




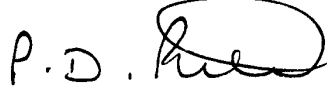
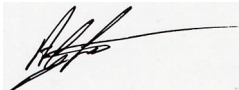
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Test Report for c95, c97, c125, c127, e95, c97, e125, e127 Marine Multifunction Displays

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

Model Number	E70022, E70024		
Product Description	e97, e127 Marine Multifunction Displays		
Report Number	TP/753/1035		
Report Author Mike Thompson EMC Engineer		Date	17 th Jan 2012
Technical Check Paul Pitt EMC Engineer		Date	17 th Jan 2012
Approval Andrew Little Compliance Manager		Date	17 th Jan 2012

Test Date Range	13/01/2012 to 17/01/2012
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Product Status	PASS
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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

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.

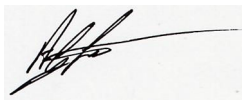
All measuring instruments used to determine the status of the product's compliance to the identified standards are calibrated regularly in accordance with UKAS requirements.

A comprehensive system of traceable calibration in accordance with ISO9001 is maintained.

Name/Position	Signature	Date
Mike Thompson EMC Engineer		17 th Jan 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: 17th Jan 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	TBC TBC
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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:	13/01/2011
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:	e97
Unique Type Identification:	E70022
Serial Number:	1210012 / EMC120117A
CCT Diagram Number(s) & Issue:	See table in section 4.3
PCB Assembly Number(s) & Issue:	See table in section 4.3
Software Version:	Boot 2.05 Application 2.04D
Modifications to Unit:	TLA2 + Video Out Mod ECN000249 Sonar 24V Mod ECN000250

Unit 2

Model Name or Number:	e127
Unique Type Identification:	E70024
Serial Number:	1210026 / EMC120117B
CCT Diagram Number(s) & Issue:	See table in section 4.3
PCB Assembly Number(s) & Issue:	See table in section 4.3
Software Version:	Boot 2.05 Application 2.04D
Modifications to Unit:	TLA2 + Video Out Mod ECN000249 Sonar 24V Mod ECN000250 400MHz DDR

4.3 Tables of Schematics & PCB

Schematics

Variant	CPU board	Sonar Board	GPS Board	Keyboard	uSD Slot
c95	1000199-6	1000219-5	1000415-1	1000287-3	
c97	1000197-6	1000217-5	1000415-1	1000287-3	
c125	1000199-6	1000219-5	1001404-1	1000327-3	
c127	1000197-6	1000217-5	1001404-1	1000327-3	
e95	1000195-6	1000215-5	1000415-1	1000287-3	
e97	1000193-6	1000213-5	1000415-1	1000287-3	
e125	1000195-6	1000215-5	1001404-1	1000327-3	
e127	1000193-6	1000213-5	1001404-1	1000327-3	

PCB's

Variant	CPU board	Sonar Board	GPS Board	Keyboard	uSD Slot
c95	1000190-2	1000210-3	1000413-2	1000284-2	3015-493-5
c97	1000190-2	1000210-3	1000413-2	1000284-2	3015-493-5
c125	1000190-2	1000210-3	1001401-1	1000324-3	3015-493-5
c127	1000190-2	1000210-3	1001401-1	1000324-3	3015-493-5
e95	1000190-2	1000210-3	1000413-2	1000284-2	3015-493-5
e97	1000190-2	1000210-3	1000413-2	1000284-2	3015-493-5
e125	1000190-2	1000210-3	1001401-1	1000324-3	3015-493-5
e127	1000190-2	1000210-3	1001401-1	1000324-3	3015-493-5

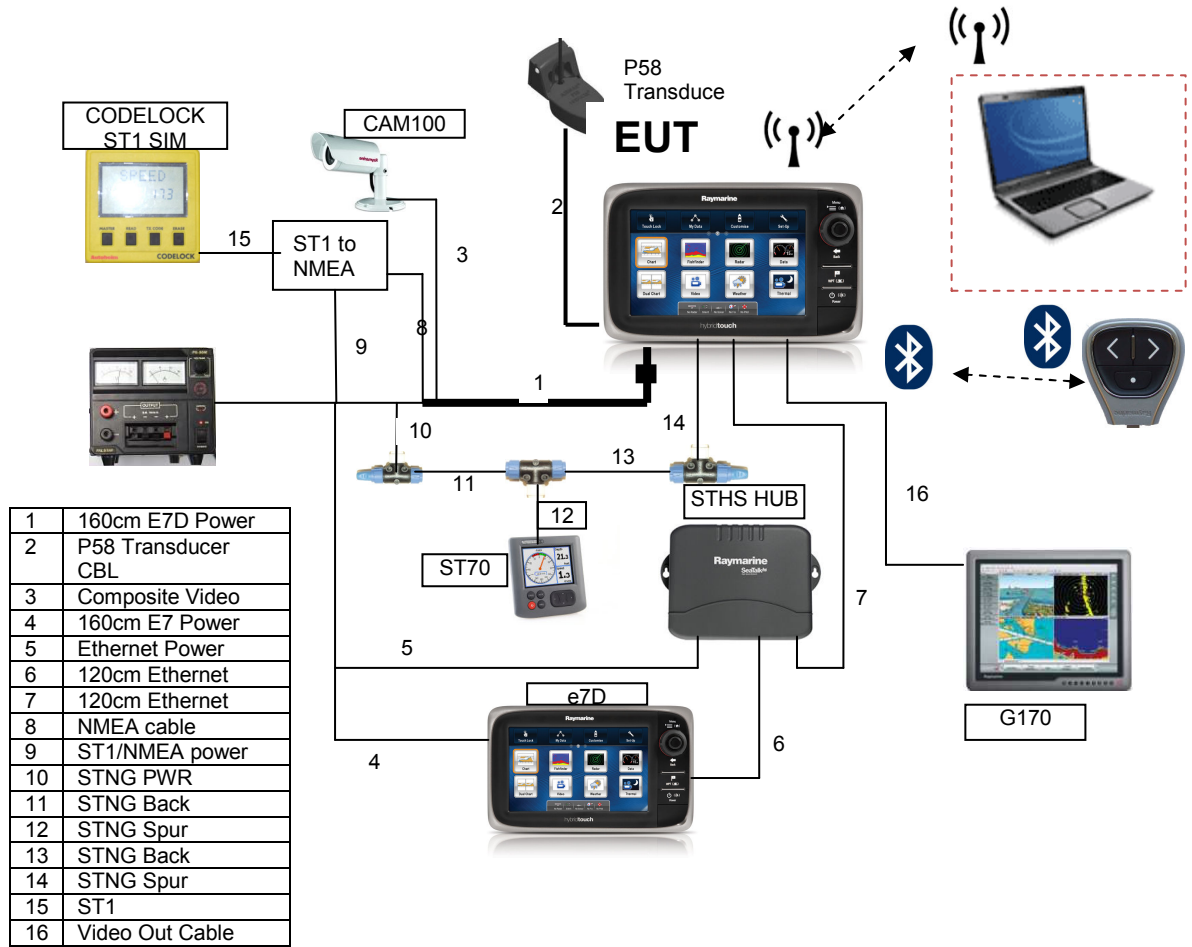
4.4 Additional information

This test report is also applicable to the following multifunctional displays :-	
Product Name	Unique Description
c95	E70011
c97	E70012
c125	E70013
c127	E70014
e95	E70021
e125	E70023

4.5 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
Transducer	P58	n/a
STHS Switch	E55058	0570950
Compaq Laptop	NC6220	RM0048
RCU-3	E62351	00:40:7F:70:01:A7
e7D Aux Display	E62355	EMC110929
G170 Monitor	E02036	EMC081202

4.6 Test setup



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. The P58 transducer required two turns on a TDK ZCAT2436-1330 ferrite

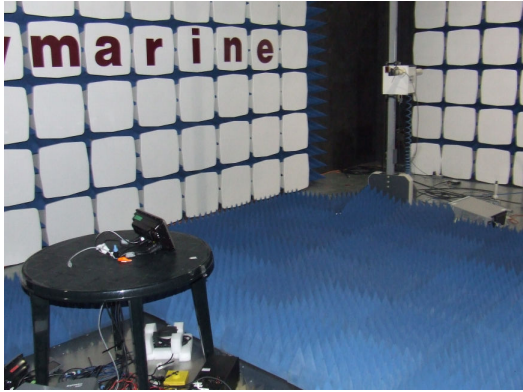
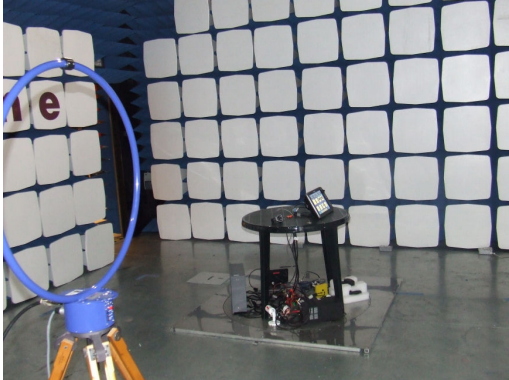
4.7 Emissions – Below 2GHz

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

4.8 Transmitter Spurious Emissions – 2GHz to 26GHz

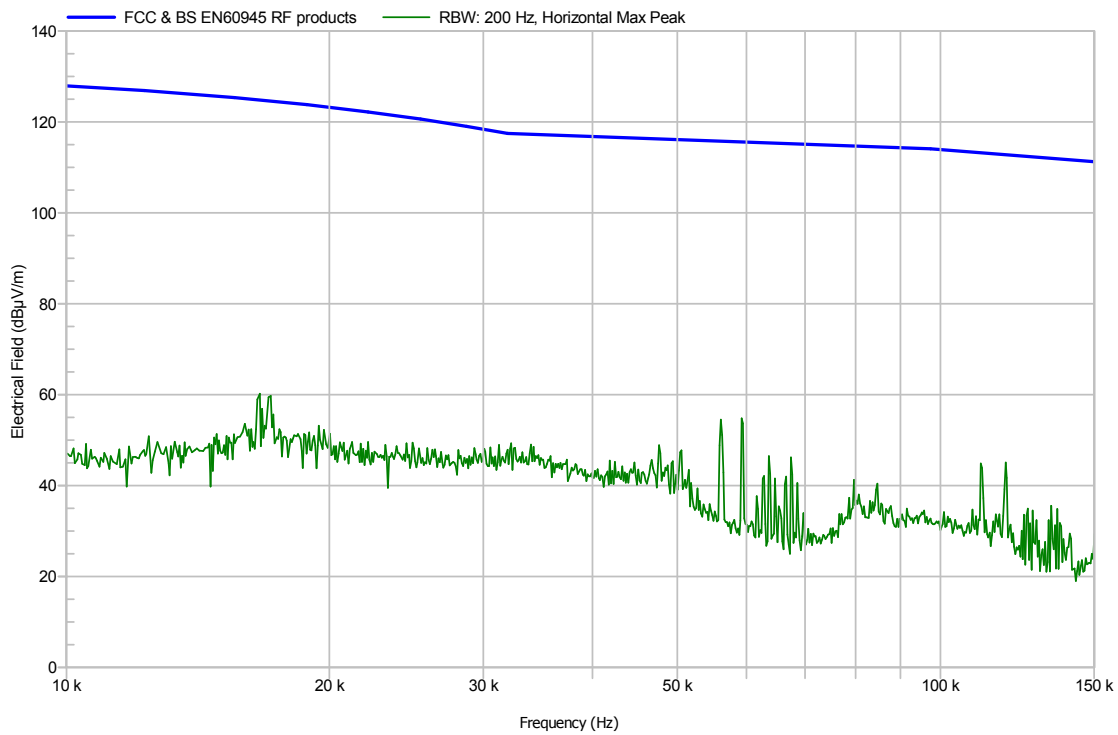
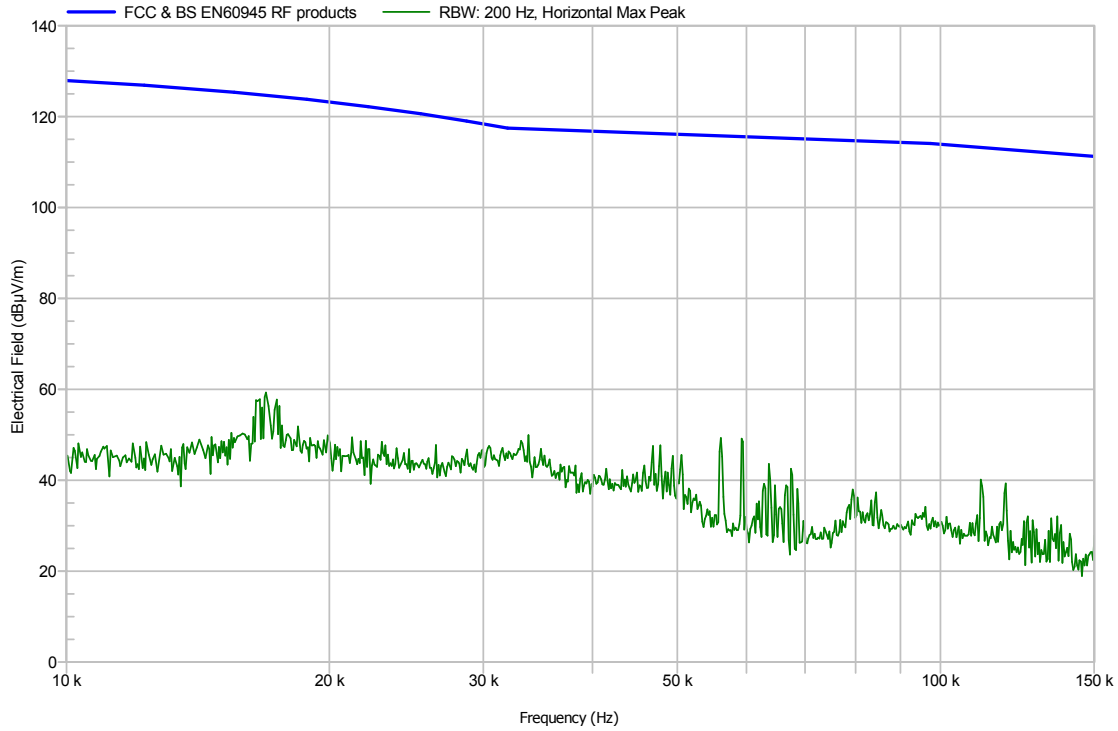
2GHz to 26GHz the unit was setup in a system to ensure the EUT was fully functional. Control of the WIFI and Bluetooth was controlled externally to enable the WIFI and Bluetooth Emissions to be measured separately.

