A RADIO TEST REPORT

FOR

AXELL WIRELESS

ON

MBF2307-2317-15XX

DOCUMENT NO. TRA-015162-47-00-B

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TRaC Wireless Test Report	**:** TRA-015162-47-03-B
Applicant	**:** Axell Wireless
Apparatus	**:** MBF2307-2317-15XX
Specification(s)	**:** CFR47 Part 27
Purpose of Test	**: Certification**
FCCID	**: NEOMBF23072317**
Authorised by	**:**
	: Radio Product Manager
Issue Date	**:** 29th May 2014
Authorised Copy Number	**:** *PDF*

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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.

Test performed by:

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1.2 Tests Requested By

This testing in this report was requested by :

Aerial House
Asheridge Road
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HP5 1TU

1.3 Manufacturer

Aerial House
Asheridge Road
Chesham
Buckinghamshire
HP5 1TU

1.4 Apparatus Assessed

The following apparatus was assessed between 27th August and 25th September 2013

Multi-Band Fibre Optic system

The Multi-Band Fibre Optic system is composed of two building blocks: OMU (Optical Master unit) and MBF2307-2317-1510 (Fibre Distributed Antenna System) Remote Unit. This is an indoor solution for single or multi operator use.

Technical specifications			
Frequency Range	Uplink	Downlink	CFR 47 Rule Part
700 MHz	Lower band 698 - 716 MHz and Upper band 776 - 787 MHz	Lower band 728 - 746 MHz and Upper band 746 - 757 MHz	27, Subpart C
1700 MHz	1710 - 1755 MHz	2110 - 2155 MHz	27, Subpart C

Variants

Model	Part Number
MBF2307-2317-1510	MBF2006
MBF2307-2317-1530	MBF2007
MBF2307-2317-1550	MBF2008
MBF2307-2317-1570	MBF2009

1.5 Test Result Summary

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

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 2	FCC Part 27	Appendix in Report
RF Power Output	2.1046	27.50 (a)	A1 & B1
Intermodulation Spurious Emissions	2.1051	27.53(c) & (g)	A2 & B2
Occupied Bandwidth & Modulation	2.1049 *KDB 935210	N/A	A3 & B3
Spurious Emissions at Antenna Terminals Less than 1 MHz	2.1051	27.53(c) & (g)	A4 & B4
Spurious Emissions at Antenna Terminals Greater than 1MHz	2.1051	27.53(c) & (g)	A5 & B5
Field Strength of Spurious Emissions	2.1053	27.53(c),(f) & (g)	A6 & B6
Passband Gain & 20dB bandwidth	*KDB 935210	N/A	A7 & B7
Frequency Stability	2.1055	27.54	N/A(note 1)
Transient behaviour	2.1055	N/A	N/A(note 2)
Audio Frequency Response (a)	TIA EIA-603.3.2.6	N/A	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A	N/A
Signal Booster Labelling Requirements	20.21(f)(1)(ii)	N/A	N/A

Notes:
1 The EUT does not contain modulation circuitry; therefore the test was not performed.
2 The EUT is not a keyed carrier system; therefore the test was not performed.
3 *KDB 935210 D02 Signal Boosters Certification v02

Abbreviations used in the above table:

CFR	: Code of Federal Regulations	ANSI	: American National Standards Institution
REFE	: Radiated Electric Field Emissions	PLCE	: Power Line Conducted Emissions
A	Uplink Results Appendix	B	Downlink Results Appendix

1.6 Equipment Test Conditions

Product class:	Uplink	Class A [ ] Class B [X]
	Downlink	Class A [ ] Class B [X]
Product Use:	Private Land Mobile Repeater	
Emission Designator(s):		
Supply Voltages:	Vnom	+230Vac/110Vac
Note: Vnom voltages are as stated above unless otherwise shown on the test report page		
Equipment Category:	Single channel	[ ]
	Two channel	[ ]
	Multi-channel	[X]
Channel spacing:	Wideband	Uplink
	Wideband	Downlink
Test Location	TRaC Global	
	Skelmersdale	[X]
	Hull	[ ]
	Other	[ ] Please Specify

1.7 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 22	Code of Federal Regulations, Title 47, Part 22,” Public Mobile Services”
47 CFR 24	Code of Federal Regulations, Title 47, Part 24,” Personal Communications Services”
47 CFR 27	Code of Federal Regulations, Title 47, Part 27,” Miscellaneous Wireless Communications Services”
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”
C63.4-2003	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”
KDB 935210 D01	Booster Definitions v02
KDB 935210 D02	Certification Requirements v02
KDB 935210 D03	Signal Booster Measurements v02

1.8 Notes Relating To Assesment

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).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

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 ISO/IEC 17025.

1.9 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 (Frequency Counter) = **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: Uplink Formal Emission Test Results

Abbreviations used in the tables in this appendix:

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

A1 RF Gain and Output Power

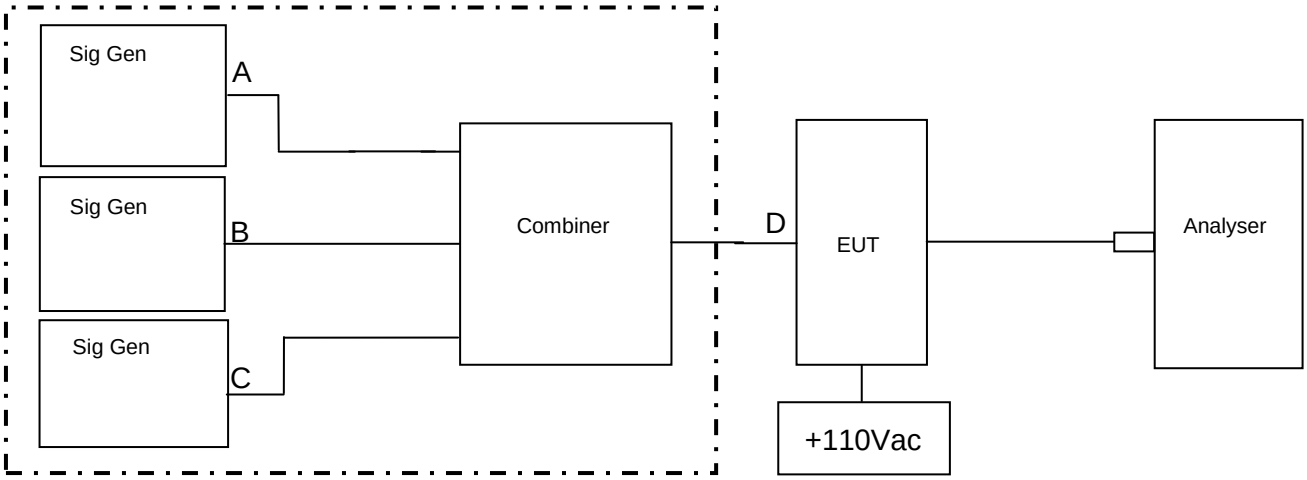
Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1046, 27.50(a)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
Temperature	23°C
Humidity	46%
EUT set up	Refer to Appendix C

Frequency (MHz)	Signal Generator input level (dBm)	Input Cable Loss (dB)	Input Level (dBm)	Level at Spectrum Analyser (dBm)	Output Cable & Attenuator loss (dB)	Gain (dB)	Conducted Output Power (dBm)	Gain after 10dB input level increase (dB)
700MHz (Lower)								
698.000	-49.40	0.34	-49.74	-30.26	0.7	20.14	-29.60	10.37
707.000	-48.70	0.34	-49.04	-30.27	0.7	19.43	-29.61	9.65
716.000	-45.40	0.34	-45.74	-30.38	0.7	16.02	-29.72	6.25
700MHz (Upper)								
777.000	-48.00	0.47	-48.47	-31.43	0.7	17.70	-30.77	7.89
782.000	-49.30	0.47	-49.77	-31.45	0.7	18.98	-30.79	9.17
787.000	-49.80	0.47	-50.27	-31.55	0.7	19.38	-30.89	9.59
1700 MHz								
1710.000	-46.70	0.75	-47.45	-31.65	1.0	16.84	-30.61	6.91
1732.500	-47.90	0.75	-48.65	-31.46	1.0	18.23	-30.42	8.32
1755.000	-46.10	0.75	-46.85	-31.30	1.0	16.59	-30.26	6.69

Notes: 1.The signal generator input was increased by 10dBs and the level of the output signal remeasured.

A2 Amplifier Intermodulation Spurious Emissions

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C



Signal Generator B was varied in frequency to check if intermodulation products where produced.

RF Input Frequency (MHz)			Highest Intermodulation Product Level (dBm)	Limit (dBm)
700MHz (Lower)				
698.00 MHz	704.00 MHz	716.00 MHz	No Emissions Within 10 dB of the limit	-13
700MHz (Upper)				
777.00 MHz	870.30 MHz	787.00 MHz	No Emissions Within 10 dB of the limit	-13
1700 MHz				
1710.00 MHz	1725.00 MHz	1755.00 MHz	No Emissions Within 10 dB of the limit	-13

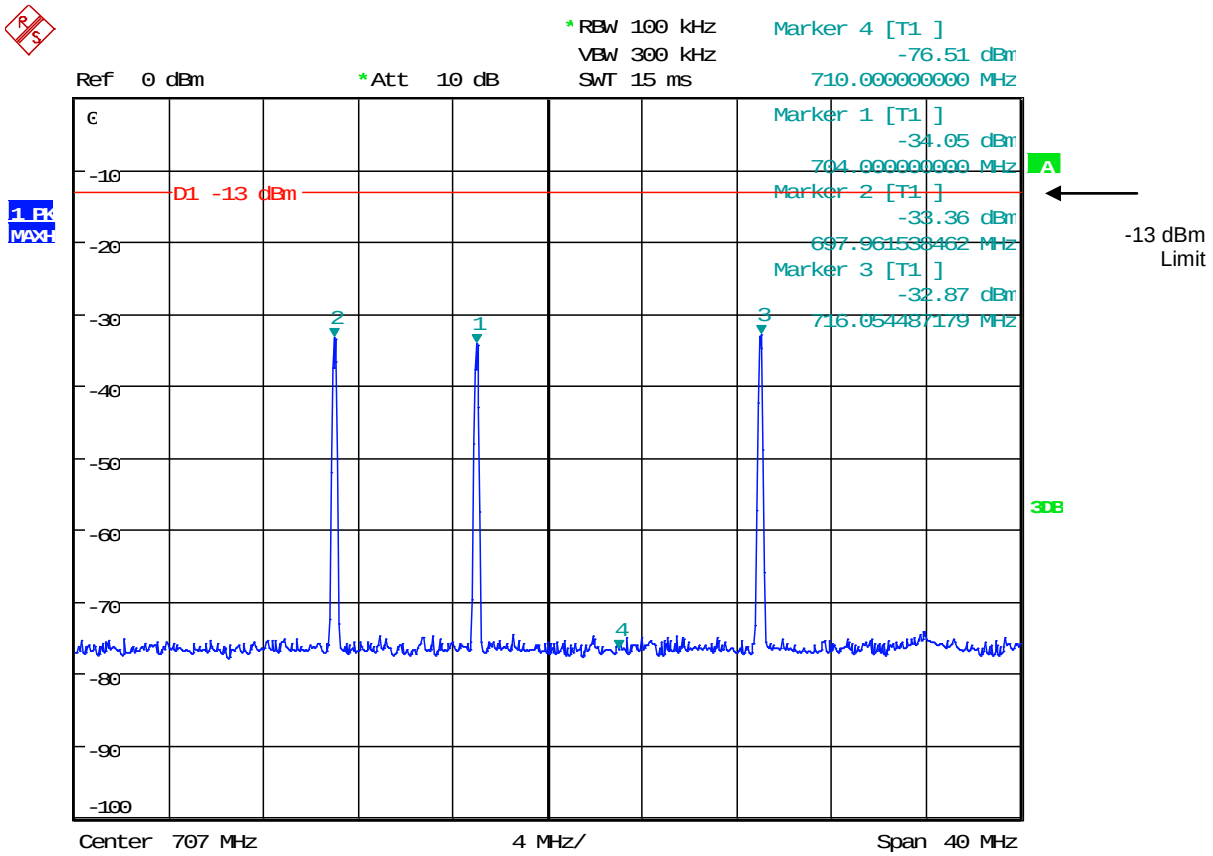
Sweep data is shown on the next page:

Results

The EUT was found to comply with the limits

See plots below

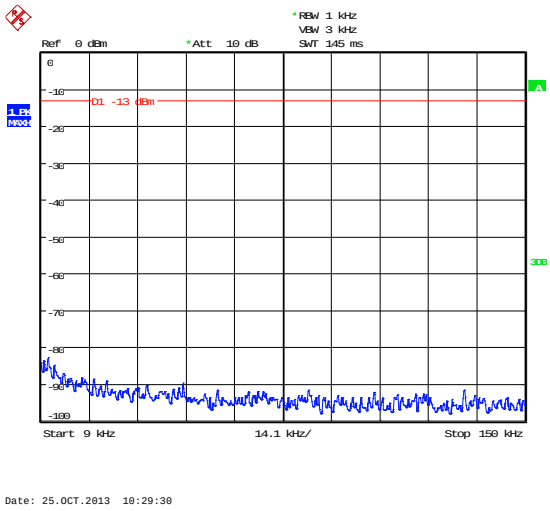
700 MHz (Lower) Intermodulation Close View



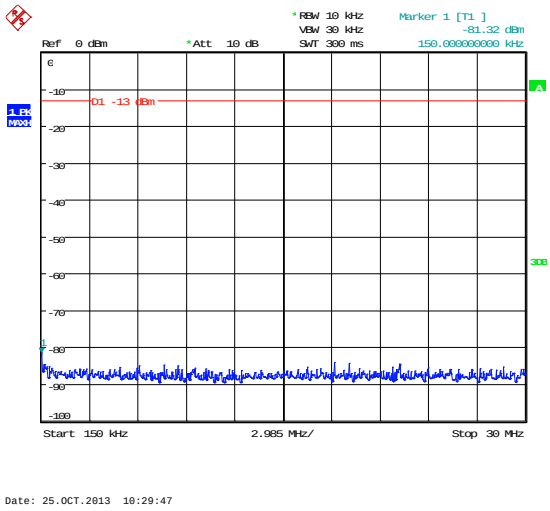
Date: 25.OCT.2013 10:28:55

The above plots show that there are no products within 20 dB of the spurious limit.

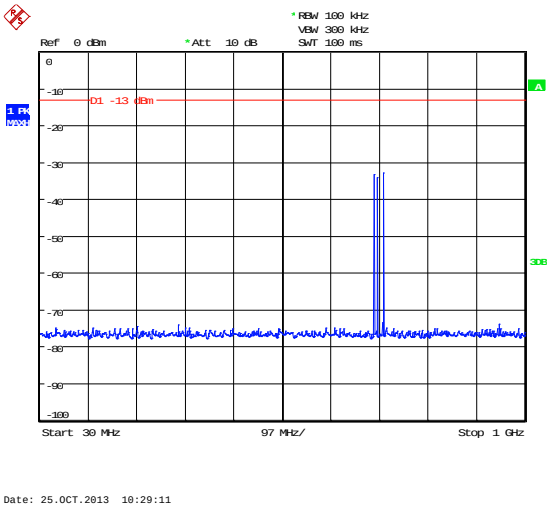
700 MHz (Lower) Intermodulation



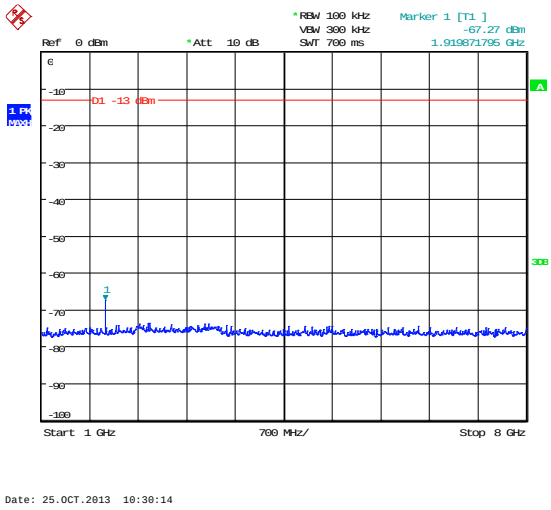
9 – 150kHz



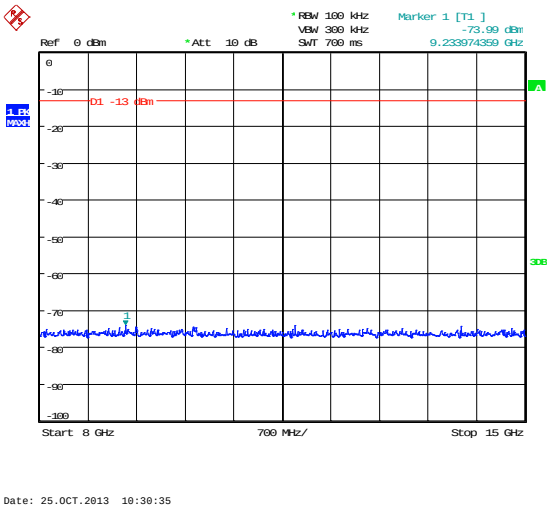
150kHz – 30MHz



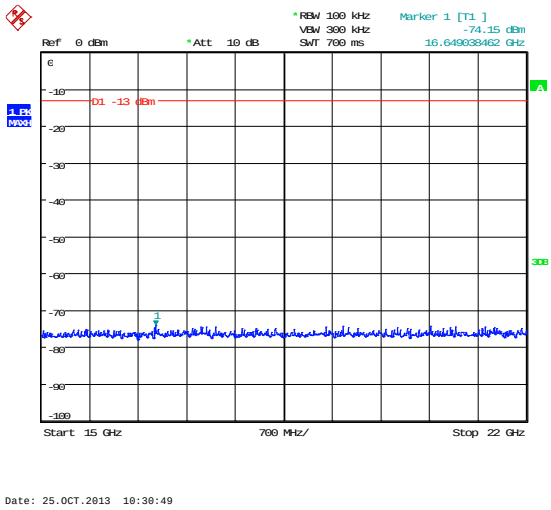
30MHz – 1GHz



1GHz – 8GHz

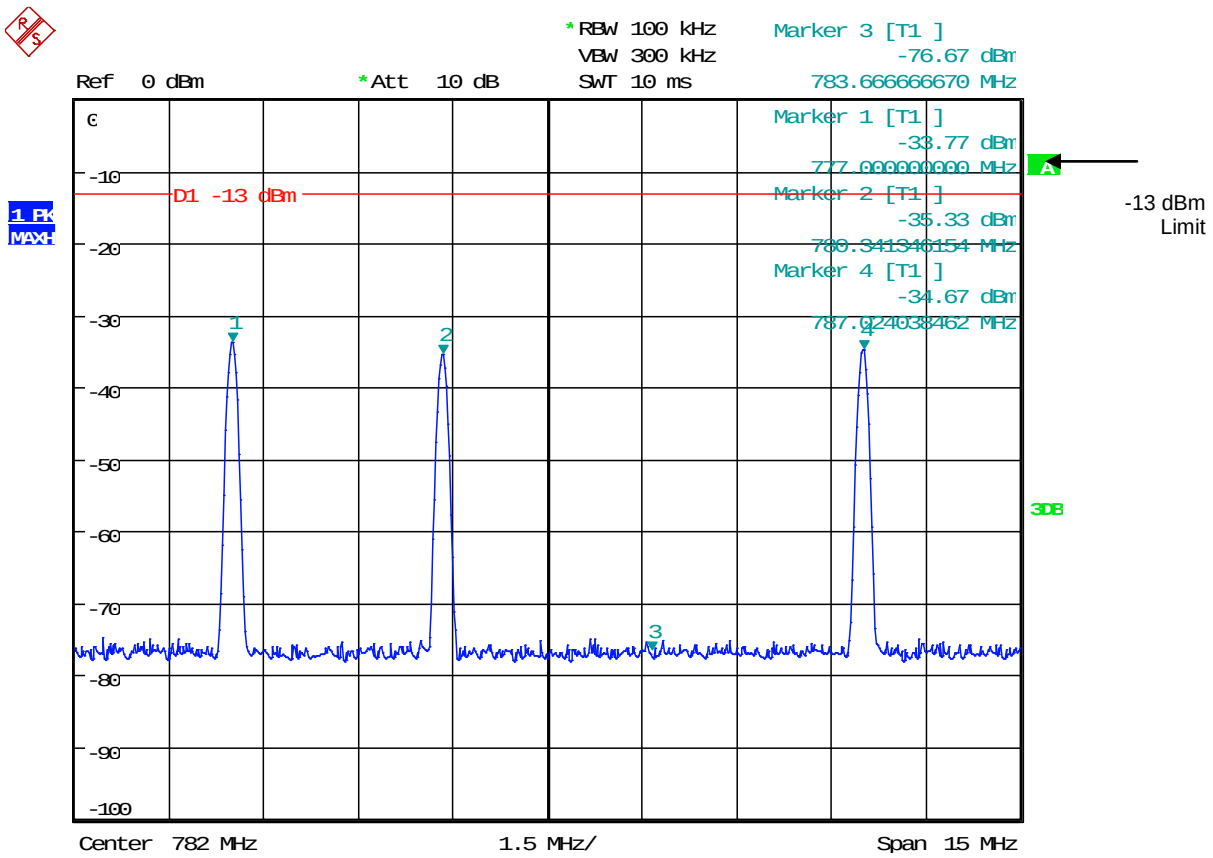


8GHz – 15GHz



15GHz – 22GHz

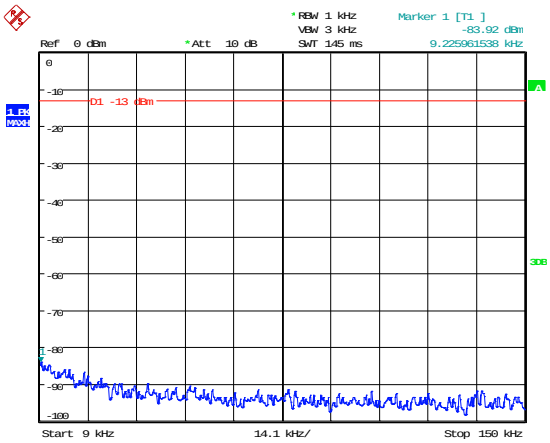
700 MHz (Upper) Intermodulation Close View



Date: 25.OCT.2013 10:32:44

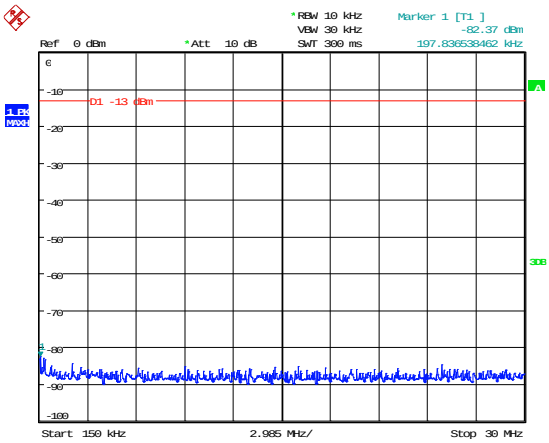
The above plots show that there are no products within 20 dB of the spurious limit.

700 MHz (Upper) Intermodulation



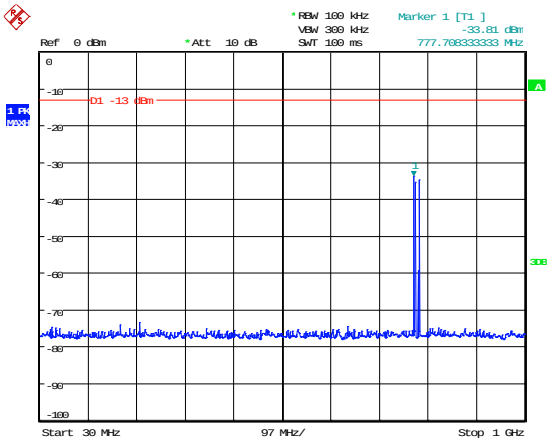
Date: 25.OCT.2013 10:33:03

9 – 150kHz



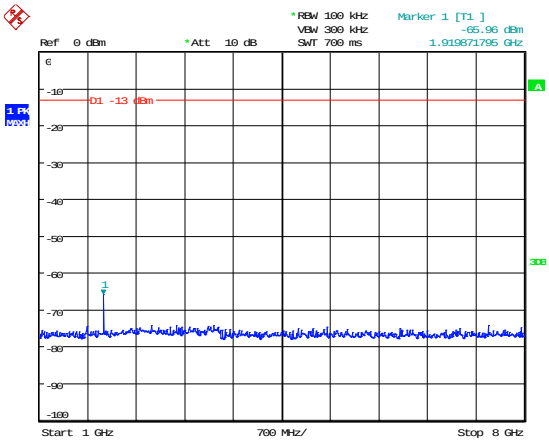
Date: 25.OCT.2013 10:33:17

150kHz – 30MHz



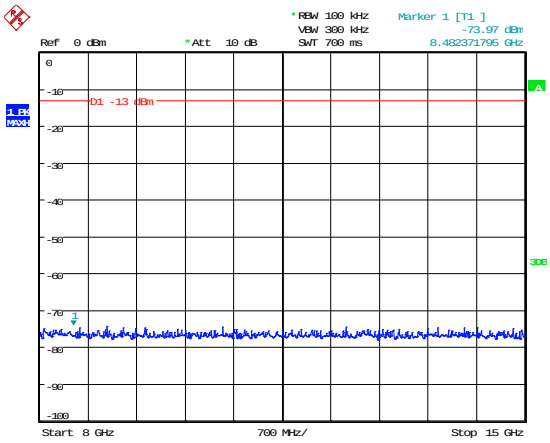
Date: 25.OCT.2013 10:33:30

30MHz – 1GHz



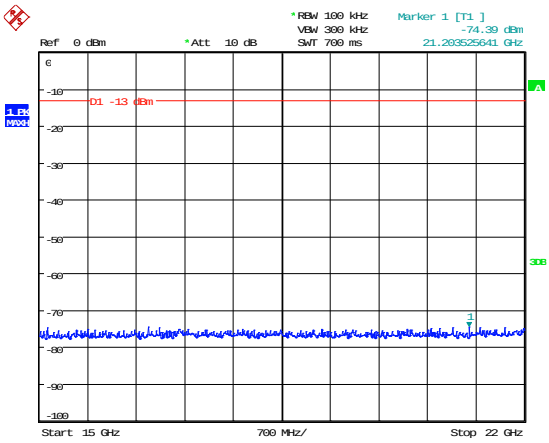
Date: 25.OCT.2013 10:33:41

1GHz – 8GHz



Date: 25.OCT.2013 10:33:53

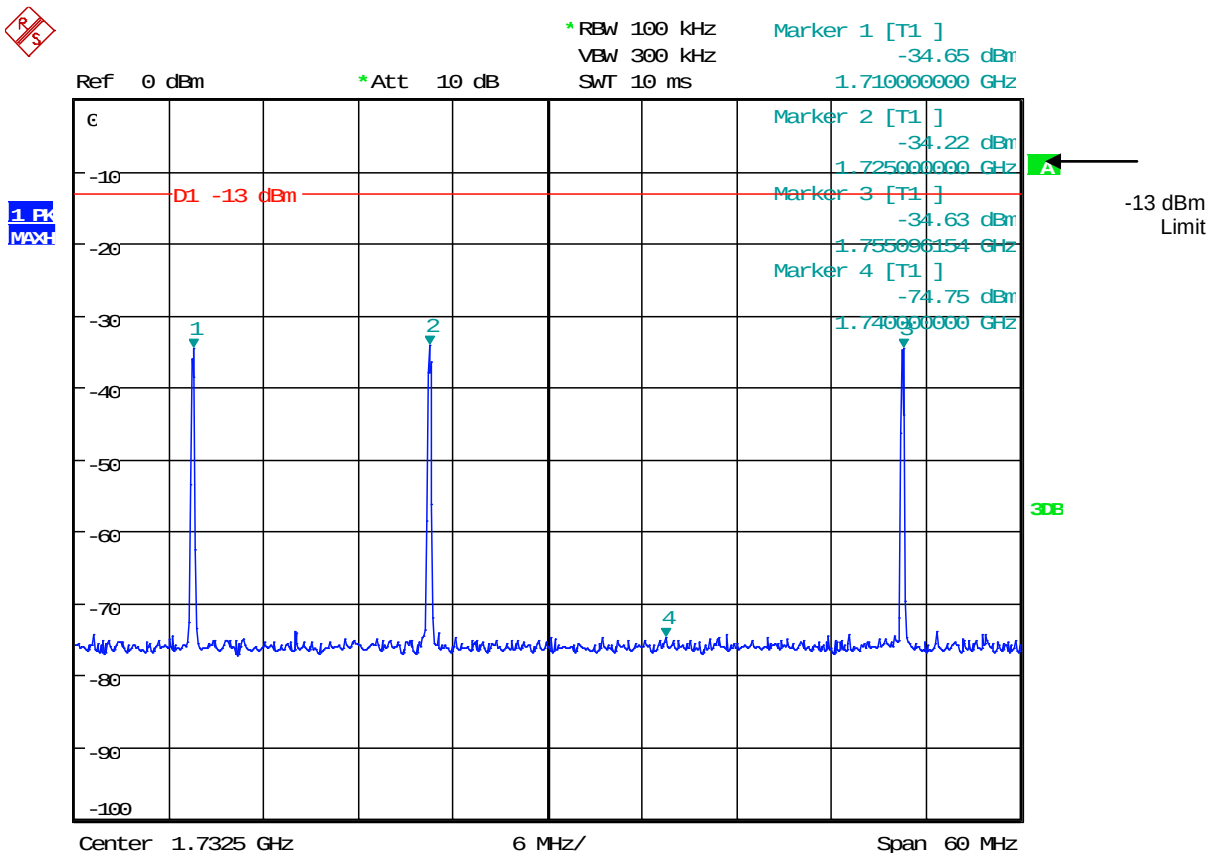
8GHz – 15GHz



Date: 25.OCT.2013 10:34:06

15GHz – 22GHz

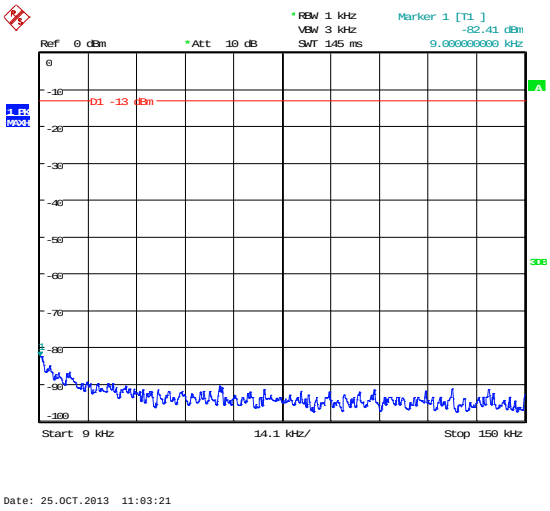
1710 MHz Intermodulation Close View



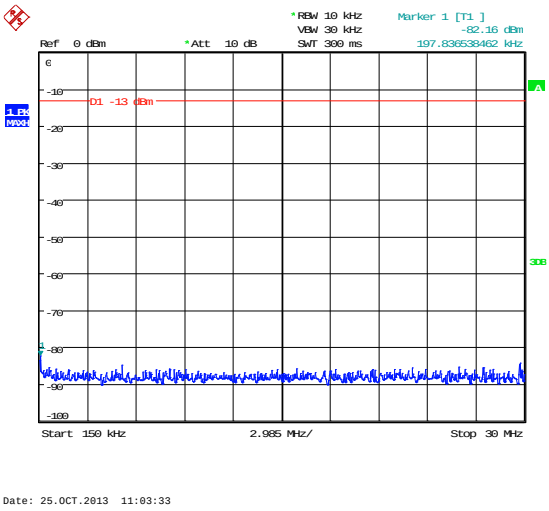
Date: 25.OCT.2013 11:02:02

The above plots show that there are no products within 20 dB of the spurious limit.

