



Raymarine UK Ltd
Marine House
Cartwright Drive
Fareham
Hampshire
PO15 5RJ
Tel: 01329 246897

Email: compliance@raymarine.com

<http://www.raymarine.com>

Test Report for a65, a67 Marine Multifunction Displays

To 47 CFR Part 15 Subpart C and RSS 210

Model Number	E70076. E70077		
Product Description	a65, a67 Marine Multifunction Displays		
Report Number	TP/808/1055		
Report Author Mike Thompson EMC Engineer		Date	26 th October 2012
Technical Check Paul Pitt EMC Engineer		Date	26 th October 2012
Approval Andrew Little Compliance Manager		Date	26 th October 2012

Test Date Range	19 th October 2012-26 th October 2012
-----------------	---

Product Status	PASS
----------------	------

This test report shall not be reproduced except in full, without written approval of Raymarine UK Ltd.

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 Separation	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		26/10/2012

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: 26th October 2012

TABLE OF CONTENTS

1	47 CFR Part 15 and RSS-210 Test Summary	2
2	Attestations	3
3	Test Information	5
3.1	Test Facilities	5
3.2	Overall Test Conditions	5
3.3	Test Methods	5
4	EUT Information	6
4.1	Test Rationale	6
4.2	Description of Equipment under Test (EUT)	6
4.3	Additional information	7
4.4	Description of Auxiliary Equipment	7
4.5	Test Configurations	8
4.6	Operating Modes	8
5	Test Results	9
5.1	Transmit Duty Cycle, "x"	9
5.2	UUT Antenna Gain, "G"	9
5.3	Peak Output Power	10
5.4	Frequency Hopping Requirements	11
5.5	Frequency Range	12
5.6	Medium Access Protocol	13
5.7	20dB Channel Bandwidth	14
5.8	Frequency Band Edges	15
5.9	Transmitter Spurious Emissions	16
5.10	Receiver Spurious Emissions	23
5.11	Conducted Emissions at Antenna Port	24
6	List of Test Equipment	25

3 Test Information

3.1 Test Facilities

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

3.2 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

3.3 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

3.3.1 Deviations from Test Methods

None

4 EUT Information

4.1 Test Rationale

Full compliance

Additional units covered by this report

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

4.2 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:	<u>Chartplotter Only Variant</u> CPU 1001511 Issue 6 GPS 1001651 Issue 3 Keyboard 1001671 Issue 1 Chart Reader 1001661 Issue 1 <u>Chartplotter + Sonar Variant</u> 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:	<u>Chartplotter Only Variant</u> CPU 1001510 Issue 5 GPS 1001650 Issue 3 Keyboard 1001670 Issue 1 Chart Reader 1001660 Issue 1 <u>Chartplotter + Sonar Variant</u> 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:	

4.3 Additional information

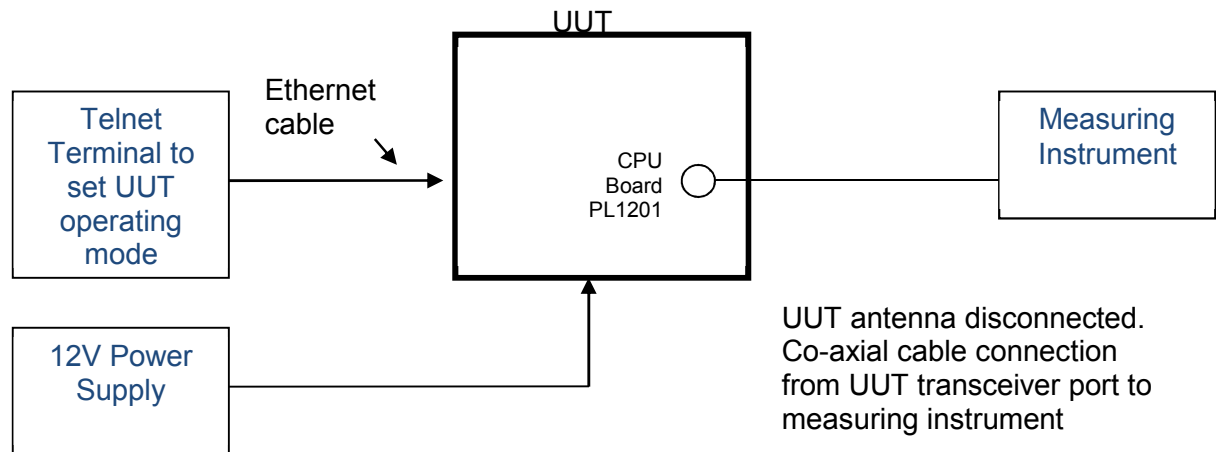
This test report is also applicable to E70076 a65 Multifunction Display.
The only difference between the a65 & a67 is the a65 does not have a built in sonar. All other functionality & features are the same.