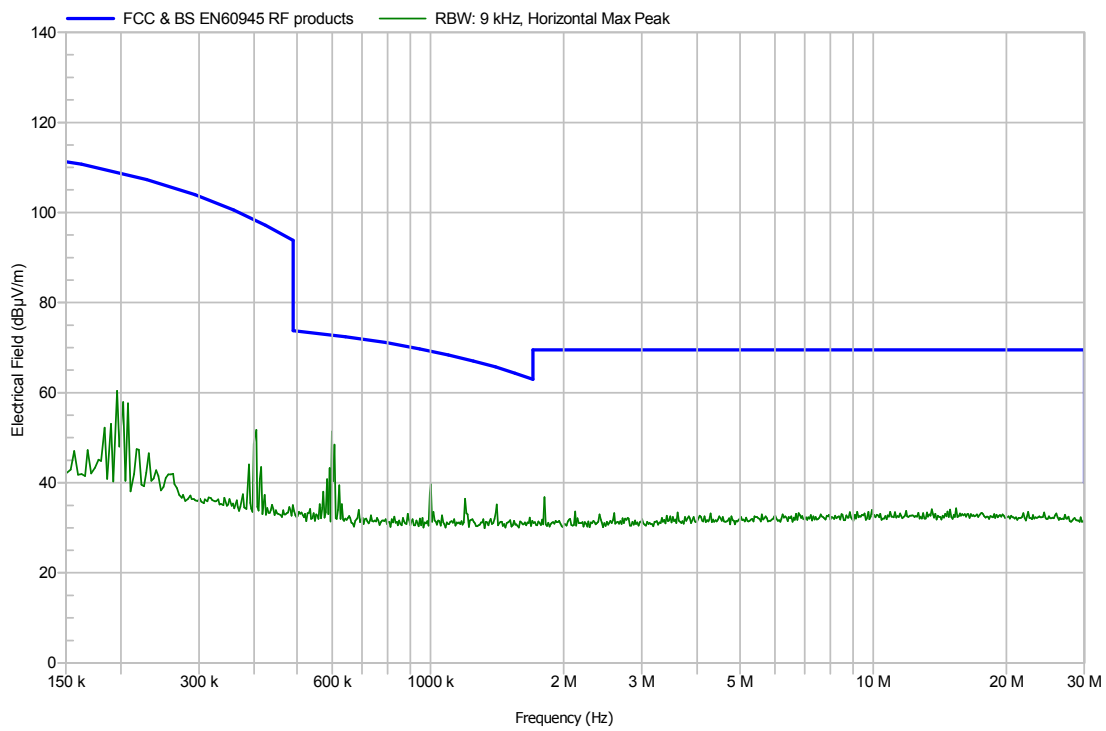
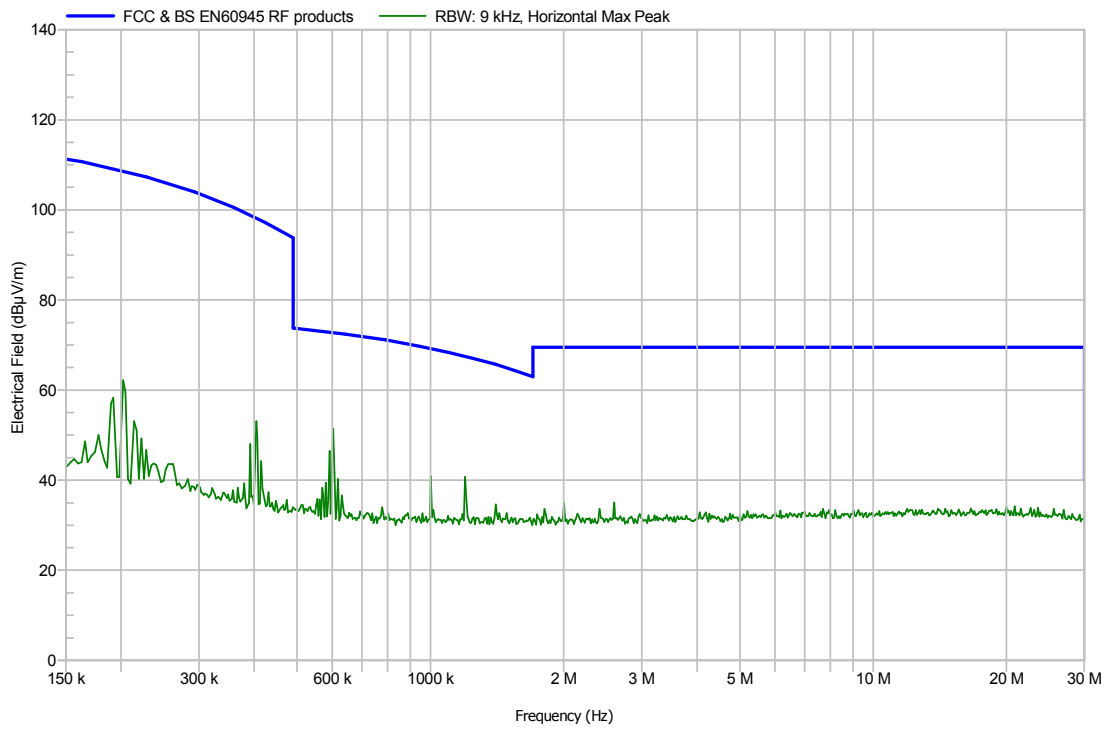
5 Photographs



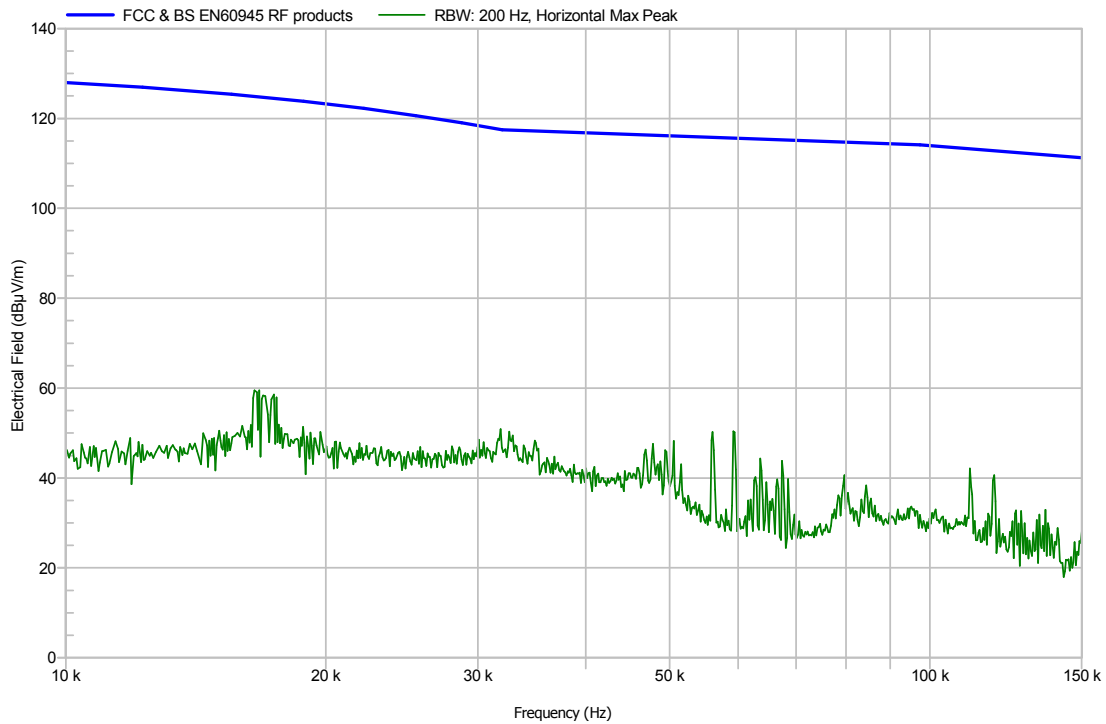
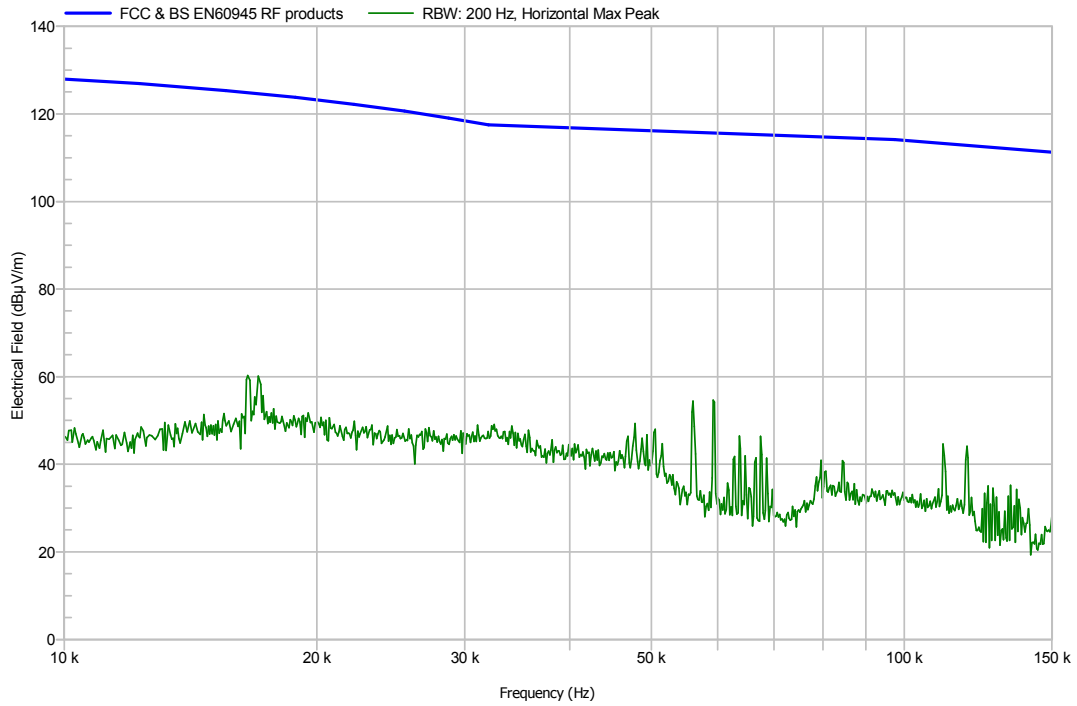
6 Emissions Results