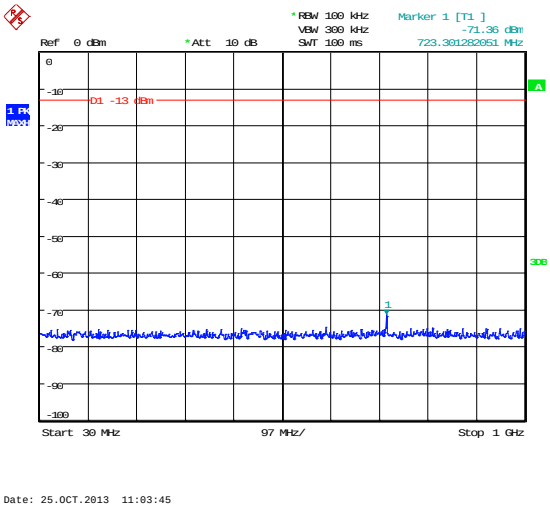
1710 MHz Intermodulation



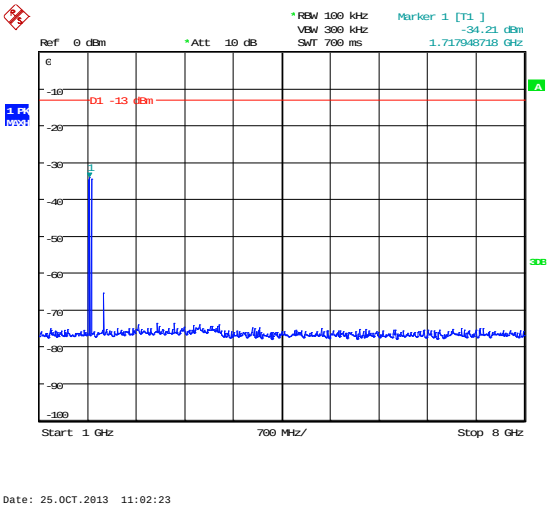
9 – 150kHz



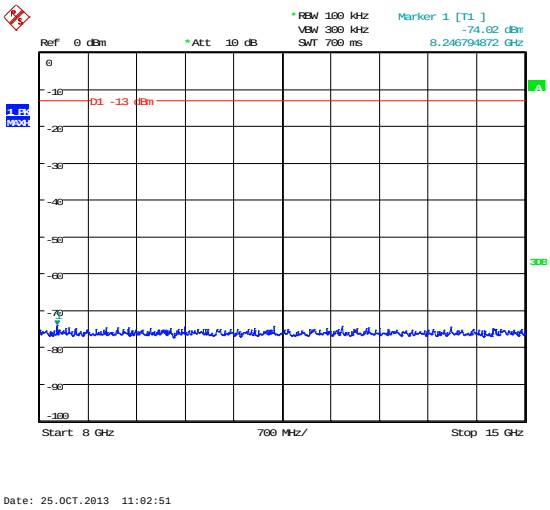
150kHz – 30MHz



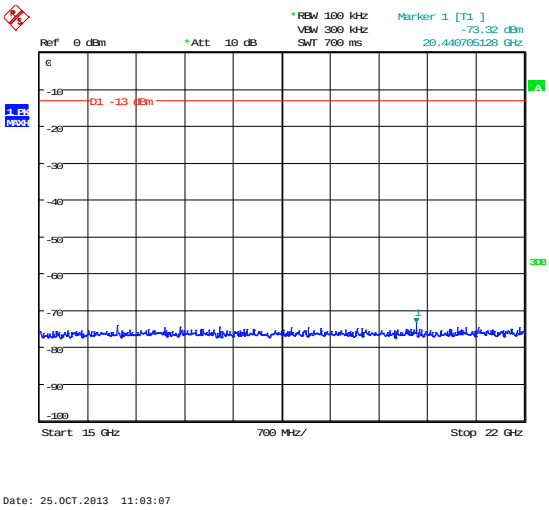
30MHz – 1GHz



1GHz – 8GHz



8GHz – 15GHz



15GHz – 22GHz

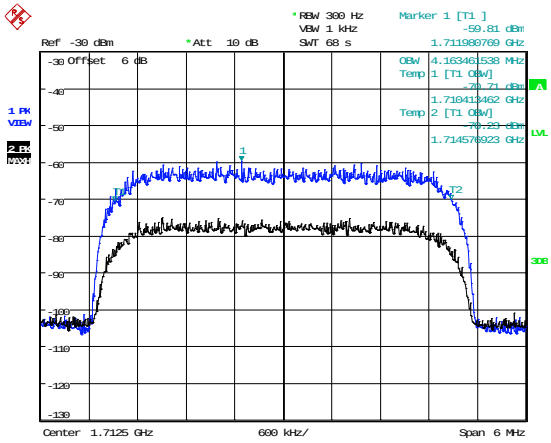
A3 Amplifier Modulated Channel Test

Test Details:	
Measurement standard	D.3 Policies + Procedures (j) of KDB 935210 D02 Signal Boosters Certification v02
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency Of Operation Channel	Modulation Type		
	WCDMA	LTE 1.4 MHz	LTE 20.0 MHz
698.0 MHz	N/A	1.089 MHz	N/A
707.0 MHz	N/A	1.089 MHz	17.828 MHz
716.0 MHz	N/A	1.086 MHz	N/A
777.0 MHz	N/A	1.089 MHz	N/A
782.5 MHz	N/A	1.089 MHz	8.961 MHz
787.0 MHz	N/A	1.086 MHz	N/A
1710.0 MHz	4.163 MHz	1.089 MHz	17.908 MHz
1732.5 MHz	4.173 MHz	1.089 MHz	17.868 MHz
1755.0 MHz	4.173 MHz	1.086 MHz	17.868 MHz

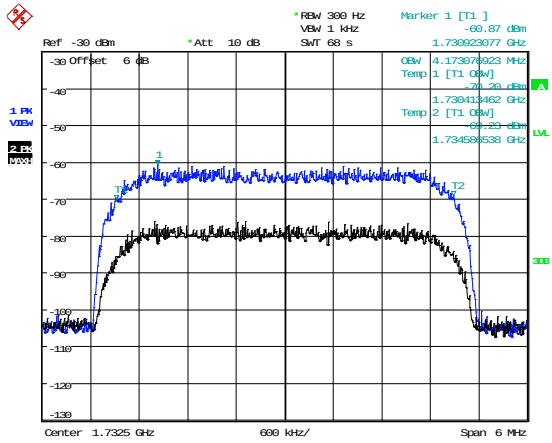
Waveforms applied to selected bands as requested.
698.0 – 716.0 MHz < 20MHz therefore waveform centred around centre frequency only applied.
777.0 – 787.0 MHz = 10 MHz wide therefore only a 10 MHz wide waveform is applied.

WCDMA Modulation



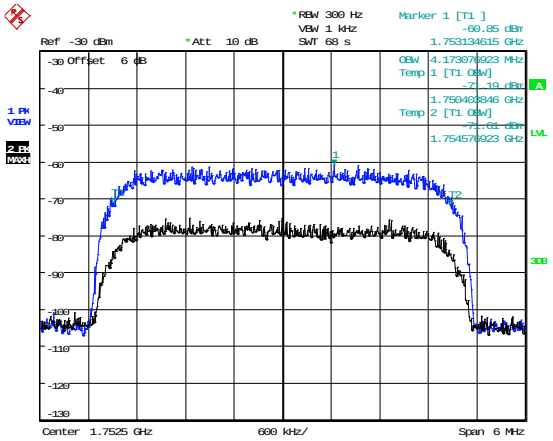
Date: 24.OCT.2013 16:29:46

1710.0 MHz



Date: 24.OCT.2013 16:32:22

1732.5 MHz

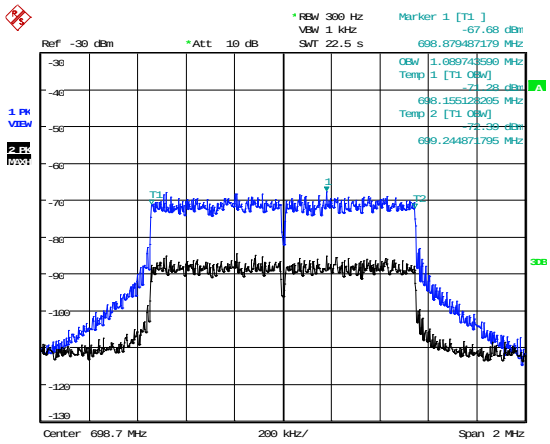


Date: 24.OCT.2013 16:35:27

1755.0 MHz

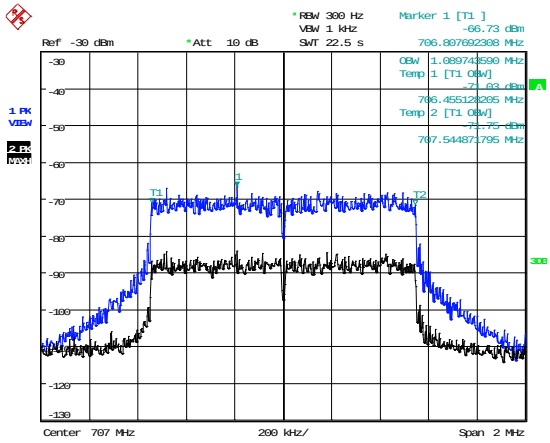
The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

1.4 MHz LTE Modulation



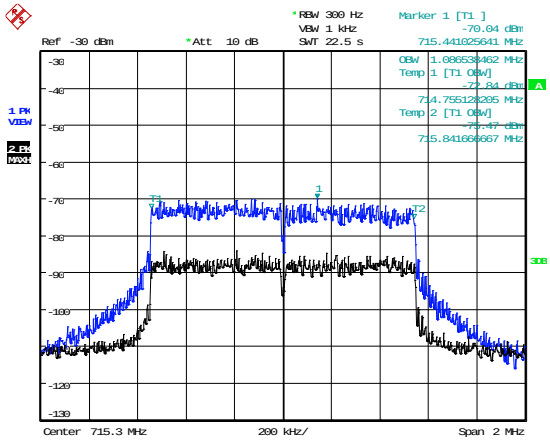
Date: 6.NOV.2013 15:10:08

698.0 MHz



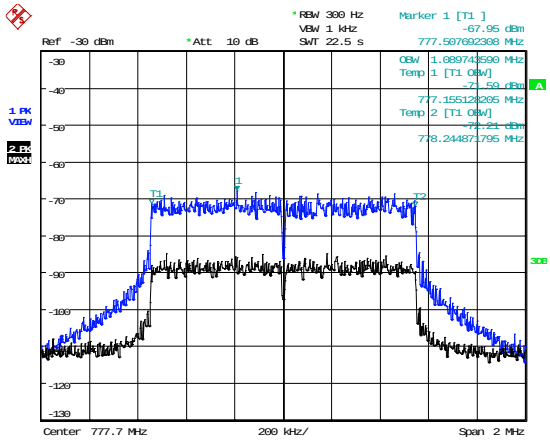
Date: 6.NOV.2013 15:15:43

707.0 MHz



Date: 6.NOV.2013 15:13:13

716.0 MHz



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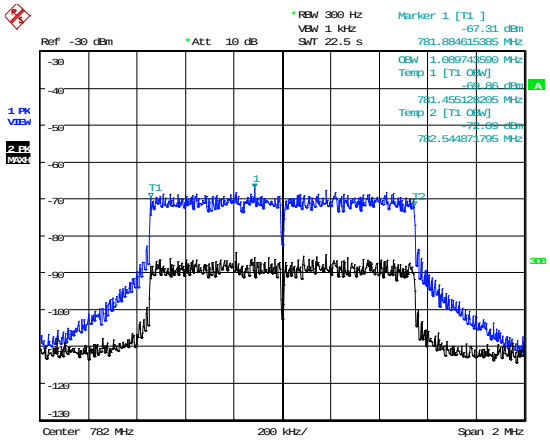
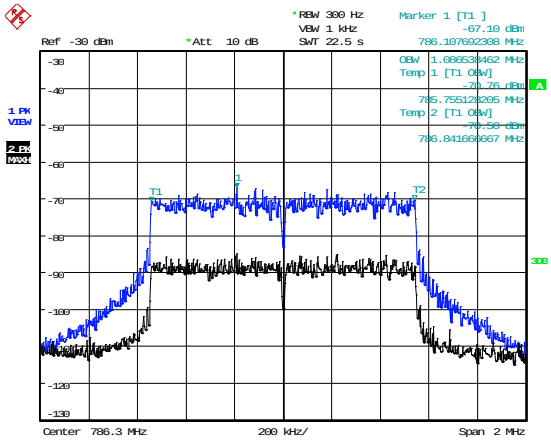
777.0 MHz



Date: 6.NOV.2013 15:07:27

782.5 MHz

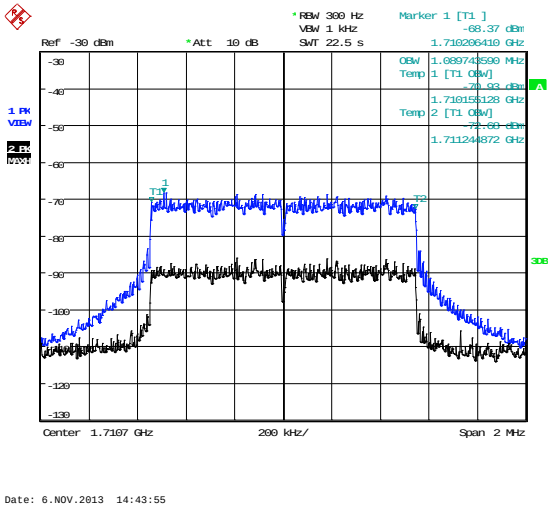


Date: 6.NOV.2013 15:04:48

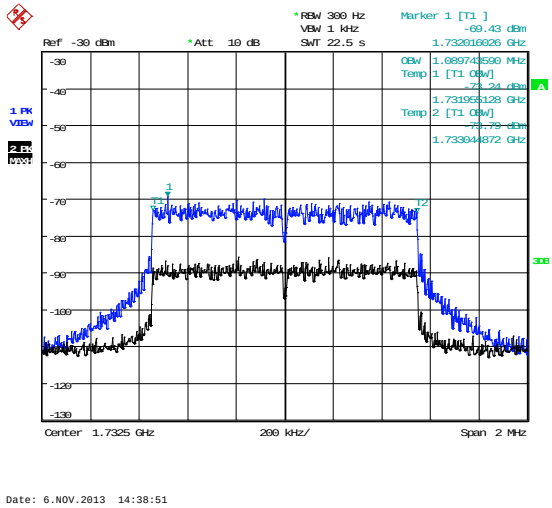
787.0 MHz

The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

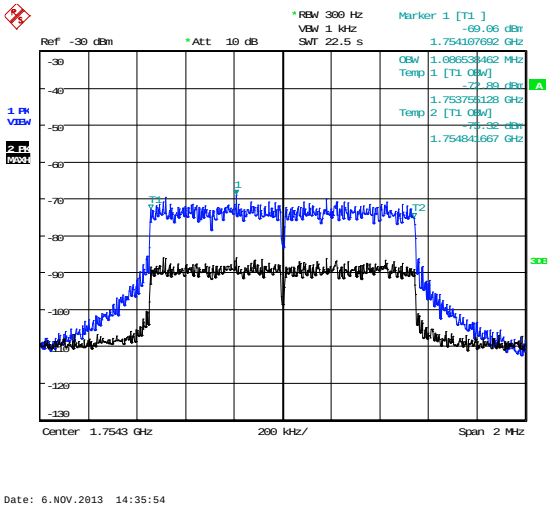
1.4 MHz LTE Modulation



1710.0 MHz



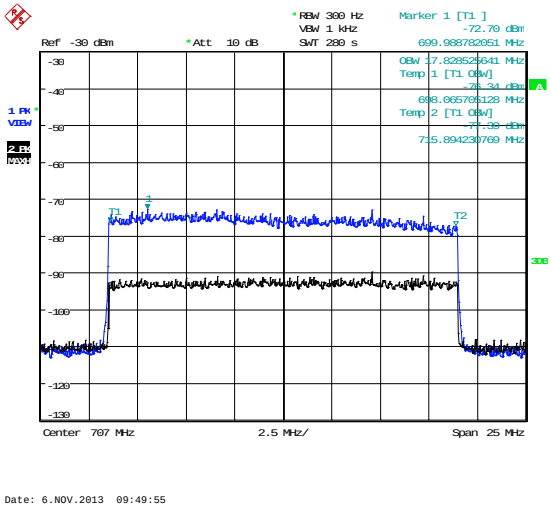
1732.5 MHz



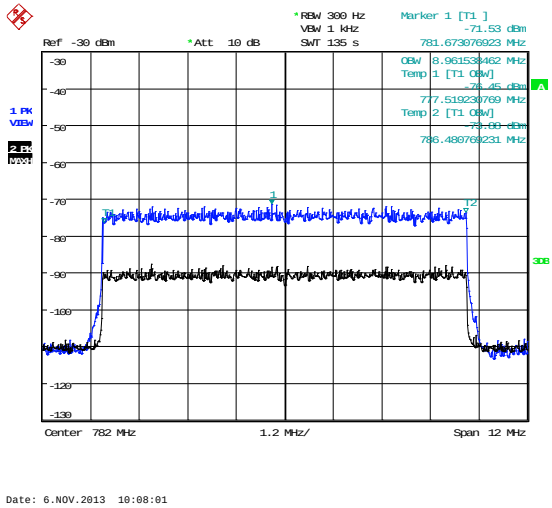
1755.0 MHz

The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

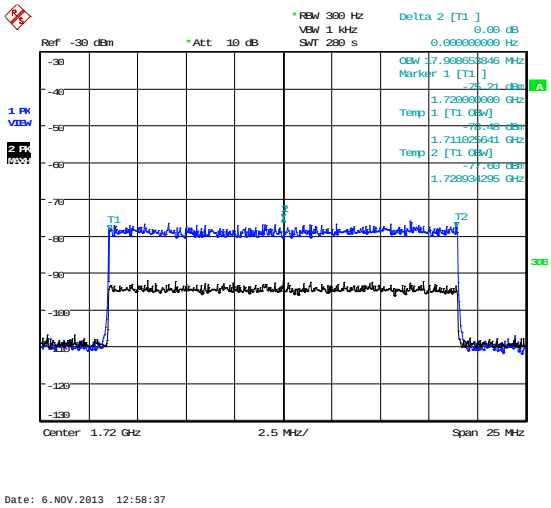
20 MHz LTE Modulation



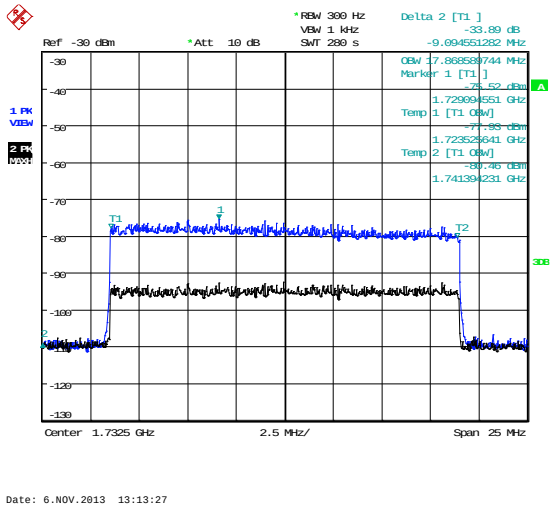
707.0 MHz



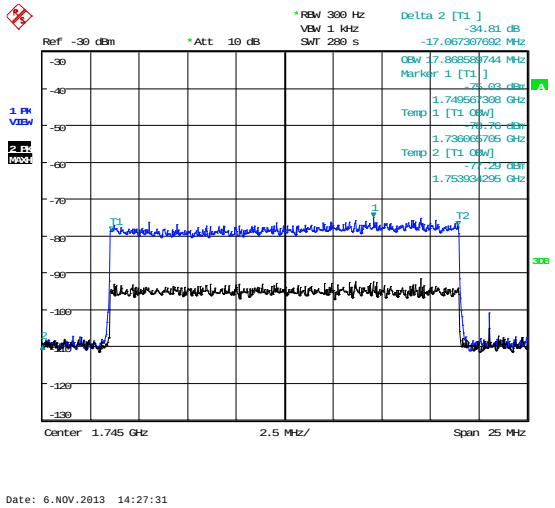
782.0 MHz



1720.0 MHz



1732.5 MHz



1745.0 MHz

The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

A4 Spurious Emissions at Antenna Terminals Less than 1MHz

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Modulation Type	Bandedge	Carrier Frequency (MHz)	Max Level @ bandedge (dBm)
WCDMA	Maximum output power is less than the spurious limit		
LTE 1.4 MHz	Maximum output power is less than the spurious limit		
LTE 20.0 MHz	Maximum output power is less than the spurious limit		

A5 Spurious Emissions at Antenna Terminals Greater than 1 MHz

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency (MHz)	Frequency Range (MHz)	Freq. of Emission (MHz)	Measured Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit (dBm)
700MHz (Lower)						
698.000	No Significant Emissions Within 20 dB of limit					-13
707.000						-13
716.000						-13
700MHz (Upper)						
777.000	No Significant Emissions Within 20 dB of limit					-13
782.000						-13
787.000						-13
1700 MHz						
1710.000	No Significant Emissions Within 20 dB of limit					-13
1732.500						-13
1755.000						-13

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

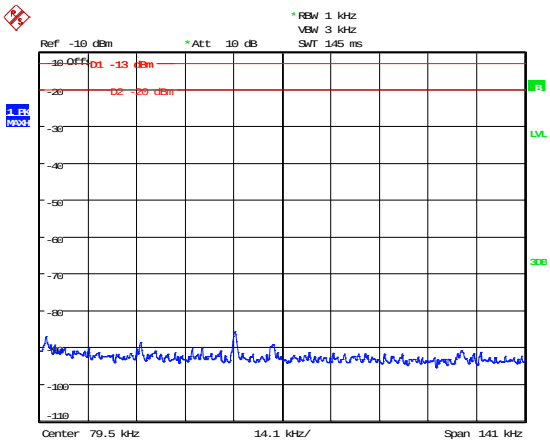
At least 43 + 10 log P dB

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

Result

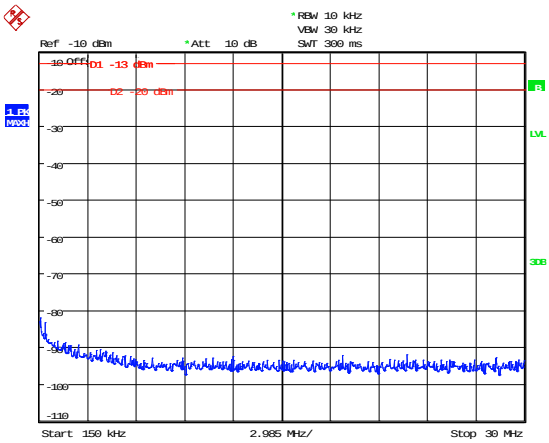
The EUT was found to comply with the limits

700 MHz (Lower) – 698.0 MHz



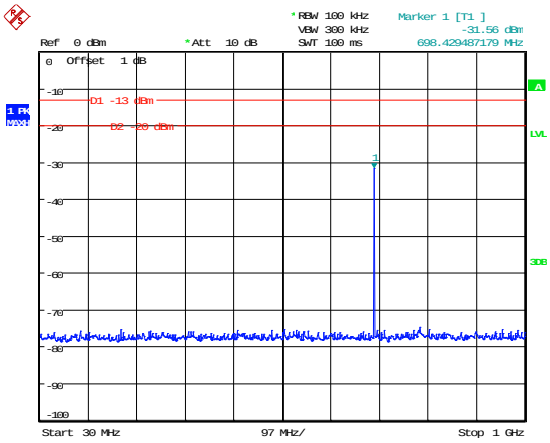
Date: 28.AUG.2013 12:04:39

9kHz - 150kHz



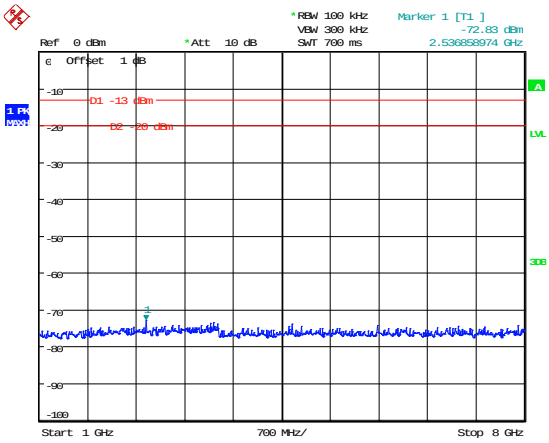
Date: 28.AUG.2013 12:07:30

150kHz – 30MHz



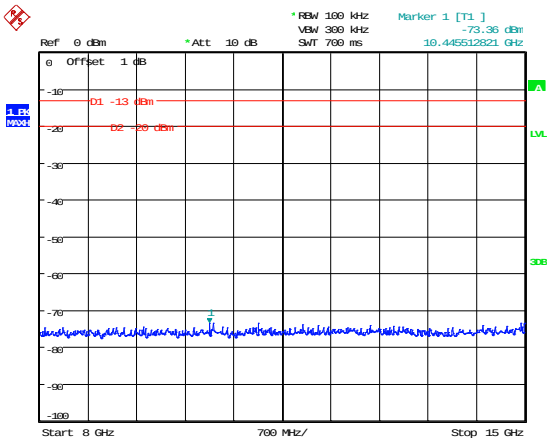
Date: 28.AUG.2013 12:07:41

30MHz – 1GHz



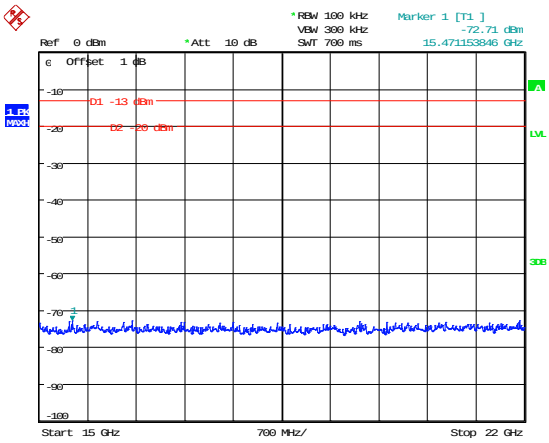
Date: 28.AUG.2013 12:08:34

1GHz – 8GHz



Date: 28.AUG.2013 12:09:05

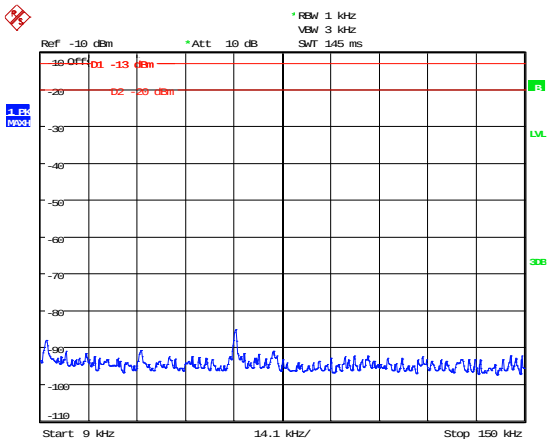
8GHz – 15GHz



Date: 28.AUG.2013 12:09:17

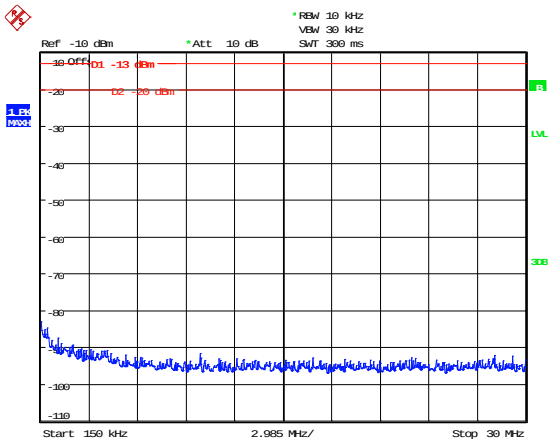
15GHz – 22GHz

700 MHz (Lower) – 707.0 MHz



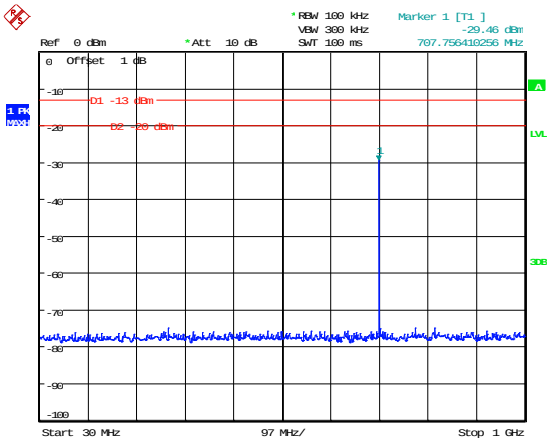
Date: 28.AUG.2013 12:10:53

9kHz - 150kHz



Date: 28.AUG.2013 12:10:39

150kHz – 30MHz



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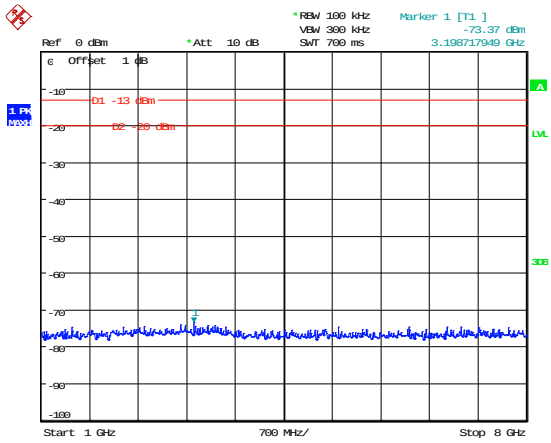
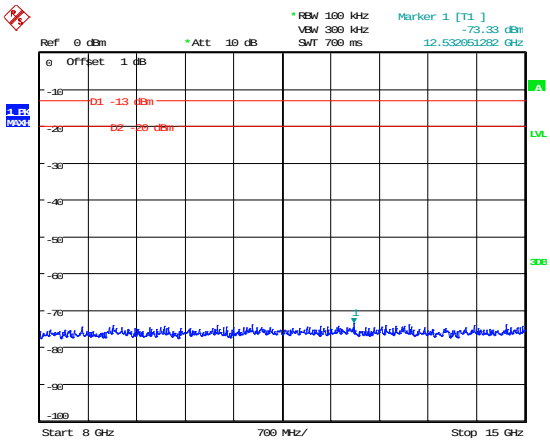
30MHz – 1GHz