4.4 Description of Auxiliary Equipment

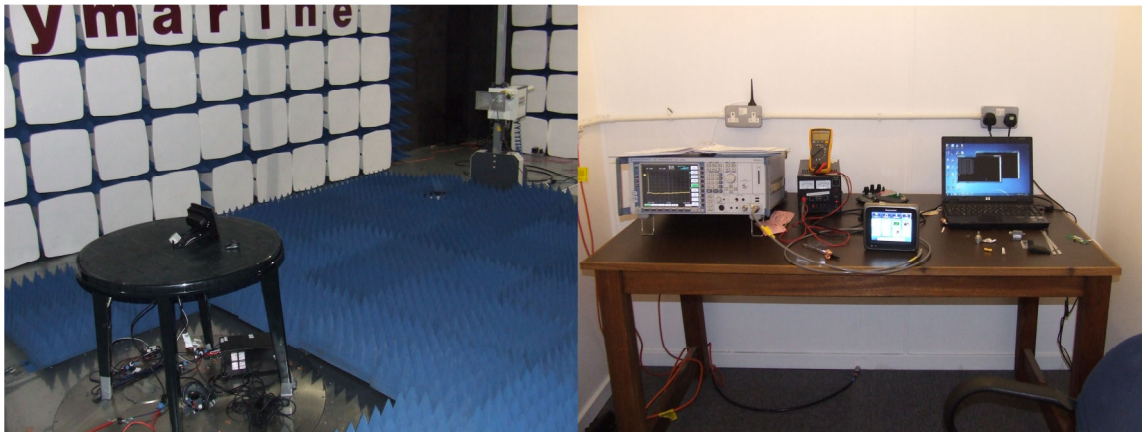
Product Type	Part Number	Serial Number
none		

4.5 Test Configurations

4.5.1 Maximum Power, EIRP Spectral Density and Frequency Range tests



4.5.2 Photos



4.6 Operating Modes

4.6.1 Peak Output Power and Frequency Range

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

5 Test Results

5.1 Transmit Duty Cycle, “x”

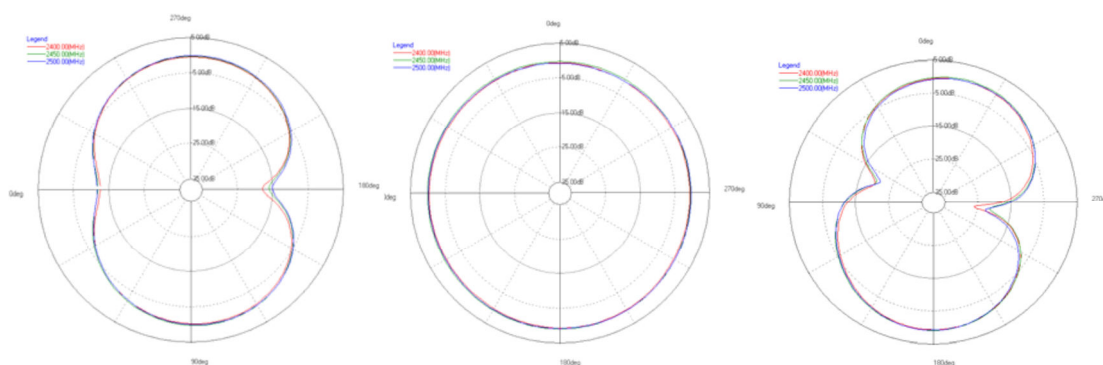
Transmit duty cycle (symbol “x”) is required for the calculations relating average power (measured) to EIRP for Maximum Transmit Power, Maximum EIRP Spectral Density and Frequency Range tests.

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

5.2 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



5.3 Peak Output Power

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

5.3.1 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

5.4 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.	79	Pass
	Adaptive hopping uses 90% min. of 2.4000 to 2.4835 band	N/A	
	Adaptive hopping uses 20 channels min.	N/A	
	Each channel occupied at least once during period $T = 4 \times \text{dwell time} \times \text{no. of channels}$	The Bluetooth channel hopping sequence is designed to visit each 1 MHz channel spacing frequency regularly and with roughly equal probability	

5.5 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 measured average power) = Threshold relative EIRP - G - $10\log(1/x)$ - 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

