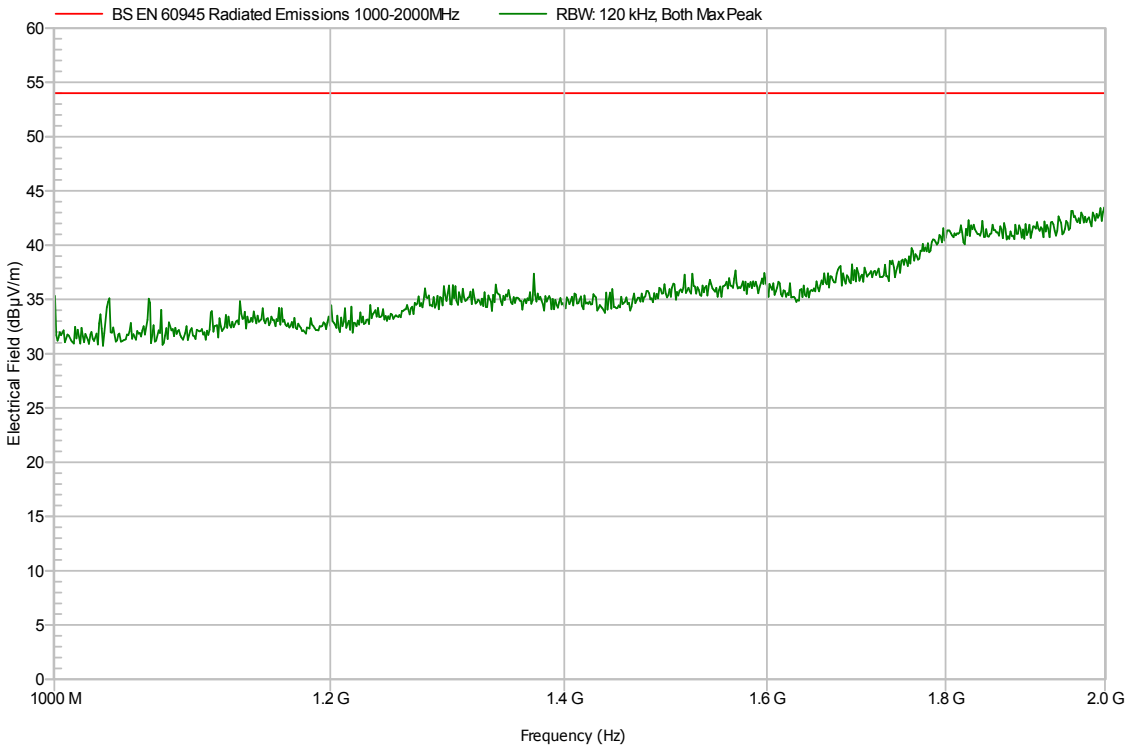


a68 display

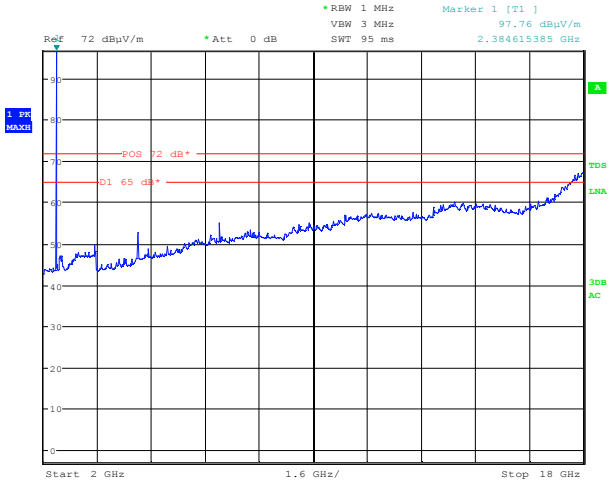
30ft Range



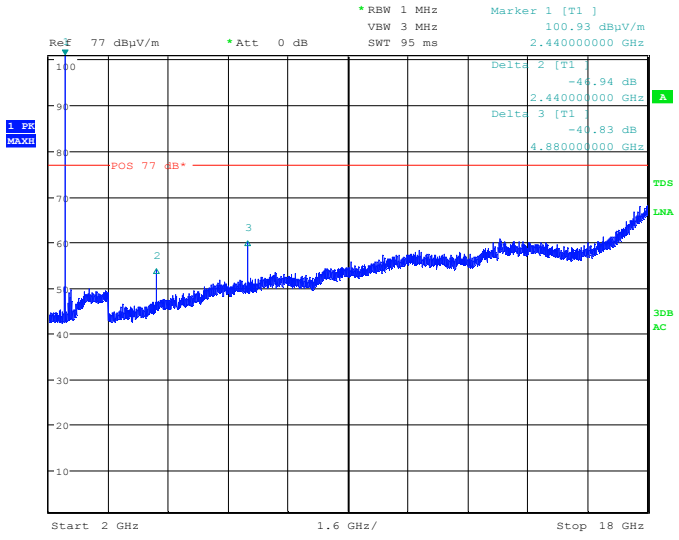
400ft Range


BS EN 60945 Radiated Emissions 1000-2000MHz
RBW: 120 kHz, Both Max Peak
Electrical Field (dBµV/m)