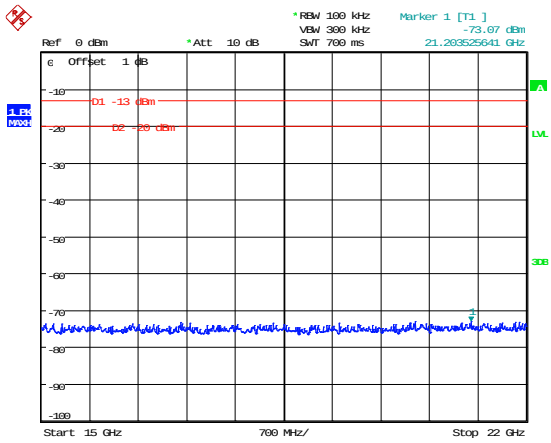
Date: 28.AUG.2013 12:10:17

1GHz – 8GHz



Date: 28.AUG.2013 12:09:56

8GHz – 15GHz



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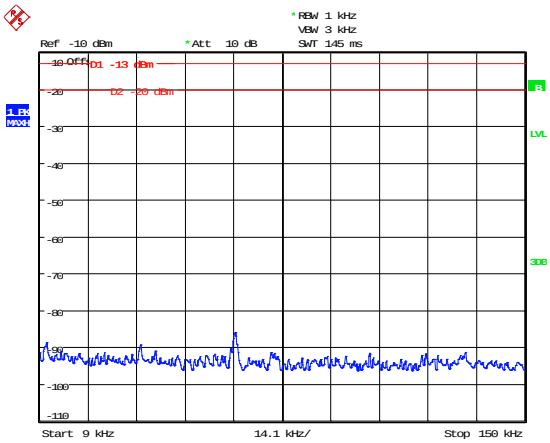
15GHz – 22GHz

700 MHz (Lower) – 716.0 MHz



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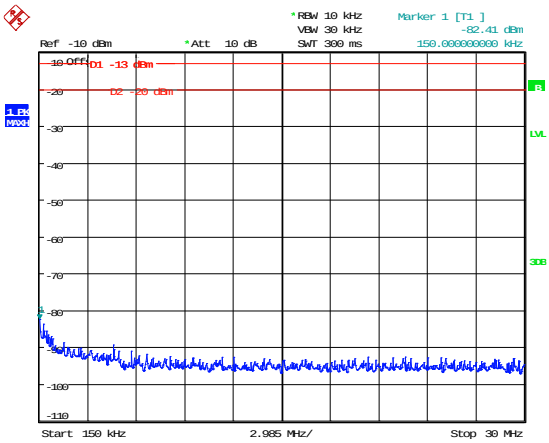
9kHz - 150kHz



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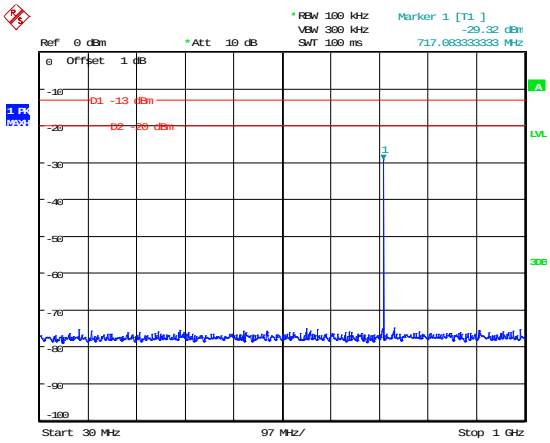
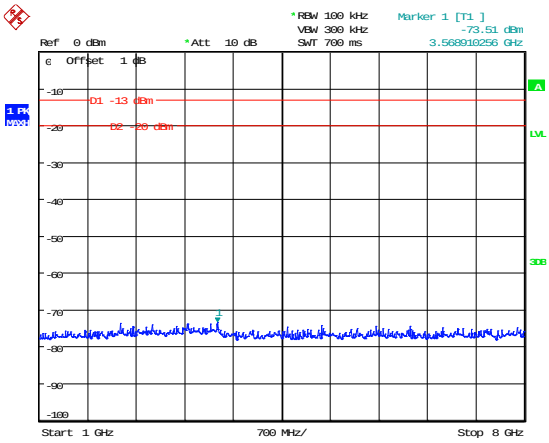
150kHz – 30MHz



Date: 28.AUG.2013 12:11:51

30MHz – 1GHz



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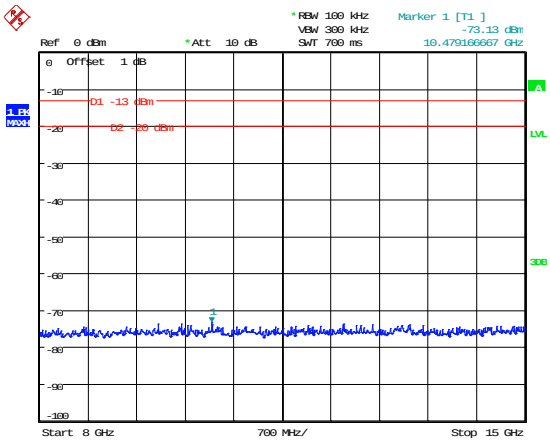
1GHz – 8GHz



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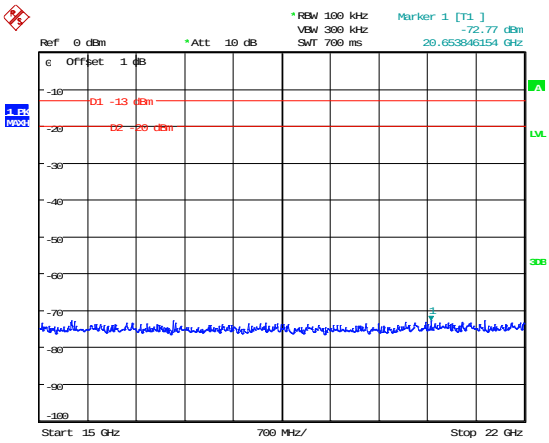
8GHz – 15GHz



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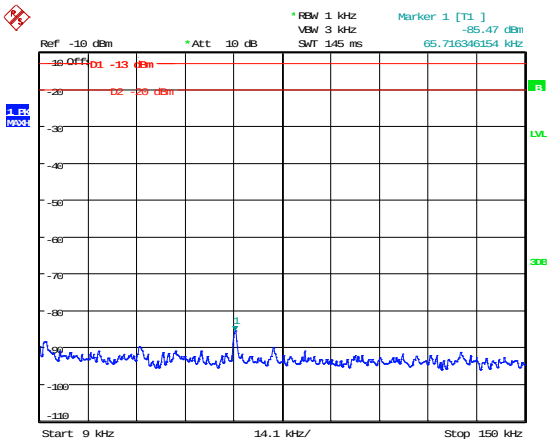
15GHz – 22GHz

700 MHz (Upper) – 777.0 MHz



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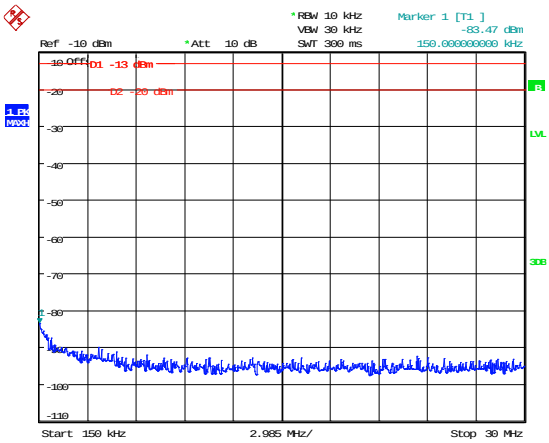
9kHz - 150kHz



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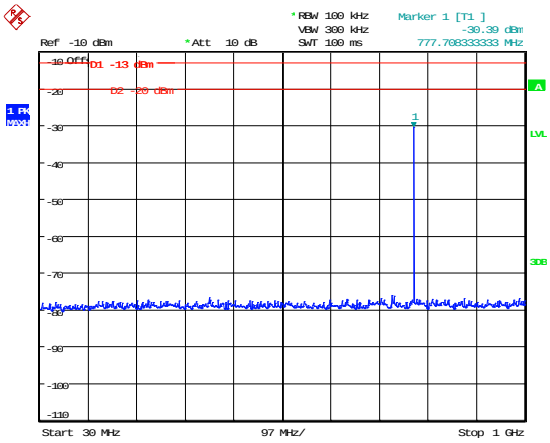
150kHz – 30MHz



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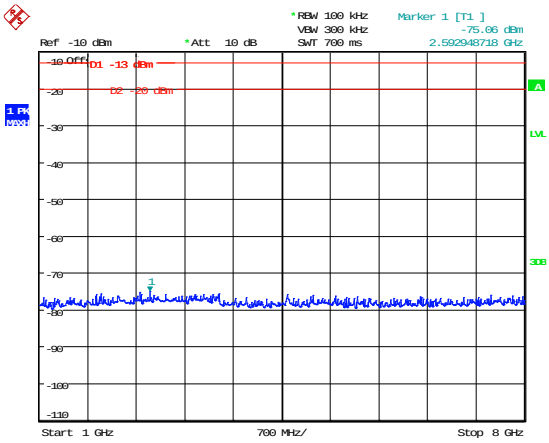
30MHz – 1GHz



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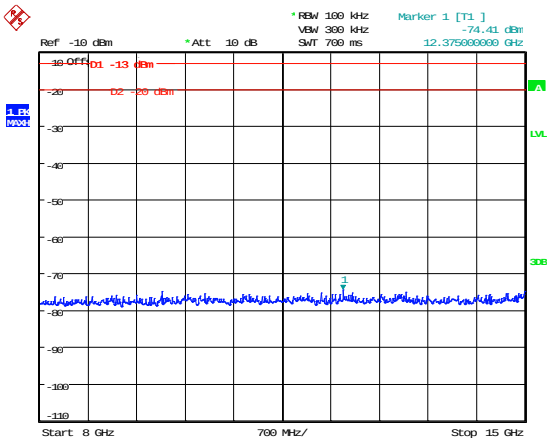
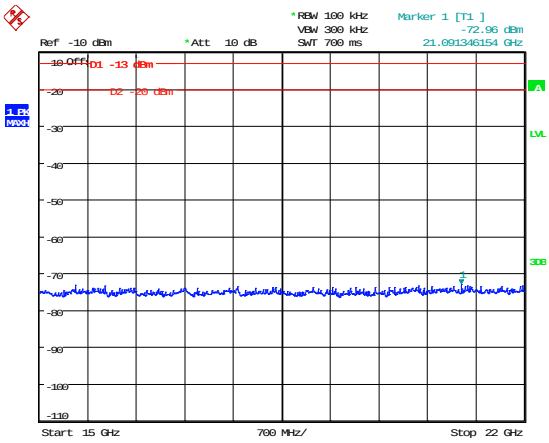
1GHz – 8GHz



Date: 28.AUG.2013 12:34:05

8GHz – 15GHz



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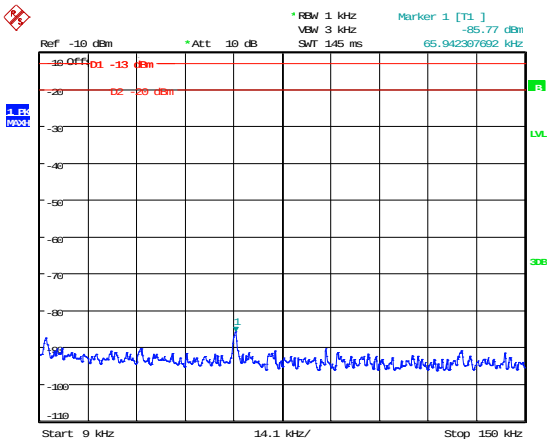
15GHz – 22GHz

700 MHz (Upper) – 782.0 MHz



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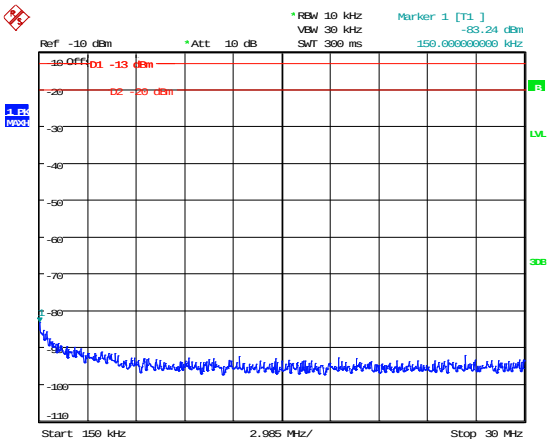
9kHz - 150kHz



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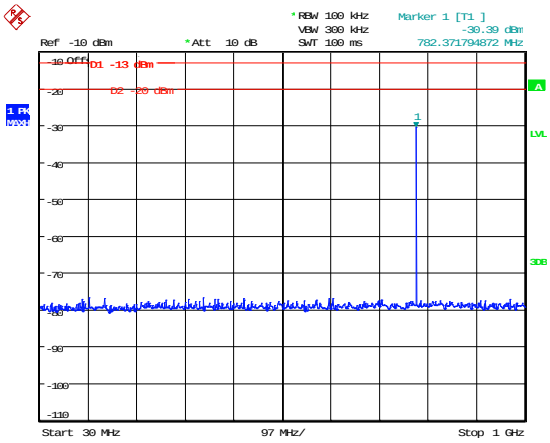
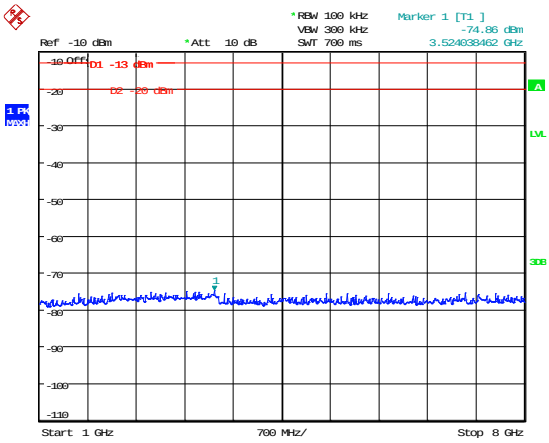
150kHz – 30MHz



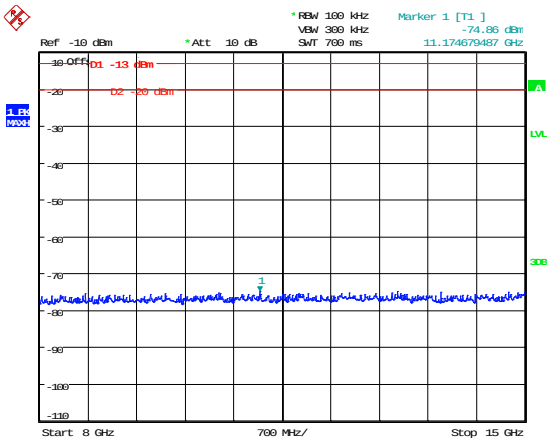
Date: 28.AUG.2013 12:38:51

30MHz – 1GHz



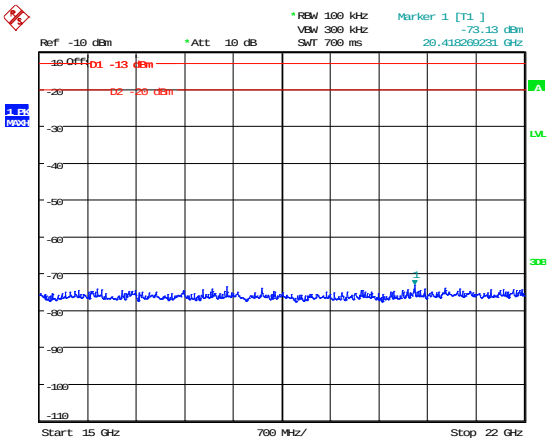
Date: 28.AUG.2013 12:39:16

1GHz – 8GHz



Date: 28.AUG.2013 12:39:41

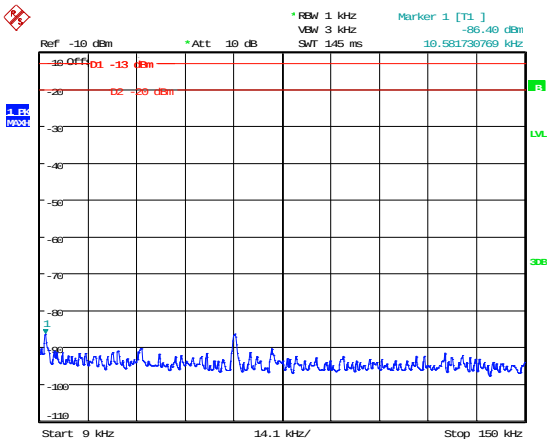
8GHz – 15GHz



Date: 28.AUG.2013 12:39:53

15GHz – 22GHz

700 MHz (Upper) – 787.0 MHz



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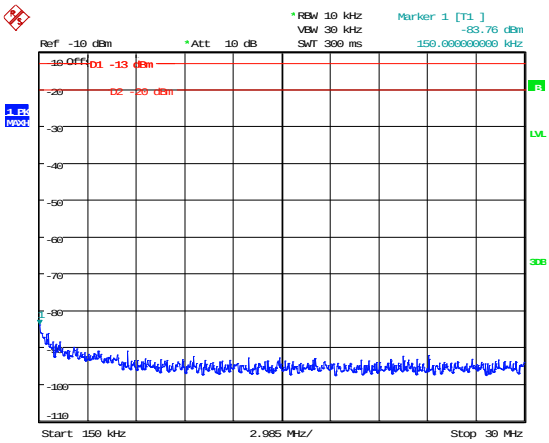
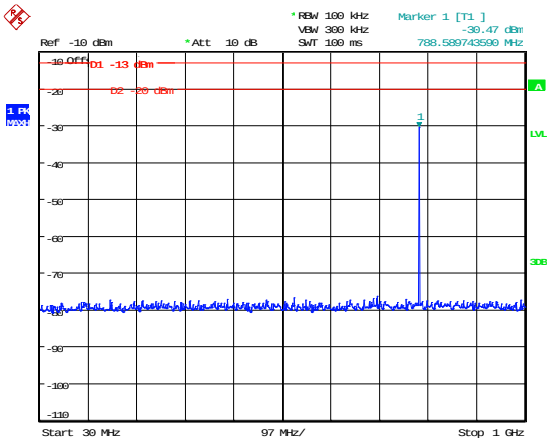
9kHz - 150kHz



Date: 28.AUG.2013 12:41:36

150kHz – 30MHz



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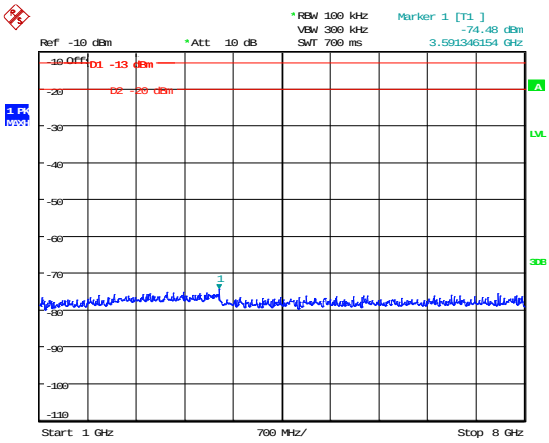
30MHz – 1GHz



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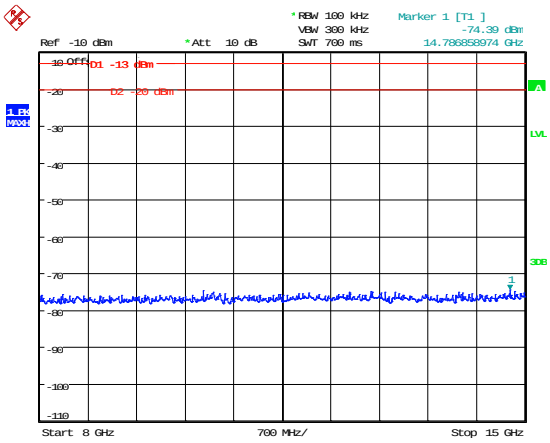
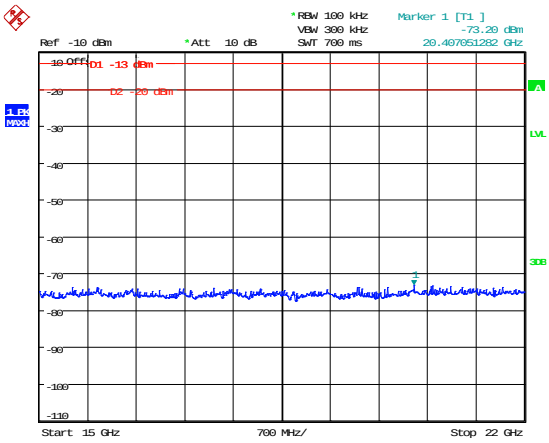
1GHz – 8GHz



Date: 28.AUG.2013 12:41:01

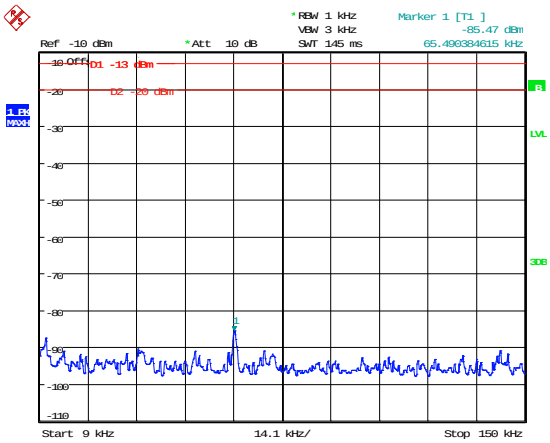
8GHz – 15GHz



Date: 28.AUG.2013 12:40:36

15GHz – 22GHz

1700 MHz – 1710.0 MHz



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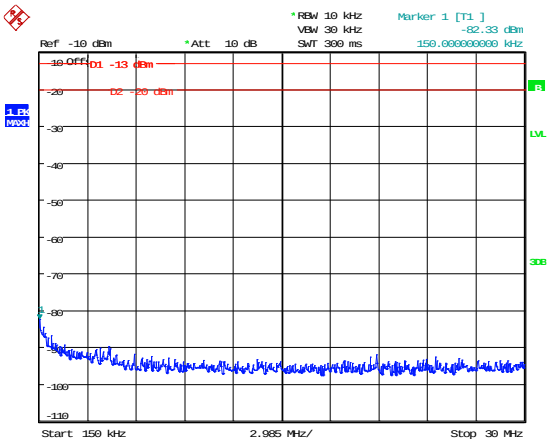
9kHz - 150kHz



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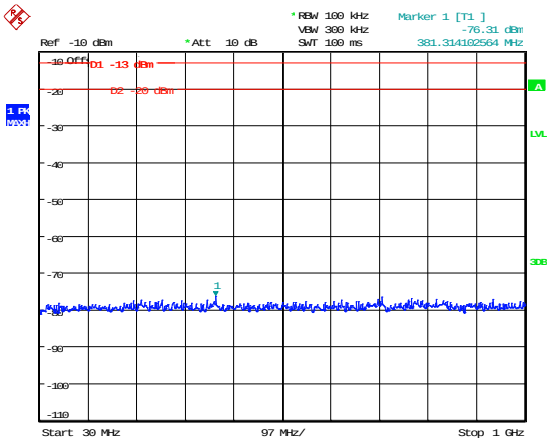
150kHz – 30MHz



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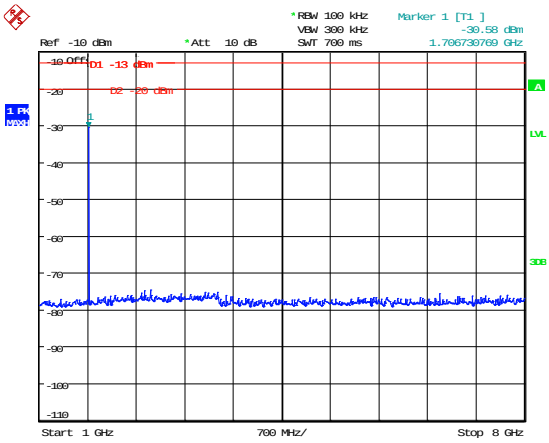
30MHz – 1GHz



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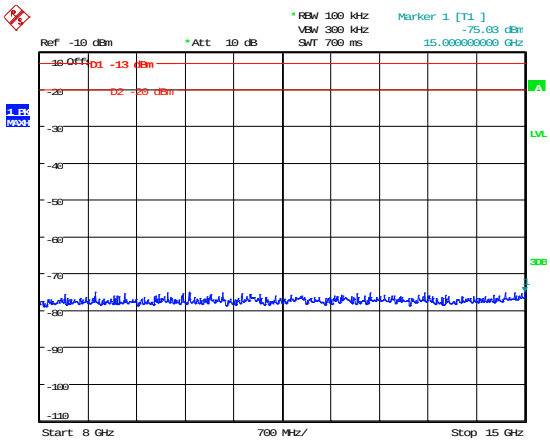
1GHz – 8GHz



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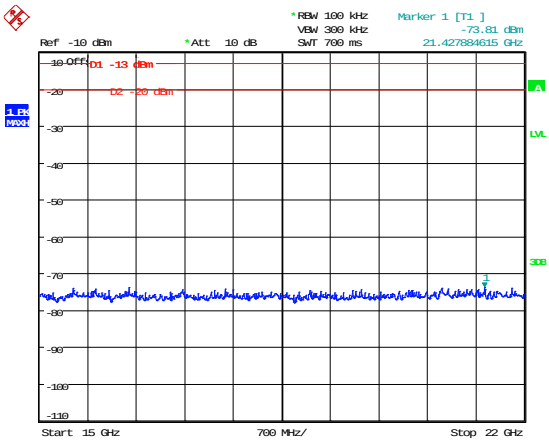
8GHz – 15GHz



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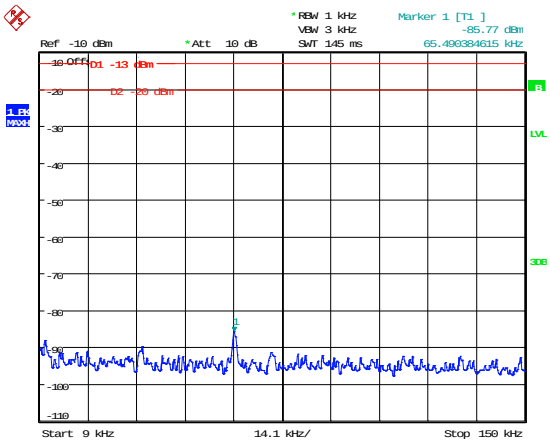
15GHz – 22GHz

1700 MHz – 1732.5 MHz



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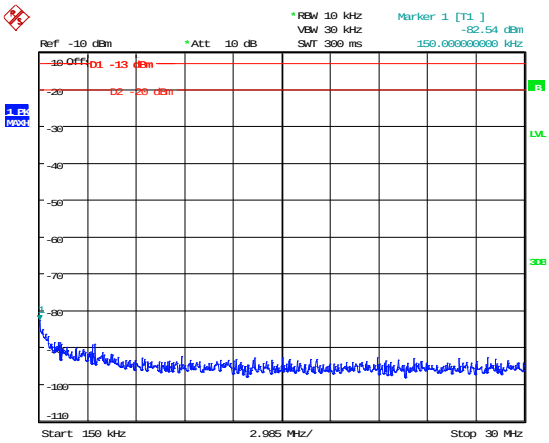
9kHz - 150kHz



