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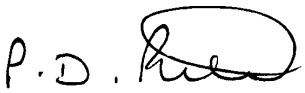
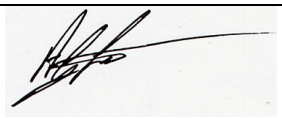
Test Report for e165 Marine Multifunction Display

To RSS-210 and 47 CFR Part 15 Subpart C – Spurious Emissions

Model Number	E70025		
Product Description	e165 Marine Multifunction Displays		
Report Number	TP/752/1014a		
Report Author Mike Thompson EMC Engineer		Date	8th October 2012
Technical Check Paul Pitt EMC Engineer		Date	9th October 2012
Approval Andrew Little Compliance Manager		Date	10th October 2012

Test Date Range	15/8/2012 to 16/8/2012 & 17/09/2012

Product Status	PASS

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

1 RSS 210 and 47 CFR Part 15 Test Summary

47 CFR Part 15	RSS-210	
15.209(a) Radiated Emissions	RSS-GEN 7.5.2	Pass
15.247(d) Spurious Emissions	A8.5 Out of band emissions	Pass

Conducted results are included in report TP/802/1066 as the module, interface etc. is identical to the module used on the previous e7/e7D units.

	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
Spurious Emissions	15.247(d)	A8.5	Separate Report	Pass
Number of Channels	15,247(a)(1)	A8.1(d)	5.4	Pass
Directional antenna with >6dBi	15.247(c)		Antenna<6dBi	N/A
Dwell Time	15.247(a)	A8.1(d)	5.4	Pass
6dB Bandwidth		A8.2(a)	5.10	Pass
Power Spectral Density		A8.2(b)	5.11	Pass

Summary from report TP/802/1066

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		8th October 2012

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

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

Andy Little
Compliance Manager

Date: 10th October 2012

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3 Test Information

3.1 Test Facilities

Site 1	9m x 6m x 5.5m Semi Anechoic Chamber	FCC ID IC Certification	Reg 371673 Reg 4069B-2

3.2 Overall Test Conditions

Work Area	Relative Humidity (%)	Air Pressure (mbar)	Ambient Temperature (°C)
Site 1-5	60-65	1003-1005	18.5-19.6
Sites 6-10	59-65	1013-1015	21.2-22.0

3.3 Test Methods

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C paragraph 15.247(d) (Bluetooth and WIFI, 2.4GHz ISM band radiators) for the EUT FCC ID Certification:

Number	Standard Number	Document Title
1	47 CFR Part 15 (10-01-09 Edition)	Radio Frequency Devices

3.3.1 Deviations from Test Methods

None

4 EUT Information

4.1 Test Rationale

Tested to ensure compliance to FCC Chapter 47, part 15: 15.209(a) Radiated Emissions 15.247(d) Spurious Emissions

4.2 Description of Equipment under Test (EUT)

Date of Receipt:	13/08/2012
Client:	Stuart Evans – Raymarine Project Manager
Brand Name:	Raymarine
Product Range:	Multifunction Display with Sonar
Country of Manufacture:	China
Operational voltage range:	10.8V to 31.2V

Unit 1

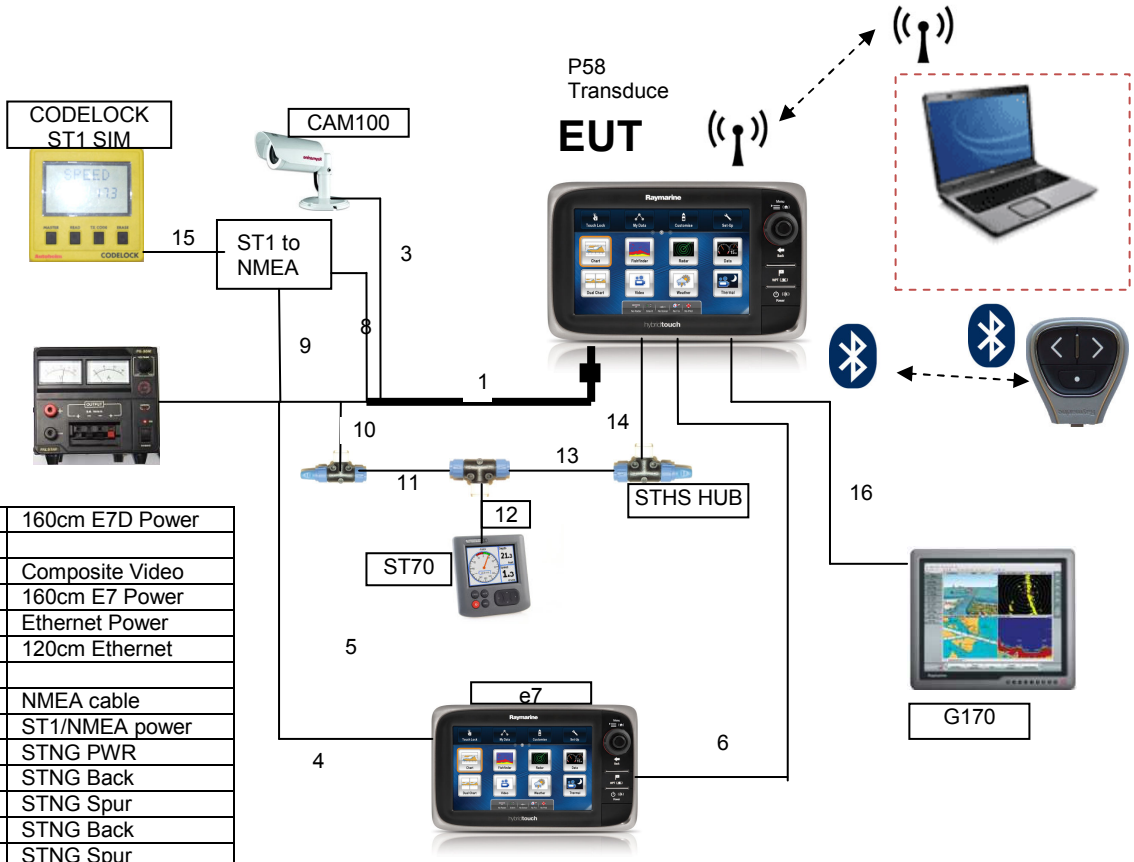
Model Name or Number:	e165
FCC ID	PJ5-WFBT3
IC ID	4069B-WFBT3
Unique Type Identification:	E70025
Serial Number:	0720014 / EMC120820
CCT Diagram Number(s) & Issue:	CPU board 1001555-3 Sonar Board 1000215-5 Keyboard 1001575-1
PCB Assembly Number(s) & Issue:	CPU board 1001550-1 Sonar Board 1000210-3 Keyboard 1001570-1
Software Version:	Application 4.28-00623 Kernel 2.6.35-7
Modifications to Unit:	None

4.3 Additional information

4.4 Description of Auxiliary Equipment

Product Type	Part Number	Serial Number
ST1 Simulator	Codelock	EMC170306d
CAM100	E03006	EMC111004
ST1 to NMEA Converter	E85001	EMC111004a
ST70	E22105	1270965
Compaq Laptop	NC6220	RM0048
RCU-3	E62351	
e7 Aux Display		EMC005
G170 Monitor		EMC081202

4.5 Test setup



1	160cm E7D Power
3	Composite Video
4	160cm E7 Power
5	Ethernet Power
6	120cm Ethernet
8	NMEA cable
9	ST1/NMEA power
10	STNG PWR
11	STNG Back
12	STNG Spur
13	STNG Back
14	STNG Spur
15	ST1
16	Video Out Cable

The equipment highlighted in red was placed in the chamber control room and powered separately. Wireless connection was realised by the use of hard-wired 2.4GHz antenna terminated through the chamber waveguide. Both uSD card slots on the EUT were operational during the test.