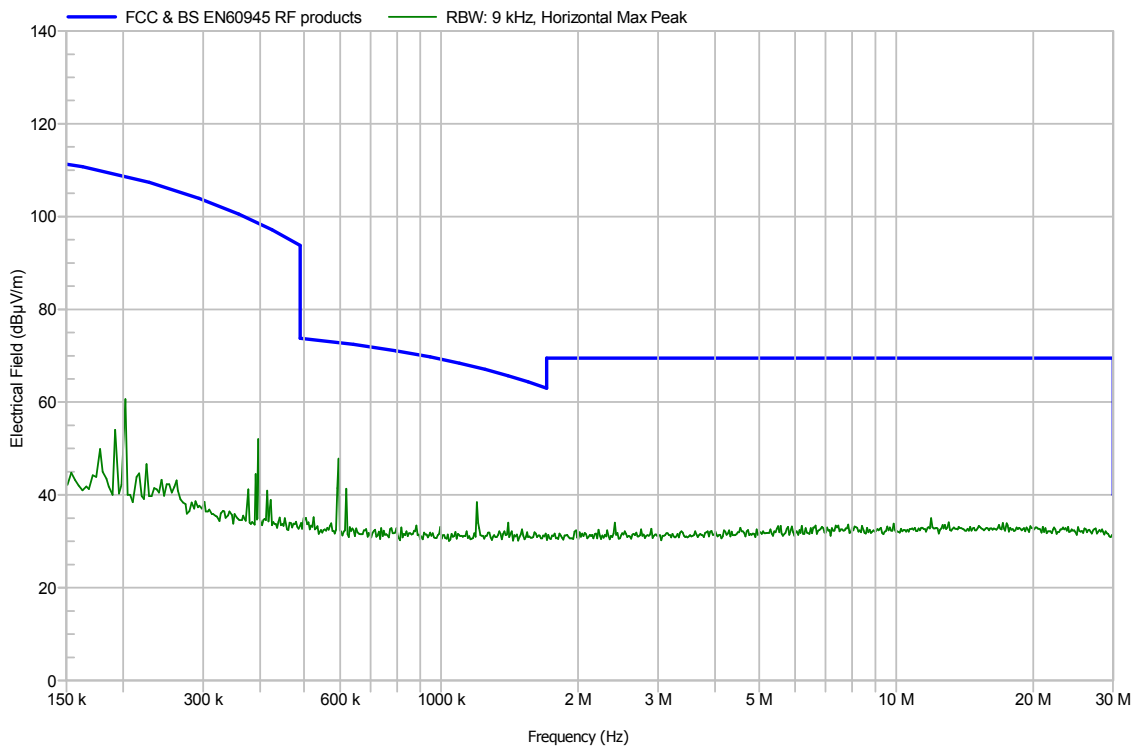
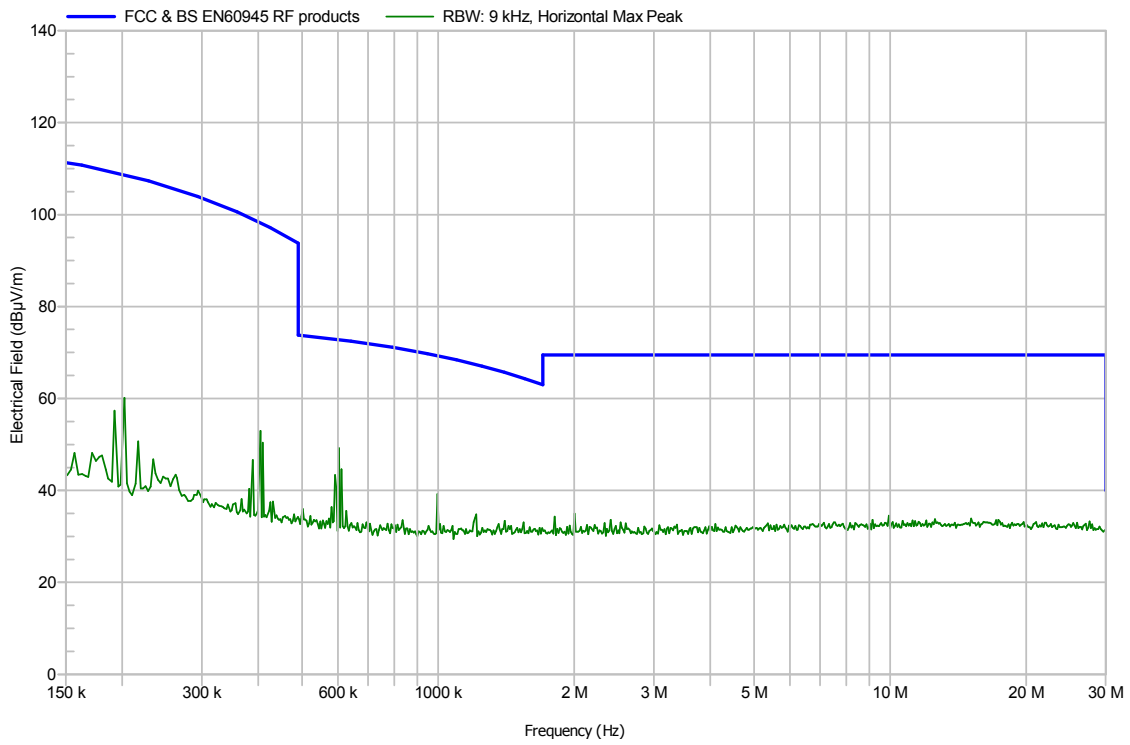
6.1 e97 Emissions 9kHz-30MHz