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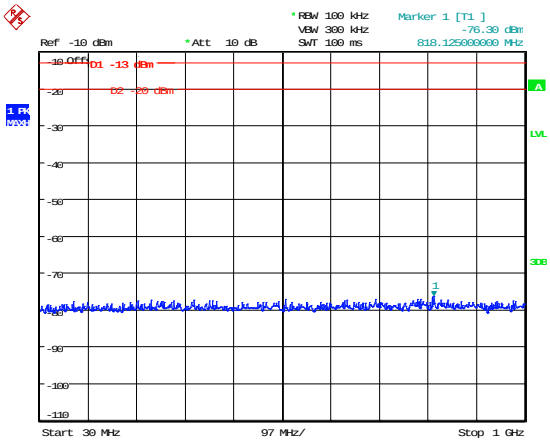
150kHz – 30MHz



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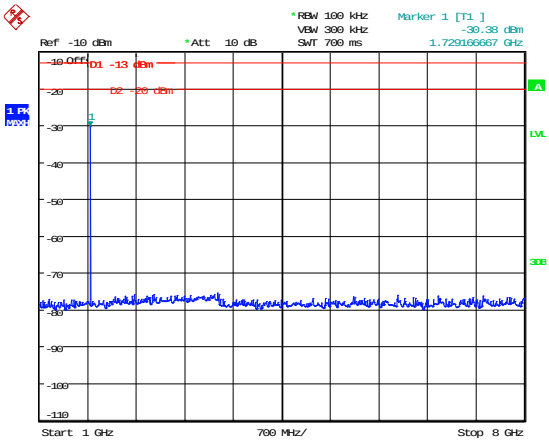
30MHz – 1GHz



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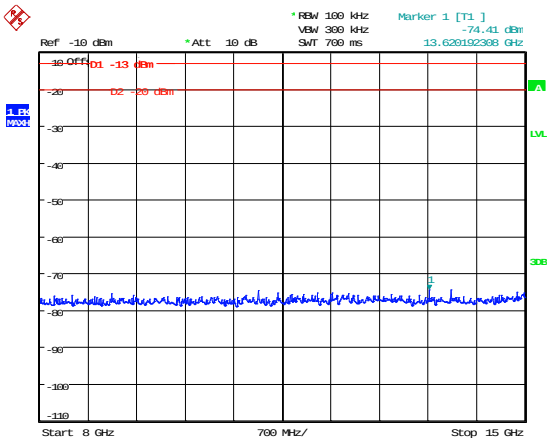
1GHz – 8GHz



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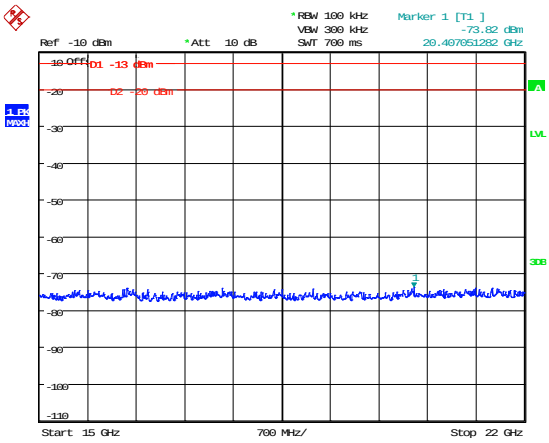
8GHz – 15GHz



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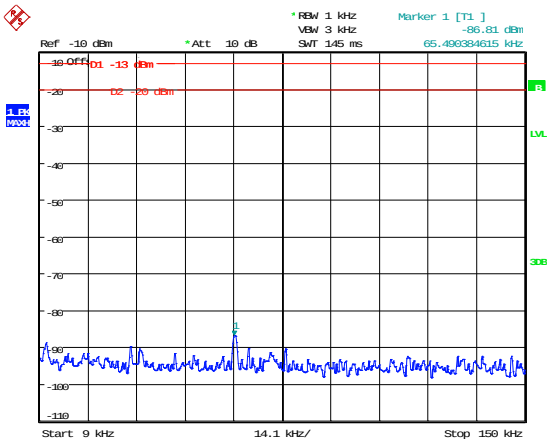
15GHz – 22GHz

1700 MHz – 1755.0 MHz



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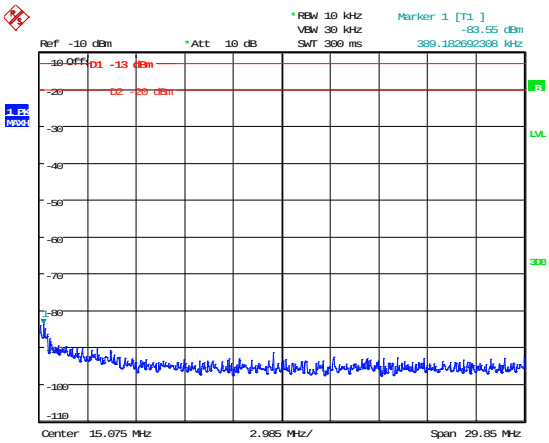
9kHz - 150kHz



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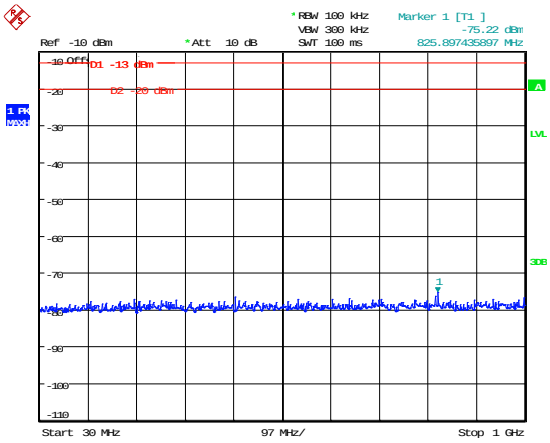
150kHz – 30MHz



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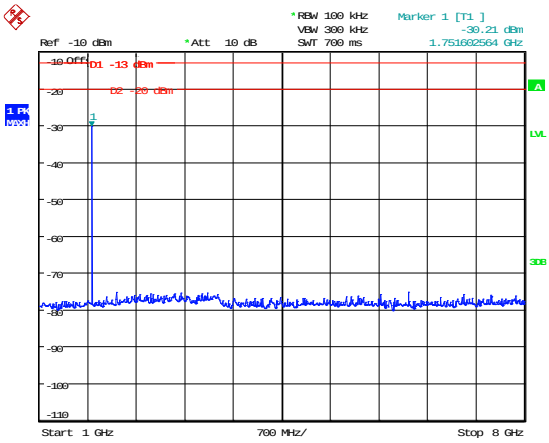
30MHz – 1GHz



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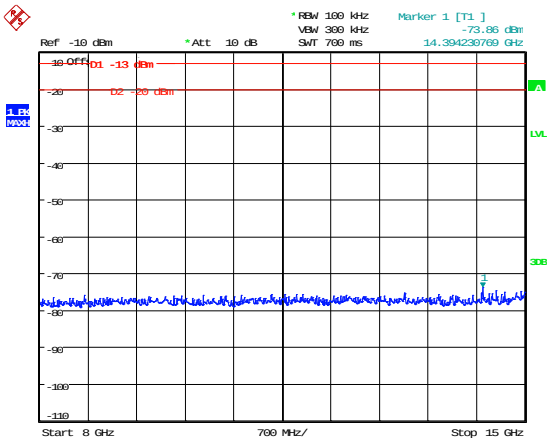
1GHz – 8GHz



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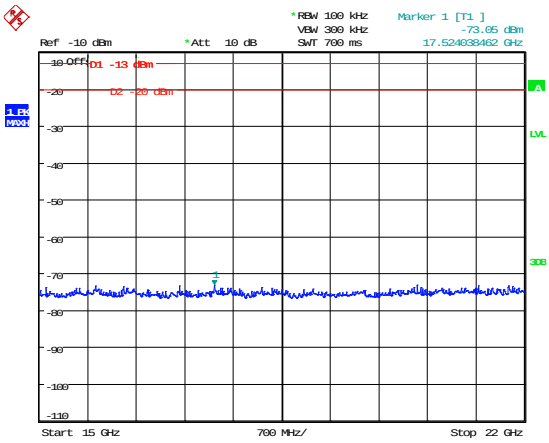
8GHz – 15GHz



Date: 28.AUG.2013 13:02:30

15GHz – 22GHz

A6 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric filed emission test applies to all spurious and harmonic emissions. The EUT was set to transmit as required.

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 : [X]

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

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
Frequency range	30 MHz – 22 GHz
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs	Appendix F

Frequency (MHz)	Freq. of Emission (MHz)	**ERP/EIRP (dBm)**	Limit (dBm)
700MHz (Lower)			
698.000	No Significant Emissions Within		-13
707.000			-13
716.000			-13
700MHz (Upper)			
777.000	No Significant Emissions Within		-13
782.000			-13
787.000			-13
1700 MHz			
1710.000	No Significant Emissions Within		-13
1732.500			-13
1755.000			-13

Result

The EUT was found to comply with the limits

Notes:

1. Emissions Checked up to 10 times Fc.

2. The unit was mounted on a turntable and rotated through 360^0 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 = ≥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

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

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:

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

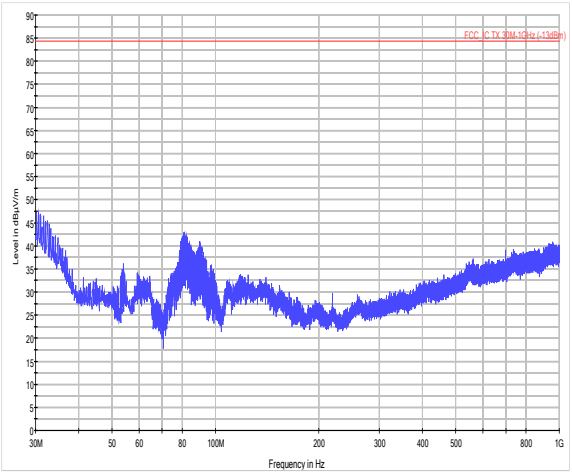
(b) The levels may have been rounded for display purposes.

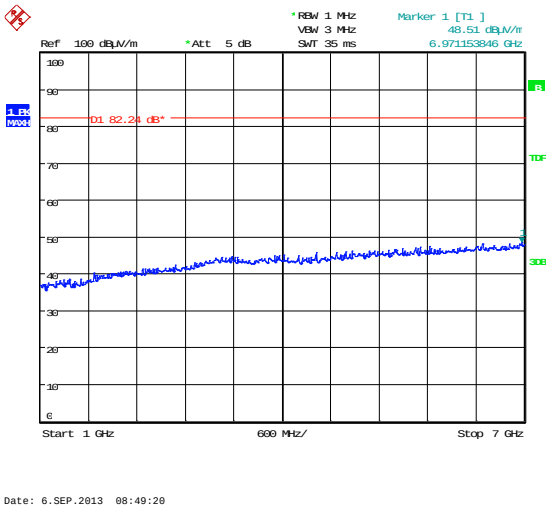
(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	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

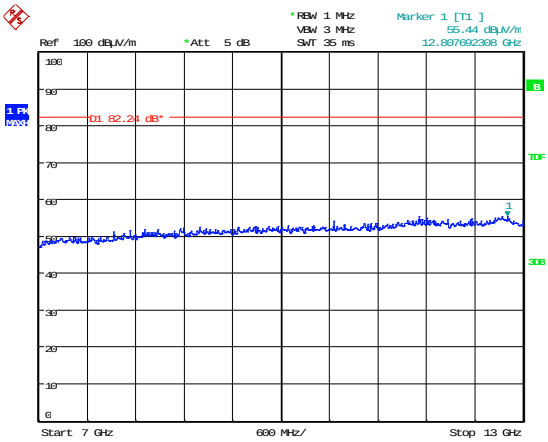
700 MHz (Lower) – 698.0 MHz

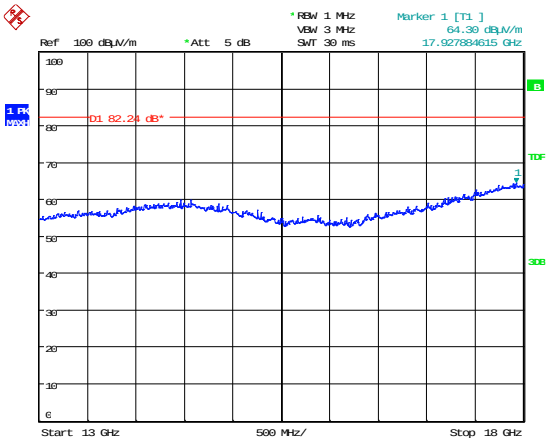




30MHz – 1GHz

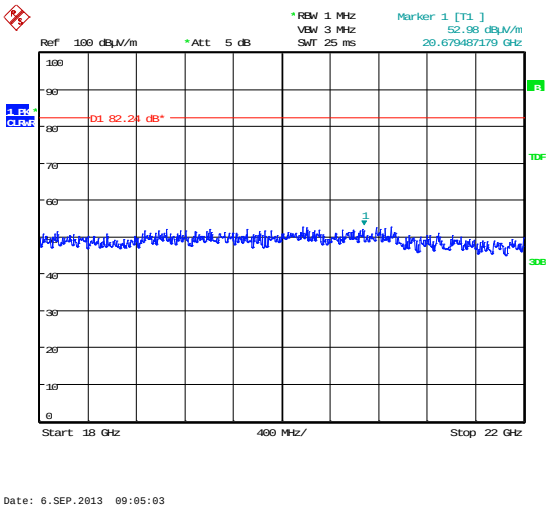
1GHz – 7GHz





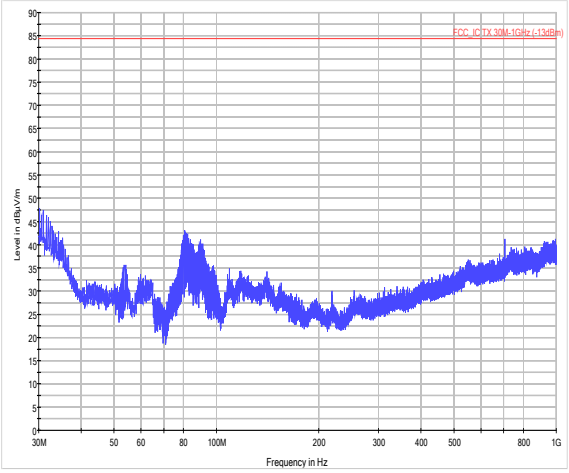
7GHz – 13GHz

13GHz – 18GHz

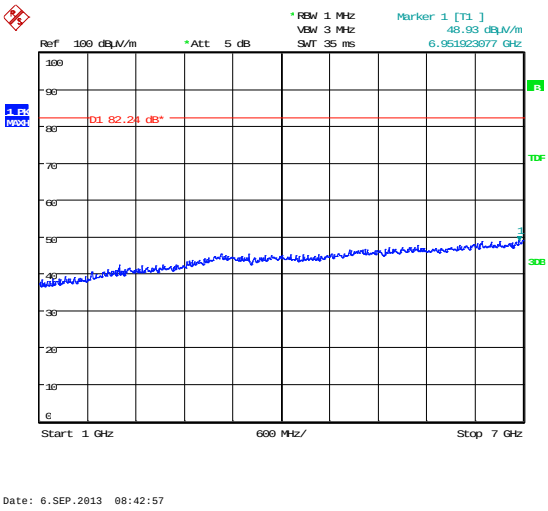


18GHz – 22GHz

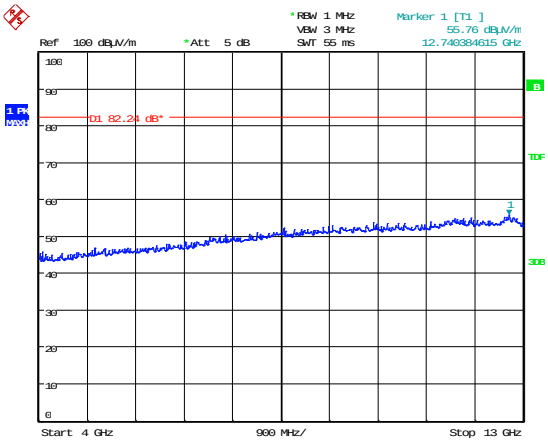
700 MHz (Lower) – 707.0 MHz



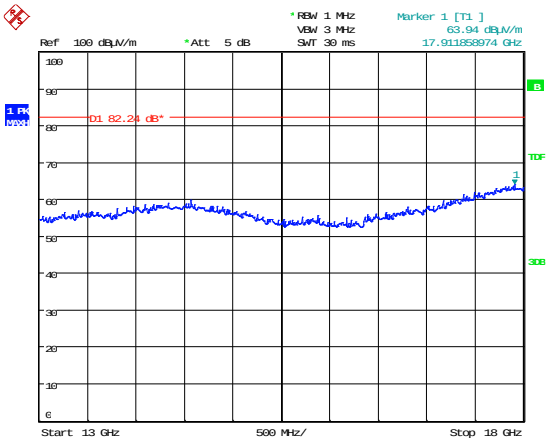
30MHz – 1GHz



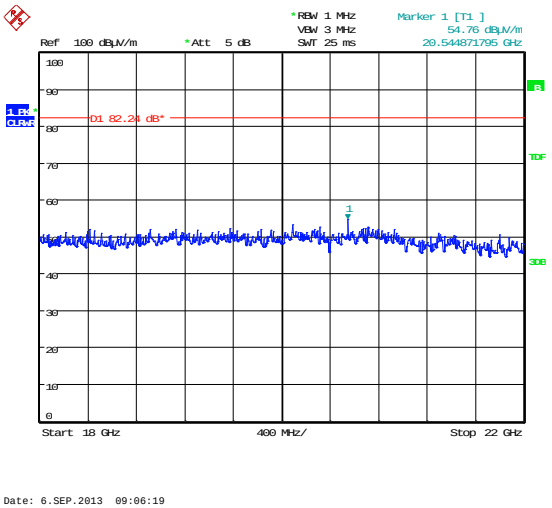
1GHz – 7GHz



7GHz – 13GHz

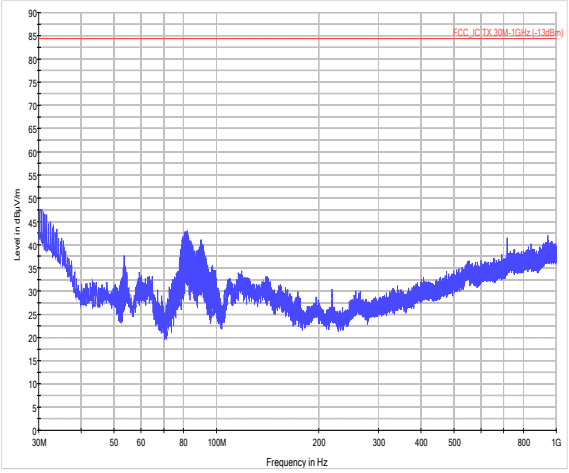


13GHz – 18GHz

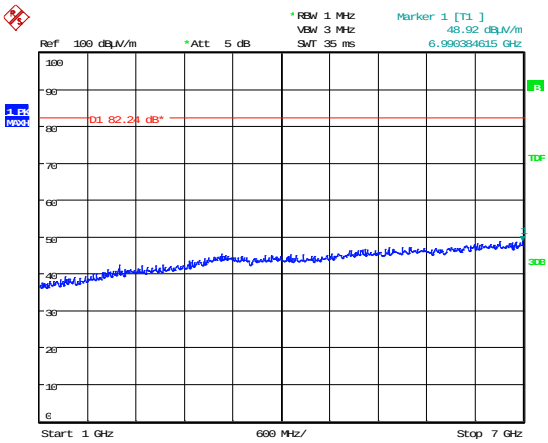


18GHz – 22GHz

700 MHz (Lower) – 716.0 MHz

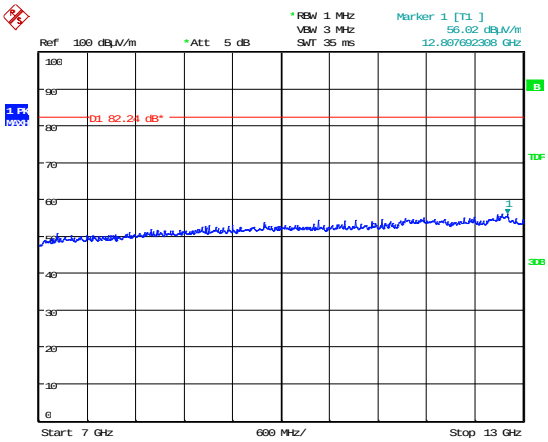


30MHz – 1GHz



Date: 6.SEP.2013 08:41:46

1GHz – 7GHz



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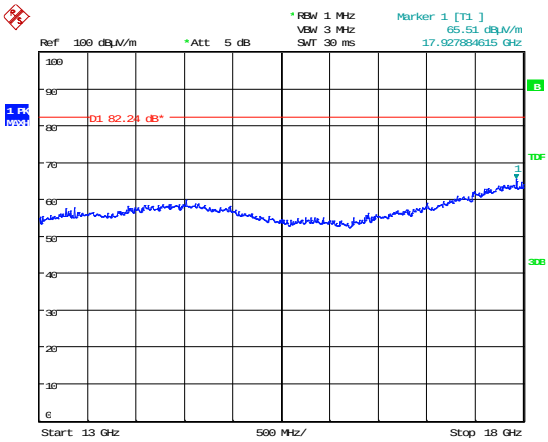
7GHz – 13GHz



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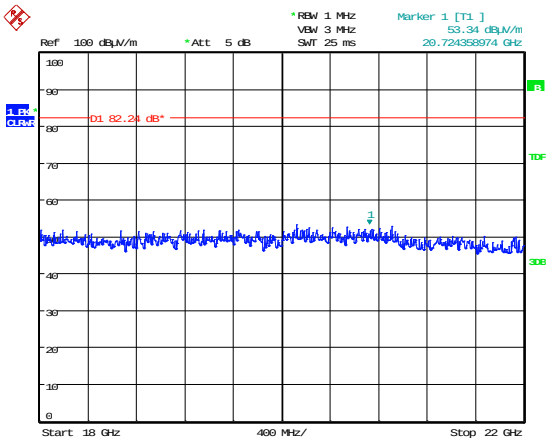
13GHz – 18GHz



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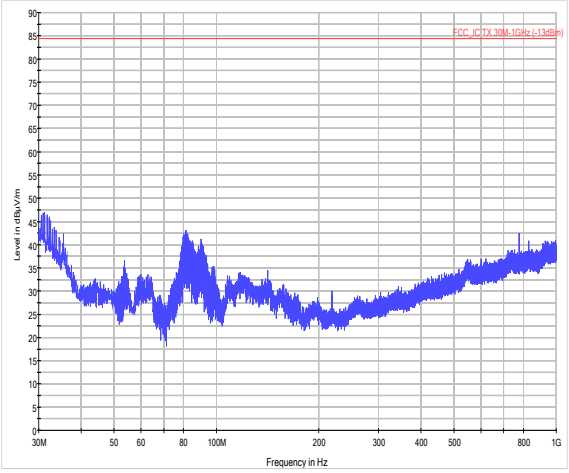
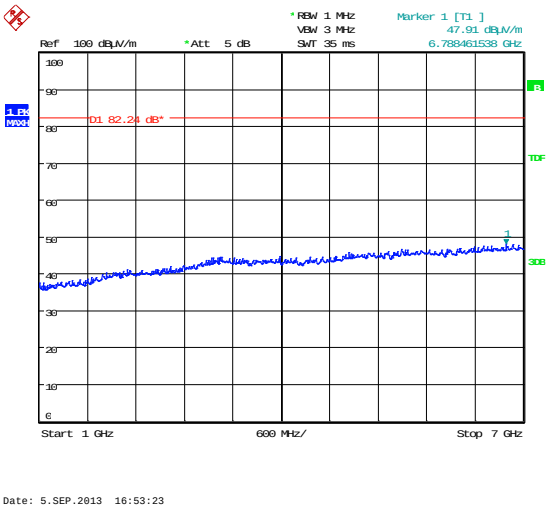
18GHz – 22GHz