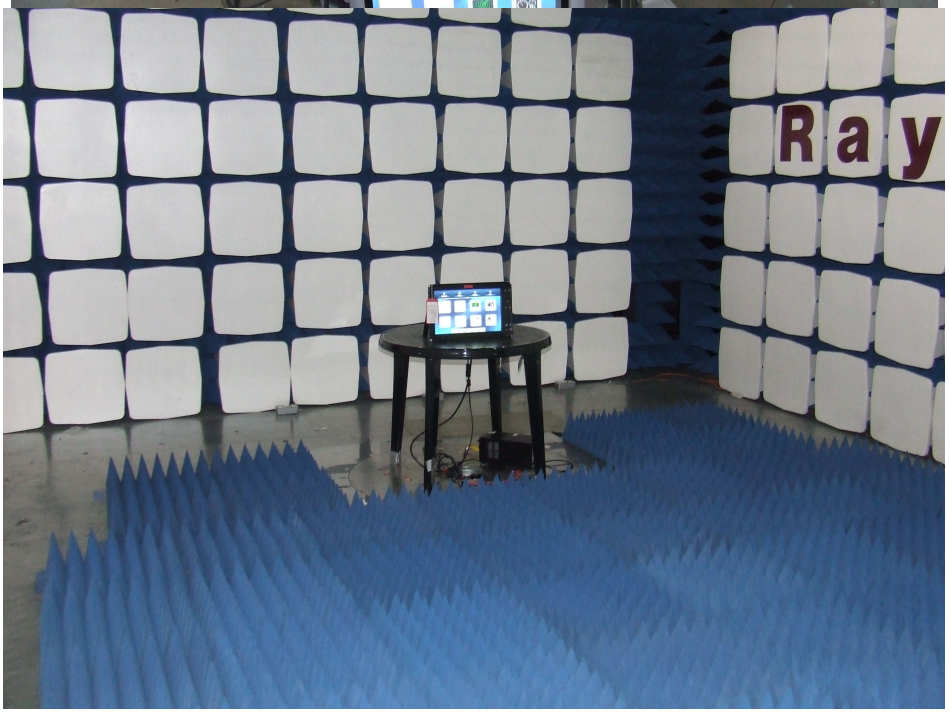
4.6 Emissions – Below 2GHz

Below 2GHz the unit was setup in a system to ensure the EUT was fully functional. The Bluetooth and WIFI were functional during testing.

4.7 Transmitter Spurious Emissions – 2GHz to 26GHz

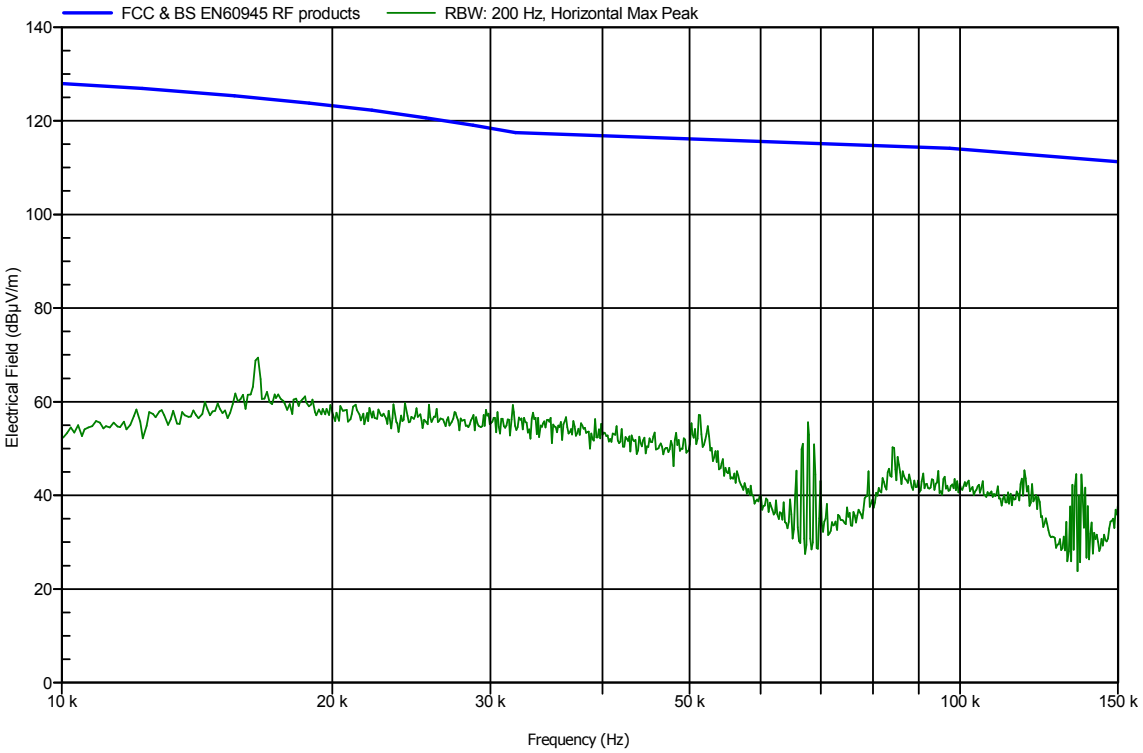
2GHz to 26GHz the unit was setup in a system to ensure the EUT was fully functional. Control of the WIFI and Bluetooth was controlled externally to enable the WIFI and Bluetooth Emissions to be measured separately.