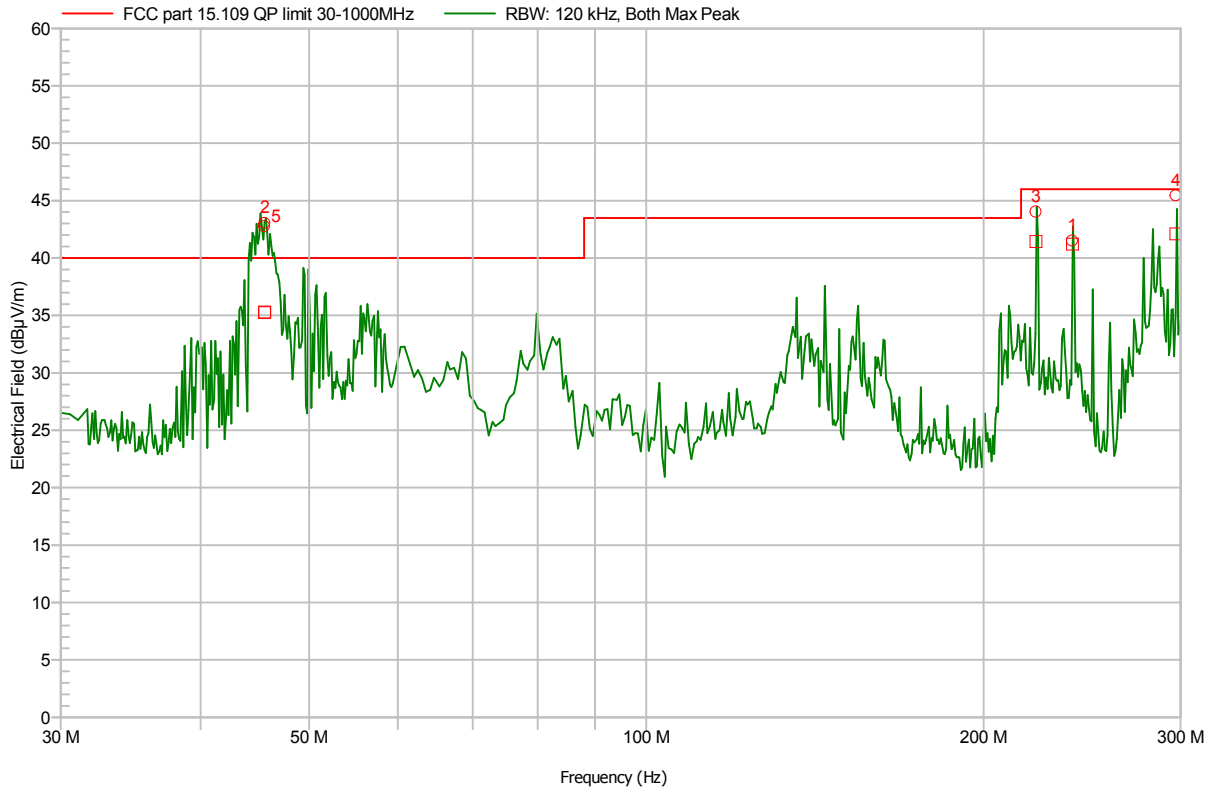


6.2 e127 Emissions 10kHz-30MHz



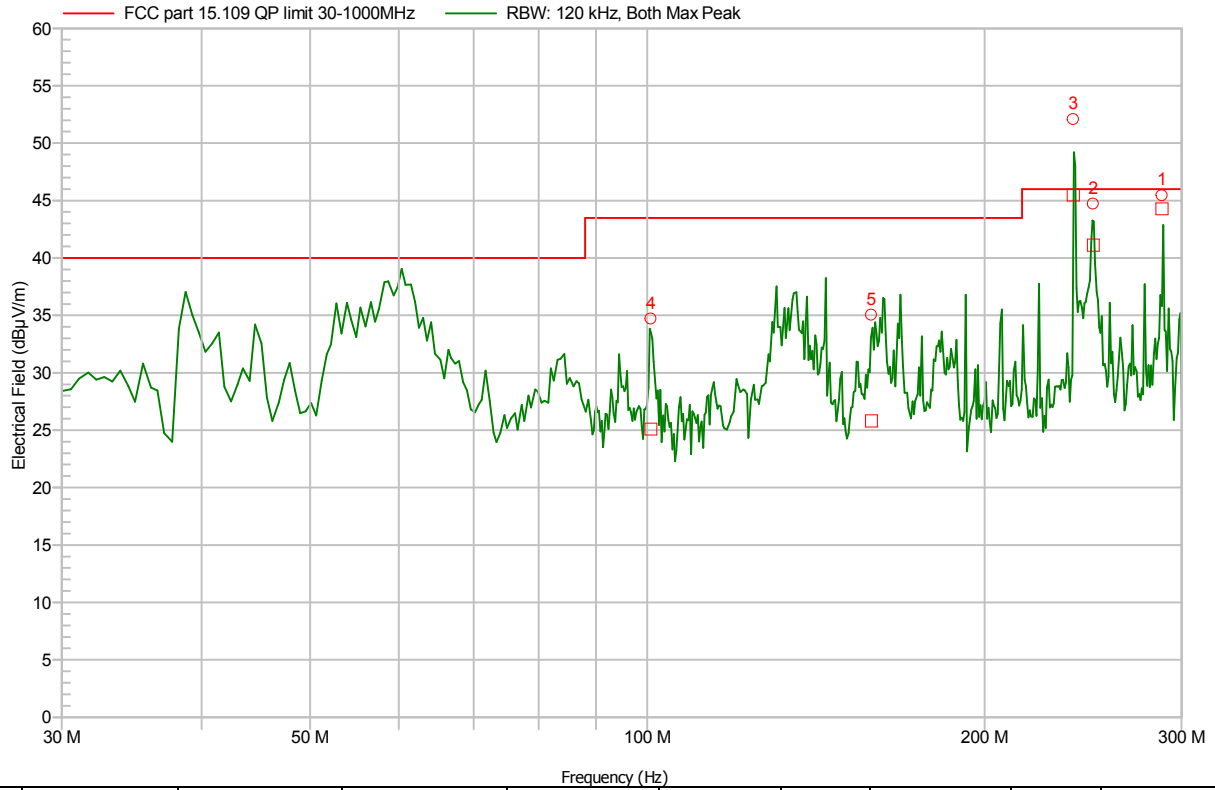


6.3 e97 Emissions 30MHz to 1GHz EUT



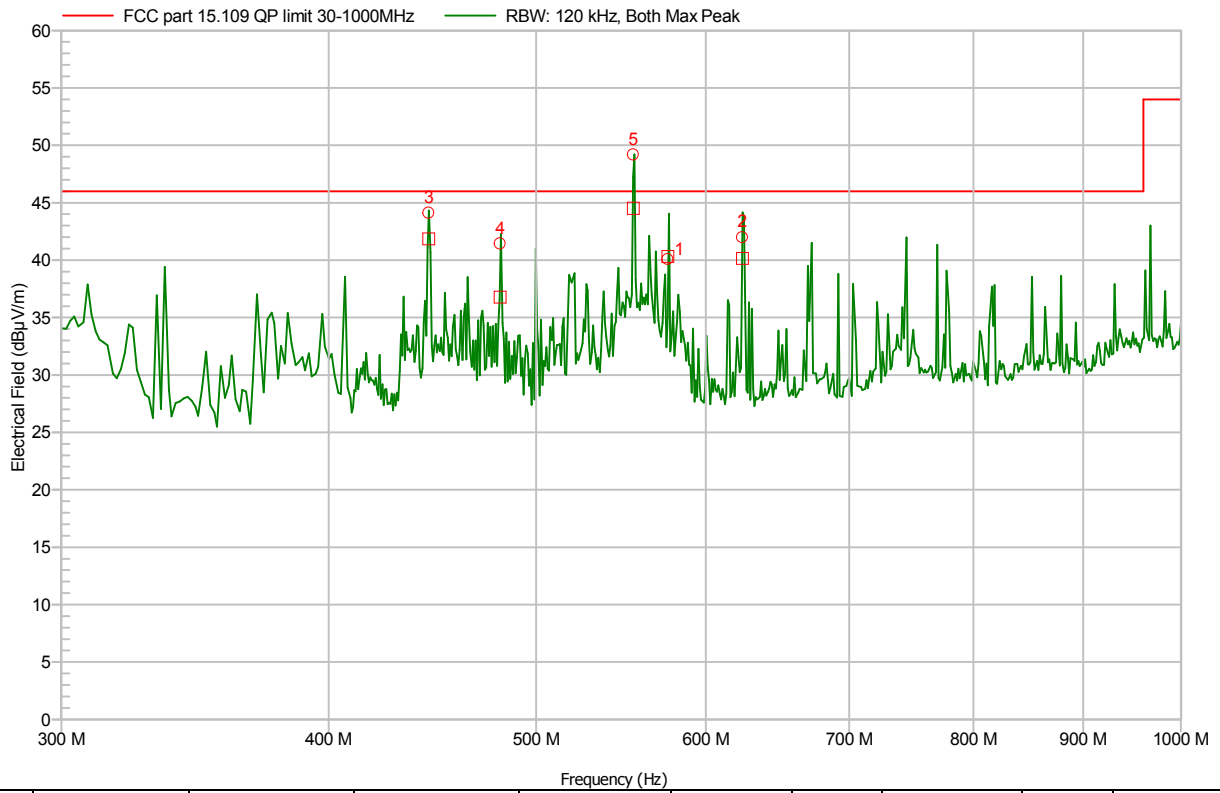
	Frequency	PK Value	QP Value	QP Limit	QP Margin	QP Result	Angle	Height	H/V
1	240.018 MHz	41.49 dBµV/m	41.21 dBµV/m	46 dBµV/m	-4.79 dB	Pass	300 Degree	1.5 m	Horizontal
2	45.648 MHz	43.03 dBµV/m	35.3 dBµV/m	40 dBµV/m	-4.7 dB	Pass	165 Degree	1.5 m	Vertical
3	222.769 MHz	44.01 dBµV/m	41.44 dBµV/m	46 dBµV/m	-4.56 dB	Pass	90 Degree	1.7 m	Vertical
4	297.012 MHz	45.42 dBµV/m	42.11 dBµV/m	46 dBµV/m	-3.89 dB	Pass	75 Degree	1.5 m	Vertical
5	45.626 MHz	42.75 dBµV/m	35.24 dBµV/m	40 dBµV/m	-4.76 dB	Pass	67 Degree	1.5 m	Vertical

6.4 e127 Radiated Emissions 30MHz to 1GHz



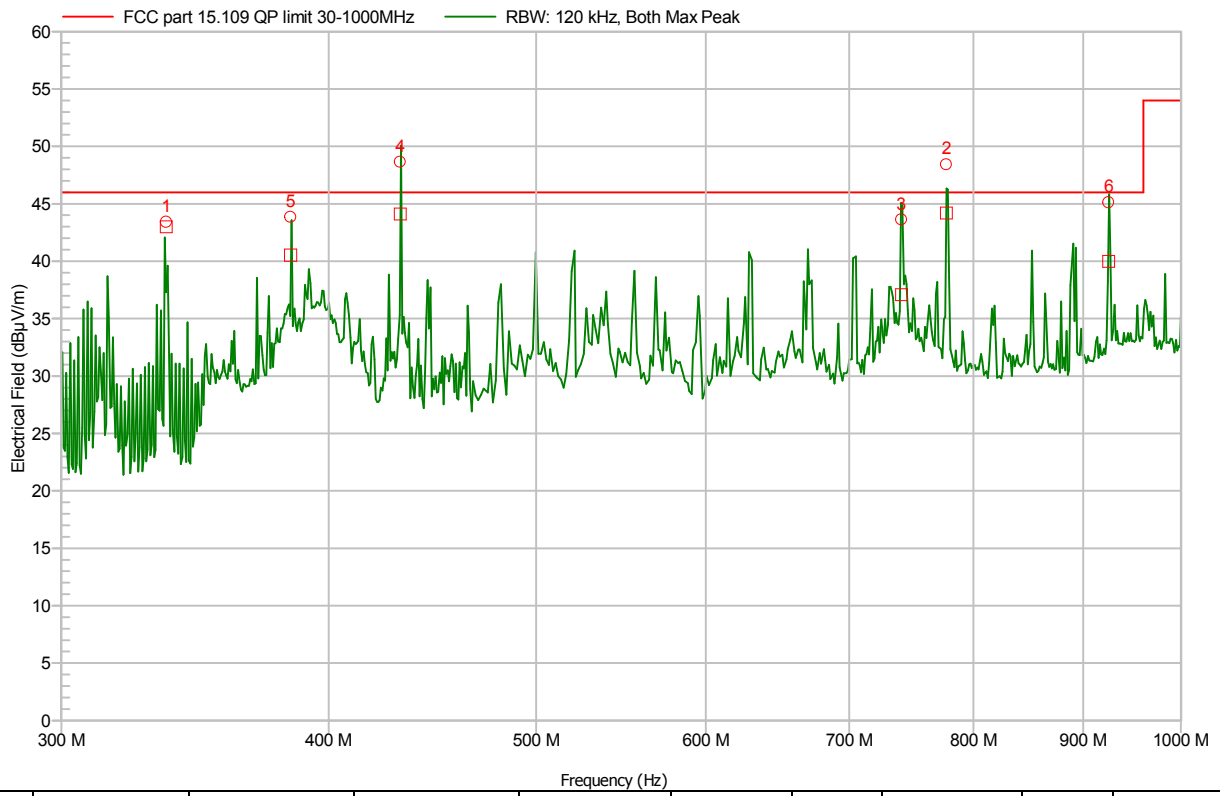
	Frequency (MHz)	PK Value (dBµV)	QP Value (dBµV)	QP Limit (dBµV)	QP Margin (dB)	QP Result	Angle (degrees)	Height (m)	H/V
1	288.007 MHz	45.43 dBµV/m	44.27 dBµV/m	46 dBµV/m	-1.73 dB	Pass	67 Degree	1.5 m	Horizontal
2	250.016 MHz	44.7 dBµV/m	41.11 dBµV/m	46 dBµV/m	-4.89 dB	Pass	300 Degree	1.5 m	Vertical
3	240.012 MHz	52.06 dBµV/m	45.48 dBµV/m	46 dBµV/m	-0.52 dB	Pass	300 Degree	2 m	Vertical
4	100.753 MHz	34.7 dBµV/m	25.09 dBµV/m	43.5 dBµV/m	-18.41 dB	Pass	157 Degree	1.7 m	Vertical
5	158.474 MHz	35.02 dBµV/m	25.8 dBµV/m	43.5 dBµV/m	-17.7 dB	Pass	180 Degree	1.5 m	Vertical

6.5 e97 Radiated Emissions 300MHz-1GHz



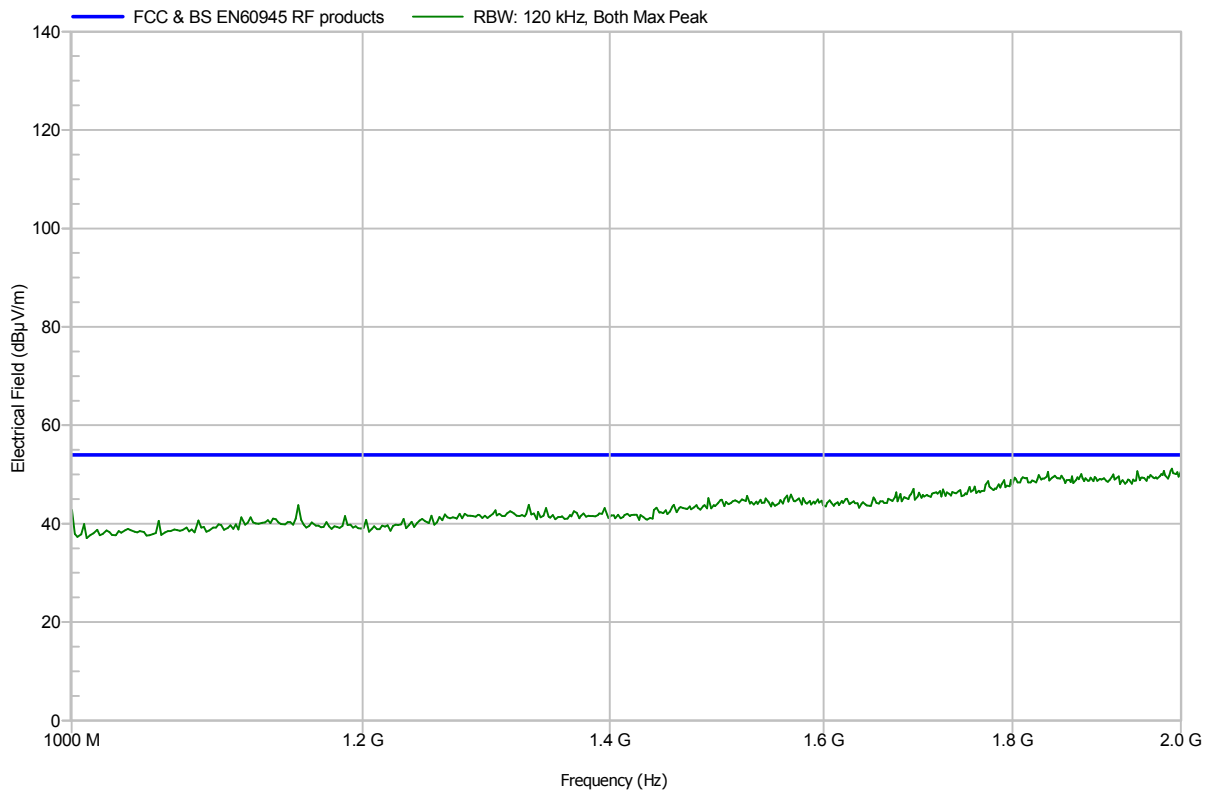
	Frequency (MHz)	PK Value (dBµV)	QP Value (dBµV)	QP Limit (dBµV)	QP Margin (dB)	QP Result	Angle (degrees)	Height (m)	H/V
1	575.996 MHz	40.06 dBµV/m	40.33 dBµV/m	46 dBµV/m	-5.67 dB	Pass	30 Degree	2 m	Horizontal
2	624.011 MHz	41.97 dBµV/m	40.16 dBµV/m	46 dBµV/m	-5.84 dB	Pass	300 Degree	1.7 m	Horizontal
3	445.504 MHz	44.1 dBµV/m	41.86 dBµV/m	46 dBµV/m	-4.14 dB	Pass	315 Degree	1.5 m	Vertical
4	480.996 MHz	41.42 dBµV/m	36.77 dBµV/m	46 dBµV/m	-9.23 dB	Pass	90 Degree	1.5 m	Vertical
5	555.027 MHz	49.17 dBµV/m	44.51 dBµV/m	46 dBµV/m	-1.49 dB	Pass	112 Degree	1.5 m	Vertical