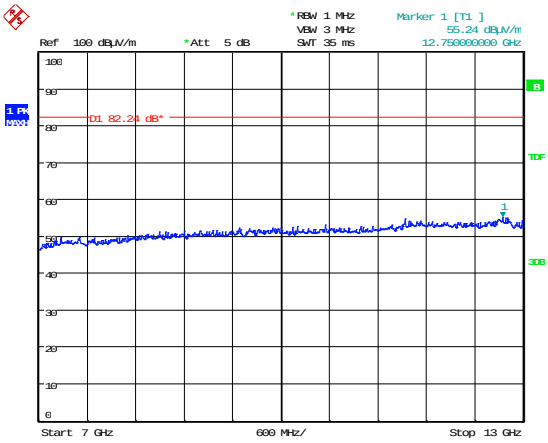
700 MHz (Upper) – 777.0 MHz



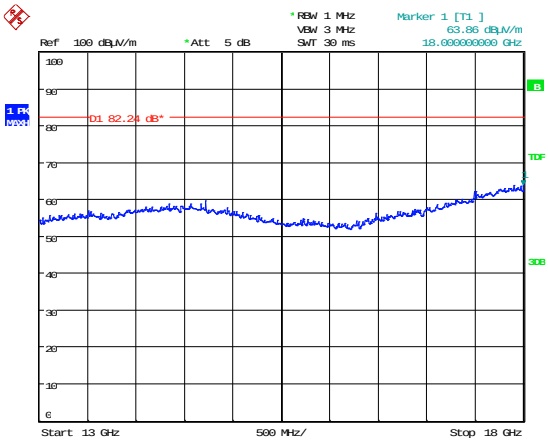
30MHz – 1GHz



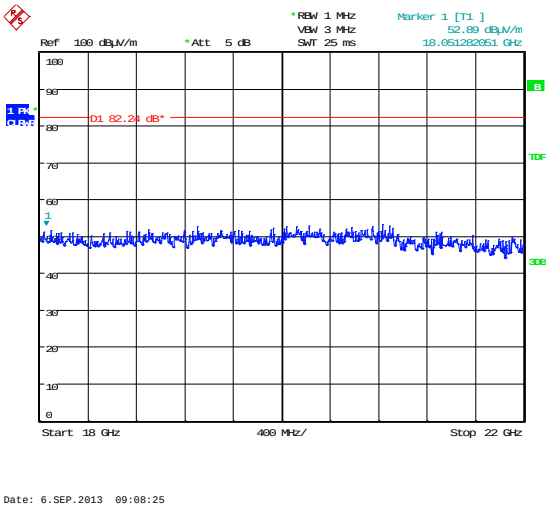
1GHz – 7GHz



7GHz – 13GHz

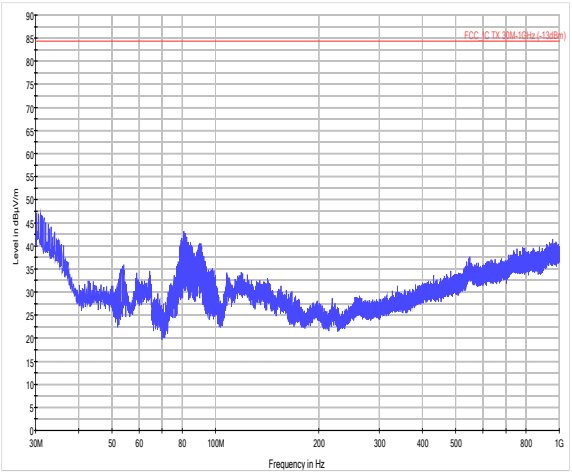


13GHz – 18GHz

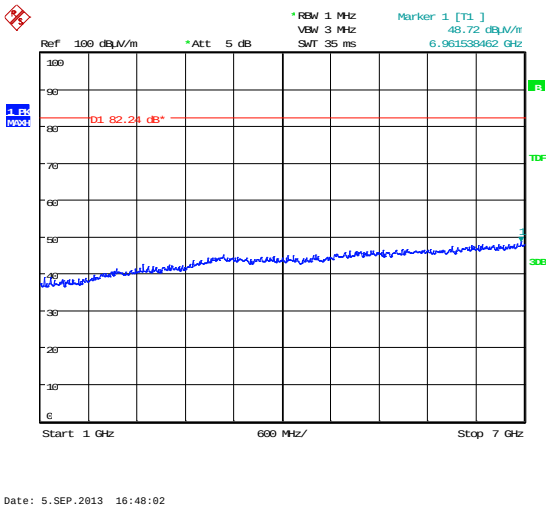


18GHz – 22GHz

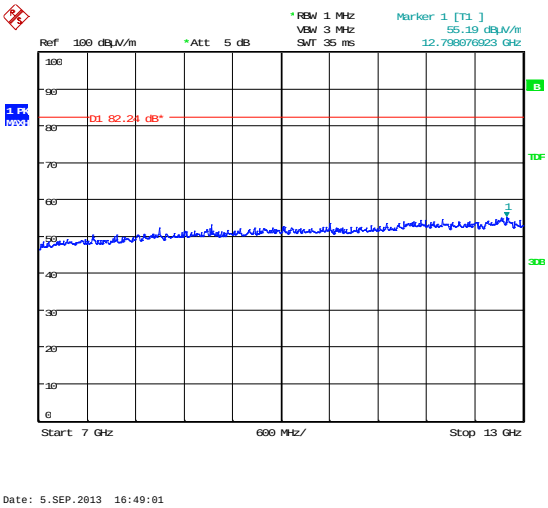
700 MHz (Upper) – 782.0 MHz



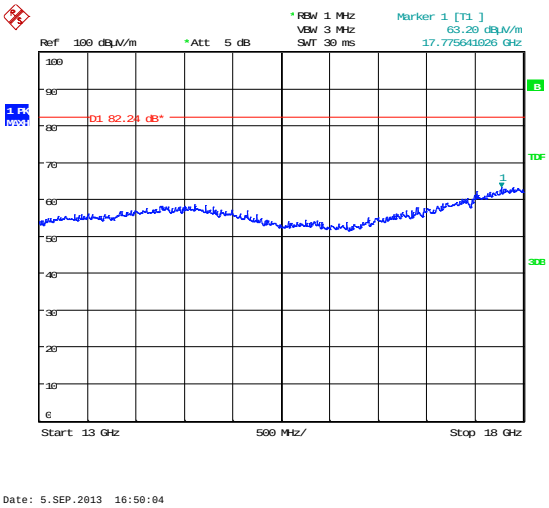
30MHz – 1GHz



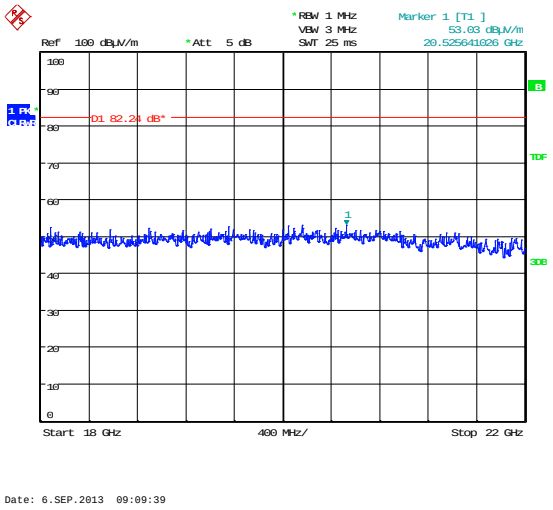
1GHz – 7GHz



7GHz – 13GHz

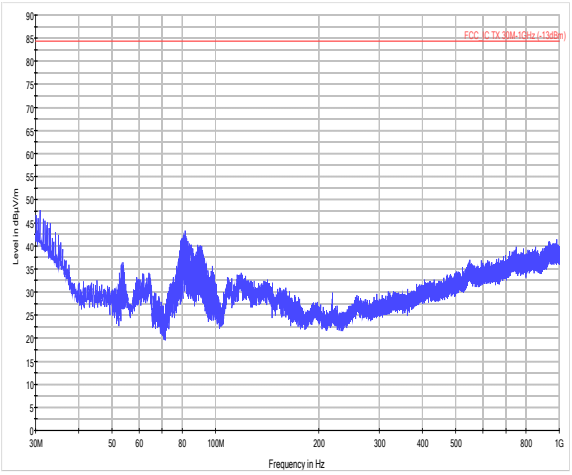


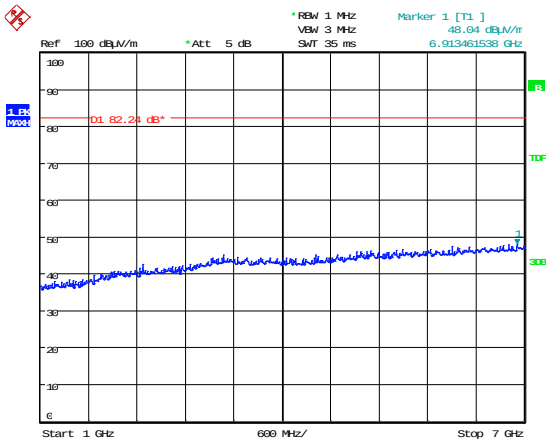
13GHz – 18GHz



18GHz – 22GHz

700 MHz (Upper) – 787.0 MHz

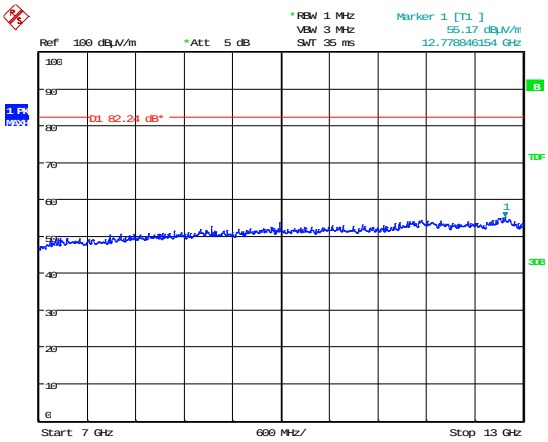




Date: 5.SEP.2013 16:45:21

30MHz – 1GHz

1GHz – 7GHz



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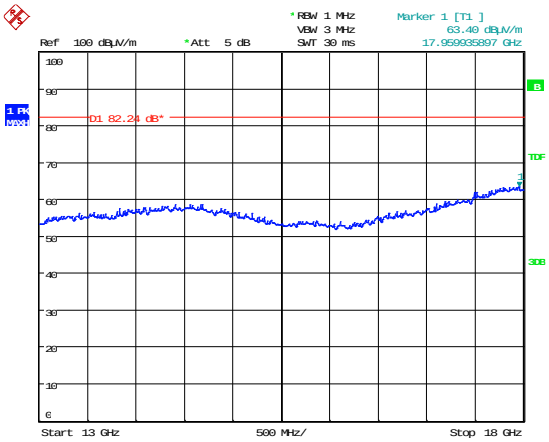
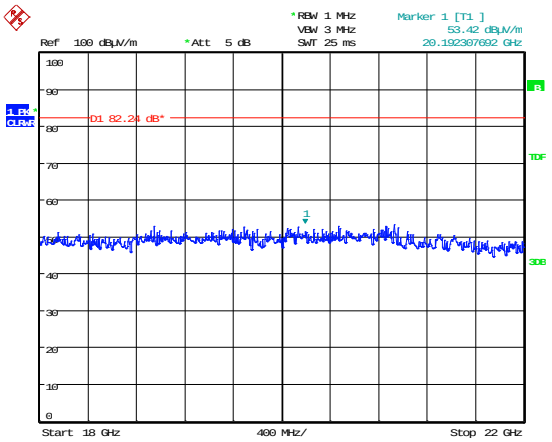


Date: 5.SEP.2013 16:43:19

7GHz – 13GHz

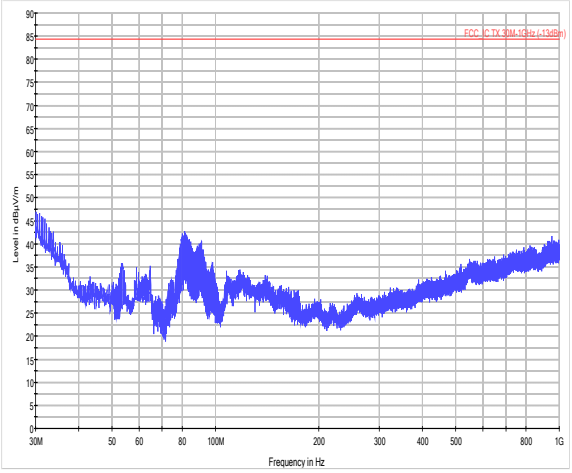
13GHz – 18GHz

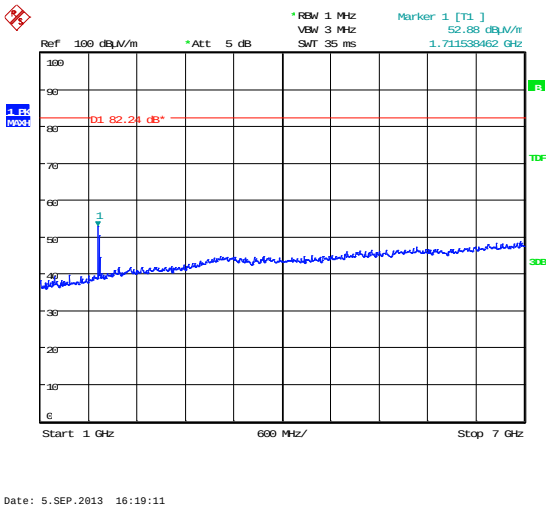


Date: 6.SEP.2013 09:10:45

18GHz – 22GHz

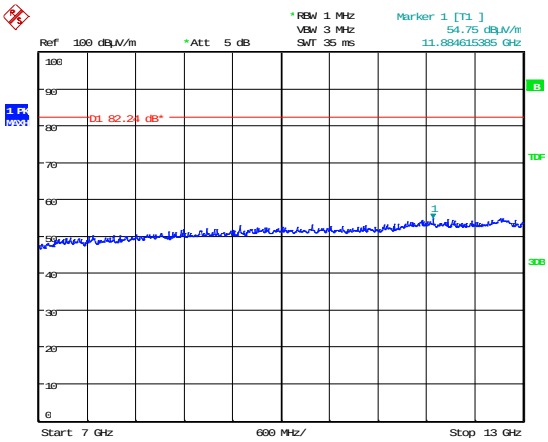
1700 MHz – 1710.0 MHz

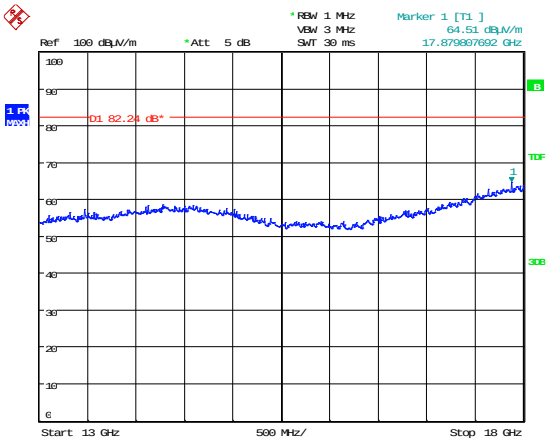




30MHz – 1GHz

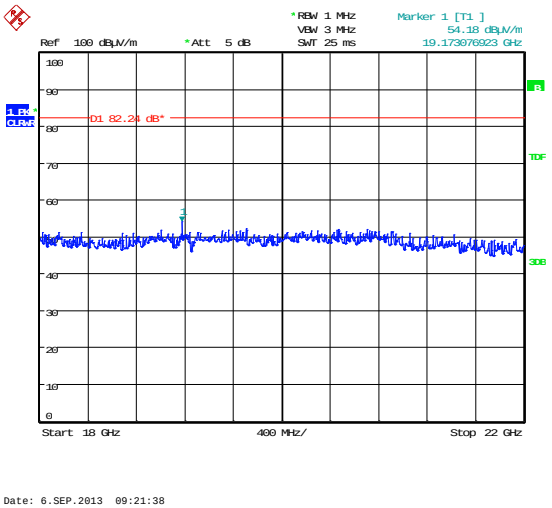
1GHz – 7GHz





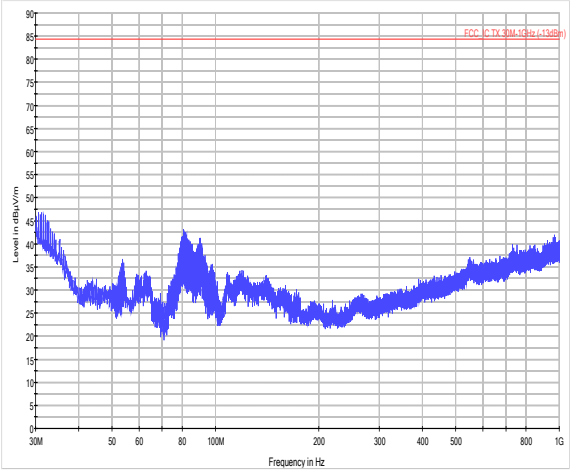
7GHz – 13GHz

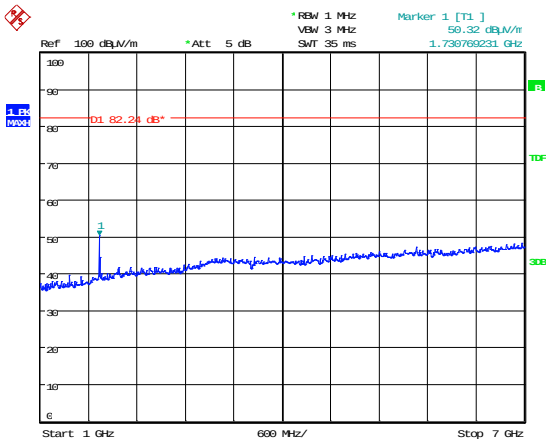
13GHz – 18GHz



18GHz – 22GHz

1700 MHz – 1732.5 MHz

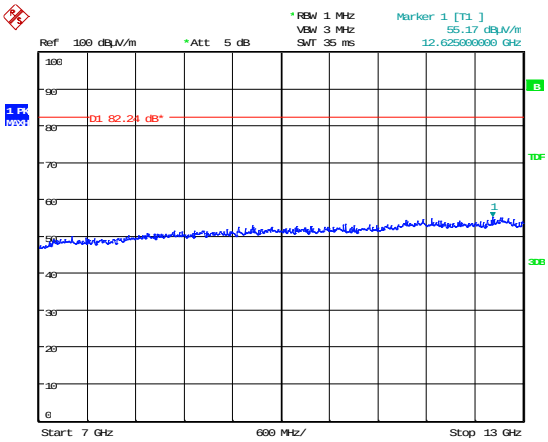




Date: 5.SEP.2013 16:16:50

30MHz – 1GHz

1GHz – 7GHz



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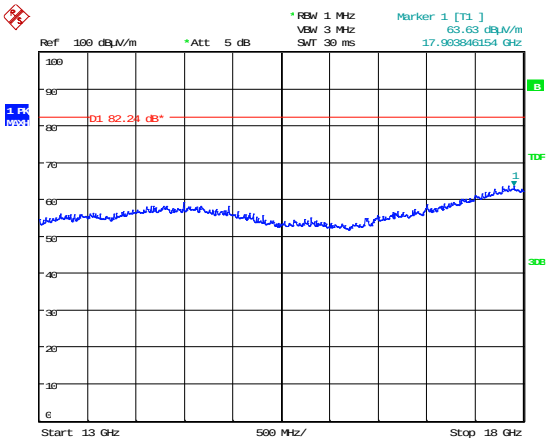

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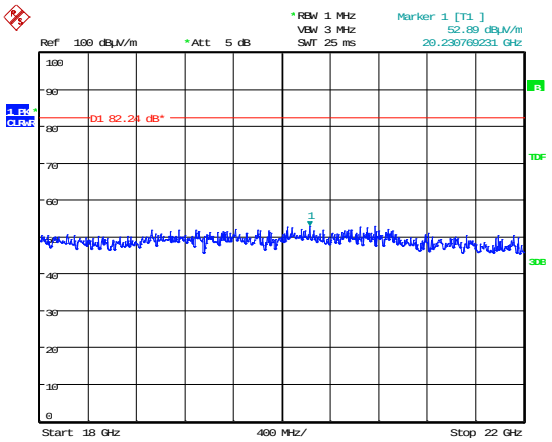
7GHz – 13GHz

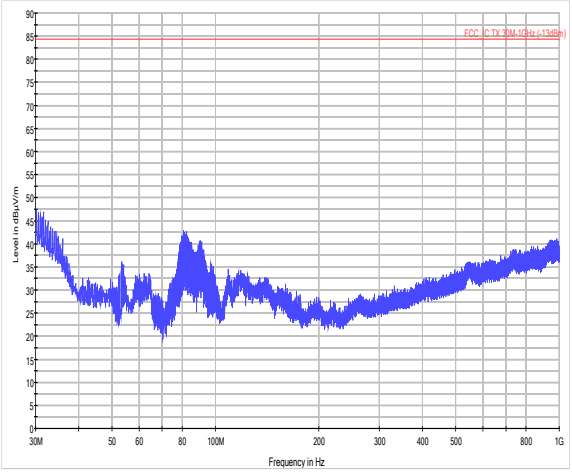
13GHz – 18GHz



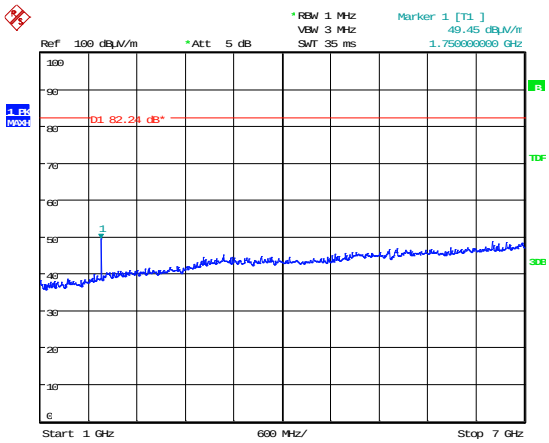
Date: 6.SEP.2013 09:22:39

18GHz – 22GHz

1700 MHz – 1755.0 MHz

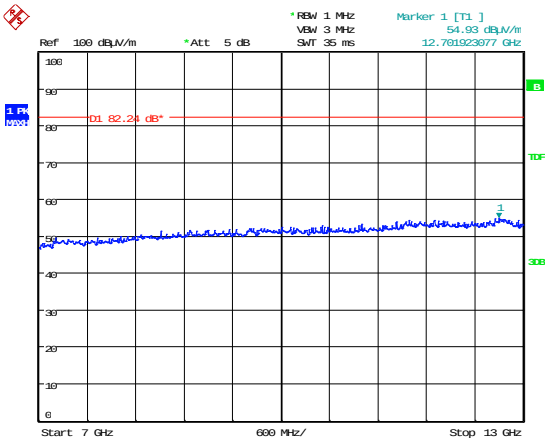


30MHz – 1GHz



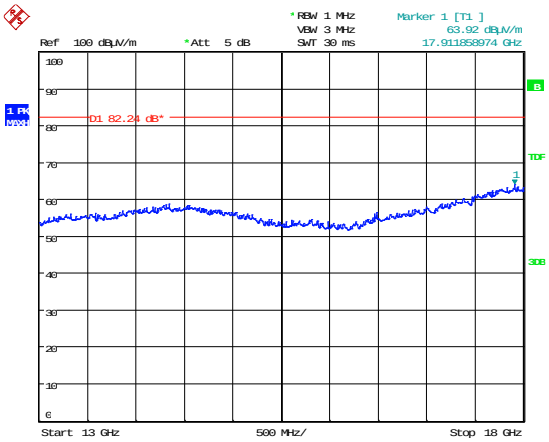
Date: 5.SEP.2013 16:12:36

1GHz – 7GHz



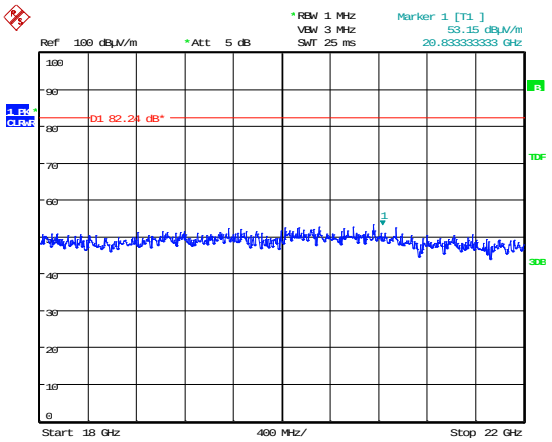
Date: 5.SEP.2013 16:11:06

7GHz – 13GHz



Date: 5.SEP.2013 16:09:59

13GHz – 18GHz



Date: 6.SEP.2013 09:23:43

18GHz – 22GHz

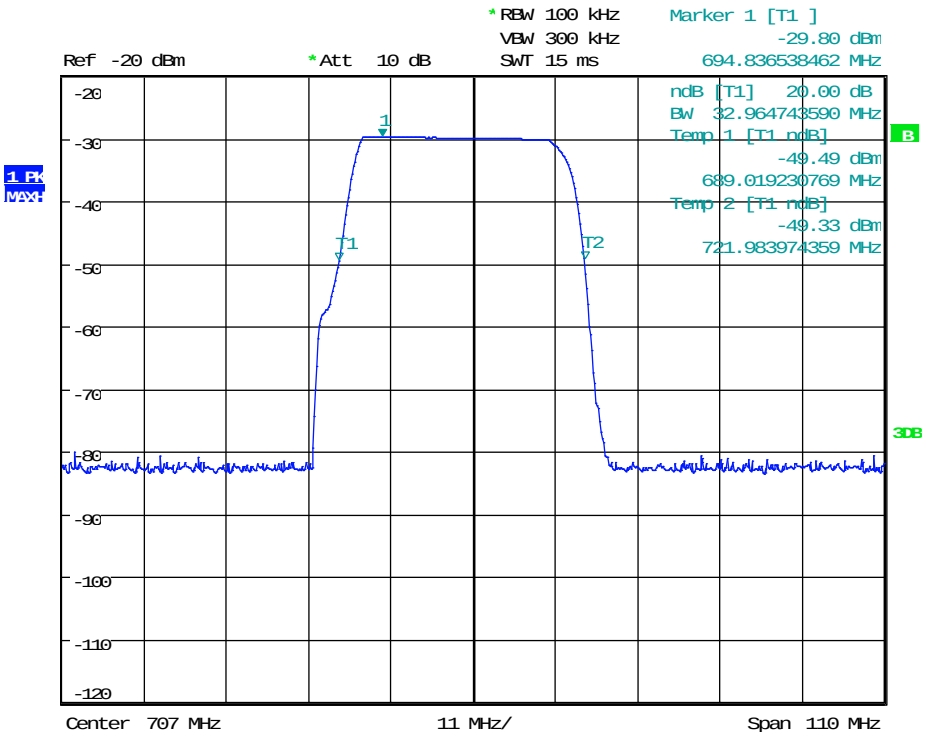
A7 Passband Gain & Bandwidth

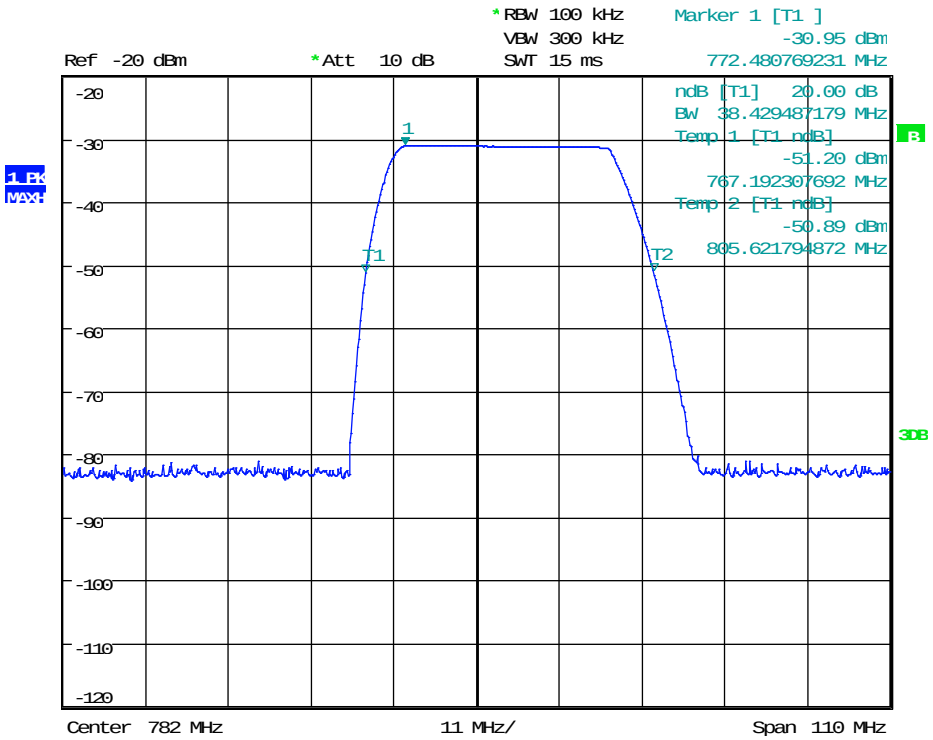
Test Details:	
Measurement standard	D.3 Policies + Procedures (k) of KDB 935210 D02 Signal Boosters Certification v02
EUT sample number	S03
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

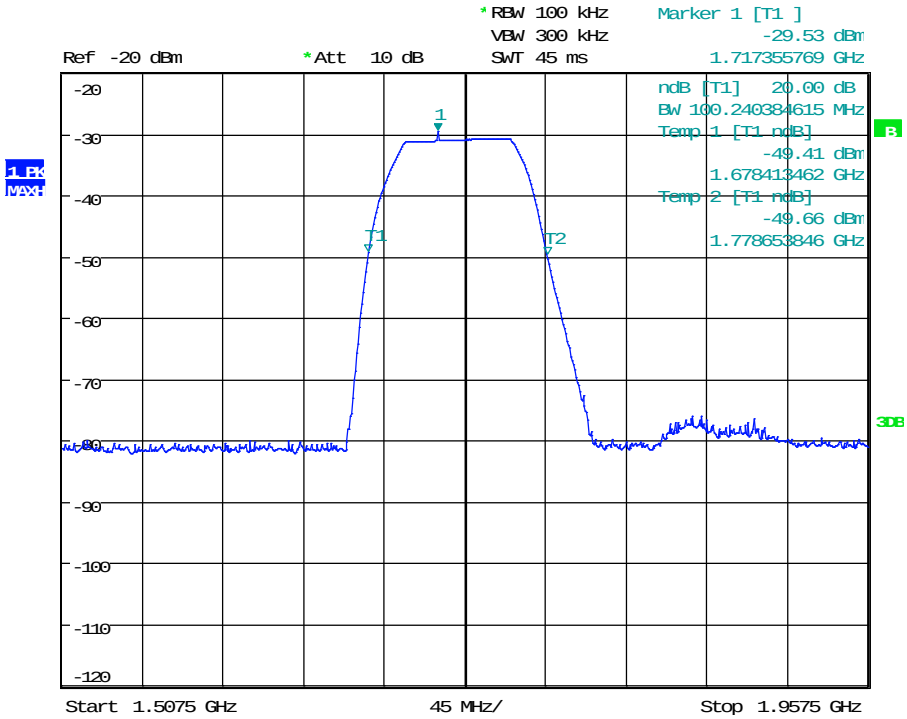
BAND	Frequency MHz	fl	fh	20 dB Bandwidth
700 MHz Lower Band	698 – 716 MHz	698.019230 MHz	721.983974 MHz	32.96 MHz
700 MHz Upper Band	776 – 787 MHz	767.192307 MHz	805.621794 MHz	38.43 MHz
1700 MHz	1710 - 1755 MHz	1678.413462 MHz	1778.653846 MHz	100.240 MHz

See below for plots showing passband gain & bandwidth

With the aid of a CW Swept signal generator and spectrum analyser, the bandwidth and frequency response of the open channel (i.e. at the point where the gain has fallen by 20 dB) is measured. This measurement shows the gain-versus-frequency response of the open channel from the midband frequency f_0 of the channel up to at least f_0 + 250% of the 20 dB bandwidth.




*RBW 100 kHz
VBW 300 kHz
SWT 15 ms
Marker 1 [T1]
-30.95 dBm
772.480769231 MHz
Ref -20 dBm
*Att 10 dB
ndB [T1] 20.00 dB
BW 38.429487179 MHz
Temp 1 [T1 ndB]
-51.20 dBm
767.192307692 MHz
Temp 2 [T1 ndB]
-50.89 dBm
805.621794872 MHz
1 Pk
MAXH
B
3DB
Center 782 MHz
11 MHz/
Span 110 MHz


*RBW 100 kHz
VBW 300 kHz
SWT 45 ms
Marker 1 [T1]
-29.53 dBm
1.717355769 GHz
Ref -20 dBm
*Att 10 dB
ndB [T1] 20.00 dB
BW 100.240384615 MHz
Temp 1 [T1 ndB]
-49.41 dBm
1.678413462 GHz
Temp 2 [T1 ndB]
-49.66 dBm
1.778653846 GHz
1 Pk
MAXH
B
3DB
Start 1.5075 GHz
45 MHz/
Stop 1.9575 GHz

Appendix B: Downlink Formal Emission Test Results

Abbreviations used in the tables in this appendix:

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

B1 RF Gain and Output Power

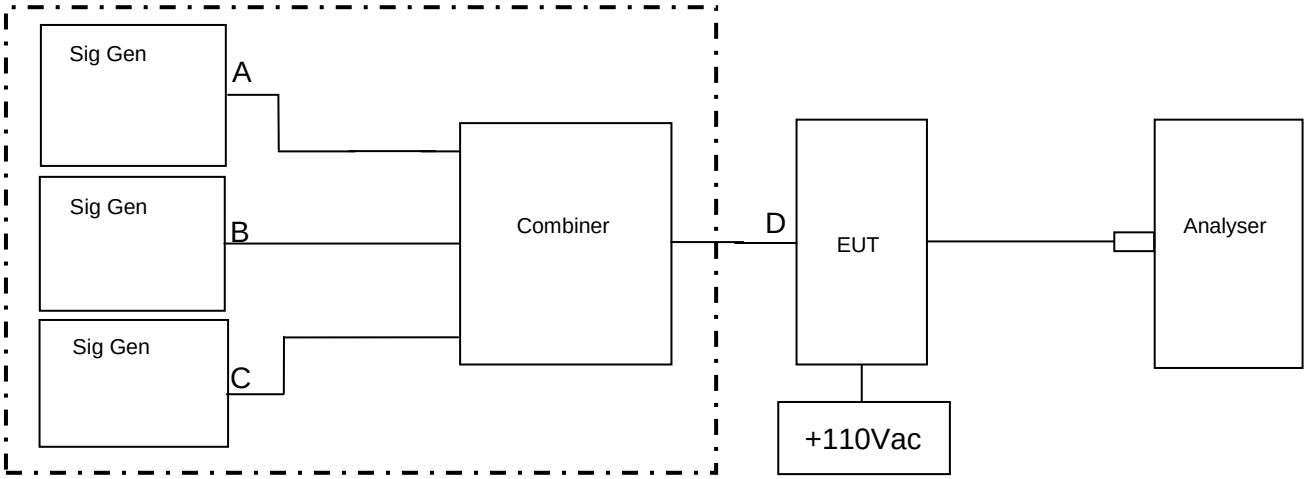
Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1046, 27.50(a)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
Temperature	23°C
Humidity	46%
EUT set up	Refer to Appendix C

Frequency (MHz)	Signal Generator input level (dBm)	Input Cable Loss (dB)	Input Level (dBm)	Level at Spectrum Analyser (dBm)	Output Cable & Attenuator loss (dB)	Gain (dB)	Conducted Output Power (dBm)	Gain after 10dB input level increase (dB)
700MHz								
728.000	4.00	0.42	3.58	-4.48	27.3	19.26	22.84	9.33
742.000	3.80	0.42	3.38	-2.47	27.3	21.47	24.85	11.50
756.000	4.70	0.42	4.28	-3.40	27.3	19.64	23.92	9.69
2100 MHz								
2110.000	5.70	0.76	4.94	-3.86	27.0	18.24	23.18	15.92
2132.500	6.60	0.76	5.84	-3.89	27.0	17.31	23.15	7.45
2155.000	7.70	0.76	6.94	-4.52	27.0	15.58	22.52	5.60

Notes: 1.The signal generator input was increased by 10dBs and the level of the output signal remeasured.