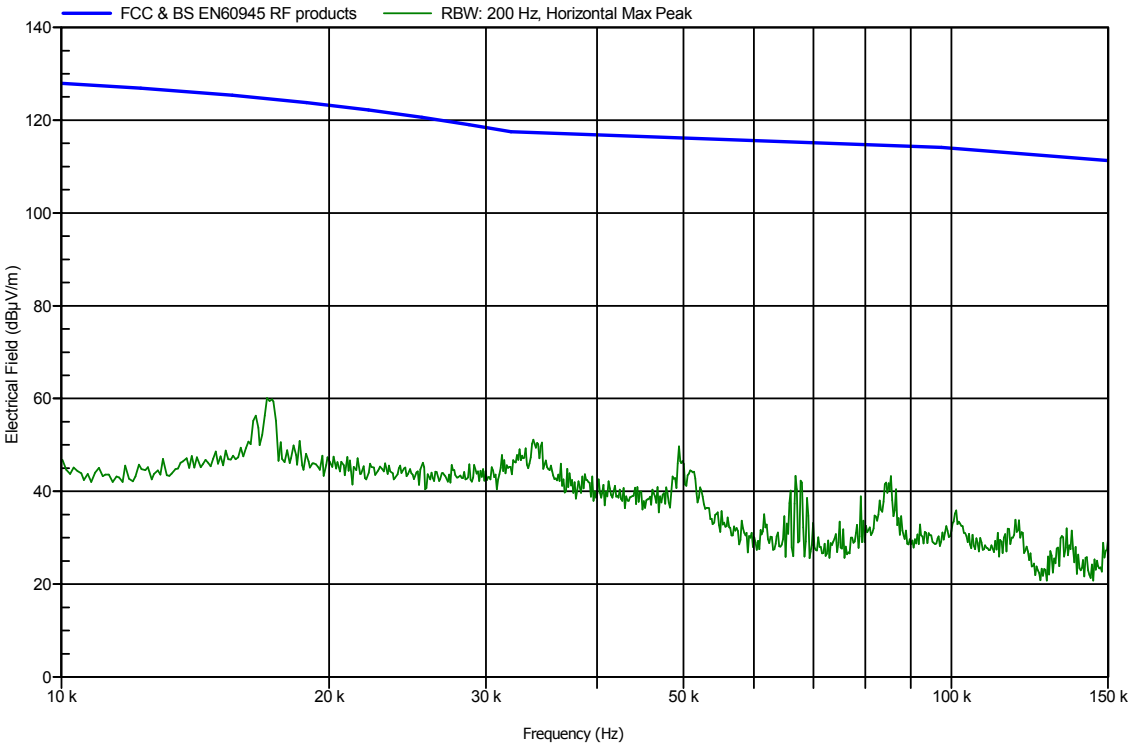
5 Photographs

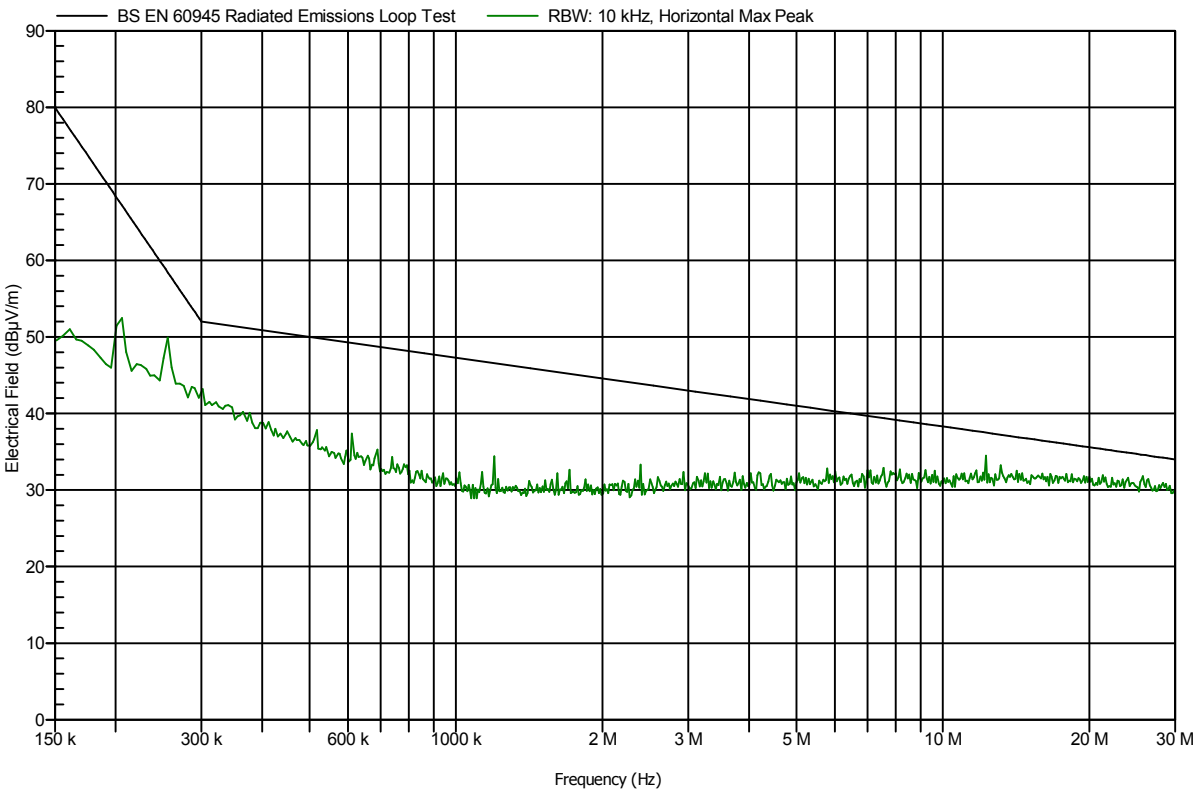


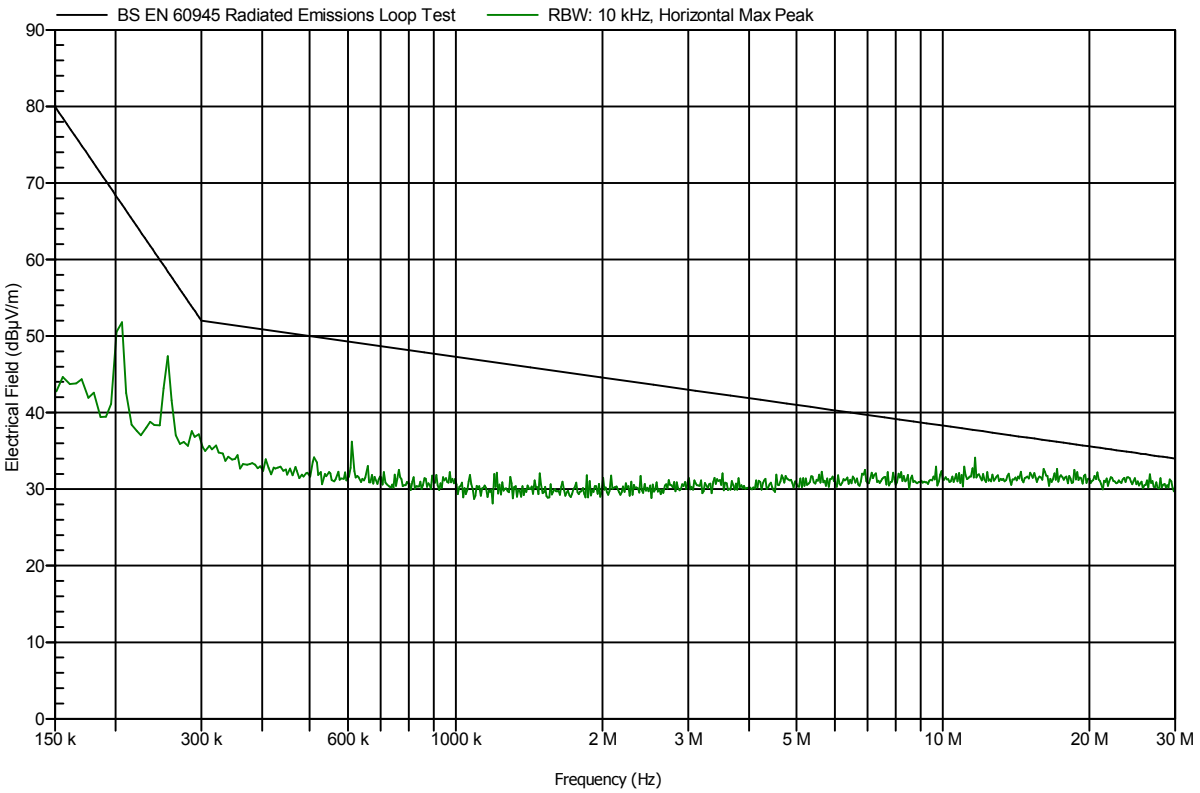
6 Emissions Results

6.1 e165 Emissions 9kHz-30MHz






BS EN 60945 Radiated Emissions Loop Test
RBW: 10 kHz, Horizontal Max Peak
Electrical Field (dBµV/m)
90
80
70
60
50
40
30
20
10
0
150 k
300 k
600 k
1000 k
2 M
3 M
5 M
10 M
20 M
30 M
Frequency (Hz)