5.6 Medium Access Protocol

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

5.7 20dB Channel Bandwidth

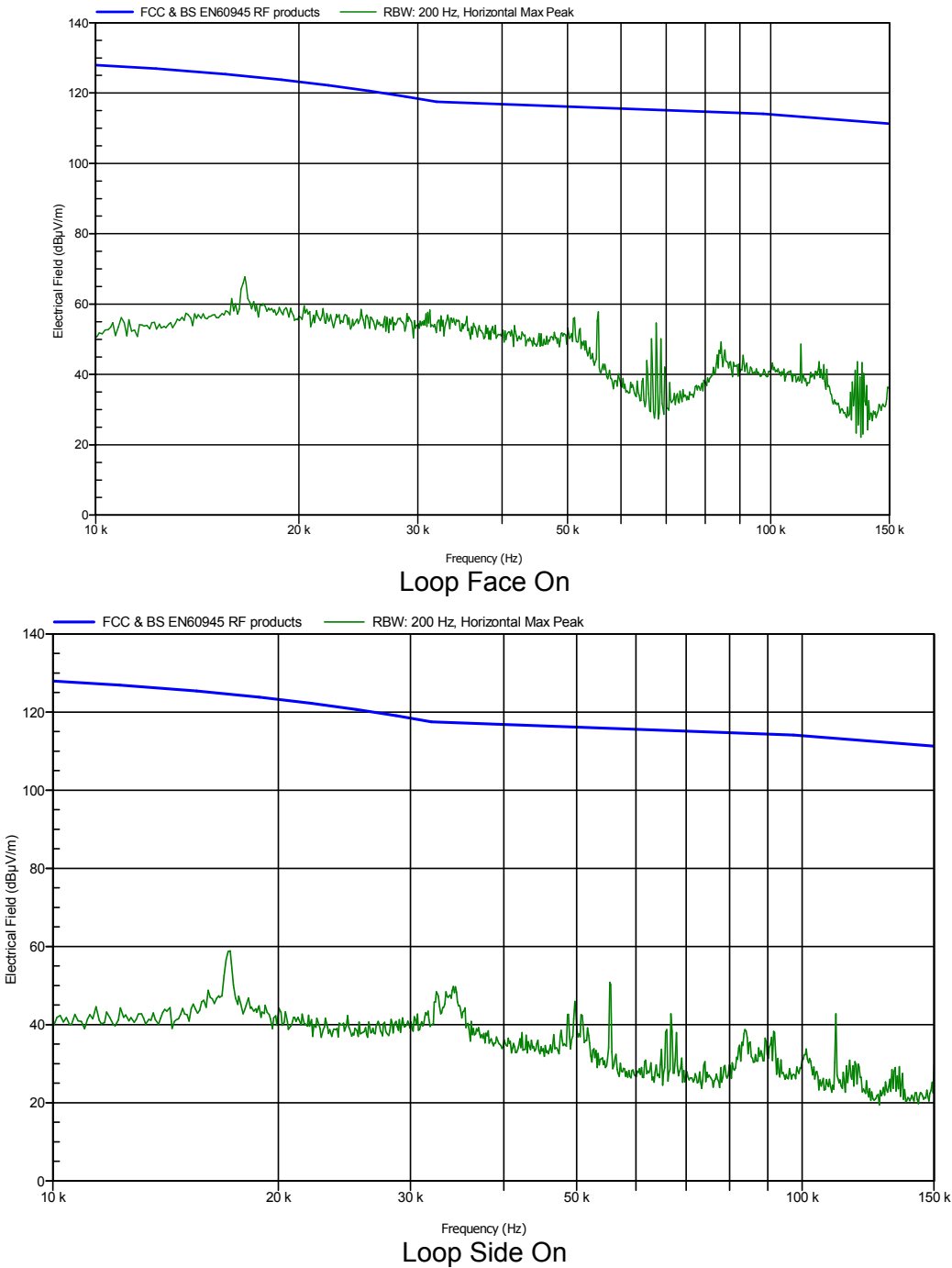
Modulation	-20dBC frequencies		-20dB BW
	fL (GHz)	fH (GHz)	fH - fL (MHz)
Ch1 \ 2.402GHz	2.40154	2.40247	0.93
Ref 14 dBmAtt 40 dB * RBW 20 kHzVSW 50 kHzSWT 20 ms Marker 1 [T1] -1.89 dBm2.40133333 GHz Marker 2 [T1] -2.25 dBm2.40189462 GHz Marker 3 [T1] -2.61 dBm2.40247154 GHz 1.93 dBm 30dB AC Center 2.402 GHz200 kHz/Span 2 MHz Date: 24.OCT.2012 17:43:35			
Ch40 \ 2.441GHz	2.44053	2.44147	0.94
Ref 14 dBmAtt 40 dB * RBW 20 kHzVSW 50 kHzSWT 20 ms Marker 1 [T1] 1.42 dBm2.44083333 GHz Marker 2 [T1] -1.35 dBm2.44053333 GHz Marker 3 [T1] -1.91 dBm2.44146794 GHz 1.93 dBm 30dB AC Center 2.441 GHz200 kHz/Span 2 MHz Date: 24.OCT.2012 17:45:11			
Ch79 \ 2.480GHz	2.47954	2.48047	0.93
Ref 14 dBmAtt 40 dB * RBW 20 kHzVSW 50 kHzSWT 20 ms Marker 1 [T1] 3.19 dBm2.47983333 GHz Marker 2 [T1] -1.83 dBm2.47954506 GHz Marker 3 [T1] -1.04 dBm2.48046794 GHz 1.93 dBm 30dB AC Center 2.48 GHz200 kHz/Span 2 MHz Date: 24.OCT.2012 17:46:43			