60
55
50
45
40
35
30
25
20
15
10
5
0
1000 M
1.2 G
1.4 G
1.6 G
1.8 G
2.0 G
Frequency (Hz)

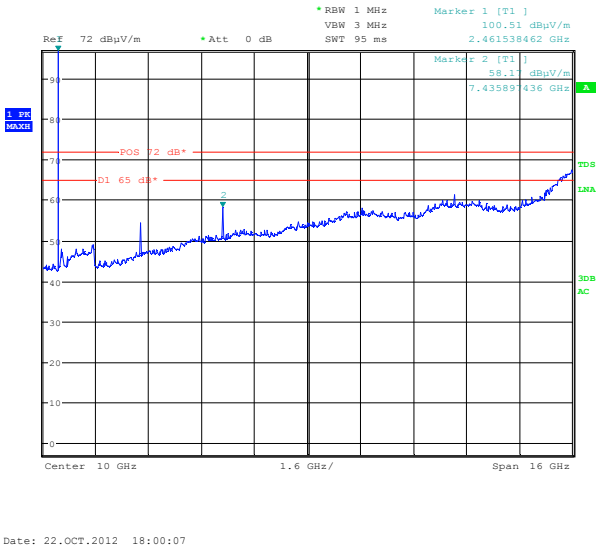
6.9.6 Radiated Emissions 2GHz-18GHz



Channel 1 (2402MHZ)

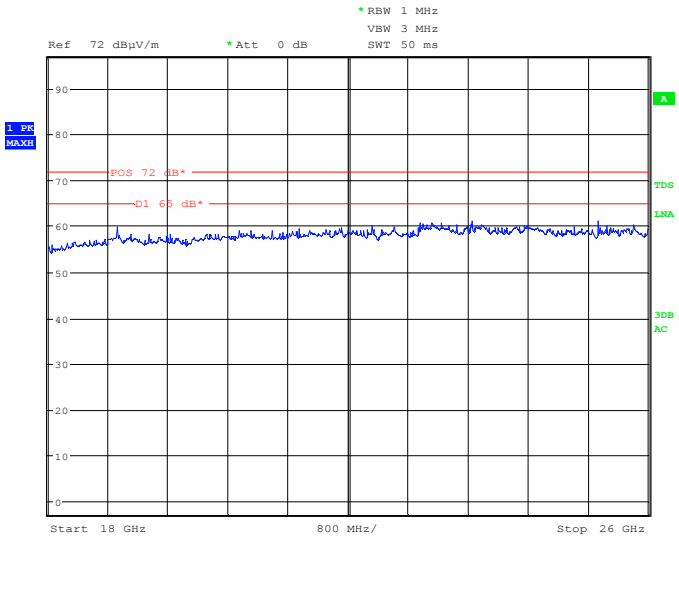


Channel 40 (2440MHz)