BS EN 60945 Radiated Emissions Loop Test
RBW: 10 kHz, Horizontal Max Peak
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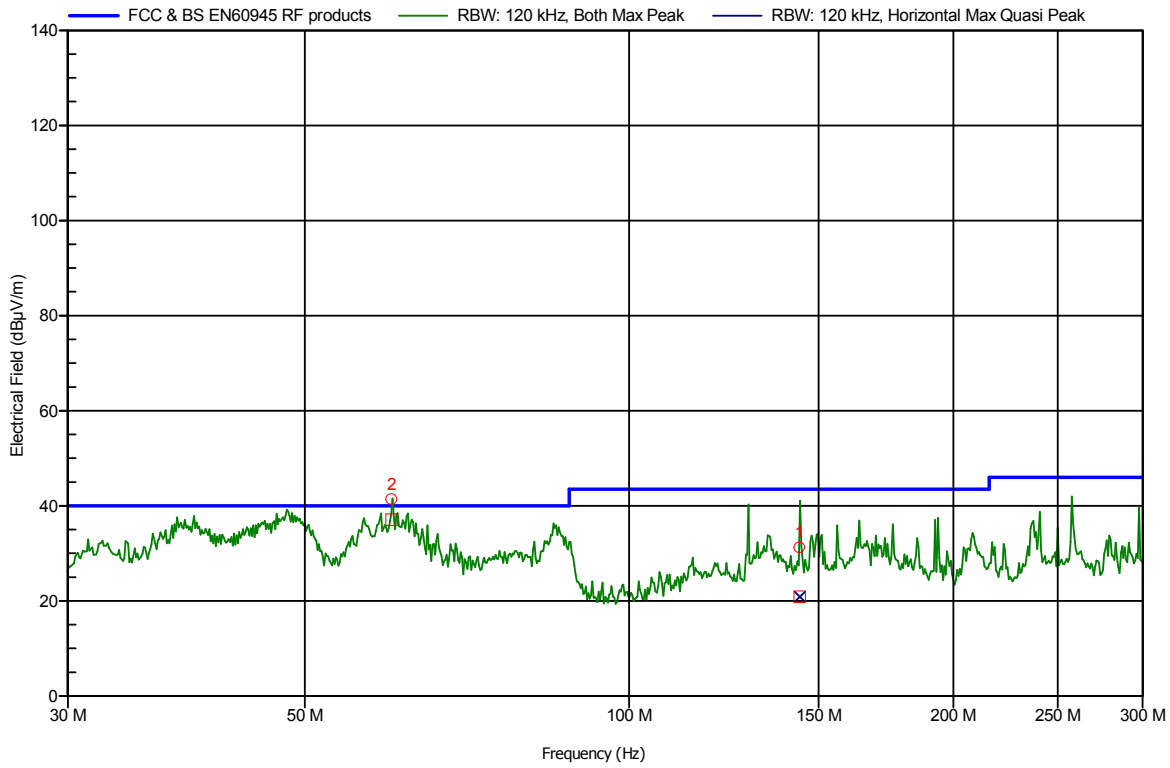
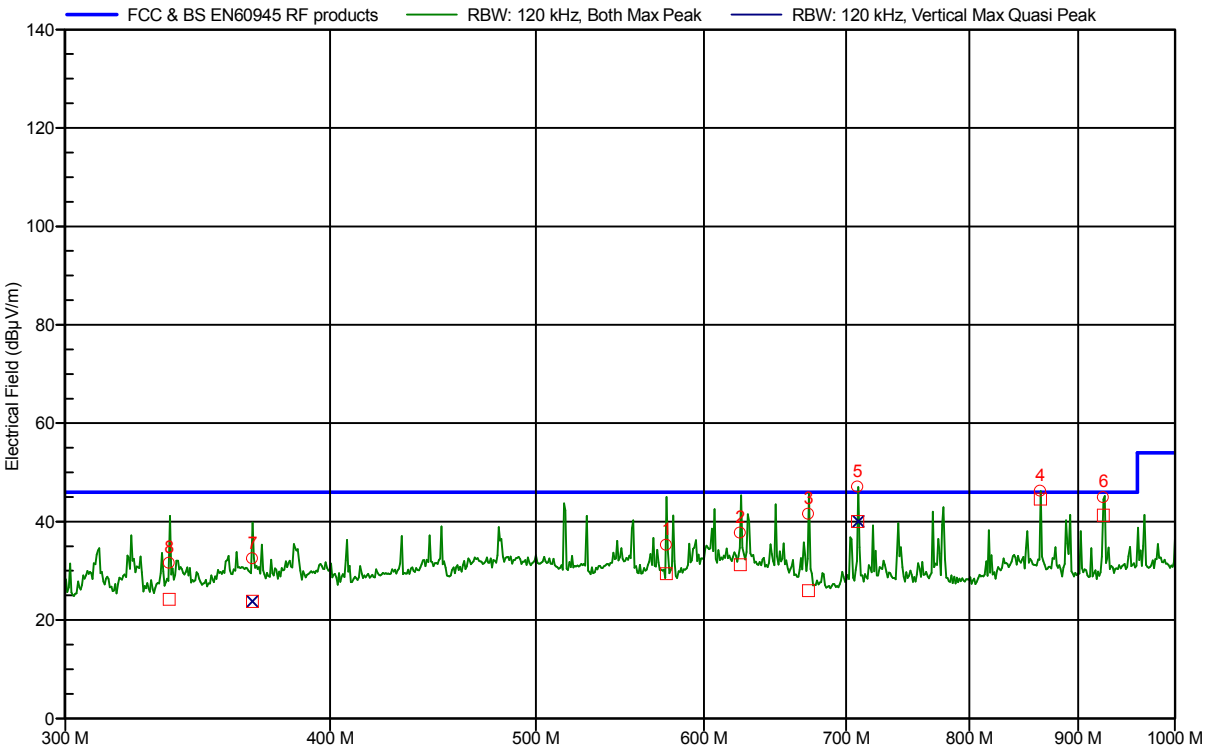
300 k
600 k
1000 k
2 M
3 M
5 M
10 M
20 M
30 M
Frequency (Hz)

6.2 e165 Emissions 30MHz to 300MHz EUT



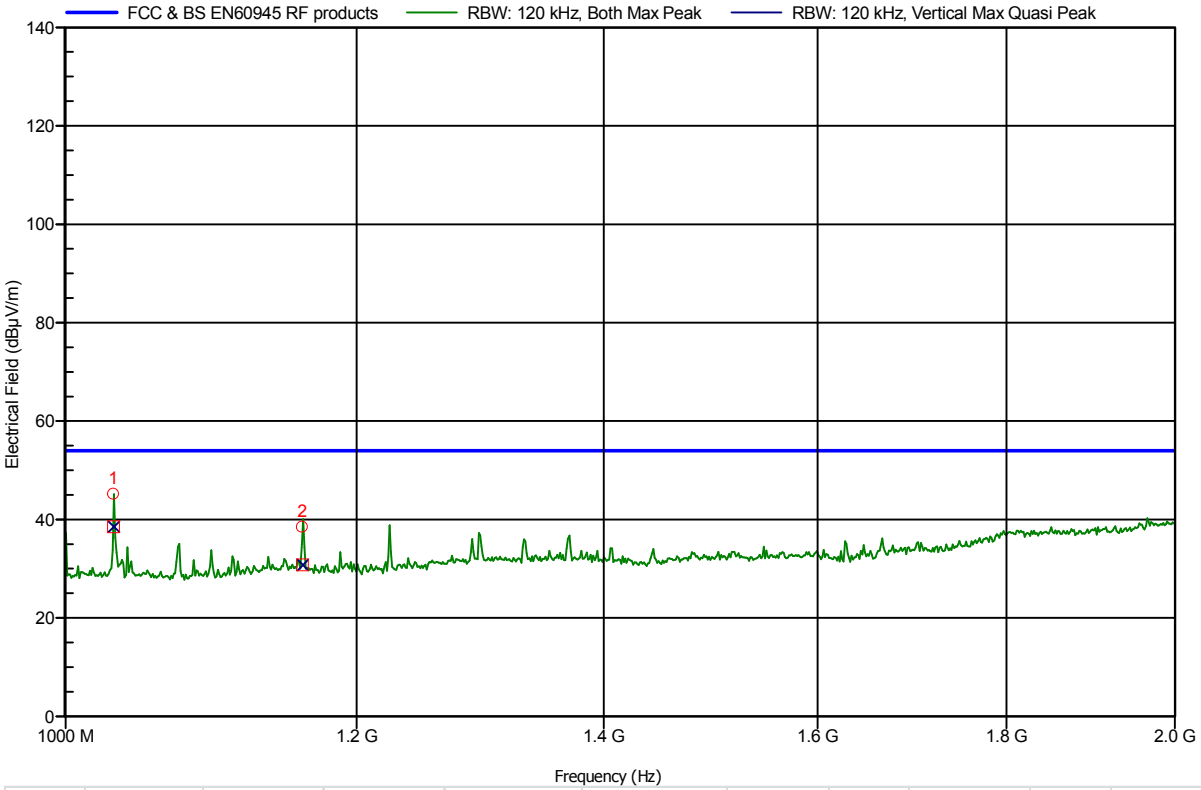
	Frequency	PK Value	QP Value	QP Limit	QP Margin	QP Result	Angle	Height	H/V
1	143.98 MHz	31.2 dBµV/m	20.88 dBµV/m	43.5 dBµV/m	-22.62 dB	Pass	247 Degree	1.95 m	Horizontal
2	60.196 MHz	41.34 dBµV/m	37.11 dBµV/m	40 dBµV/m	-2.89 dB	Pass	180 Degree	1.29 m	Vertical