5.8 Frequency Band Edges

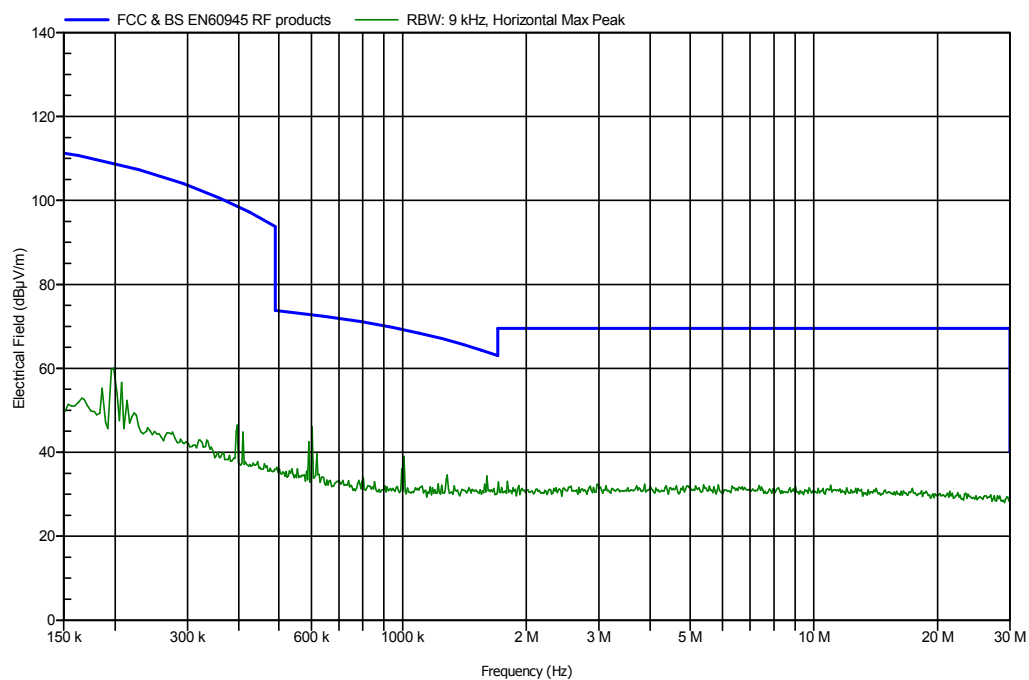
Modulation	-20dBC frequencies	
	fL (GHz)	fH (GHz)
1Mbps Bluetooth GFSK 9.5dBm nominal		
Lower Band Edge Ch1 \ 2.402GHz	2.40154	
Upper Band Edge Ch79 \ 2.480GHz		2.48047