B2 Amplifier Intermodulation Spurious Emissions

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C



RF Input Frequency (MHz)			Highest Intermodulation Product Level (dBm)	Limit (dBm)
700MHz				
728.000	737.320	756.000	-21.03 dBm @ 746.679 MHz	-13
2100 MHz				
2110.000	2124.983	2155.000	-19.06 dBm @ 2140.160 MHz	-13

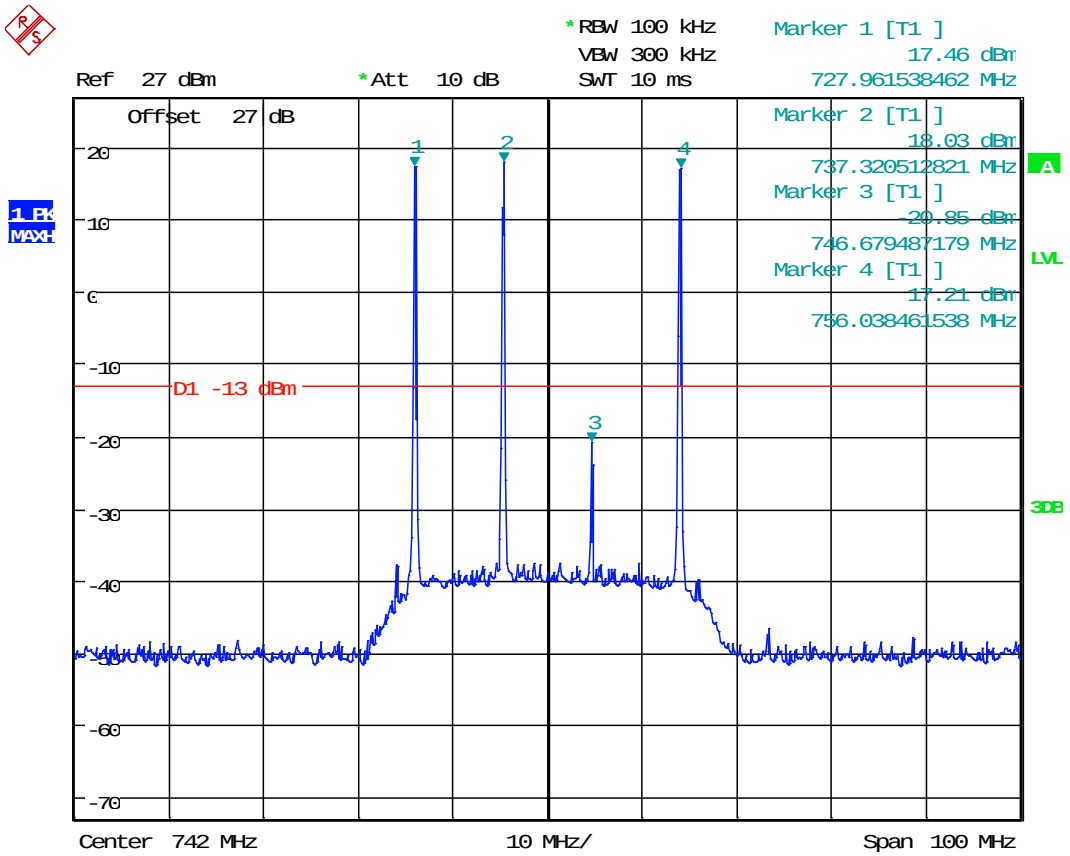
Sweep data is shown on the next page:

Results

The EUT was found to comply with the limits

See plots below

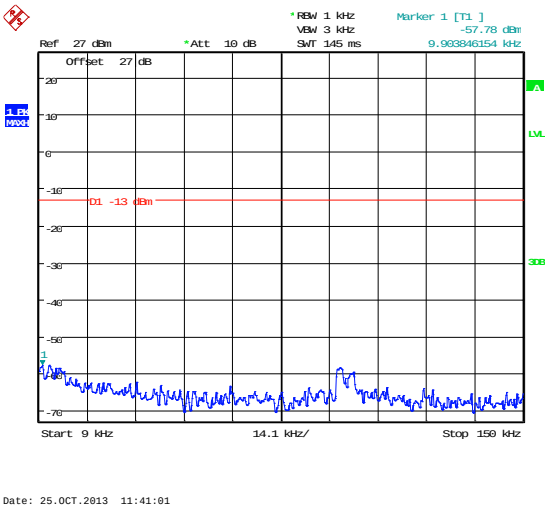
700 MHz Intermodulation close View



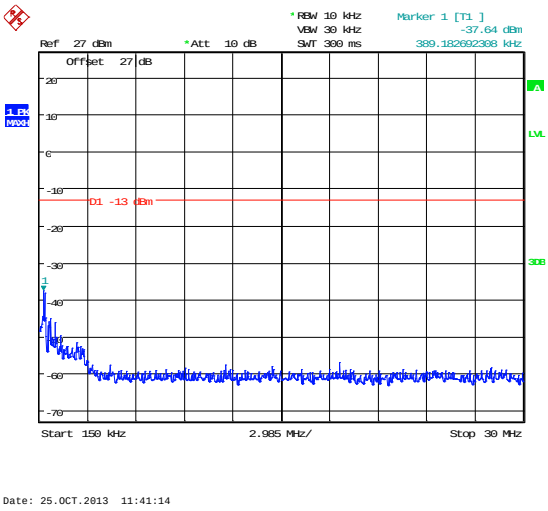
Date: 25.OCT.2013 11:37:06

The above plots show that there are no products over of the spurious limit.

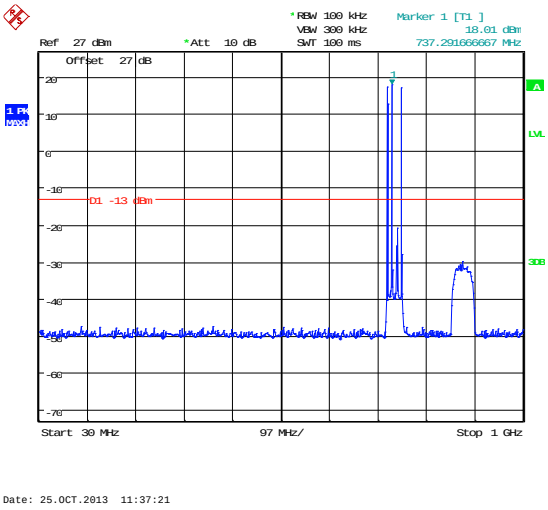
700 MHz intermodulation



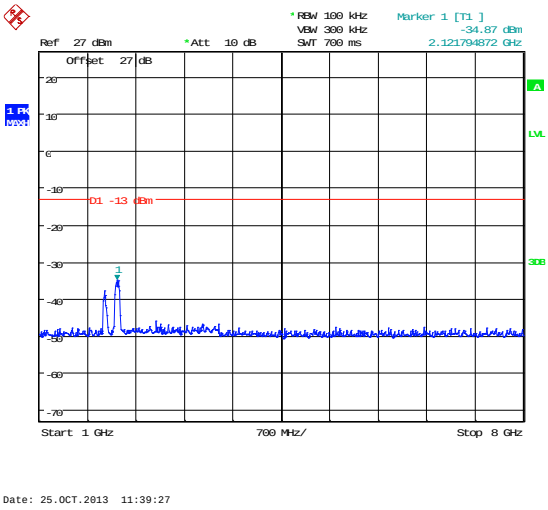
9 – 150kHz



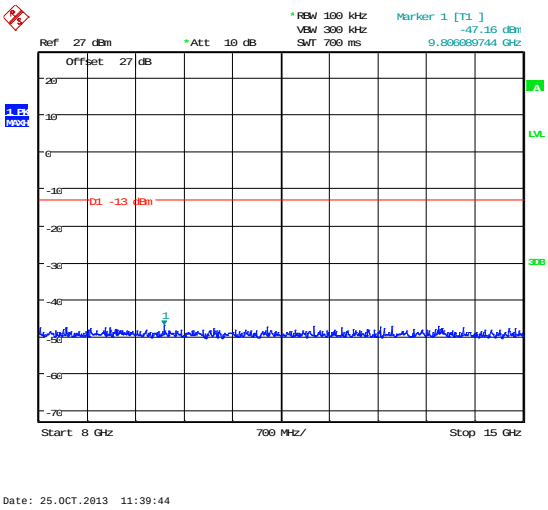
150kHz – 30MHz



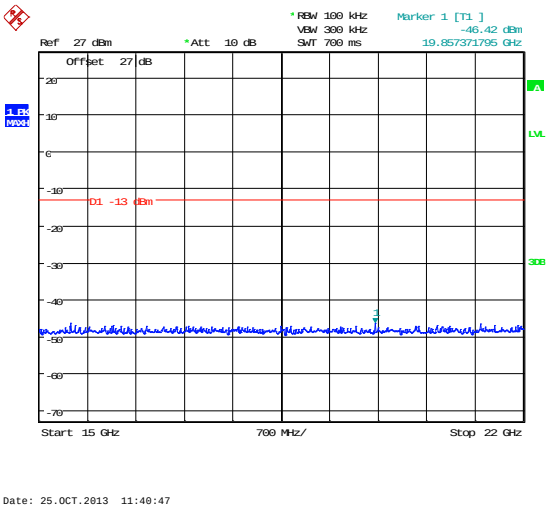
30MHz – 1GHz



1GHz – 8GHz

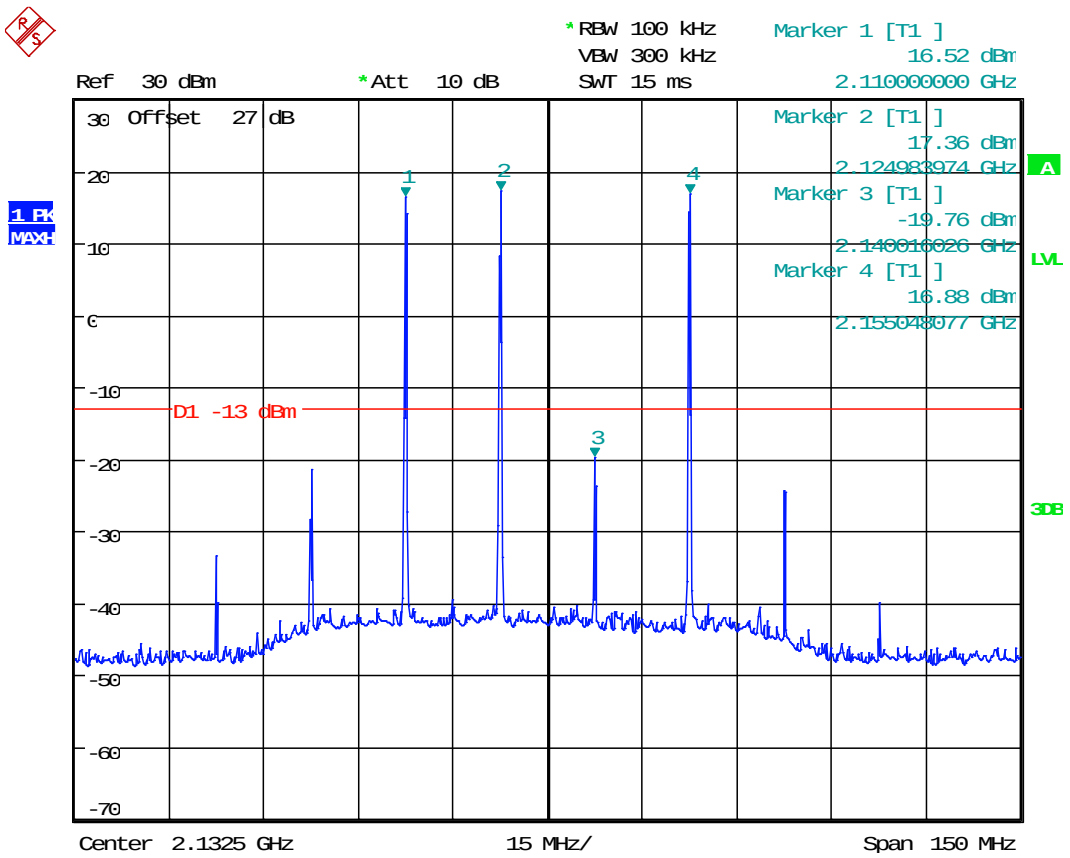


8GHz – 15GHz



15GHz – 22GHz

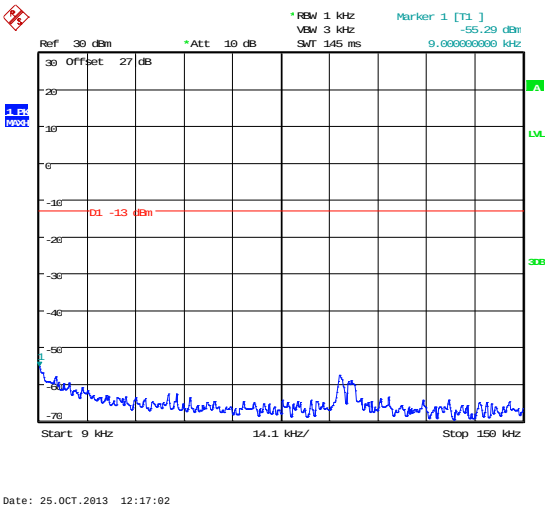
2100 MHz Intermodulation close View



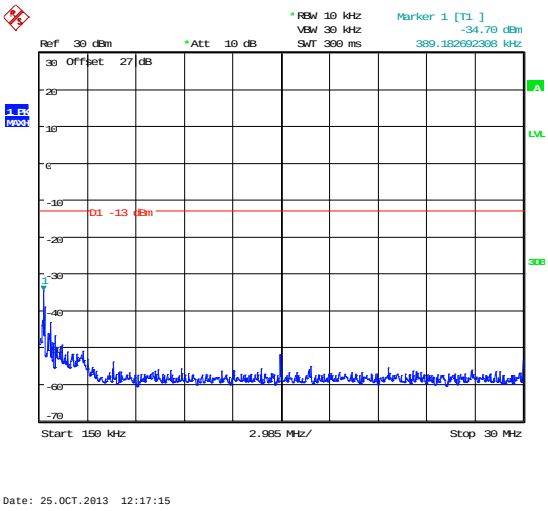
Date: 25.OCT.2013 12:15:42

The above plots show that there are no products over the spurious limit.

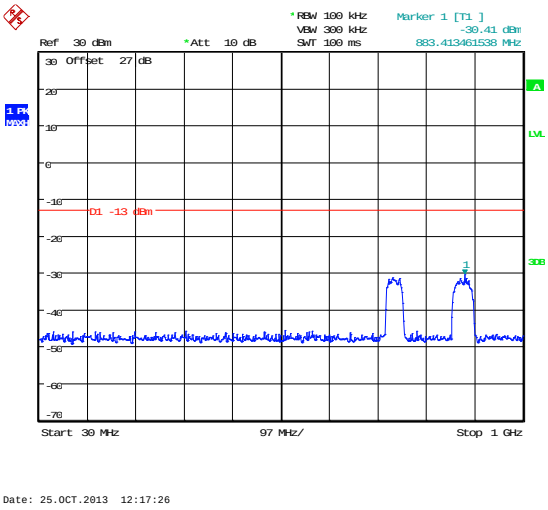
2100 MHz Intermodulation



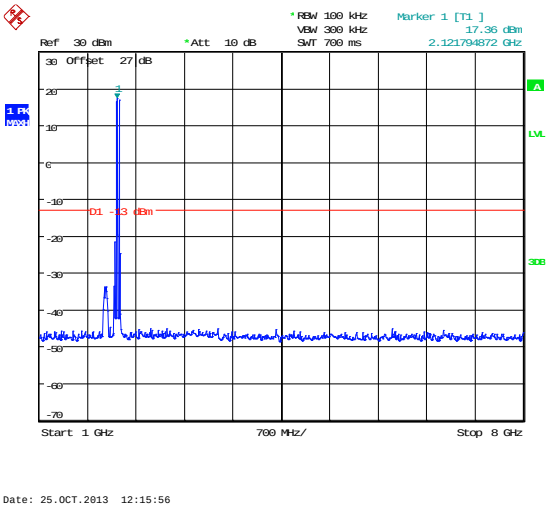
9 – 150kHz



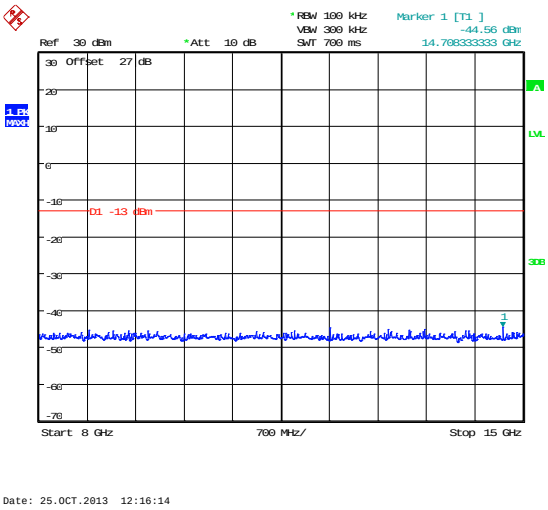
150kHz – 30MHz



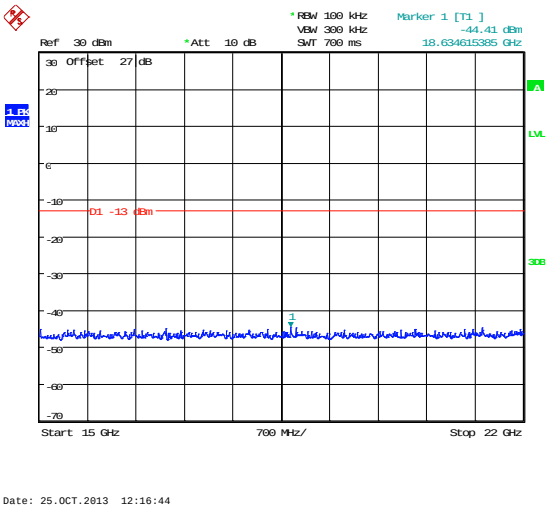
30MHz – 1GHz



1GHz – 8GHz



8GHz – 15GHz



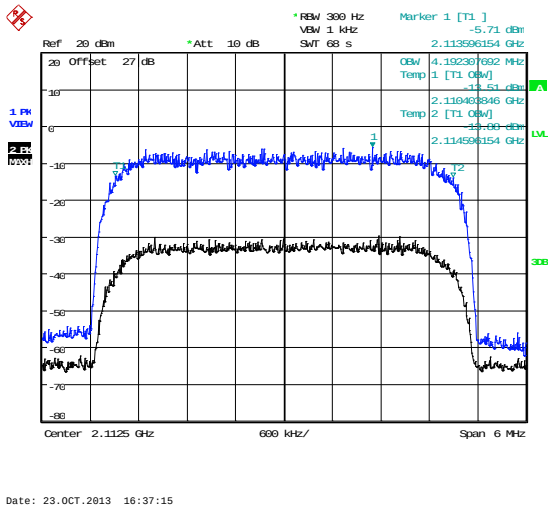
15GHz – 22GHz

B3 Amplifier Modulated Channel Test

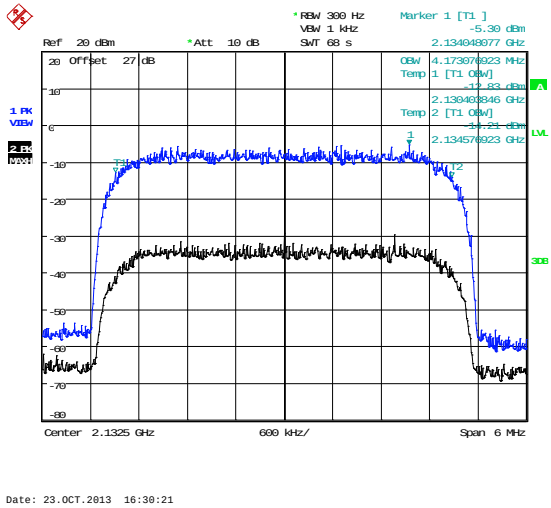
Test Details:	
Measurement standard	D.3 Policies + Procedures (j) of KDB 935210 D02 Signal Boosters Certification v02
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency Of Operation Channel	Modulation Type		
	WCDMA	LTE 1.4 MHz	LTE 20.0 MHz
728.000	N/A	1.089 MHz	17.868 MHz
742.000	N/A	1.089 MHz	17.868 MHz
756.000	N/A	1.089 MHz	17.908 MHz
2110.000	4.192 MHz	1.089 MHz	17.908 MHz
2132.500	4.173 MHz	1.089 MHz	17.908 MHz
2155.000	4.182 MHz	1.089 MHz	17.908 MHz

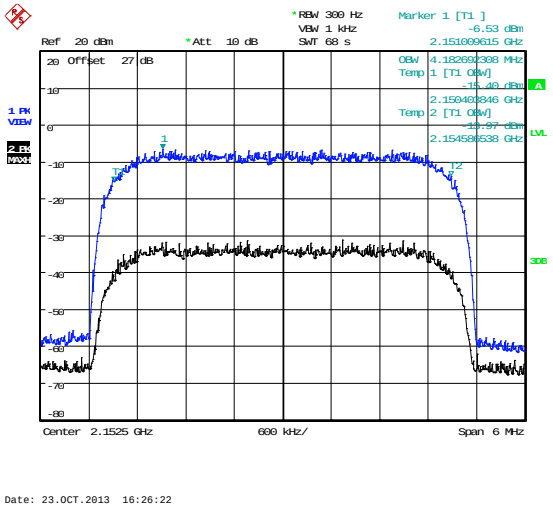
WCDMA Modulation



2110.0 MHz



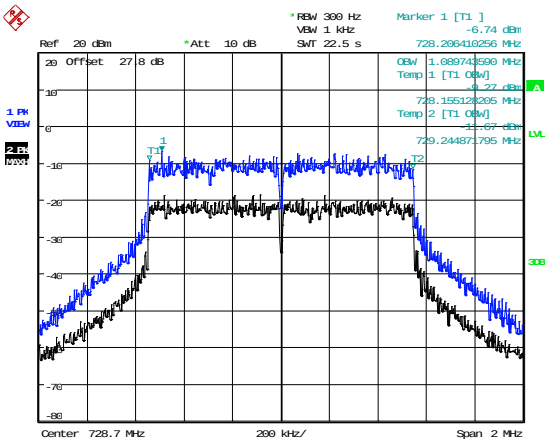
2132.5 MHz



2155.0 MHz

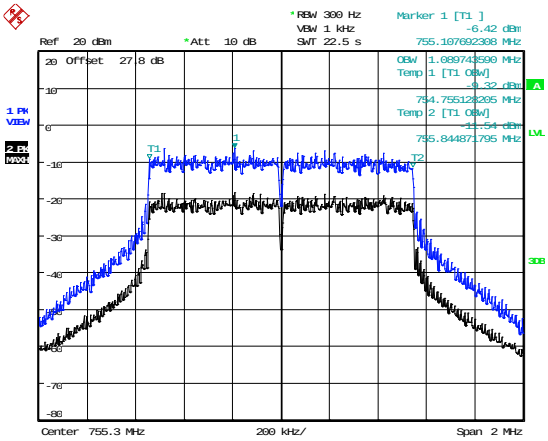
The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

1.4 MHz LTE Modulation



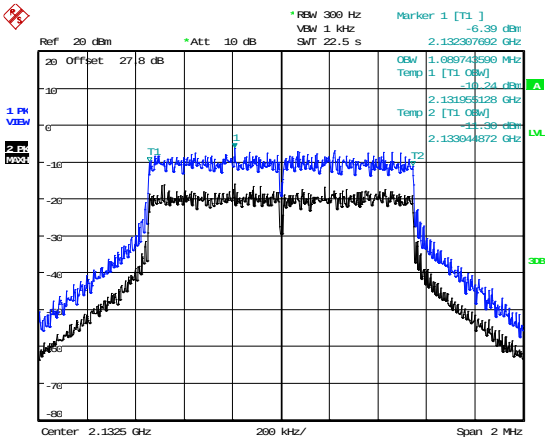
Date: 5.NOV.2013 11:29:53

728.0 MHz



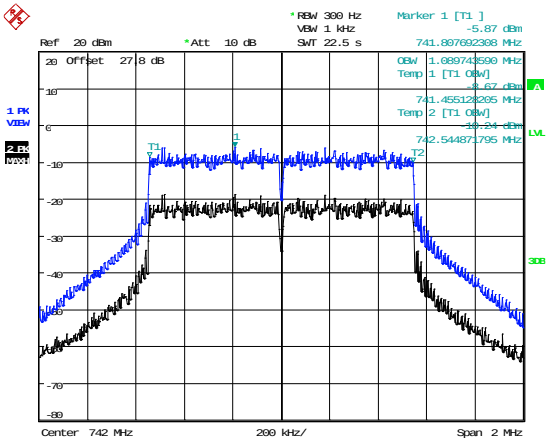
Date: 5.NOV.2013 11:46:34

756.0 MHz



Date: 5.NOV.2013 12:50:00

2132.5 MHz



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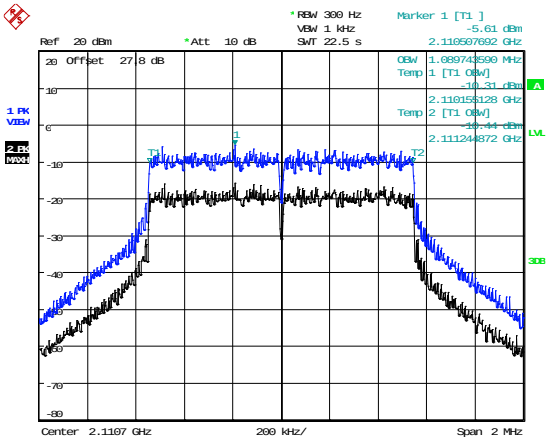
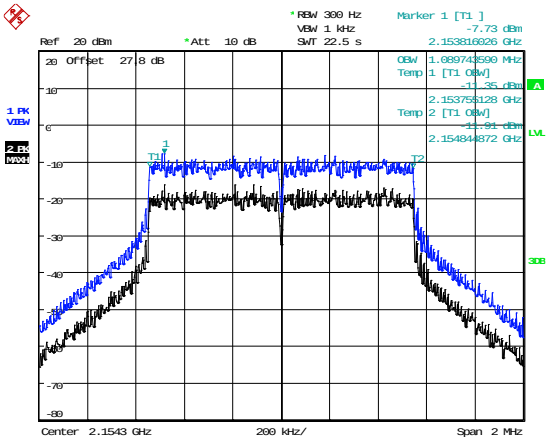
742.0 MHz



Date: 5.NOV.2013 12:47:08

2110.0 MHz

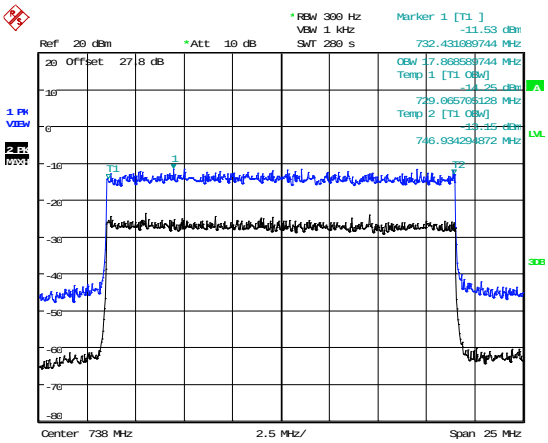


Date: 5.NOV.2013 12:51:58

2155.0 MHz

The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

20.0 MHz LTE Modulation



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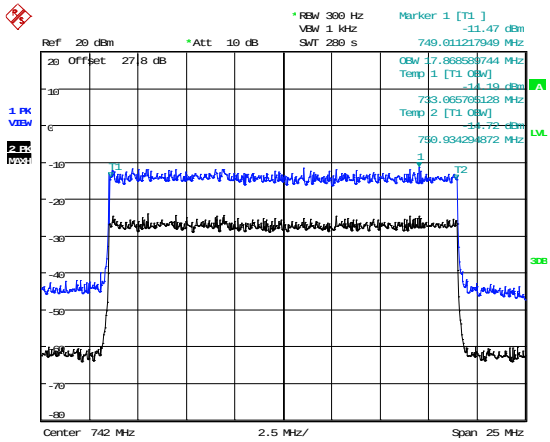
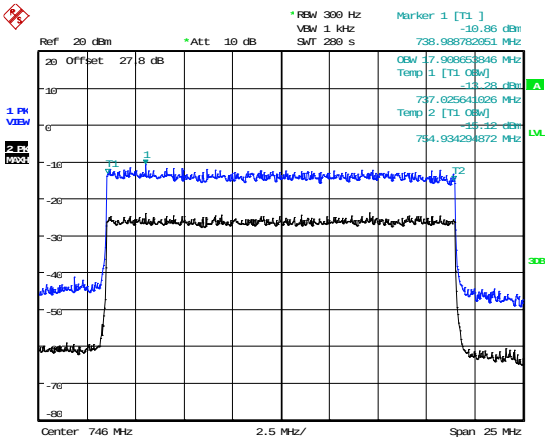


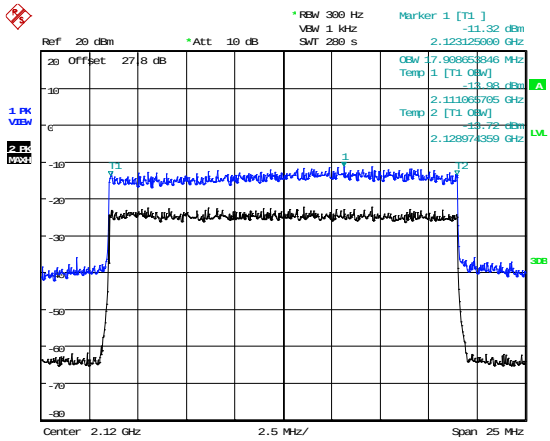
Date: 5.NOV.2013 17:28:55

728.0 MHz



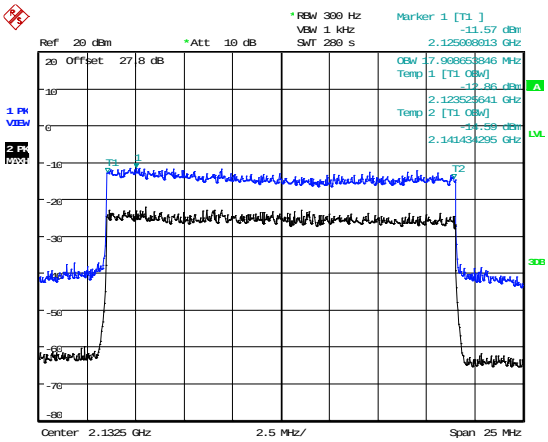
Date: 5.NOV.2013 17:19:00

742.0 MHz



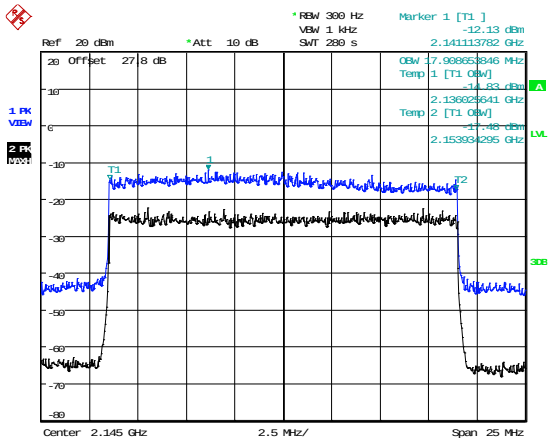
Date: 5.NOV.2013 14:41:00

756.0 MHz



Date: 5.NOV.2013 14:25:35

2110.0 MHz



Date: 5.NOV.2013 13:03:04

2132.5 MHz

2155.0 MHz

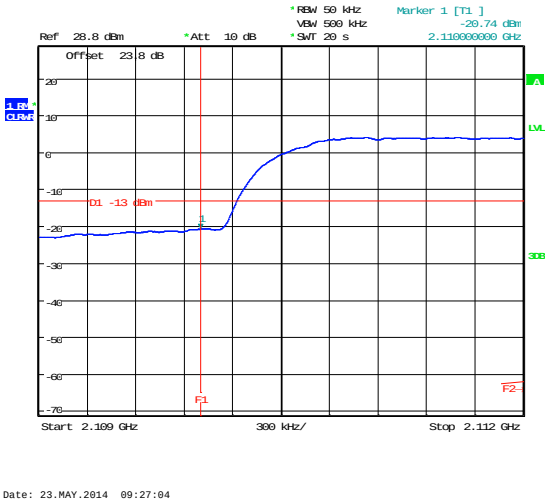
The above plots depicting the output waveshape show no measurable distortion visible when compared to the input signal.