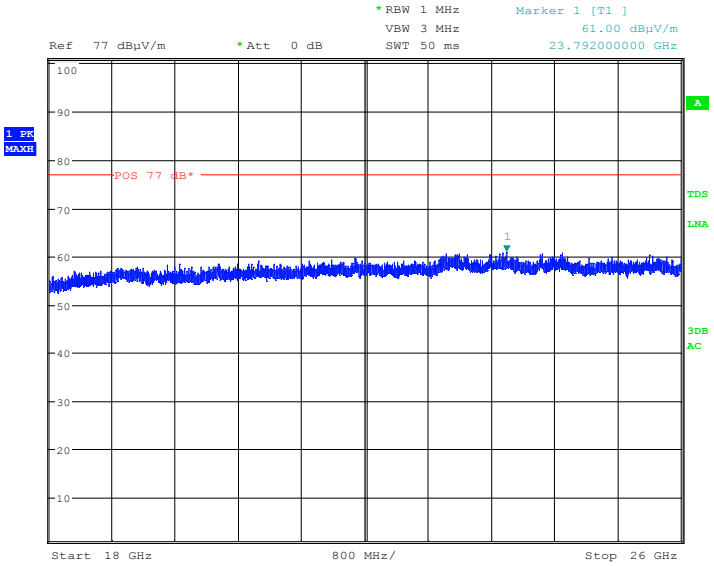


Channel 79 (2480MHz)

6.9.7 Radiated Emissions 18GHz-26GHz

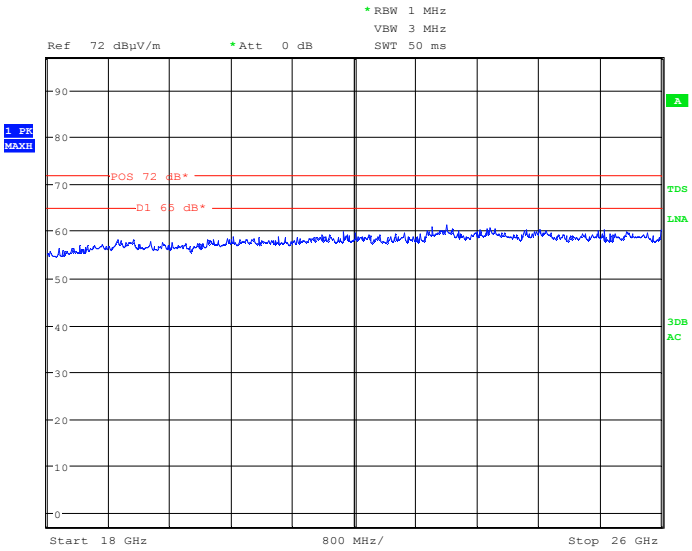


Channel 1 (2402MHz)



Date: 26.OCT.2012 10:37:13

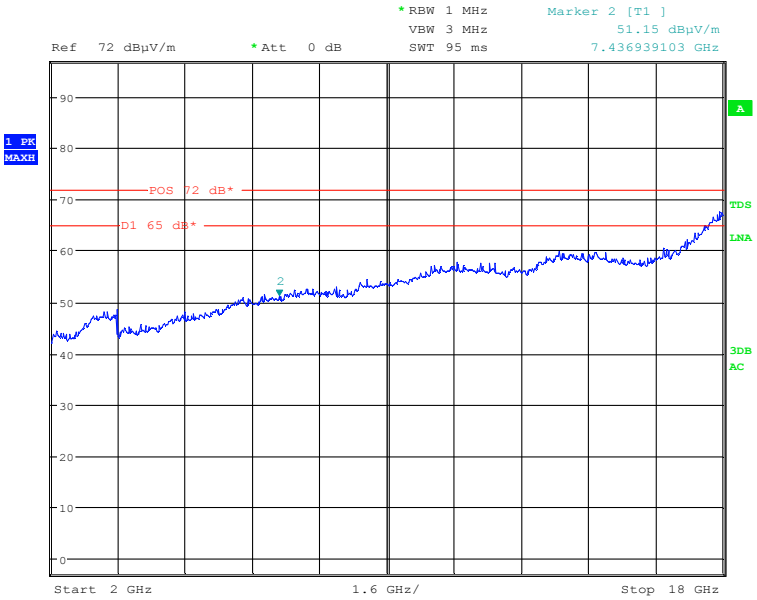
Channel 40 (2440MHz)