6.6 e127 Radiated Emissions 300MHz-1GHz

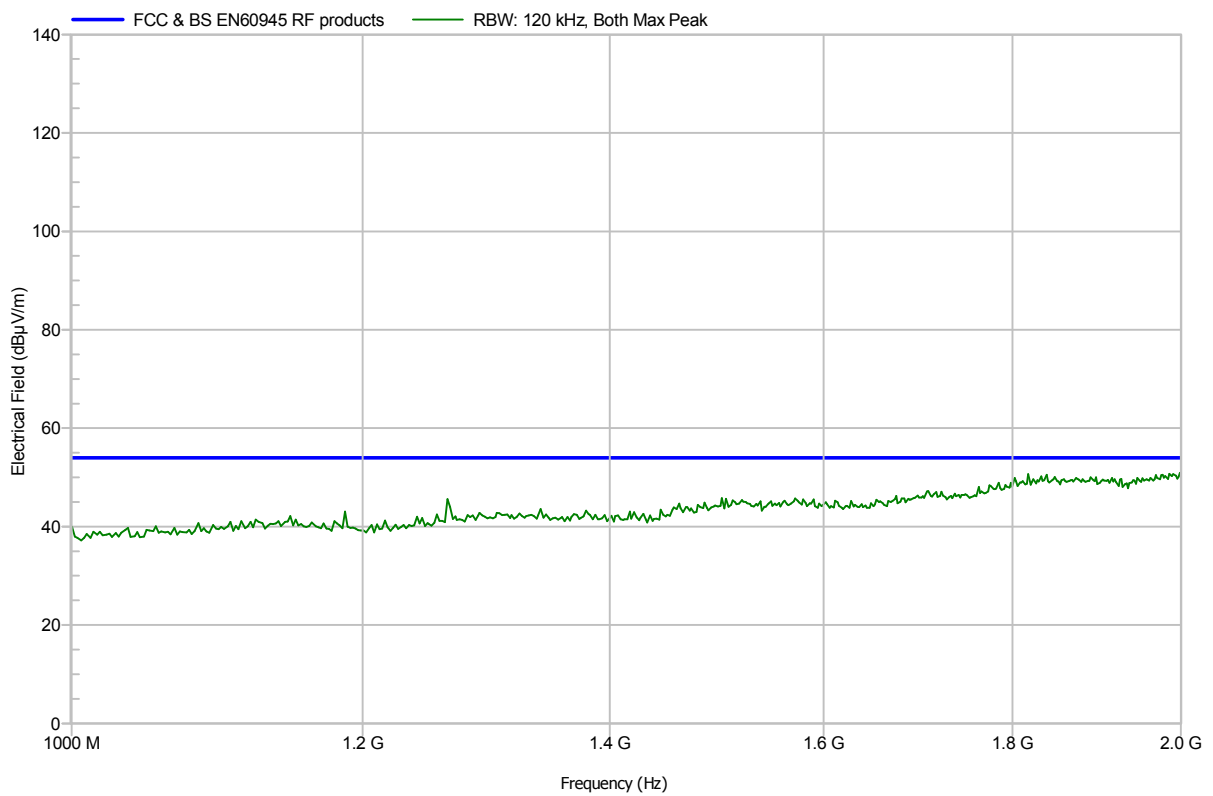


	Frequency (MHz)	PK Value (dBµV)	QP Value (dBµV)	QP Limit (dBµV)	QP Margin (dB)	QP Result	Angle (degrees)	Height (m)	H/V
1	336.002 MHz	43.4 dBµV/m	42.99 dBµV/m	46 dBµV/m	-3.01 dB	Pass	300 Degree	1.7 m	Vertical
2	776.996 MHz	48.41 dBµV/m	44.19 dBµV/m	46 dBµV/m	-1.81 dB	Pass	112 Degree	1.5 m	Vertical
3	740.339 MHz	43.61 dBµV/m	37.09 dBµV/m	46 dBµV/m	-8.91 dB	Pass	105 Degree	1.5 m	Vertical
4	432.004 MHz	48.63 dBµV/m	44.11 dBµV/m	46 dBµV/m	-1.89 dB	Pass	45 Degree	1.7 m	Vertical
5	384.014 MHz	43.83 dBµV/m	40.53 dBµV/m	46 dBµV/m	-5.47 dB	Pass	0 Degree	1.5 m	Vertical
6	925.033 MHz	45.1 dBµV/m	39.99 dBµV/m	46 dBµV/m	-6.01 dB	Pass	90 Degree	1.5 m	Horizontal

6.7 e97 Radiated Emissions 1GHz-2GHz



6.8 e127 Radiated Emissions 1GHz-2GHz

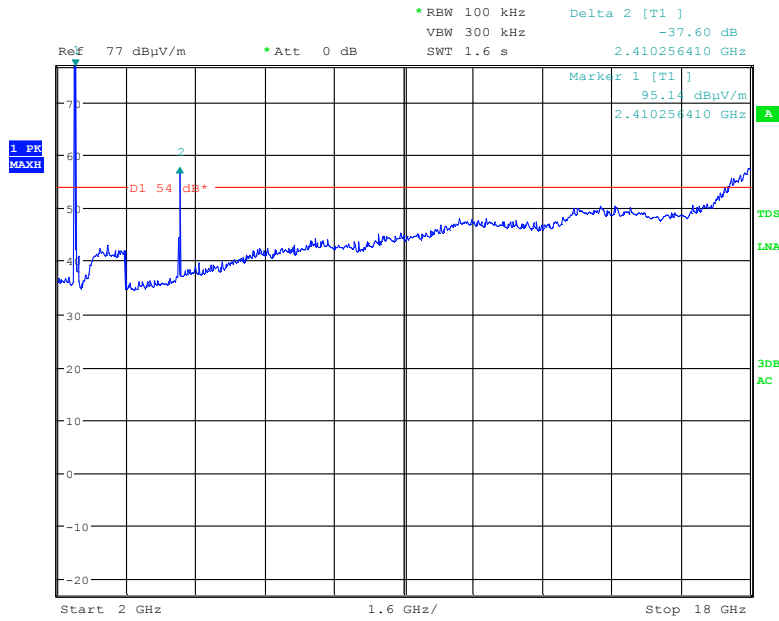


6.9 FCC Part 15, Chapter 47_15.247 Spurious Emissions 2GHz to 26GHz

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

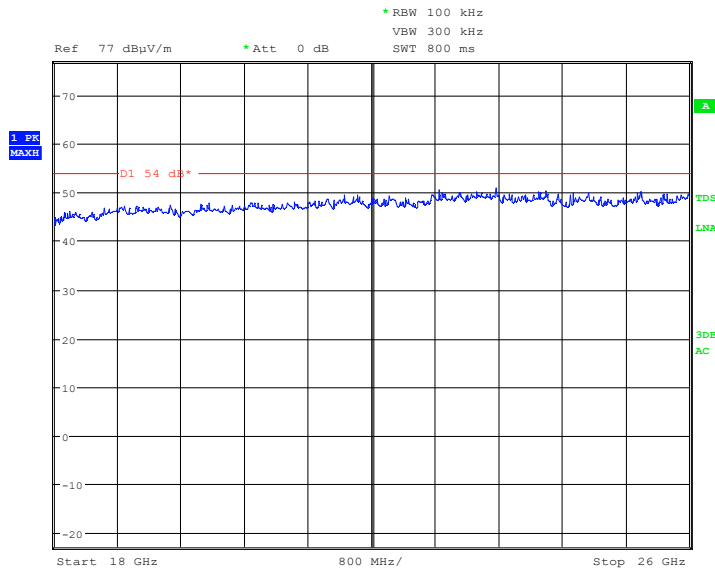
A 100kHz RBW was used in order to reduce to noise floor in the measuring receiver. The EUT was rotated through 360 degrees and antenna oriented horizontally & vertically during a peak hold sweep. The following graphs are the resultant peak hold results.

6.9.1 WIFI Emissions



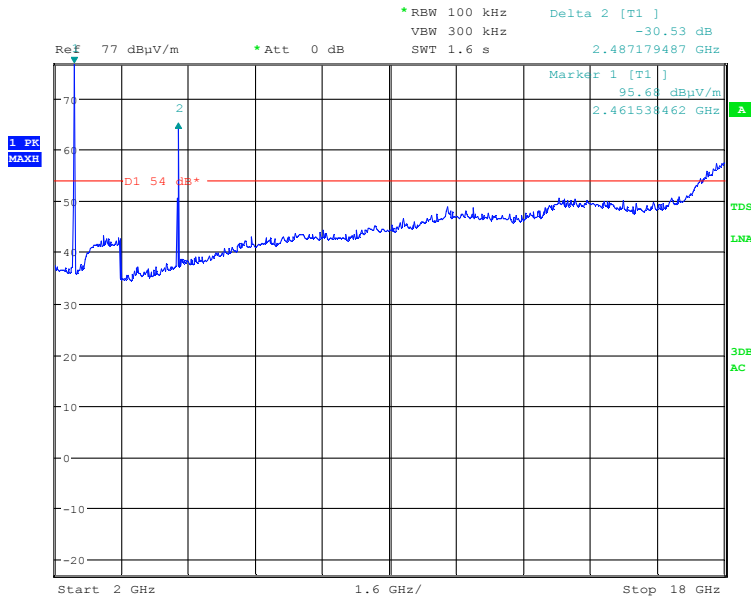
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e97 11Mbps 802.11b DSSS 20dBm nominal Channel 1 (2GHz to 18GHz)



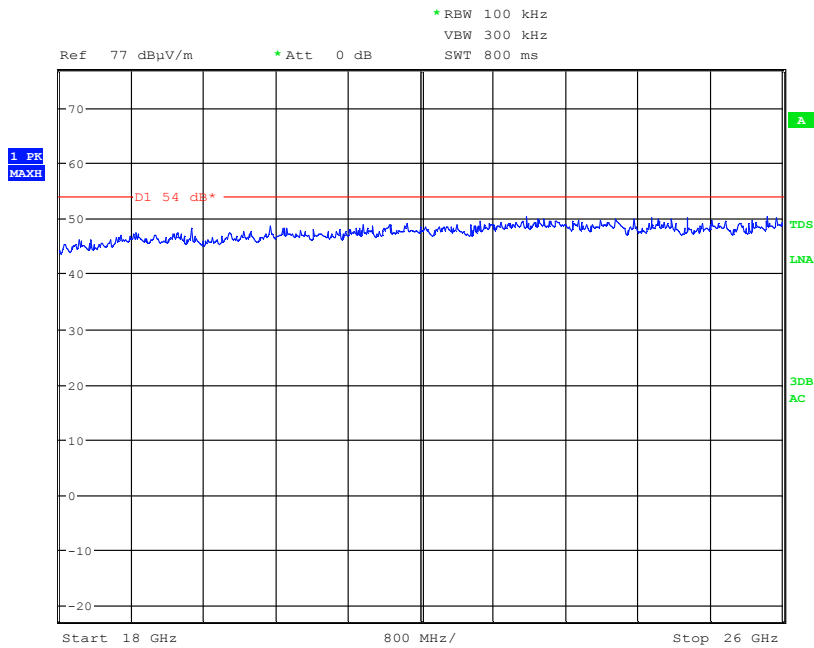
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e97 11Mbps 802.11b DSSS 20dBm nominal Channel 1 (18GHz-26GHz)