6.3 e165 Radiated Emissions 300MHz-1GHz



	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Status	Angle	Height	Polarization
1	576 MHz	35.23 dBµV/m	29.43 dBµV/m	46 dBµV/m	-16.57 dB	20.8 dB	Pass	225 Degree	1.39 m	Horizontal
2	624 MHz	37.68 dBµV/m	31.22 dBµV/m	46 dBµV/m	-14.78 dB	21 dB	Pass	210 Degree	1.2 m	Horizontal
3	672 MHz	41.53 dBµV/m	25.97 dBµV/m	46 dBµV/m	-20.03 dB	21.7 dB	Pass	210 Degree	1.2 m	Horizontal
4	864.012 MHz	46.19 dBµV/m	44.55 dBµV/m	46 dBµV/m	-1.45 dB	24.8 dB	Pass	270 Degree	1.5 m	Horizontal
5	708.708 MHz	47.05 dBµV/m	40.04 dBµV/m	46 dBµV/m	-5.96 dB	22.3 dB	Pass	255 Degree	1.2 m	Vertical
6	925.02 MHz	44.89 dBµV/m	41.29 dBµV/m	46 dBµV/m	-4.71 dB	25.7 dB	Pass	90 Degree	1.2 m	Horizontal
7	367.716 MHz	32.46 dBµV/m	23.79 dBµV/m	46 dBµV/m	-22.21 dB	15.4 dB	Pass	337 Degree	1.39 m	Vertical
8	336 MHz	31.54 dBµV/m	24.22 dBµV/m	46 dBµV/m	-21.78 dB	15.2 dB	Pass	67 Degree	1.1 m	Horizontal

6.4 e165 Radiated Emissions 1GHz-2GHz

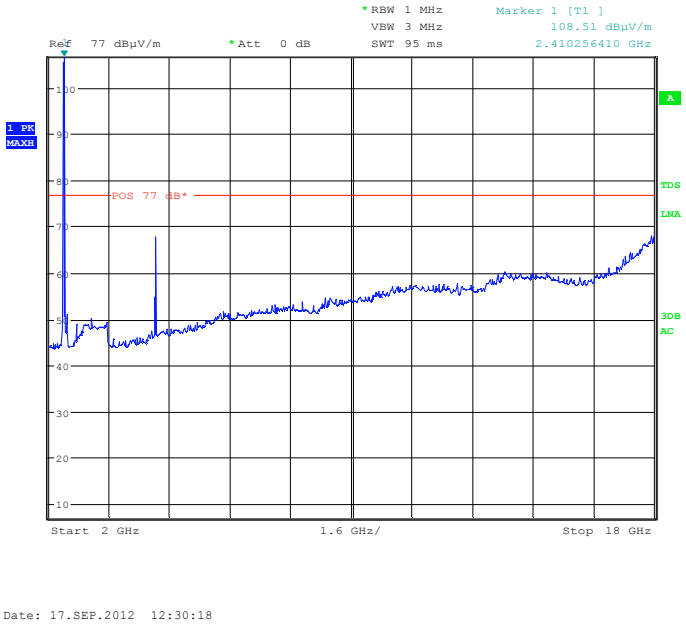


Peak identifier	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Status	Angle	Height	Polarization
1	1.031 GHz	45.14 dBµV/m	38.53 dBµV/m	54 dBµV/m	-15.47 dB	26.2 dB	Pass	180 Degree	1.2 m	Vertical
2	1.16 GHz	38.44 dBµV/m	30.77 dBµV/m	54 dBµV/m	-23.23 dB	28 dB	Pass	90 Degree	1.04 m	Vertical

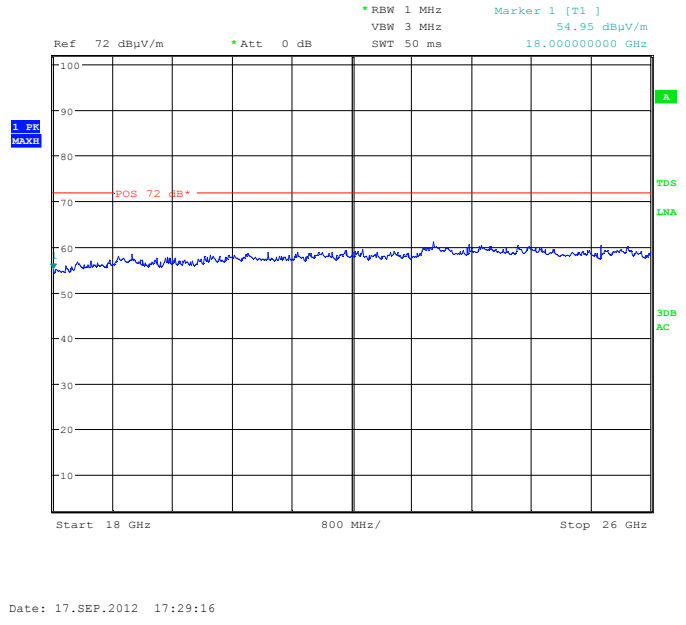
6.5 FCC Part 15, Chapter 47_15.247 Spurious Emissions –2GHz to 26GHz

The following plots illustrate the radiated emissions of the EUT from 2GHz to 26GHz. The limits for emissions in this band is 20dBc and 500µV/m. Any emissions more than 10dB of this limit are not recorded, however all emissions were more than 10dB below this limit. The 2nd harmonic is due to the receiver and not from the EUT.

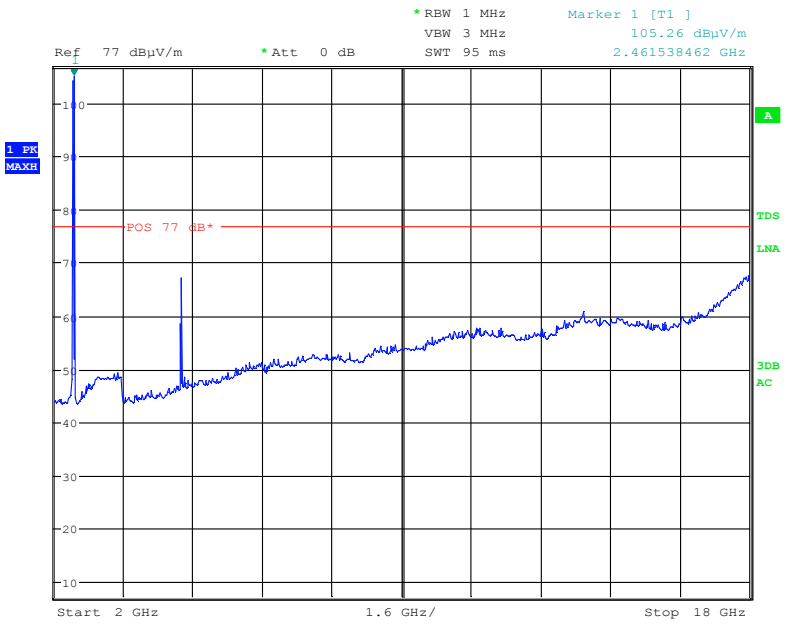
6.5.1 WIFI Emissions



e165 11Mbps 802.11b DSSS 20dBm nominal Channel 1 (2GHz to 18GHz)