B4 Spurious Emissions at Antenna Terminals Less than 1MHz

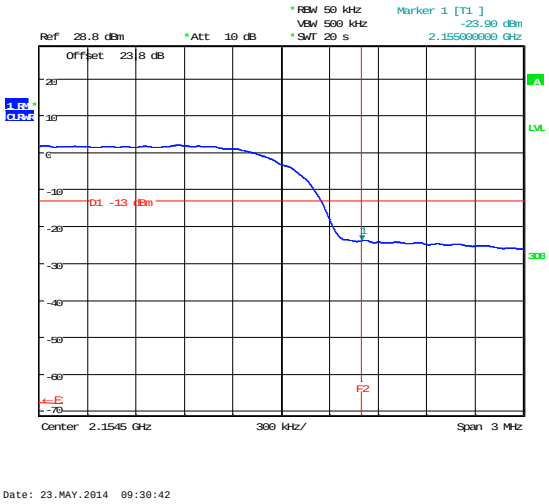
Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Modulation Type	Bandedge	Carrier Frequency (MHz)	Max Level @ bandedge (dBm)
WCDMA	Lower	2112.5	-20.74
	Upper	2152.5	-23.90
LTE 1.4 MHz	Lower	728.7	-17.15
	Upper	755.3	-16.89
	Lower	2110.7	-17.14
	Upper	2154.3	-17.19
LTE 20.0 MHz	Lower	738.0	-17.87
	Upper	746.0	-16.81
	Lower	2120.0	-16.79
	Upper	2145.0	-20.79

WCDMA Modulation

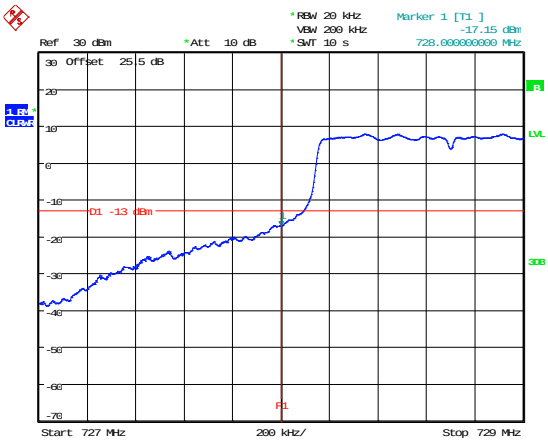


2112.5 MHz



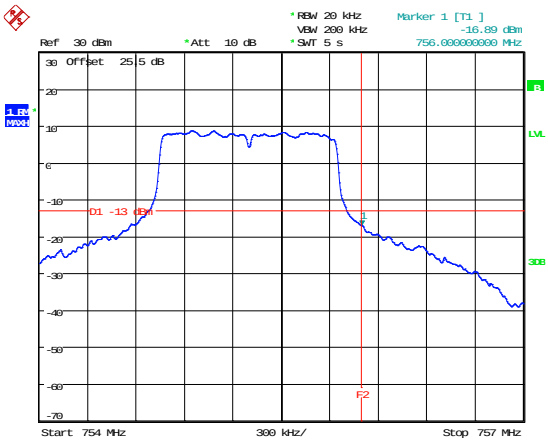
2152.5 MHz

LTE 1.4 MHz Modulation



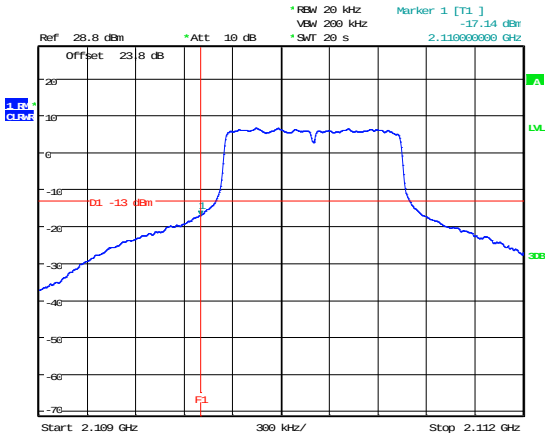
Date: 16.MAY.2014 14:02:50

728.7 MHz



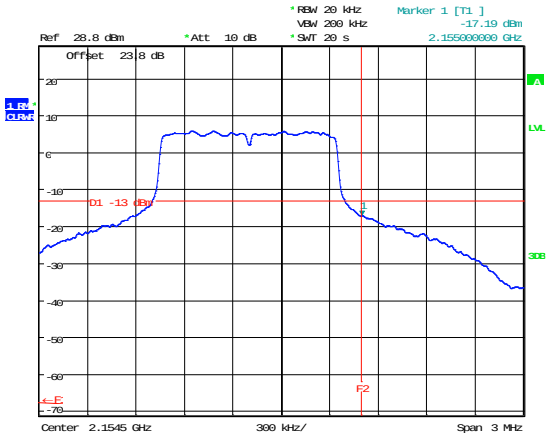
Date: 16.MAY.2014 14:10:36

755.3 MHz



Date: 23.MAY.2014 09:21:03

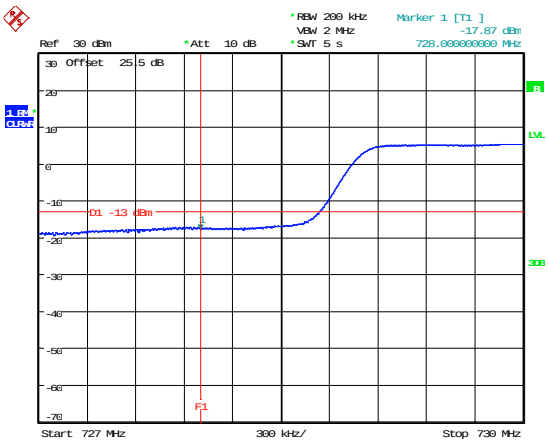
2110.7 MHz



Date: 23.MAY.2014 09:34:45

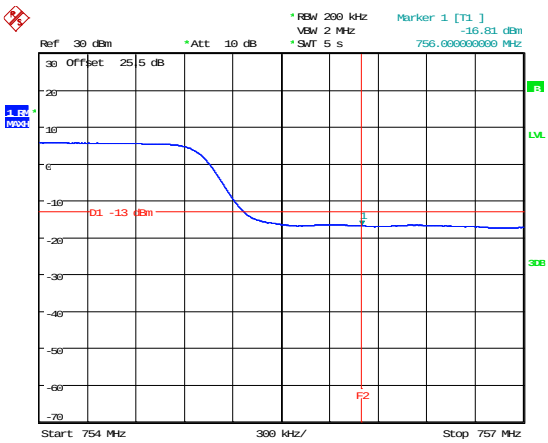
2154.3 MHz

LTE 20 MHz Modulation



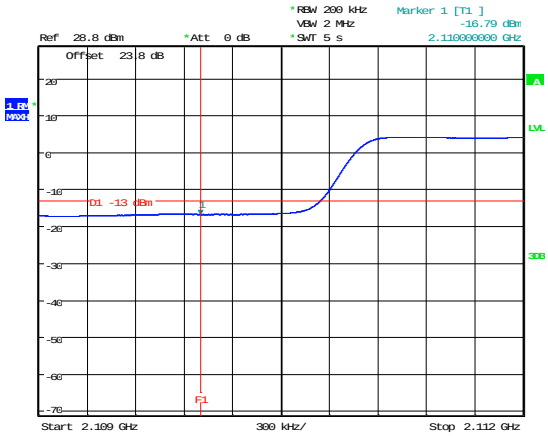
Date: 16.MAY.2014 14:04:32

738.0 MHz



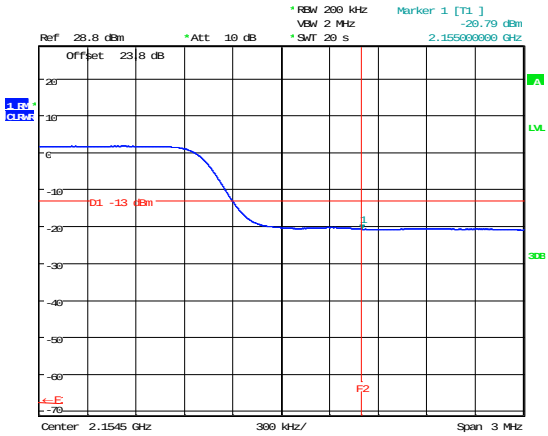
Date: 16.MAY.2014 14:09:36

746.0 MHz



Date: 23.MAY.2014 09:18:05

2120.0 MHz



Date: 23.MAY.2014 09:36:31

2145.0 MHz

B5 Spurious Emissions at Antenna Terminals Greater than 1MHz

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency (MHz)	Frequency Range (MHz)	Freq. of Emission (MHz)	Measured Level (dBm)	Attenuator & Cable Losses (dB)	Spurious Emission Level (dBm)	Limit (dBm)
700MHz						
728.000	No Significant Emissions Within 20 dB of limit					-13
742.000						-13
756.000						-13
2100 MHz						
2110.000	No Significant Emissions Within 20 dB of limit					-13
2132.500						-13
2155.000						-13

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

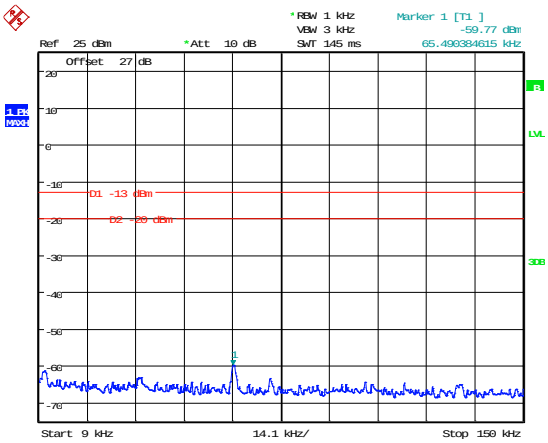
At least 43 + 10 log P dB

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

Result

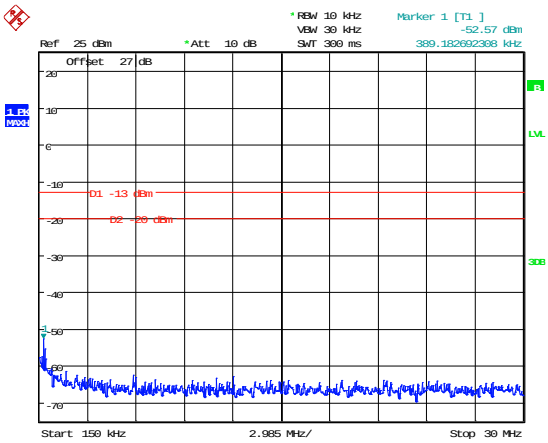
The EUT was found to comply with the limits

700 MHz – 728.0 MHz



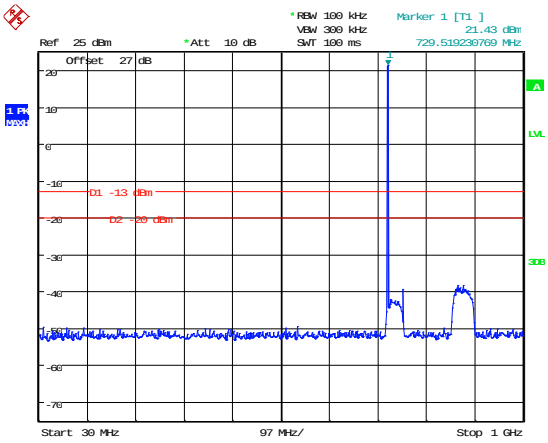
Date: 28.AUG.2013 13:13:41

9kHz - 150kHz



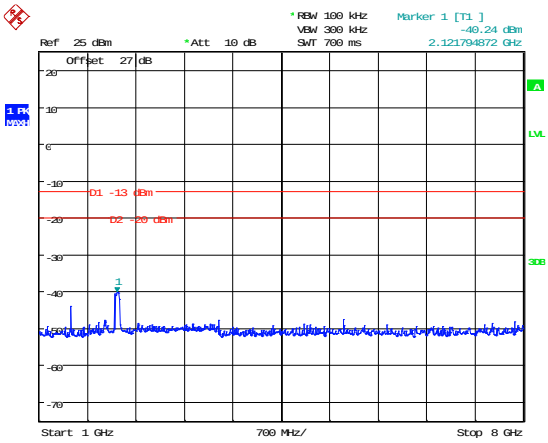
Date: 28.AUG.2013 13:13:52

150kHz – 30MHz



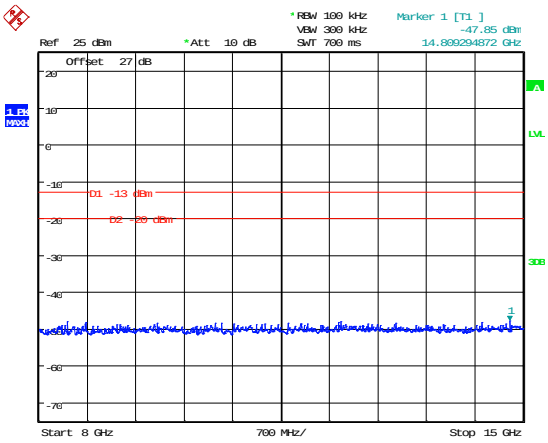
Date: 28.AUG.2013 13:13:59

30MHz – 1GHz



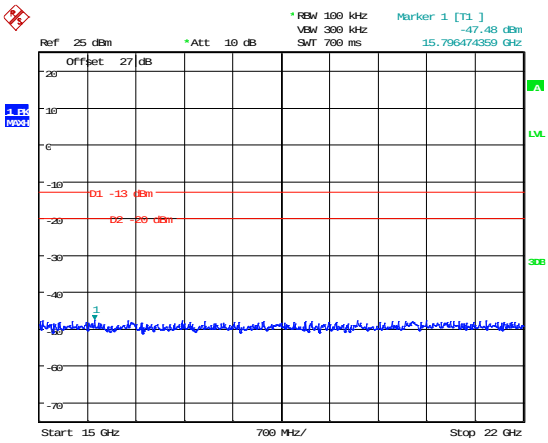
Date: 28.AUG.2013 13:14:09

1GHz – 8GHz



Date: 28.AUG.2013 13:14:29

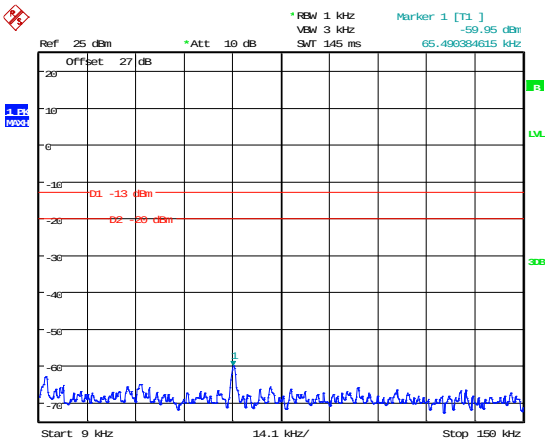
8GHz – 15GHz



Date: 28.AUG.2013 13:14:40

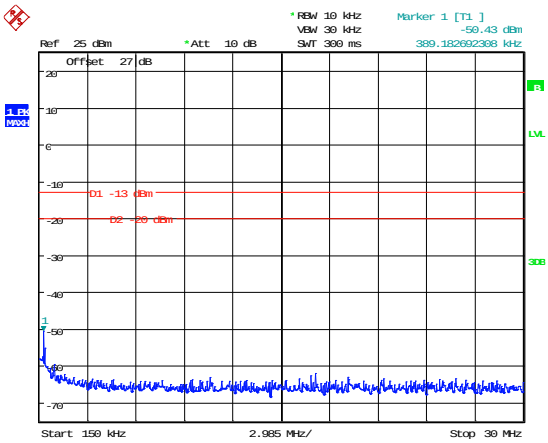
15GHz – 22GHz

700 MHz – 742.0 MHz



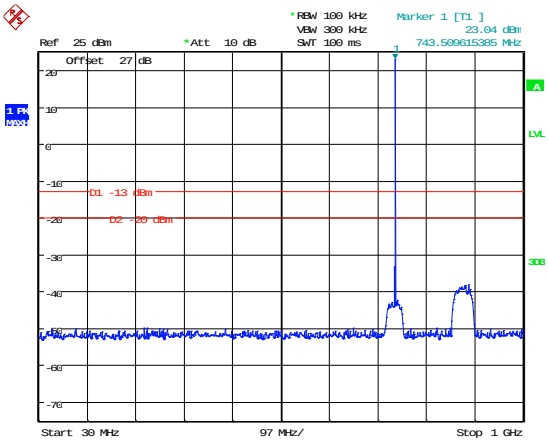
Date: 28.AUG.2013 13:16:05

9kHz - 150kHz



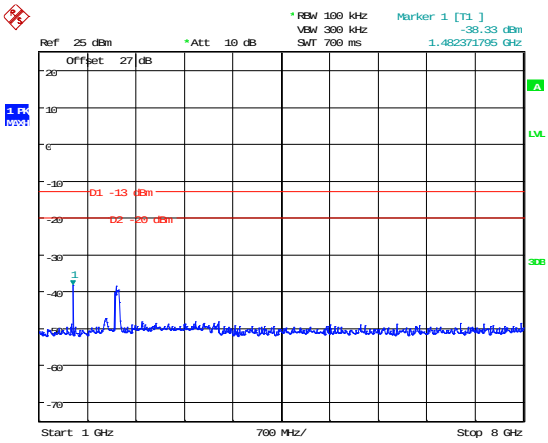
Date: 28.AUG.2013 13:15:50

150kHz – 30MHz



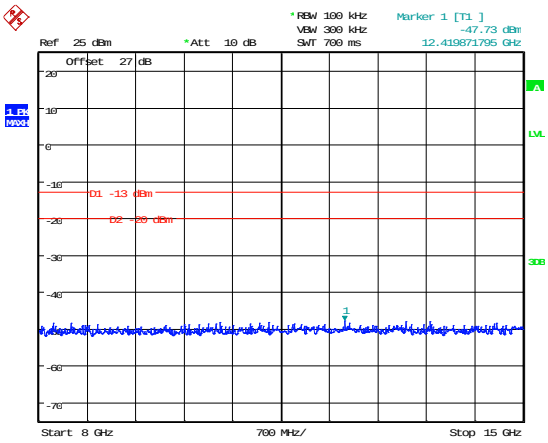
Date: 28.AUG.2013 13:15:35

30MHz – 1GHz



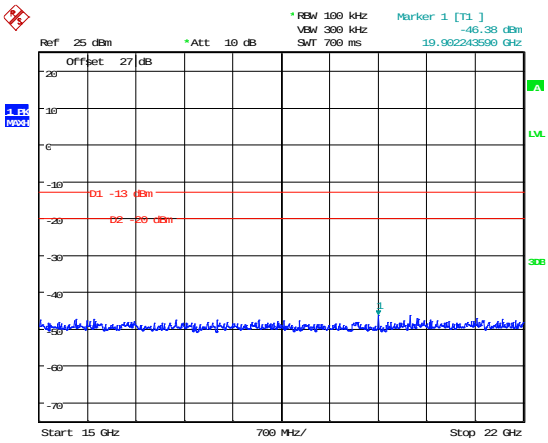
Date: 28.AUG.2013 13:15:13

1GHz – 8GHz



Date: 28.AUG.2013 13:15:01

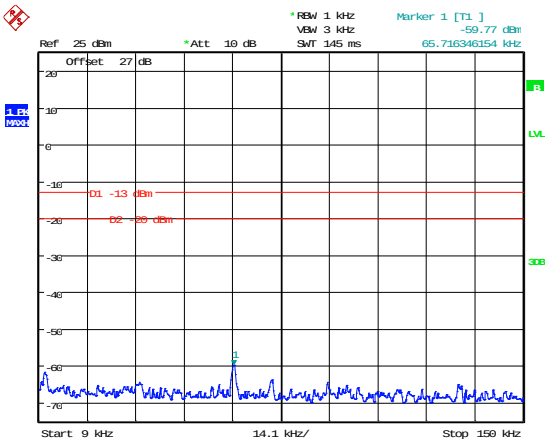
8GHz – 15GHz



Date: 28.AUG.2013 13:14:52

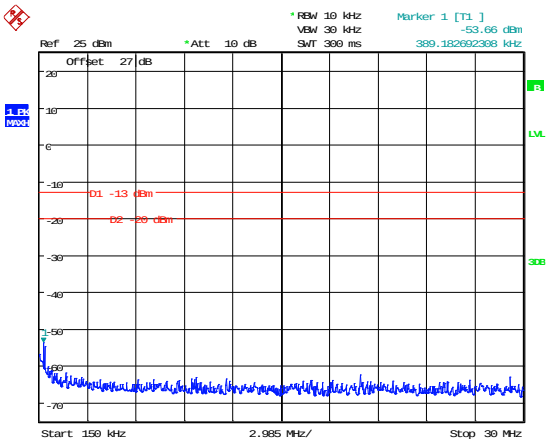
15GHz – 22GHz

700 MHz – 756.0 MHz



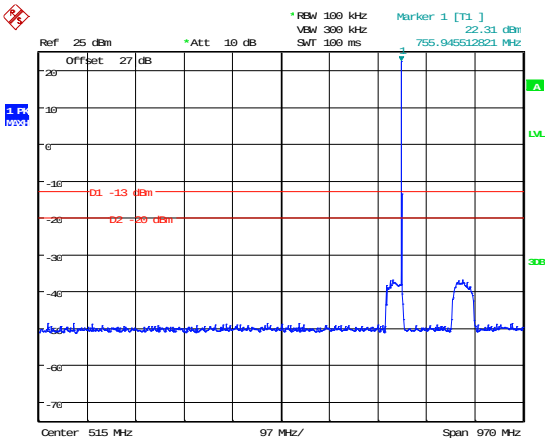
Date: 28.AUG.2013 13:16:26

9kHz - 150kHz



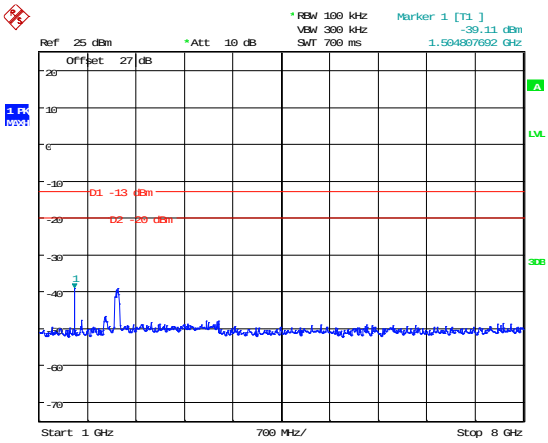
Date: 28.AUG.2013 13:16:39

150kHz – 30MHz



Date: 28.AUG.2013 13:23:53

30MHz – 1GHz



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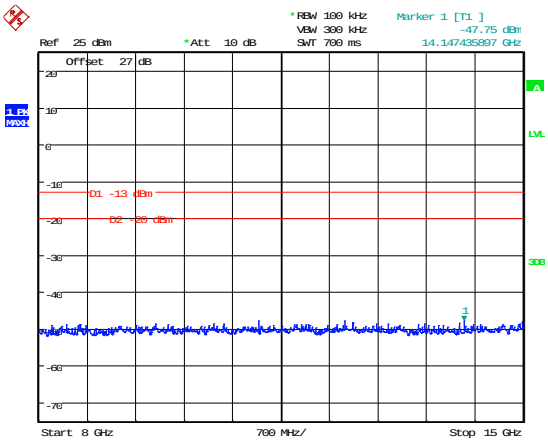
1GHz – 8GHz



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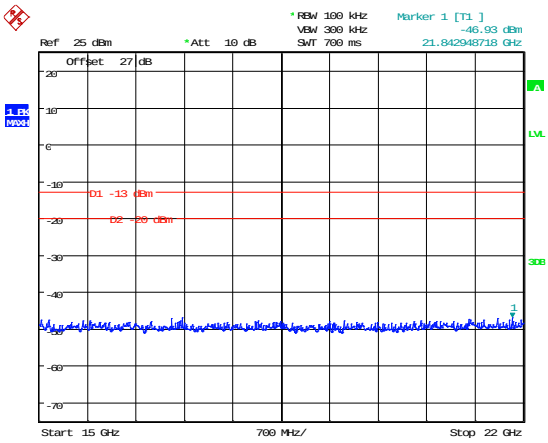
8GHz – 15GHz



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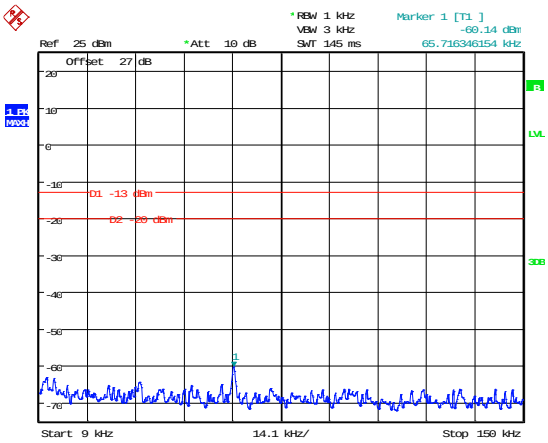
15GHz – 22GHz

2100 MHz – 2110.0 MHz



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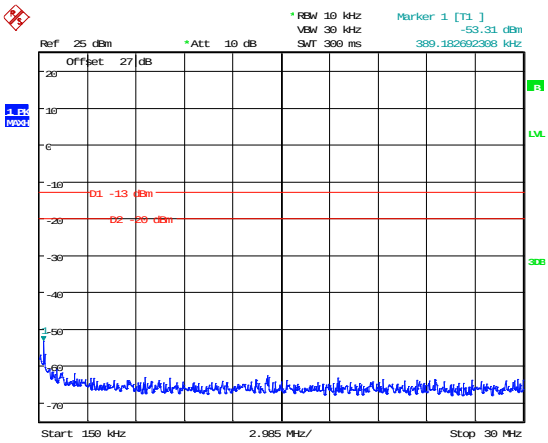
9kHz - 150kHz