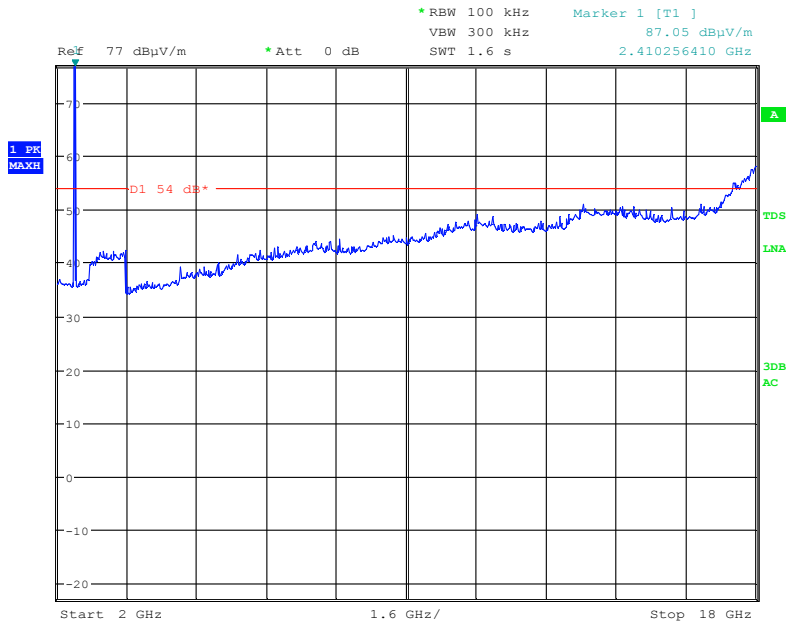
Date: 16.JAN.2012 16:53:45

e97 11Mbps 802.11b DSSS 20dBm nominal Channel 13 (2GHz to 18GHz)



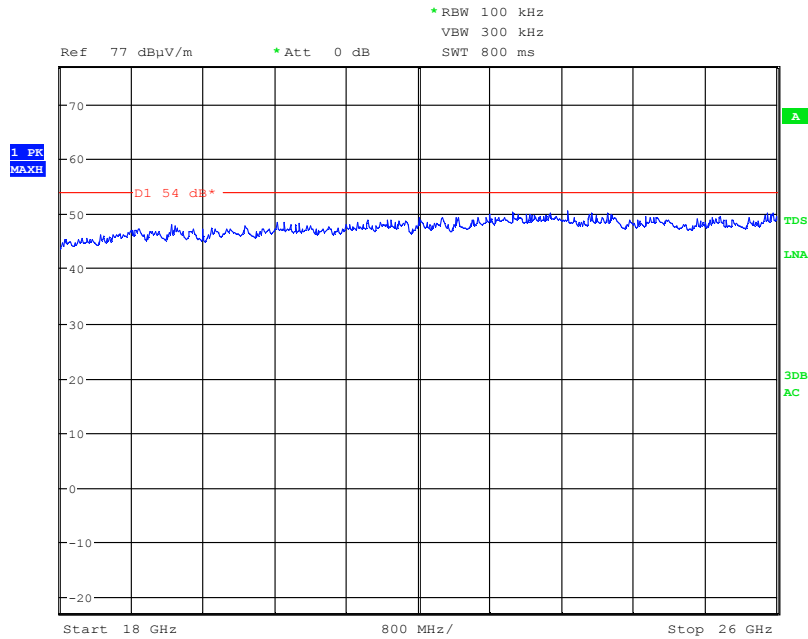
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e97 11Mbps 802.11b DSSS 20dBm nominal Channel 13 (18GHz to 26GHz)



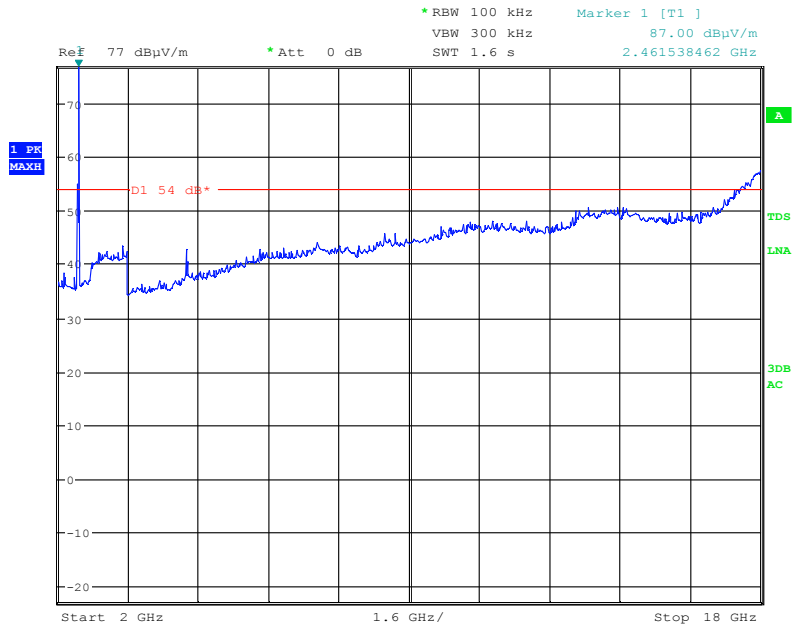
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e97 54Mbps 802.11g OFDM 14.5dBm nominal Channel 1 (2GHz to 18GHz)



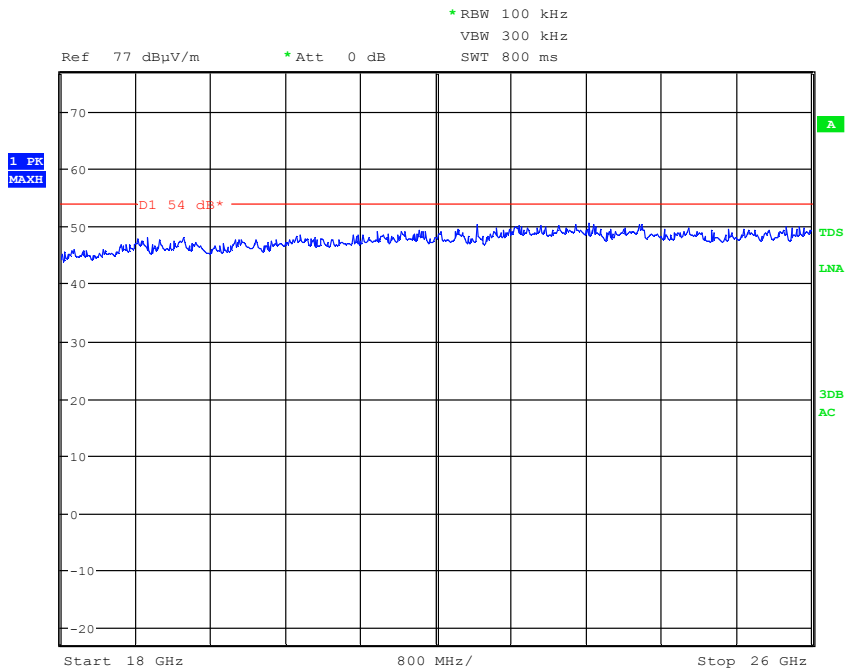
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e97 54Mbps 802.11g OFDM 14.5dBm nominal Channel 1 (18GHz to 26GHz)



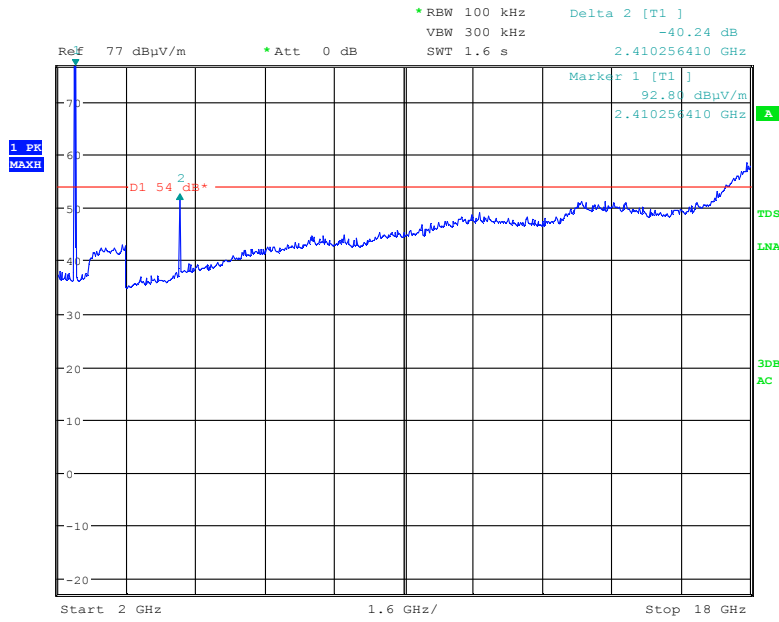
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e97 54Mbps 802.11g OFDM 14.5dBm nominal Channel 13 (2GHz to 18GHz)



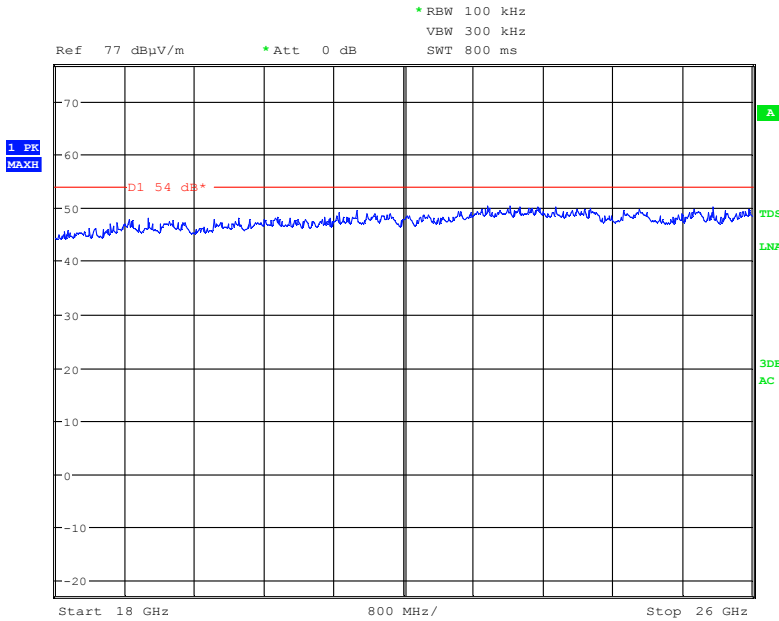
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e97 54Mbps 802.11g OFDM 14.5dBm nominal Channel 13 (18GHz to 26GHz)



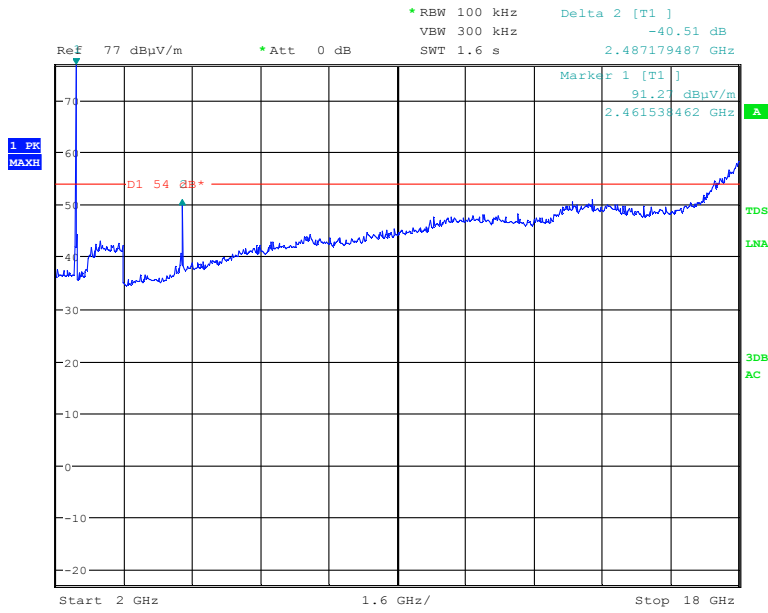
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e127 11Mbps 802.11b DSSS 20dBm nominal Channel 1 (2GHz to 18GHz)