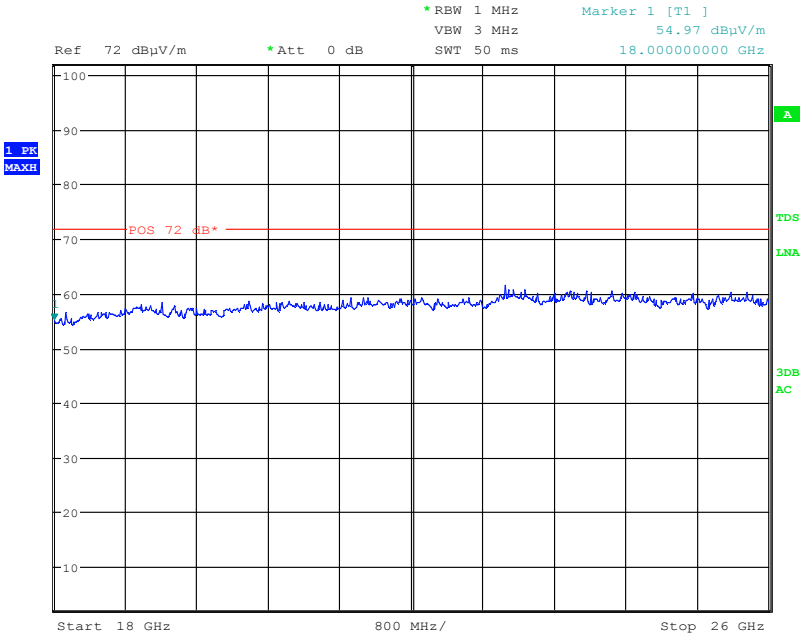


e165 11Mbps 802.11b DSSS 20dBm nominal Channel 1 (18GHz-26GHz)



Date: 17.SEP.2012 12:36:15

e165 11Mbps 802.11b DSSS 20dBm nominal Channel 11 (2GHz to 18GHz)



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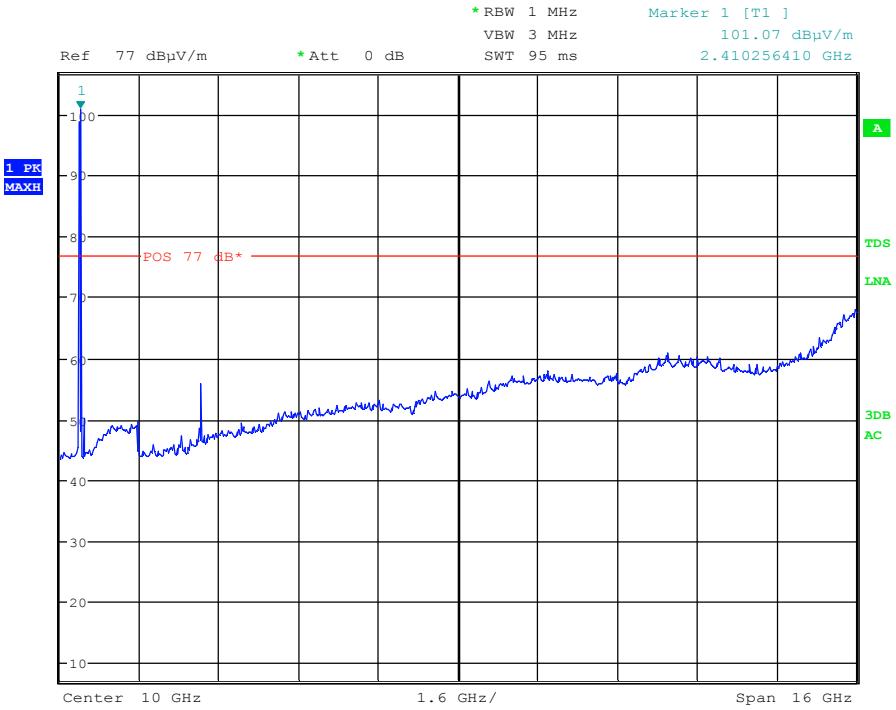
e165 11Mbps 802.11b DSSS 20dBm nominal Channel 11 (18GHz to 26GHz)



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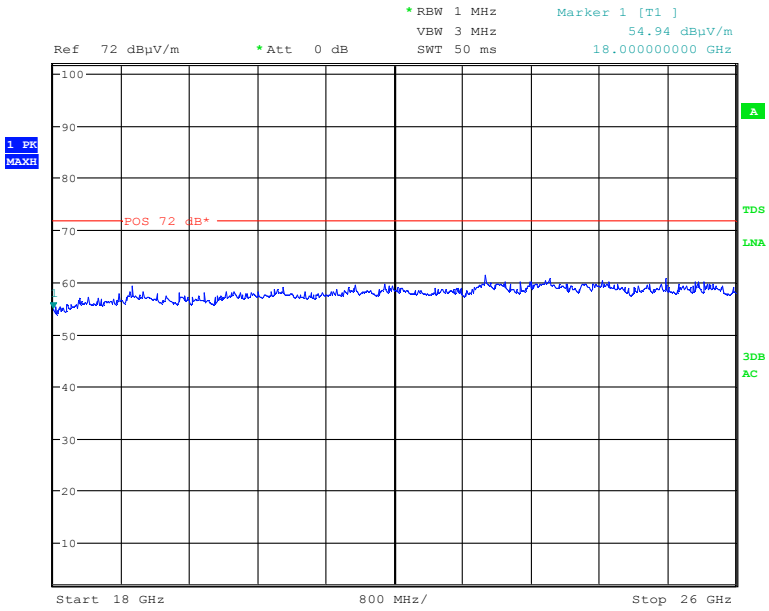
e165 54Mbps 802.11g OFDM 14.5dBm nominal Channel 1 (2GHz to 18GHz)



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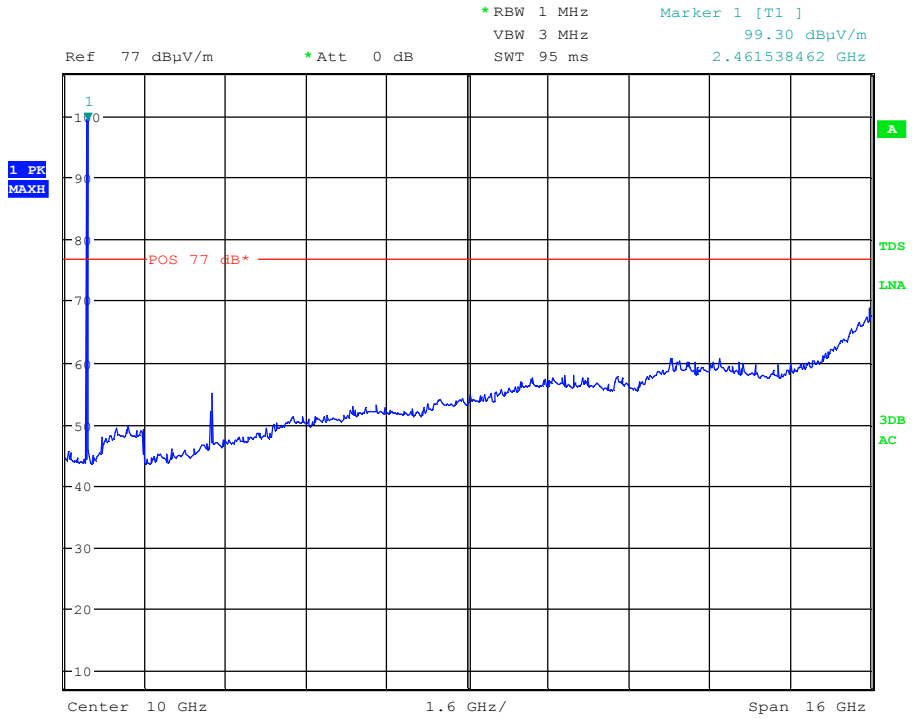
e165 54Mbps 802.11g OFDM 14.5dBm nominal Channel 1 (18GHz to 26GHz)