5.9 Transmitter Spurious Emissions

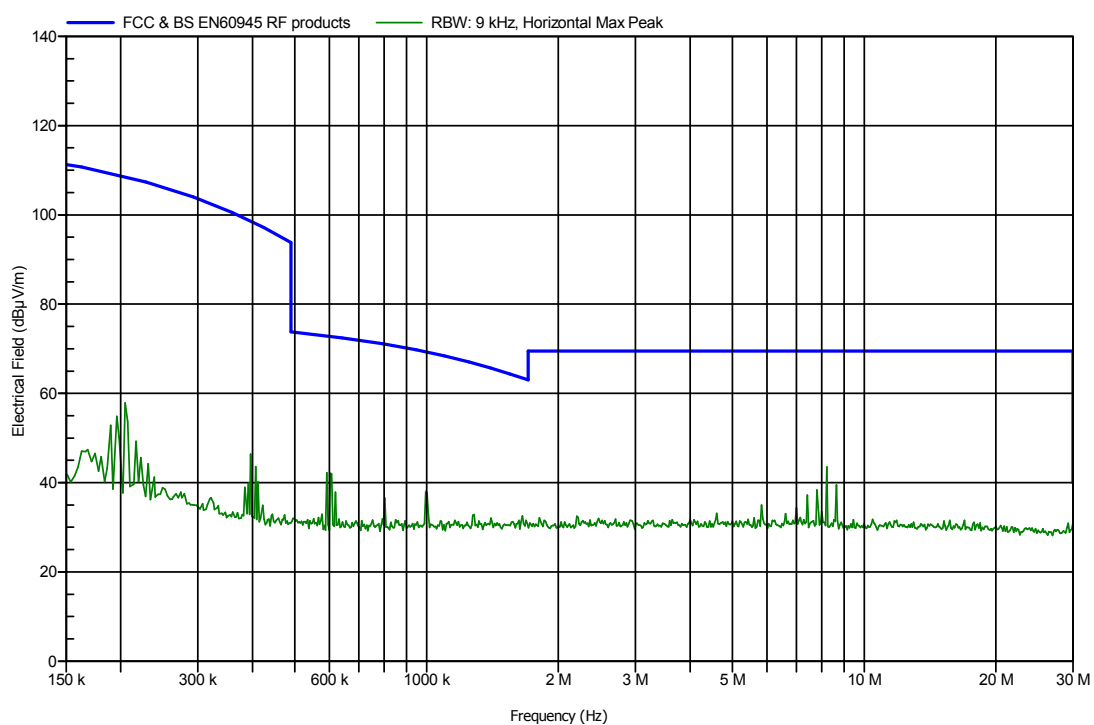
5.9.1 Radiated Emissions 9kHz-150kHz



5.9.2 Radiated Emissions 150kHz-30MHz

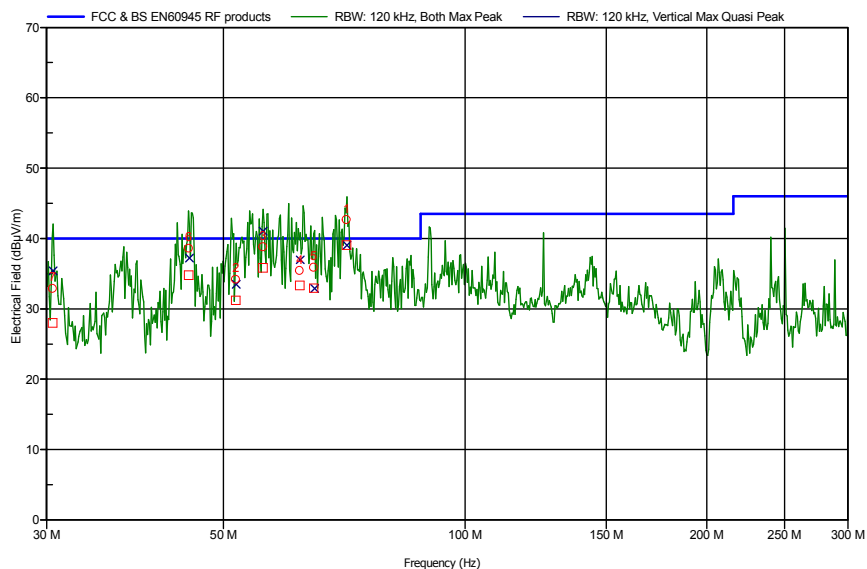


Loop Face On



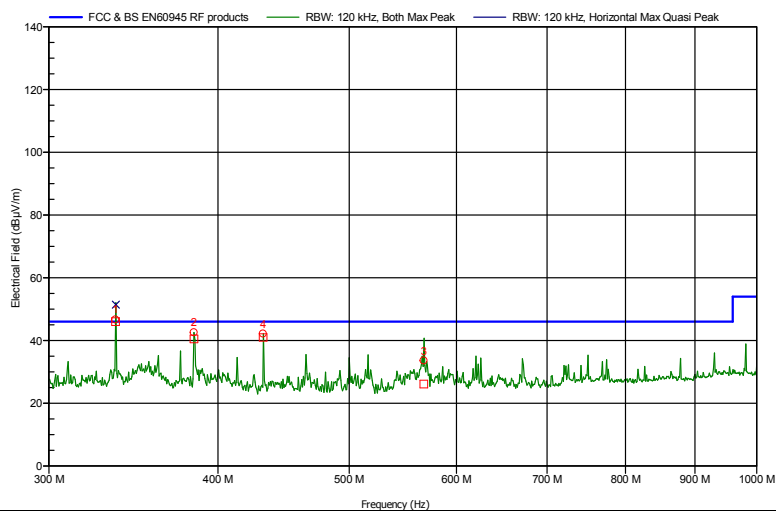
Loop Side On

5.9.3 Radiated Emissions 30MHz – 300MHz



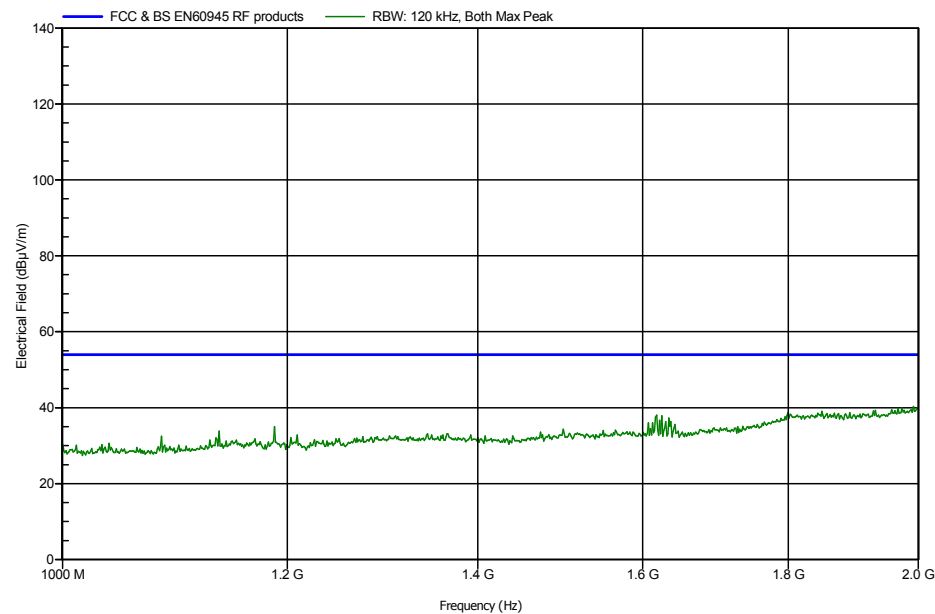
Peak identifier	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
1	71.164 MHz	42.65 dBμV/m	39.07 dBμV/m	40 dBμV/m	-0.93 dB	Pass	254 Degree	1.13 m	Vertical
2	51.808 MHz	34.16 dBμV/m	31.23 dBμV/m	40 dBμV/m	-8.77 dB	Pass	74 Degree	1.01 m	Vertical
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