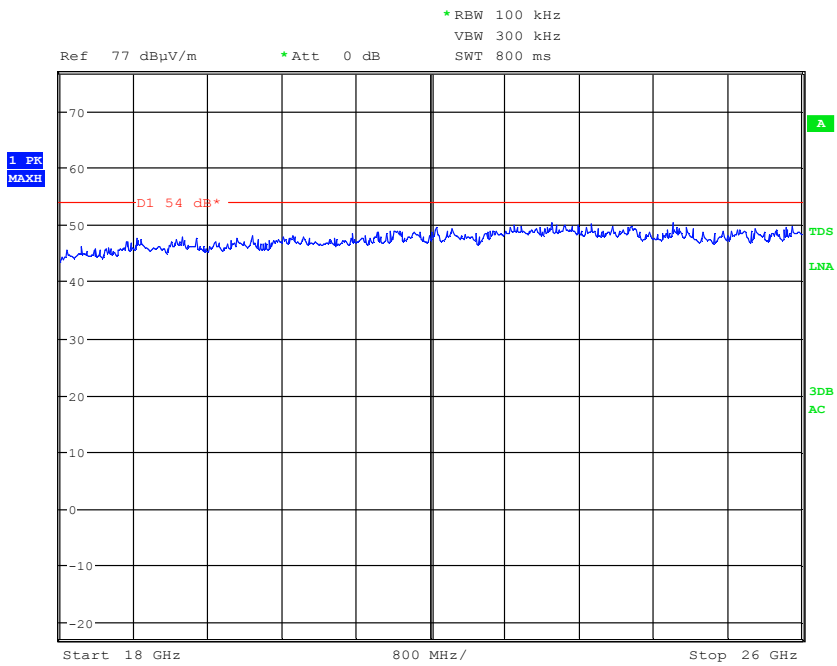
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e127 11Mbps 802.11b DSSS 20dBm nominal Channel 1 (18GHz to 26GHz)



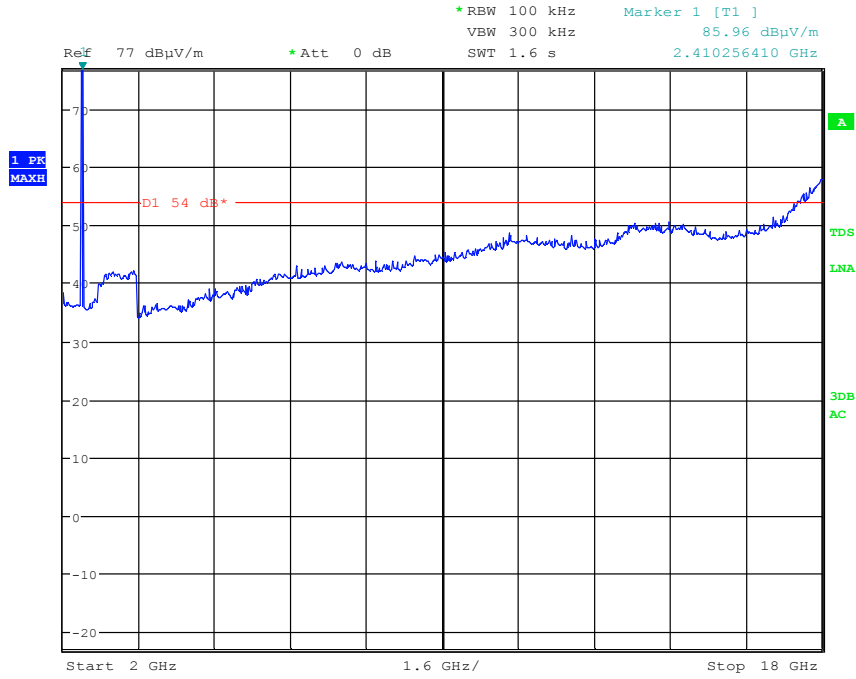
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e127 11Mbps 802.11b DSSS 20dBm nominal Channel 13 (2GHz to 18GHz)



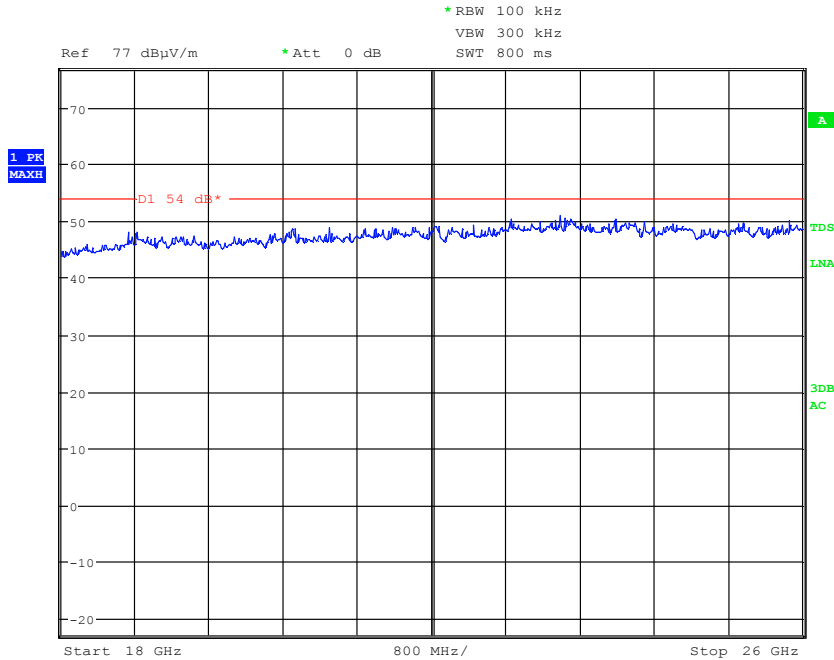
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e127 11Mbps 802.11b DSSS 20dBm nominal Channel 13 (18GHz to 26GHz)



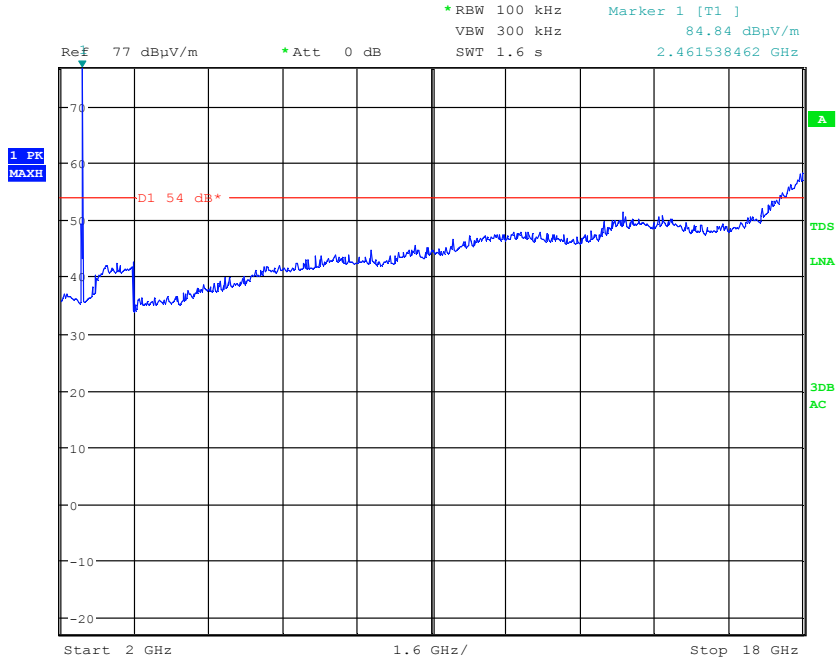
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e127 54Mbps 802.11g OFDM 14.5dBm nominal Channel 1 (2GHz to 18GHz)



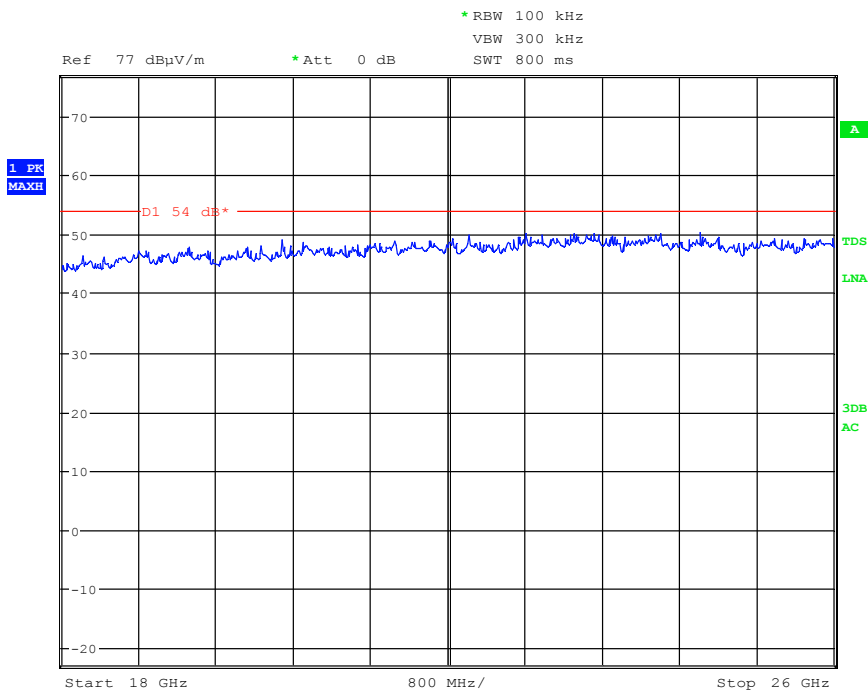
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e127 54Mbps 802.11g OFDM 14.5dBm nominal Channel 1 (18GHz to 26GHz)



Date: 16.JAN.2012 16:19:22

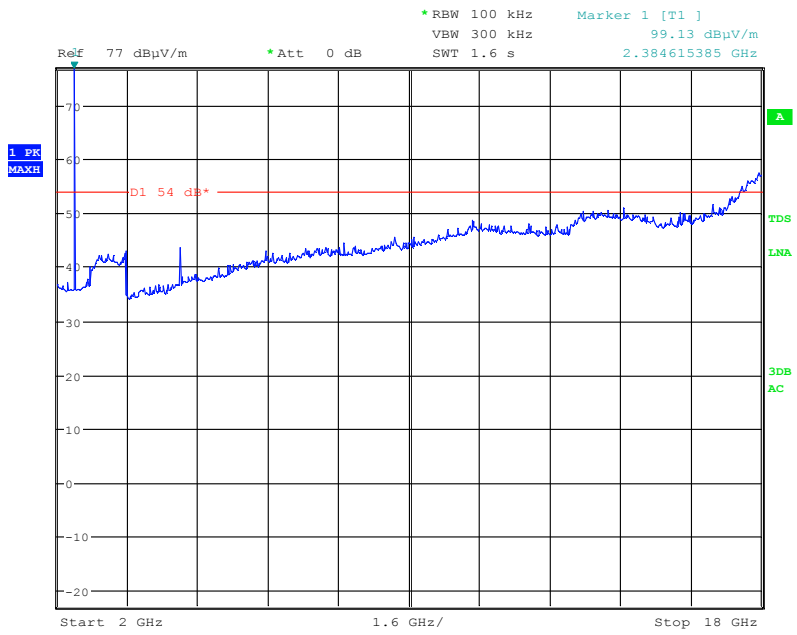
e127 54Mbps 802.11g OFDM 14.5dBm nominal Channel 13 (2GHz to 18GHz)