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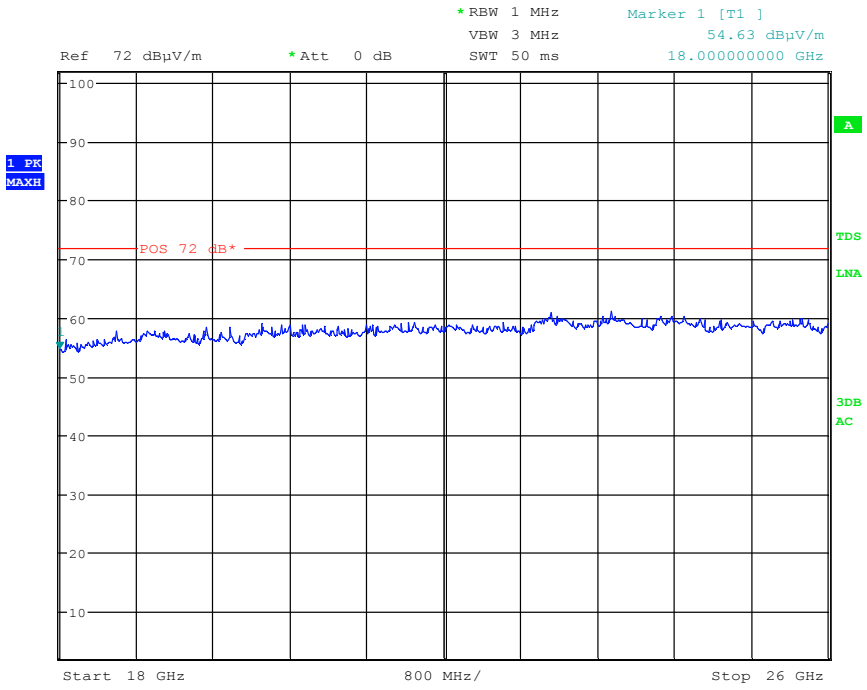
e165 54Mbps 802.11g OFDM 14.5dBm nominal Channel 11 (2GHz to 18GHz)



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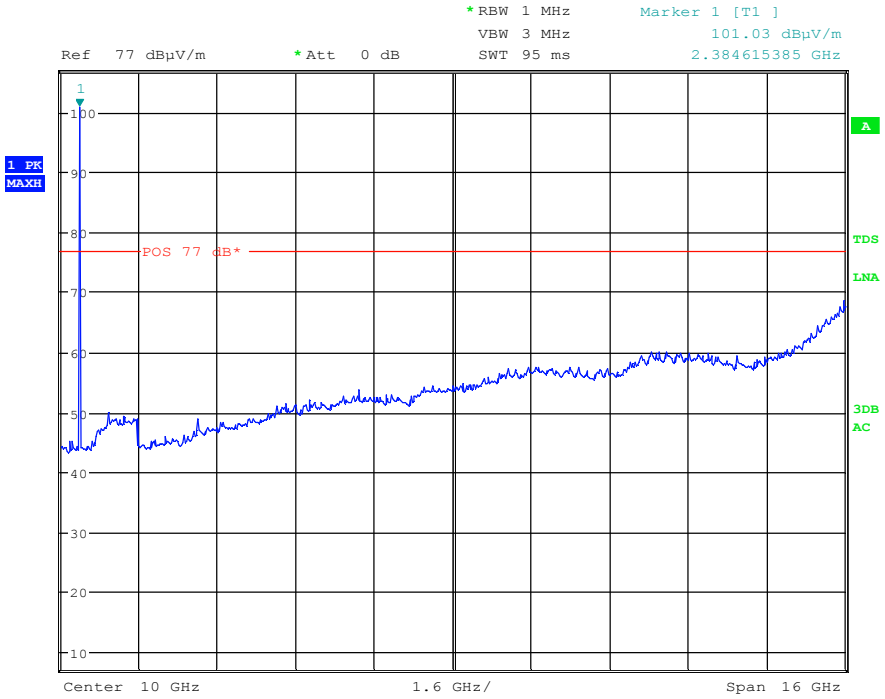
e165 54Mbps 802.11g OFDM 14.5dBm nominal Channel 11 (18GHz to 26GHz)

6.5.2 *Bluetooth Emissions*



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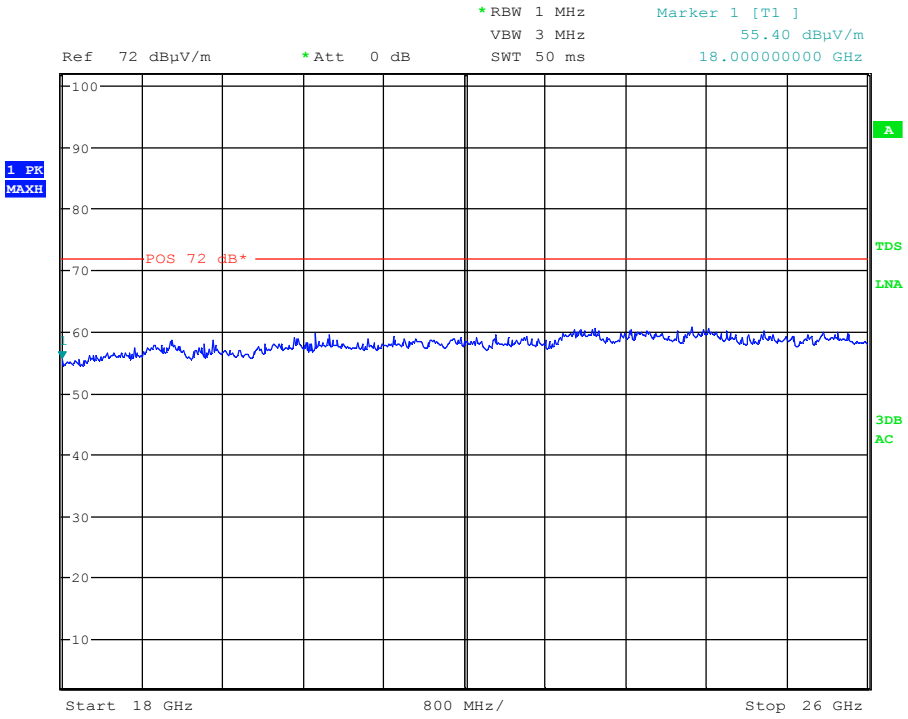
e165 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 1 (2GHz to 18GHz)