5.9.4 Radiated Emissions 300MHz-1GHz

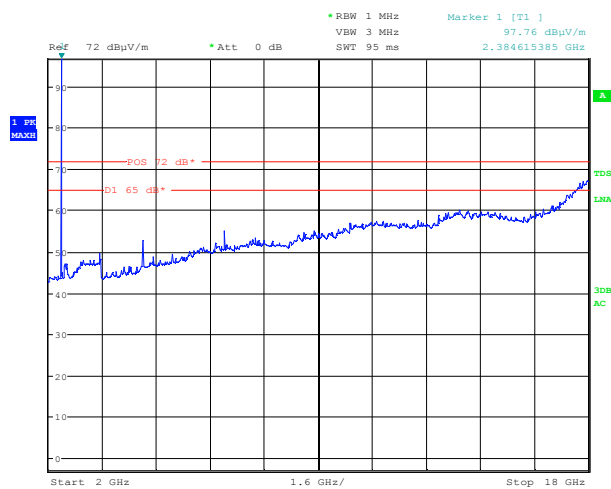


Peak identifier	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Peak Status	Angle	Height	Polarization
1	336 MHz	46.67 dBμV/m	45.97 dBμV/m	46 dBμV/m	-0.03 dB	Pass	285 Degree	100 cm	Horizontal
2	383.952 MHz	42.59 dBμV/m	40.54 dBμV/m	46 dBμV/m	-5.46 dB	Pass	45 Degree	1.04 m	Vertical
3	567.72 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

5.9.5 Radiated Emissions 1GHz-2GHz

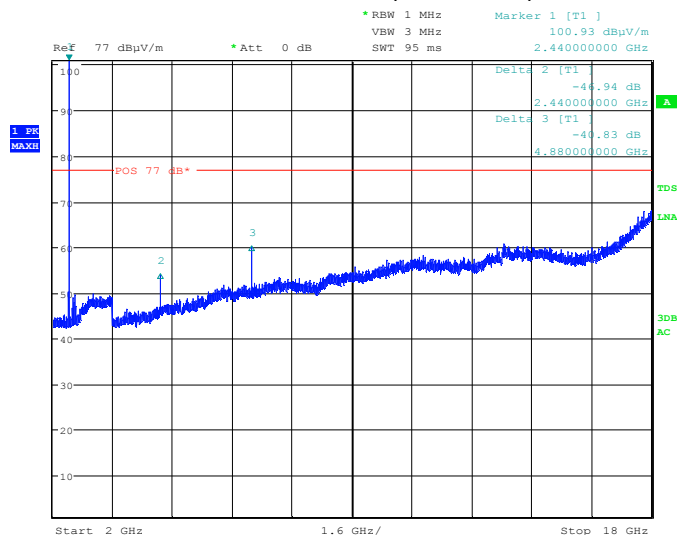


5.9.6 Radiated Emissions 2GHz-18GHz



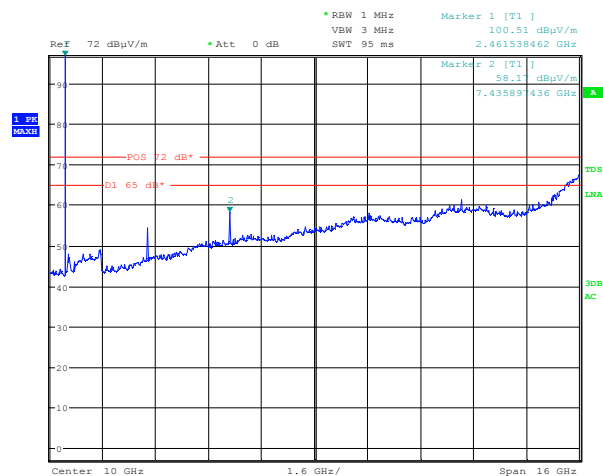
Date: 22.OCT.2012 17:56:50

Channel 1 (2402MHZ)



Date: 26.OCT.2012 10:35:06

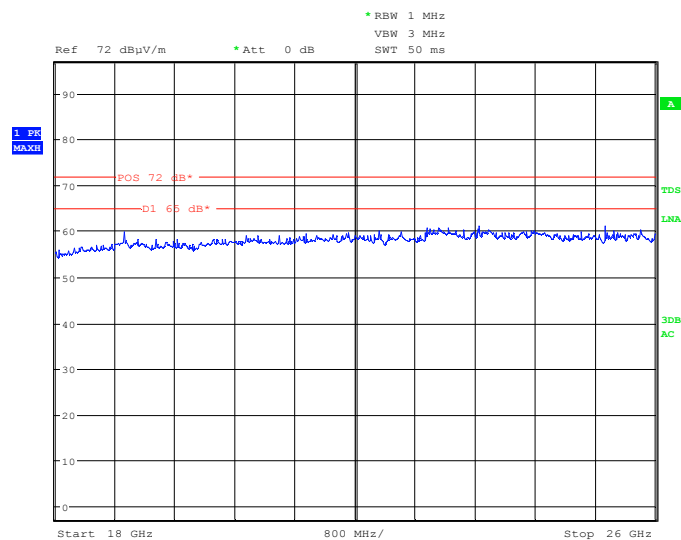
Channel 40 (2440MHZ)