Date: 16.JAN.2012 18:01:29

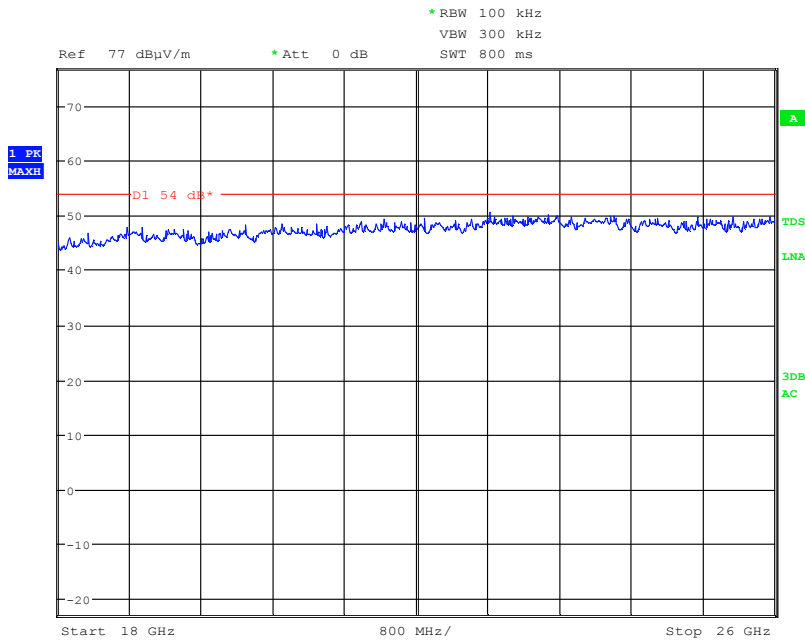
e127 54Mbps 802.11g OFDM 14.5dBm nominal Channel 13 (18GHz to 26GHz)

6.9.2 Bluetooth Emissions



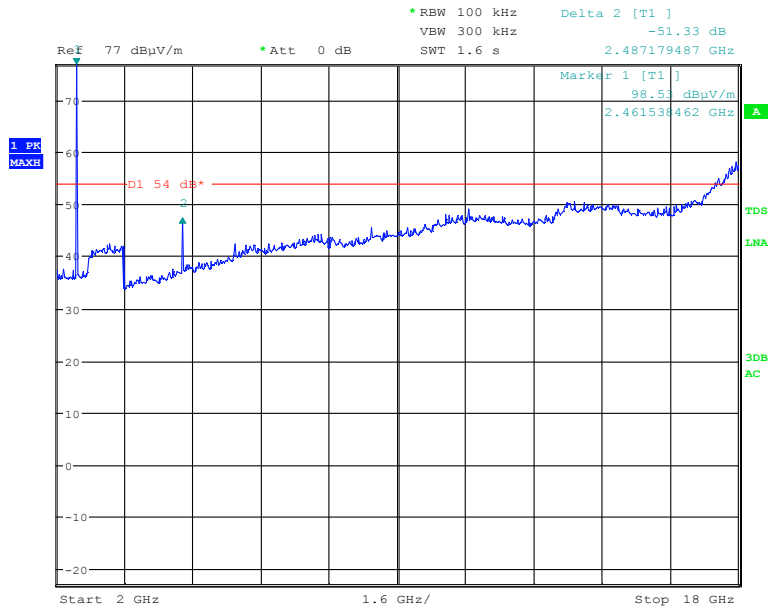
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e97 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 1 (2GHz to 18GHz)



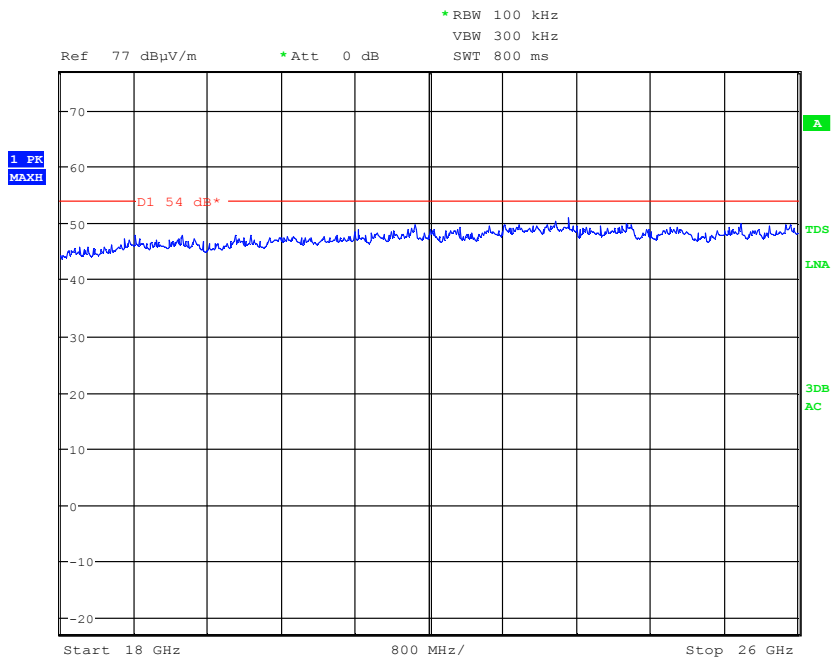
Date: 16.JAN.2012 18:22:45

e97 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 1 (18GHz to 26GHz)



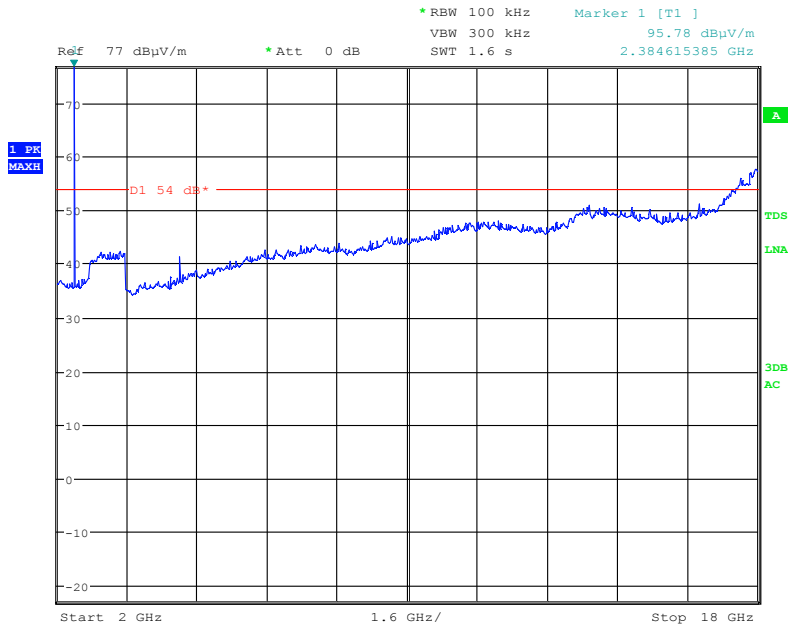
Date: 16.JAN.2012 17:25:06

e97 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 79 (2GHz to 18GHz)



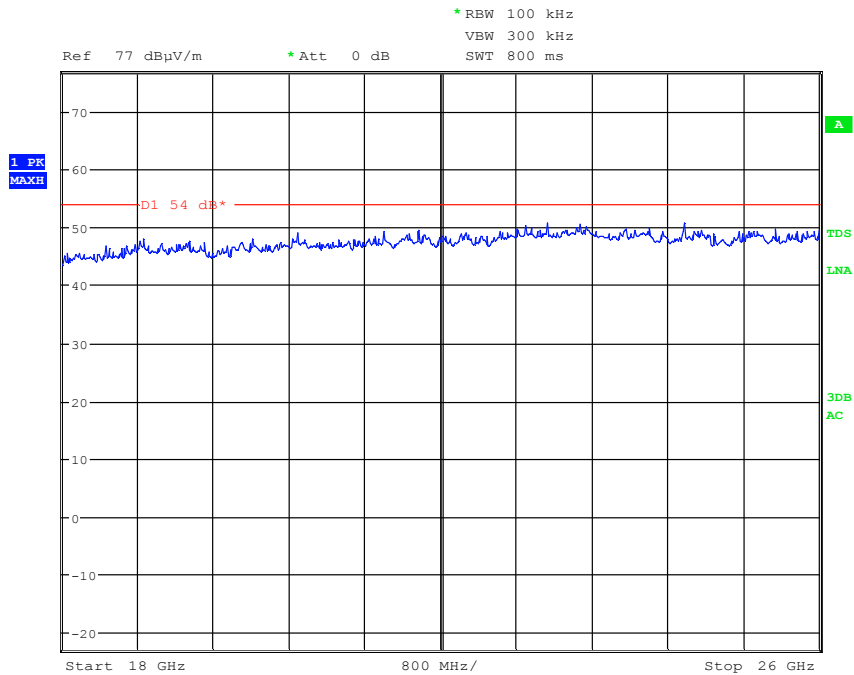
Date: 16.JAN.2012 18:19:44

e97 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 79 (18GHz to 26GHz)



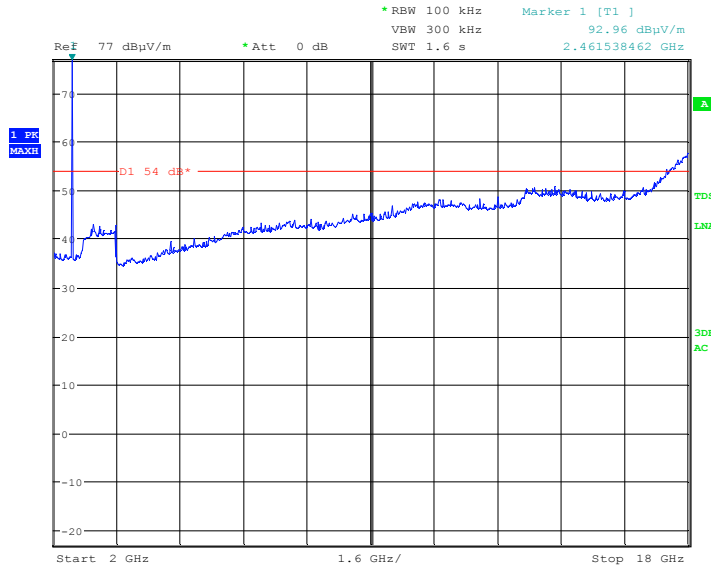
Date: 16.JAN.2012 16:34:39

e127 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 1 (2GHz to 18GHz)



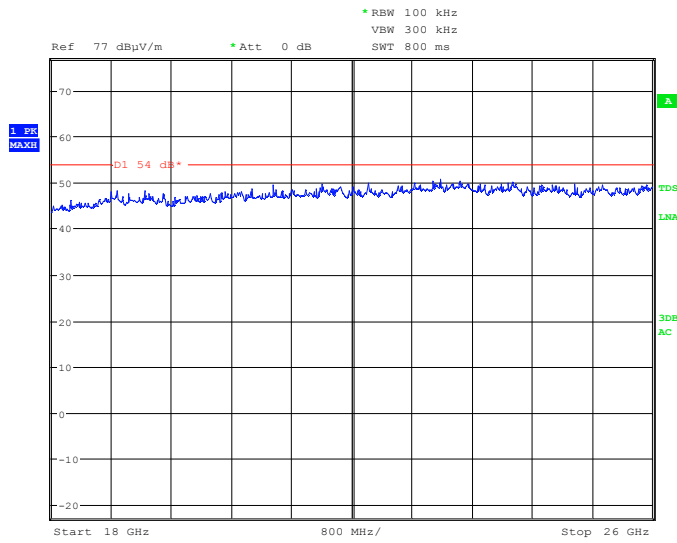
Date: 16.JAN.2012 18:08:45

e127 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 1 (18GHz to 26GHz)



Date: 16.JAN.2012 16:38:22

e127 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 79 (2GHz to 18GHz)



Date: 16.JAN.2012 18:14:12

e127 1Mbps Bluetooth GFSK 9.5dBm nominal Channel 79 (18GHz to 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	1/11/2012
EMI Receiver 20Hz to 26.5GHz	Rohde & Schwarz ESI26	832692/006	00886	03/06/2012
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	4038	00448	28/6/2012
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	31/01/2012
Power Supply Unit	Palstar PS30M	G290775401	2020	N/A

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