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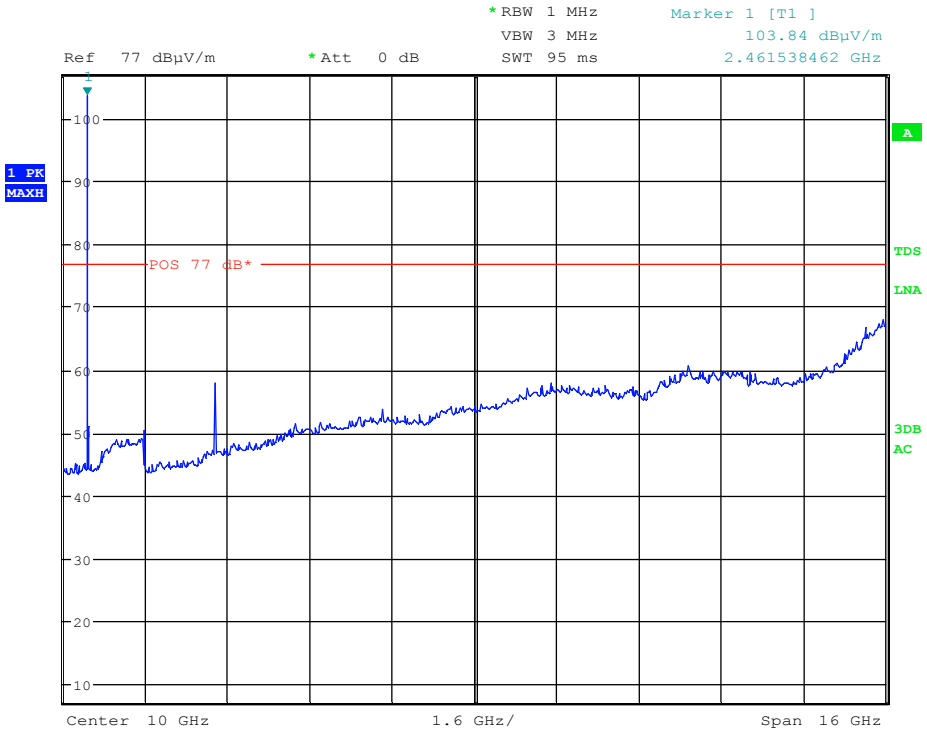
e165 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 1 (18GHz to 26GHz)



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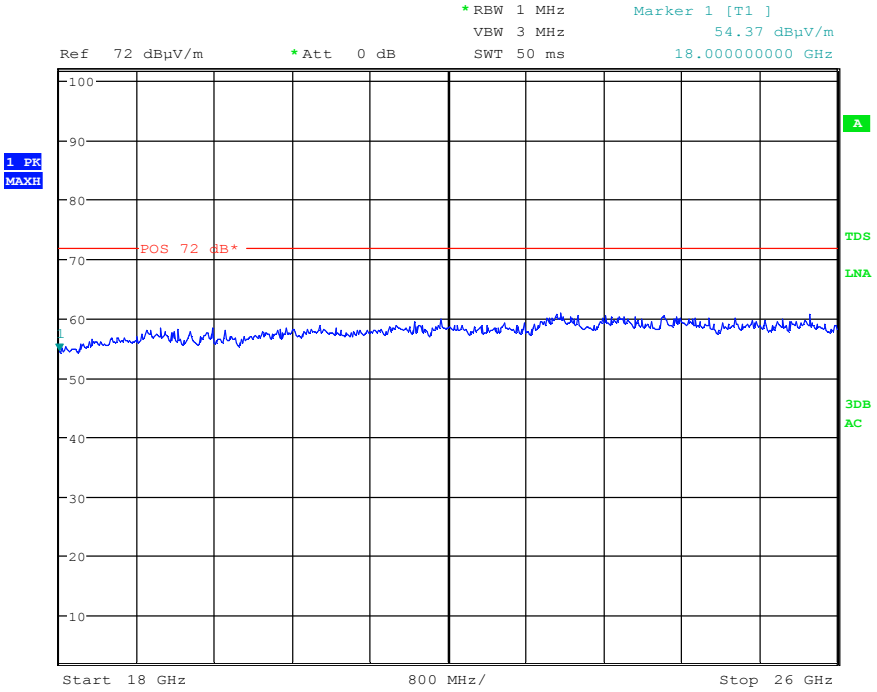
e165 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 79 (2GHz to 18GHz)



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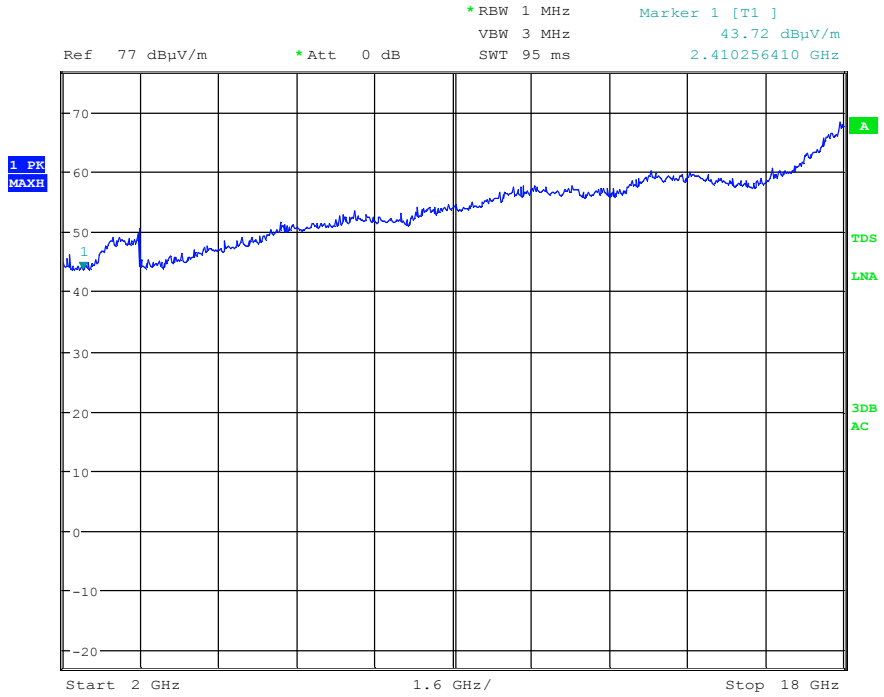
e165 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 79 (18GHz to 26GHz)



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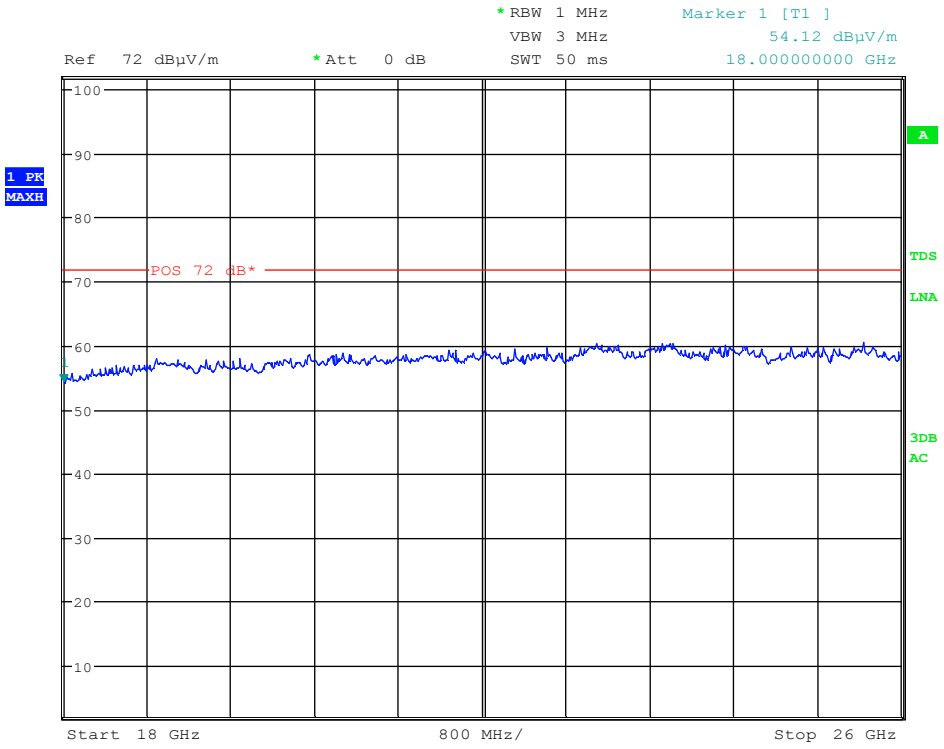

Date: 17.SEP.2012 17:44:52

Receive emissions 2GHz-18GHz & 18GHz-26GHz

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
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.