Date: 22.OCT.2012 18:00:07

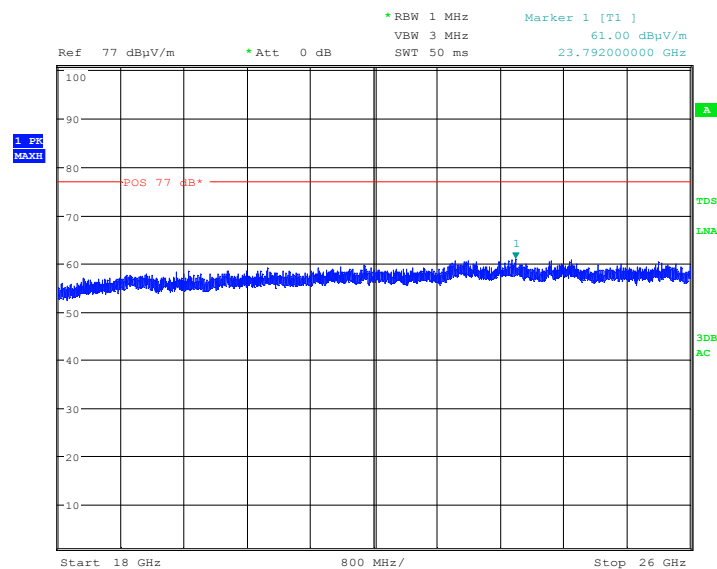
Channel 79 (2480MHz)

5.9.7 Radiated Emissions 18GHz-26GHz



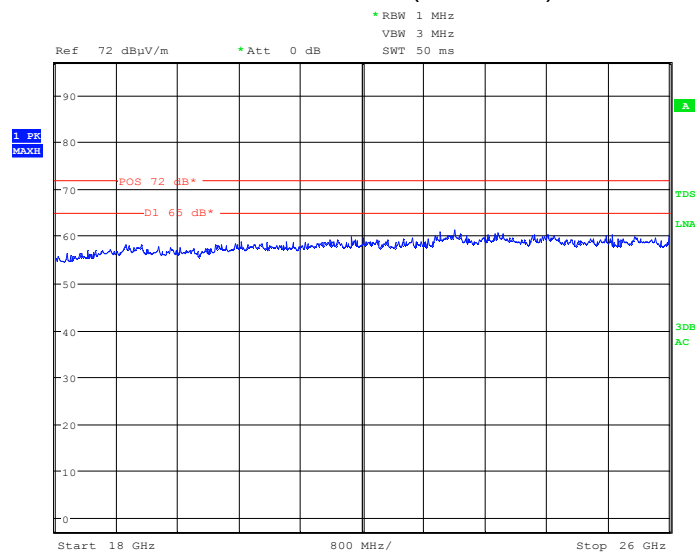
Date: 22.OCT.2012 12:19:01

Channel 1 (2402MHz)



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

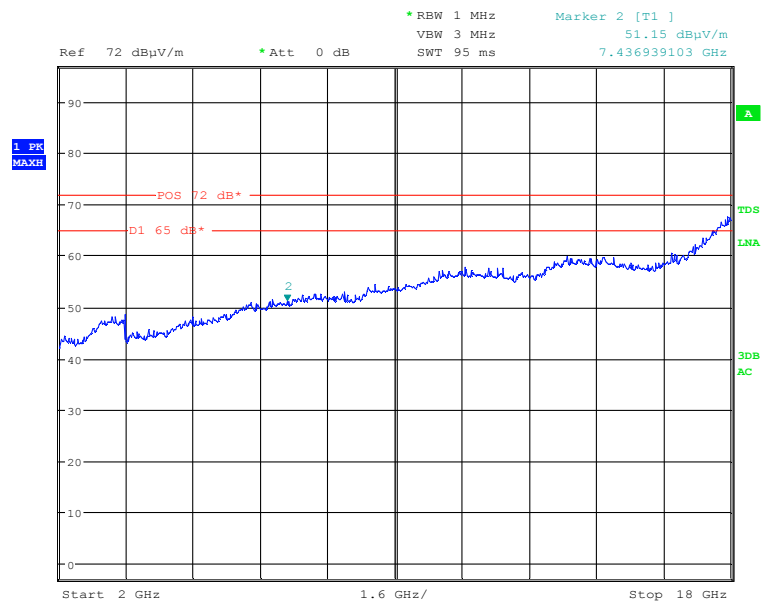
Channel 40 (2440MHz)



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

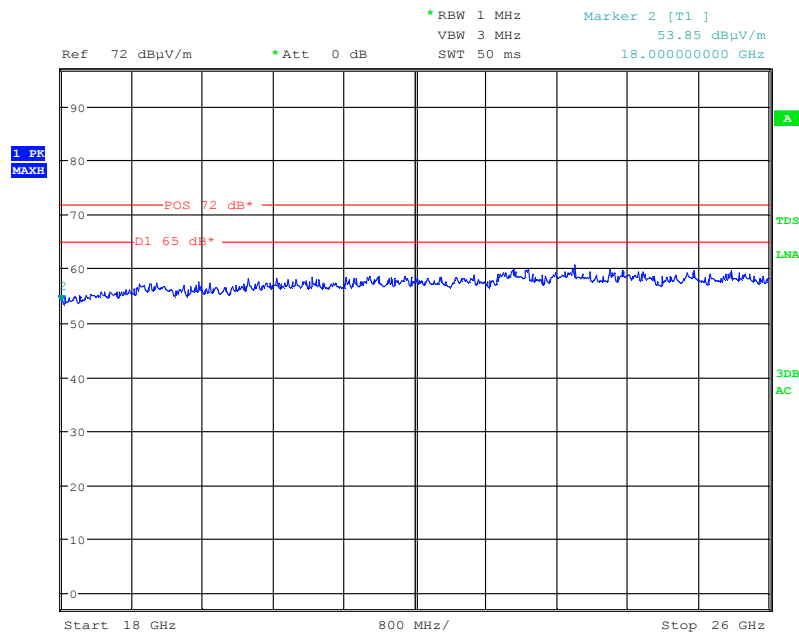
Channel 79 (2480MHz)