Date: 22.OCT.2012 12:15:53

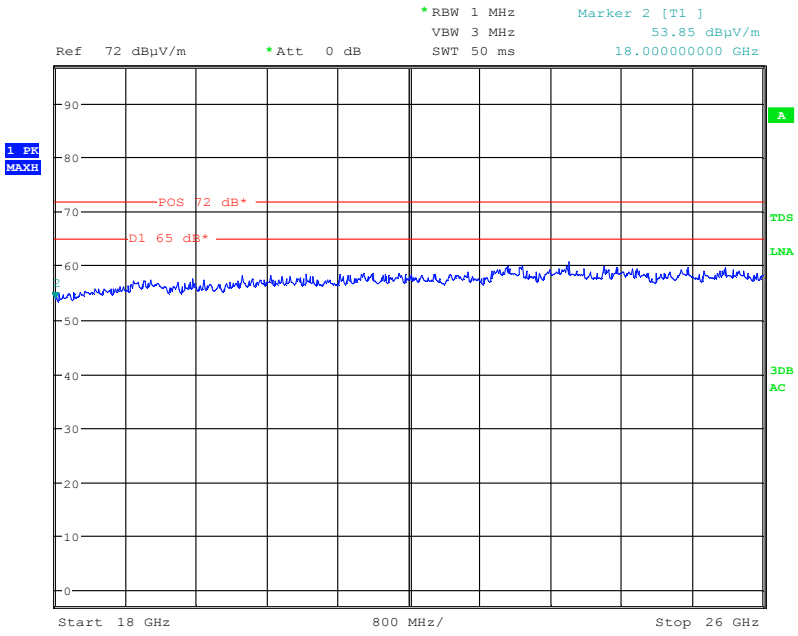
Channel 79 (2480MHz)