5.10 Receiver Spurious Emissions



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

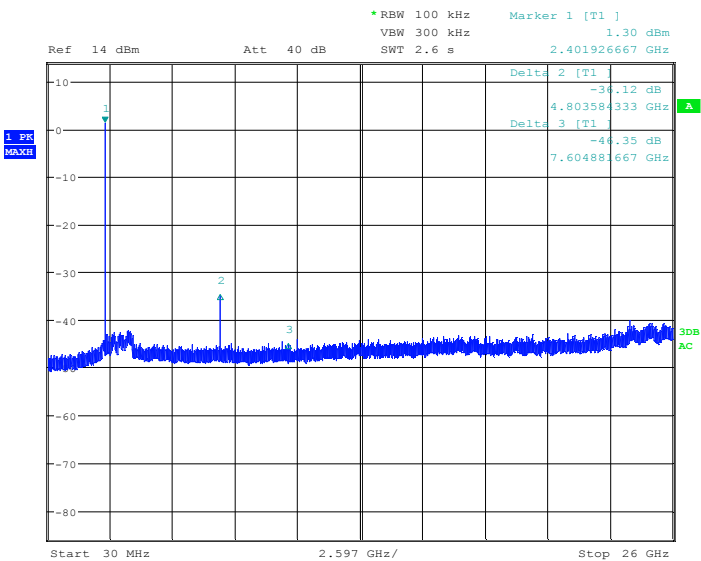
Receiver spurious emissions 2GHz-18GHz



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

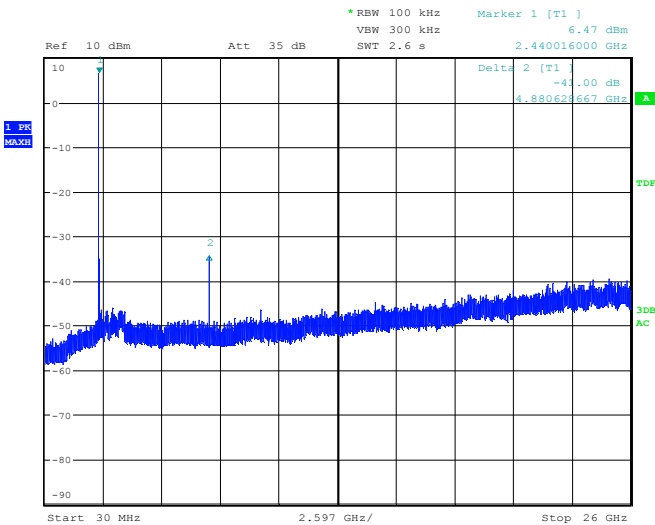
Receiver Spurious Emissions 18GHz-26GHz

5.11 Conducted Emissions at Antenna Port



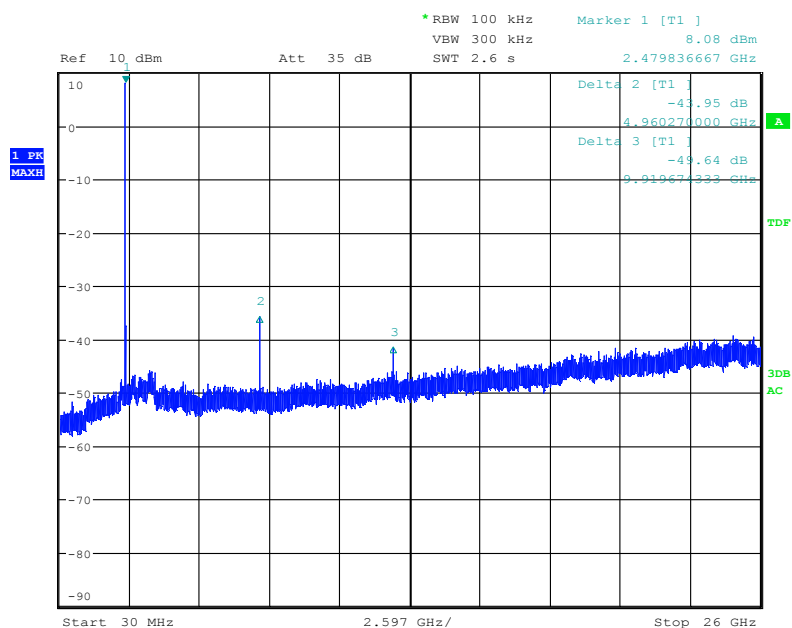
Date: 25.OCT.2012 12:13:11

Channel 1 2402MHz



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

Channel 40 (2440MHz)



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

Channel 79 (2480MHz)

6 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

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