6.10 Receiver Spurious Emissions



Date: 22.OCT.2012 18:06:14

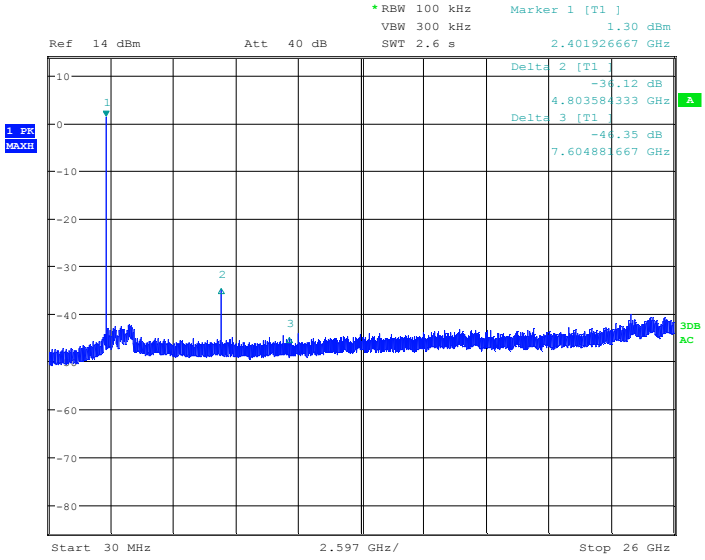
Receiver spurious emissions 2GHz-18GHz



Date: 22.OCT.2012 18:07:07

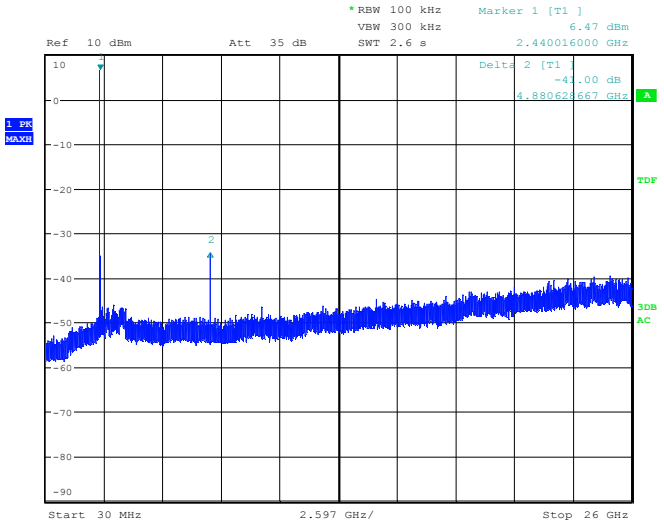
Receiver Spurious Emissions 18GHz-26GHz

6.11 Conducted Emissions at Antenna Port



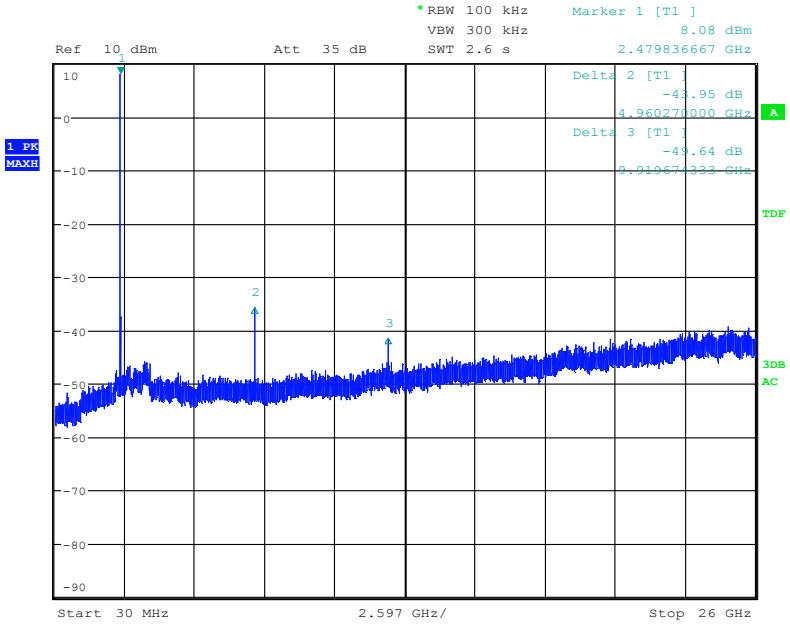
Date: 25.OCT.2012 12:13:11

Channel 1 2402MHz



Date: 25.OCT.2012 16:52:10

Channel 40 (2440MHz)



Date: 25.OCT.2012 16:53:33

Channel 79 (2480MHz)

7 List of Test Equipment

Test Equipment Type	Manufacturer and Type Number	Serial Number	Cal No.	Cal Due
Digital Multimeter	Fluke 175	97460092	2248	11/11/2012
EMI Receiver 20Hz to 26.5GHz	Rohde & Schwarz ESCI	100416	001692	30/11/2012
Active Loop Antenna 9kHz - 30MHz	Chase EMC HLA6120	1122	00442	14/2/2014
Loop Antenna PSU/Charger	Chase EMC CBP9721	N/A	02671	N/A
Antenna Horn 1-18GHz	Chase BBHA9120D	9120D-578	01719	2/11/2014
Antenna Horn 18GHz-26GHz	Credowan 20-R-2843-0007	36755	482	16/11/2014
Antenna 30MHz-3GHz	Chase CBL6141	22932	01802	23/07/2014
Antenna Mast (Site 1)	Inn-co GmbH MM4000	MM4000/056/13750 806/L	02075	N/A
Turntable (Site 1)	Inn-co GmbH DS1200S	DS1200S/175/1375 0806/L	02076	N/A
Mast/Turntable Controller (Site 1)	Inn-co GmbH Co 2000	CO/2000/359/137/5 0806/L	02077	N/A
EMI Receiver 20Hz to 40GHz	Rohde & Schwarz ESU40	100017	01721	20/02/2013
Power Supply Unit	Palstar PS30M	G290775401	2020	N/A

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Test Equipment Type	Manufacturer and Type Number	Serial Number	Cal No.	Cal Due
Semi-Anechoic Chamber, Site 1	Global EMC	GE001	02074	12/01/2015
Broadband Antenna 20-2000MHz	Chase EMC CBL6141	22932	01802	23/07/2014
Active Loop Antenna 9kHz - 30MHz	Chase EMC HLA6120	1122	00442	14/02/2014
Loop Antenna PSU/Charger	Chase EMC CBP9720	1076	00450	n/a
Antenna Mast (Site 1)	Inn-co GmbH MM4000	MM4000/056/13750806/L	02075	n/a

Turntable (Site 1))	Inn-co GmbH DS1200S	DS1200S/175/13750806/L	02076	n/a
Mast/Turntable Controller (Site 1)	Inn-co GmbH Co 2000	CO/2000/359/137/50806/L	02077	n/a
EMI Receiver 20Hz to 26.5GHz	Rohde & Schwarz ESI26	832692/006	00886	22/08/2013
Digital Multimeter	Fluke 175	97460092	02248	07/11/2013
Power Supply Unit	Palstar PS30M	520350606	01259	n/a
Computer (Site 1)			RM0401	n/a
Emissions Software	DARE RadiMation v5.3.18			n/a

In accordance with UKAS requirements, all measuring equipment is on a calibration cycle.