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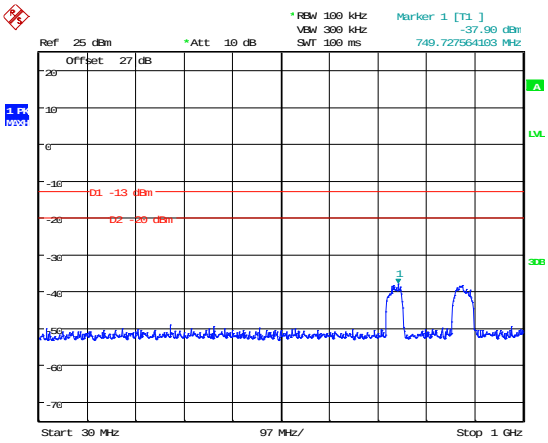
150kHz – 30MHz



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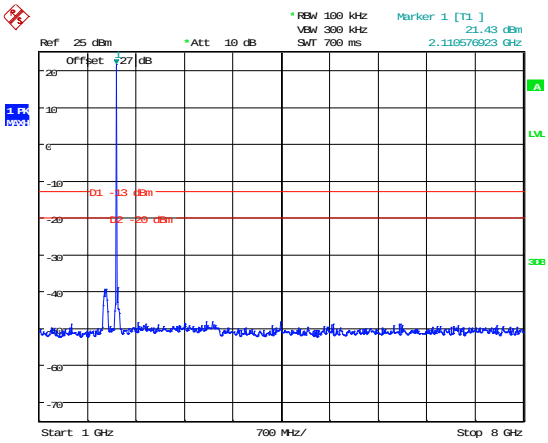
30MHz – 1GHz



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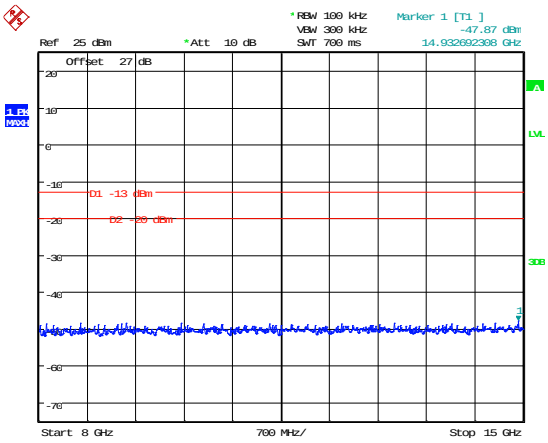
1GHz – 8GHz



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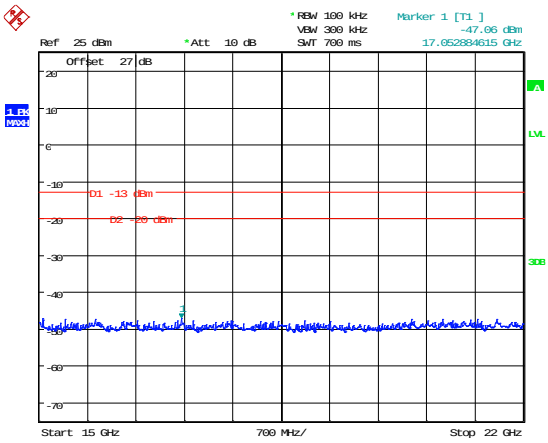
8GHz – 15GHz



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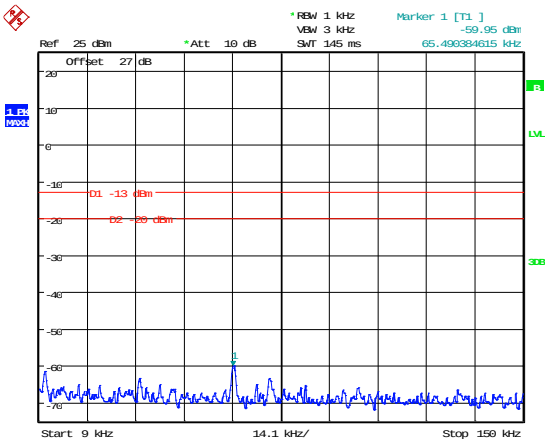
15GHz – 22GHz

2100 MHz – 2132.5 MHz



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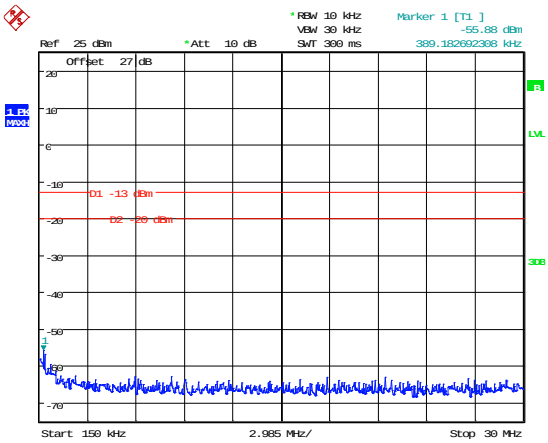
9kHz - 150kHz



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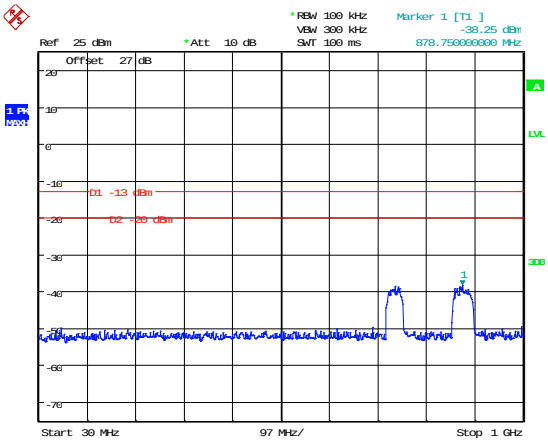
150kHz – 30MHz



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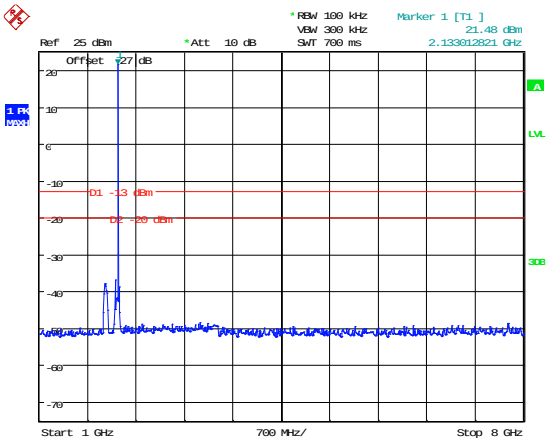
30MHz – 1GHz



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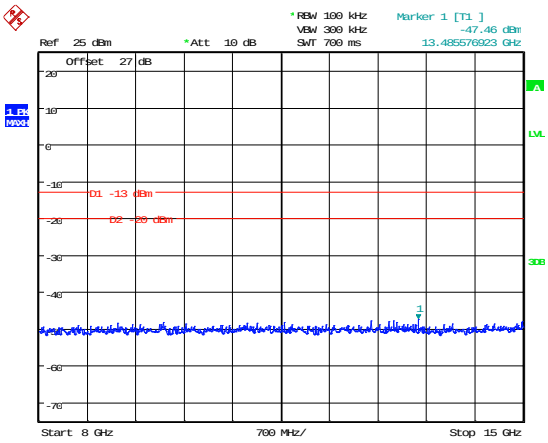
1GHz – 8GHz



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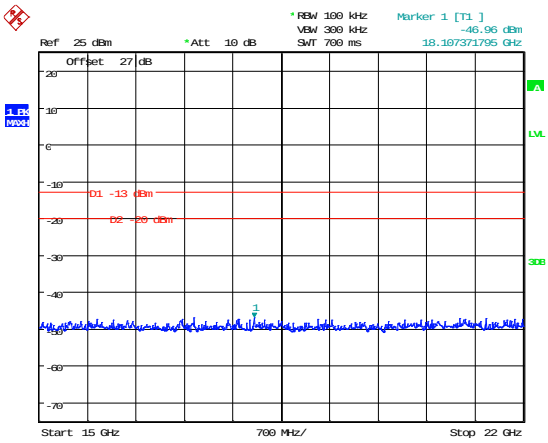
8GHz – 15GHz



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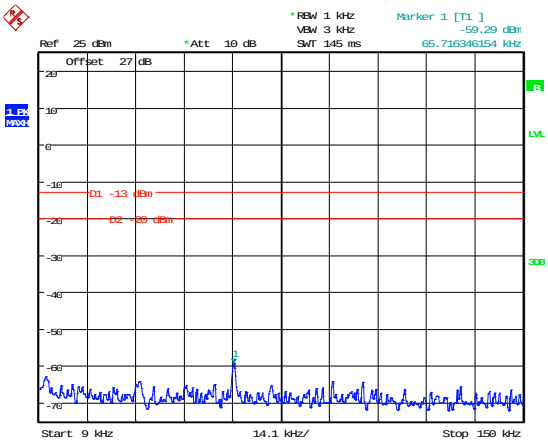
15GHz – 22GHz

2100 MHz – 2155.0 MHz



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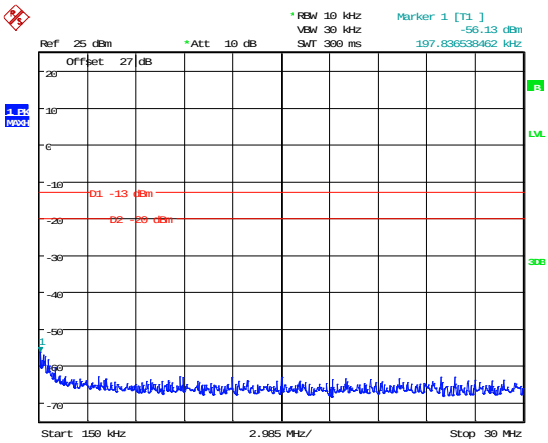
9kHz - 150kHz



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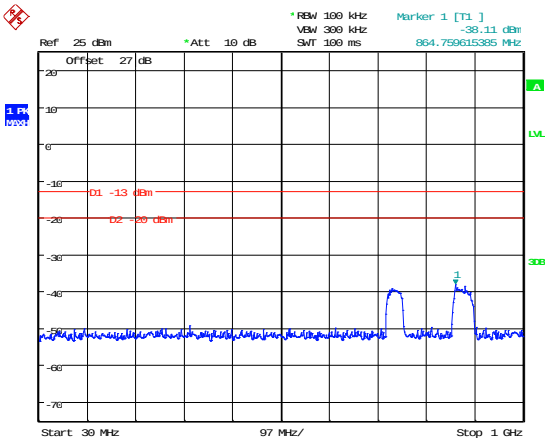
150kHz – 30MHz



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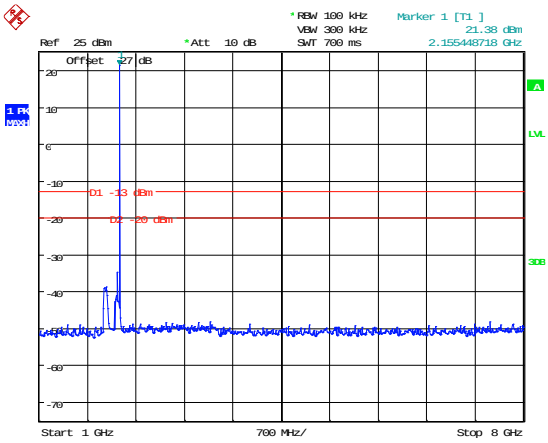
30MHz – 1GHz



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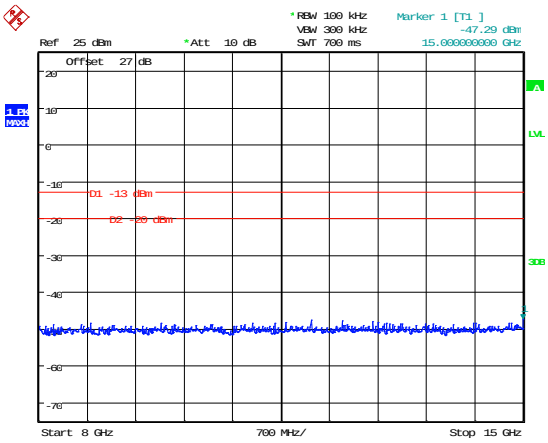
1GHz – 8GHz



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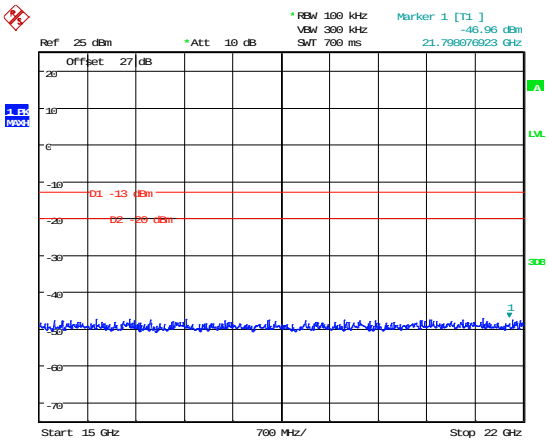
8GHz – 15GHz



Date: 28.AUG.2013 13:36:04

15GHz – 22GHz

B6 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 and harmonic emissions. The EUT was set to transmit as required.

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 : [X]

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

Test Details:	
Measurement standard	Title 47 of the CFR: Part 2.1053, 27.53(c) & (g)
Frequency range	30 MHz – 22 GHz
EUT sample number	S01 & S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Frequency (MHz)	Freq. of Emission (MHz)	**ERP/EIRP (dBm)**	Limit (dBm)
700MHz			
728.000	No Significant Emissions Within		-13
742.000			-13
756.000			-13
2100 MHz			
2110.000	No Significant Emissions Within		-13
2132.500			-13
2155.000			-13

Result

The EUT was found to comply with the limits

Notes:

1. Emissions Checked up to 10 times Fc.

2. The unit was mounted on a turntable and rotated through 360^0 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 = ≥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

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

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:

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

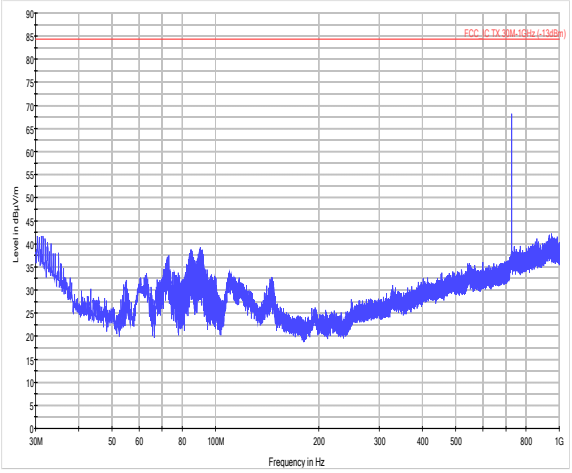
(b) The levels may have been rounded for display purposes.

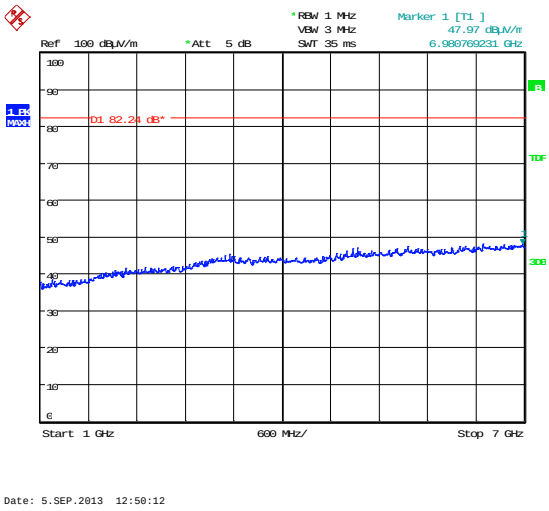
(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	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

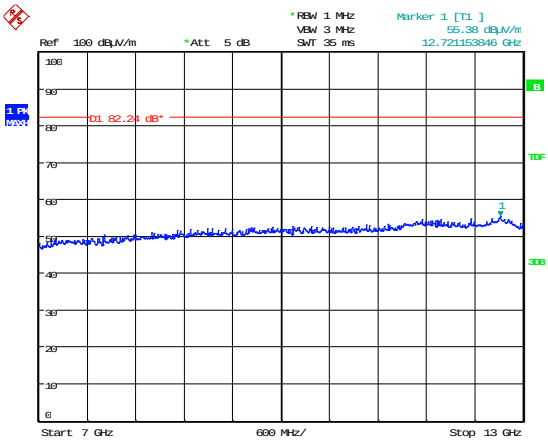
700 MHz – 728.0 MHz

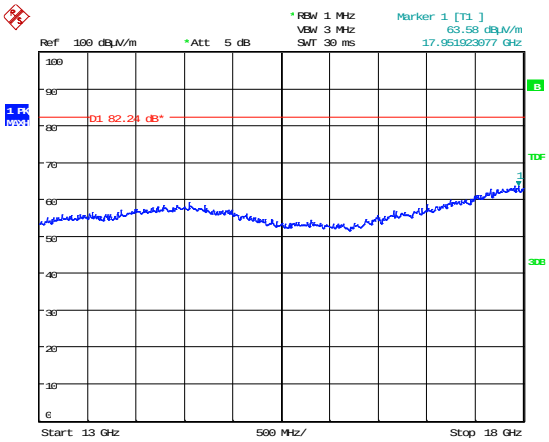




30MHz – 1GHz

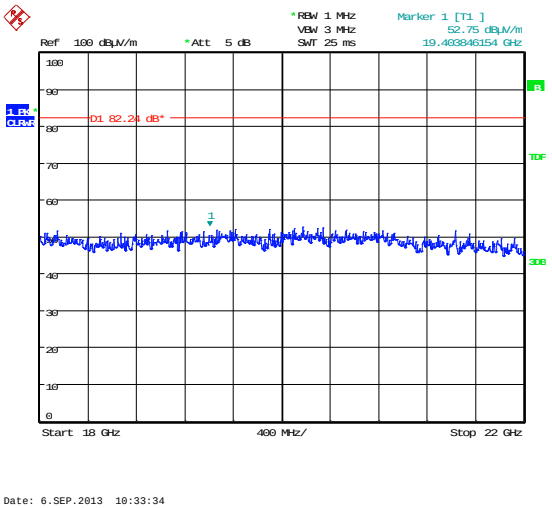
1GHz – 7GHz





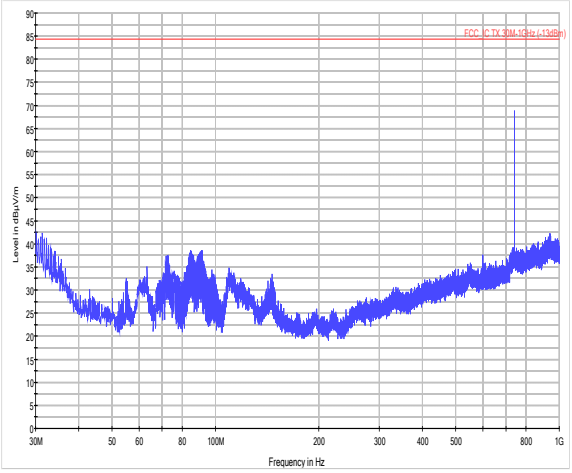
7GHz – 13GHz

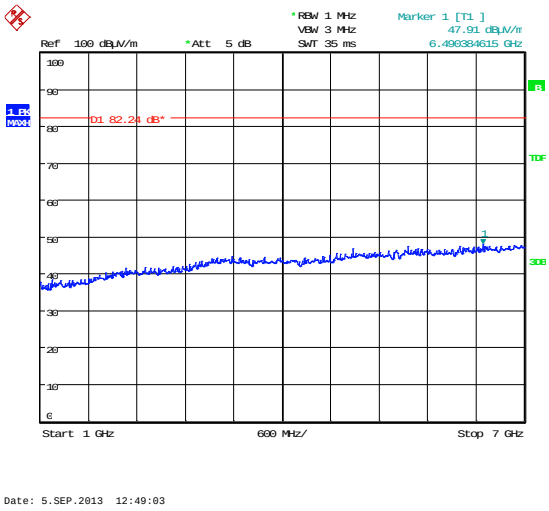
13GHz – 18GHz



18GHz – 22GHz

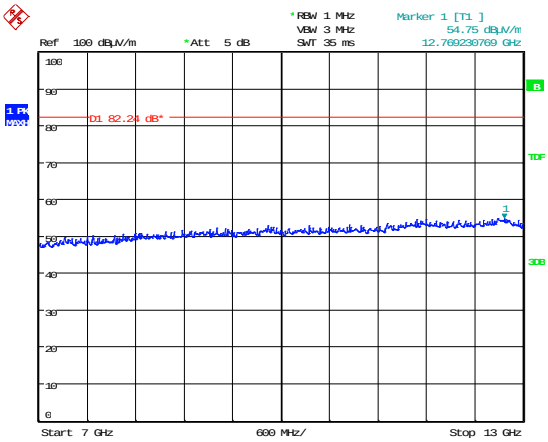
700 MHz – 742.0 MHz

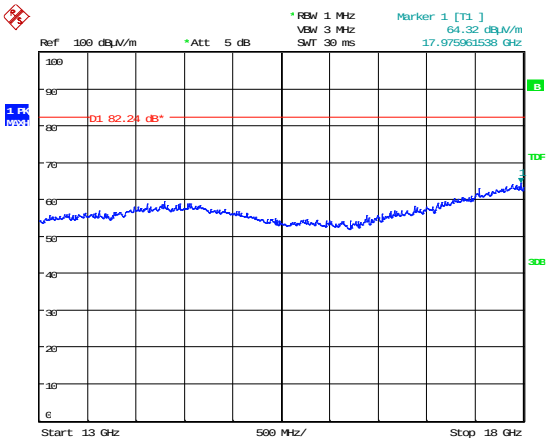




30MHz – 1GHz

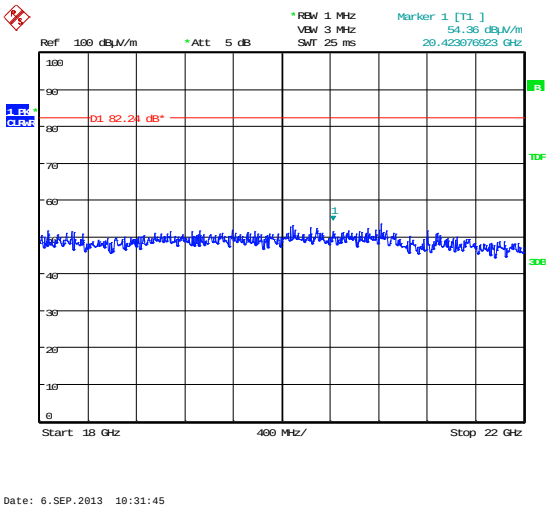
1GHz – 7GHz





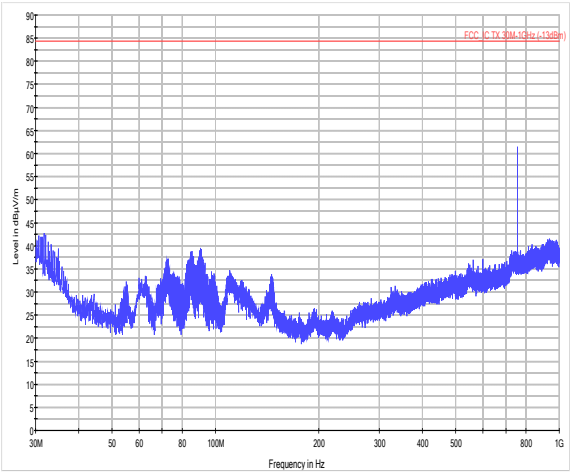
7GHz – 13GHz

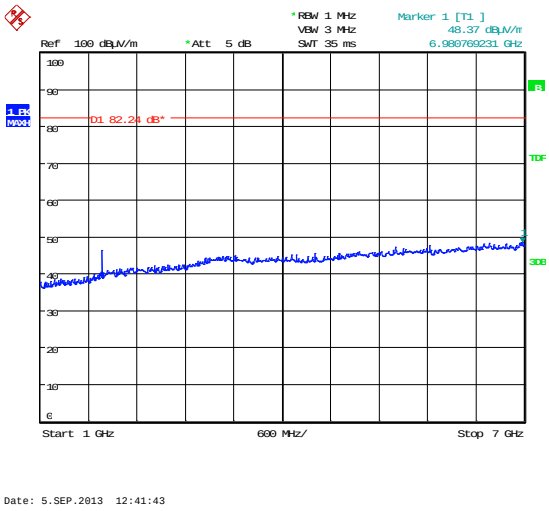
13GHz – 18GHz



18GHz – 22GHz

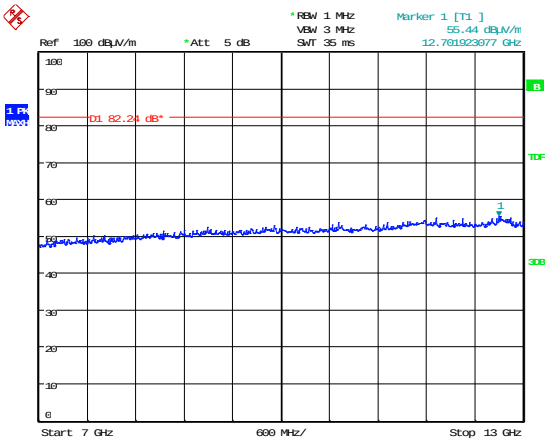
700 MHz – 756.0 MHz

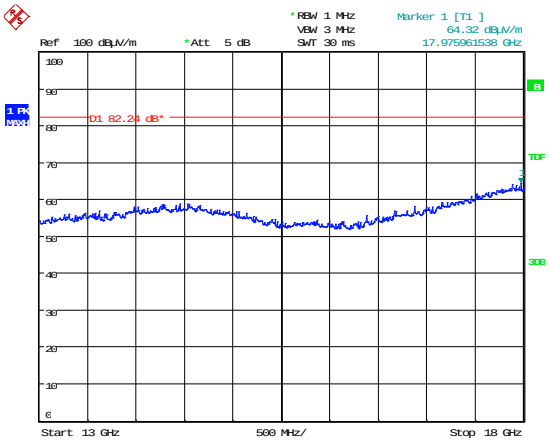




30MHz – 1GHz

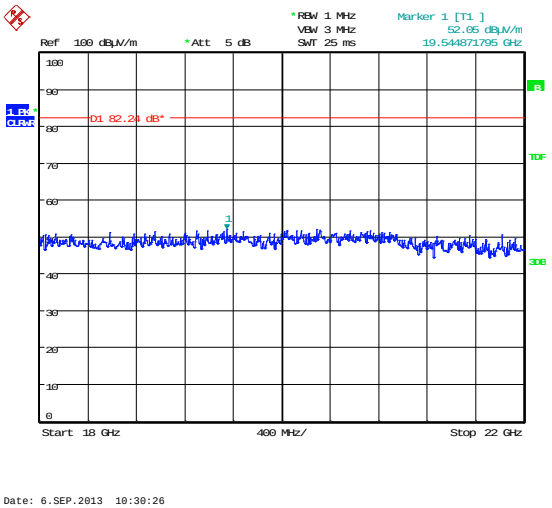
1GHz – 7GHz





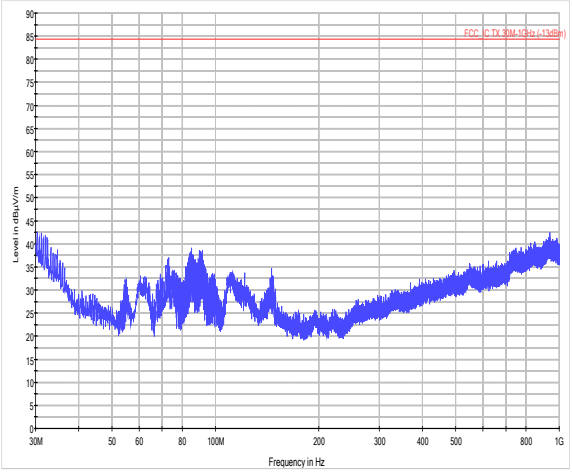
7GHz – 13GHz

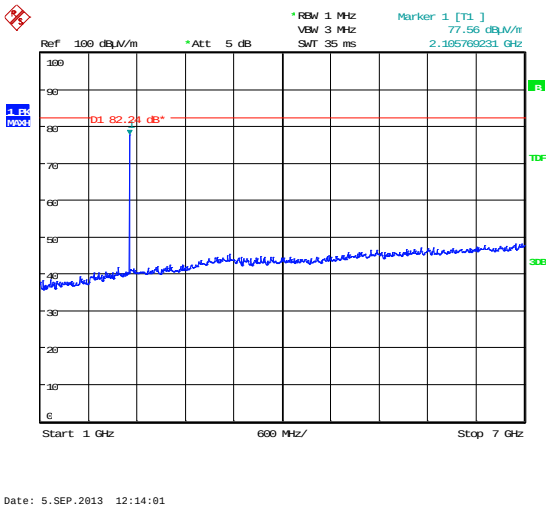
13GHz – 18GHz



18GHz – 22GHz

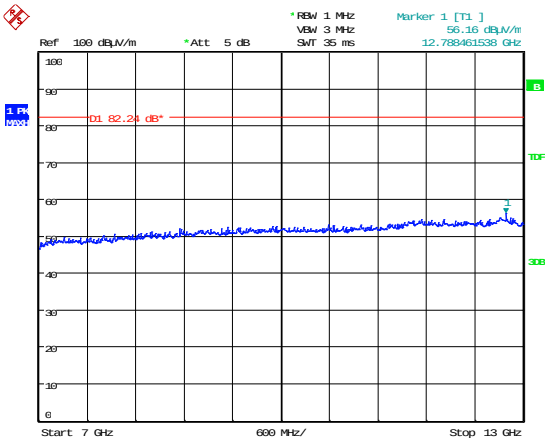
2100 MHz – 2110.0 MHz

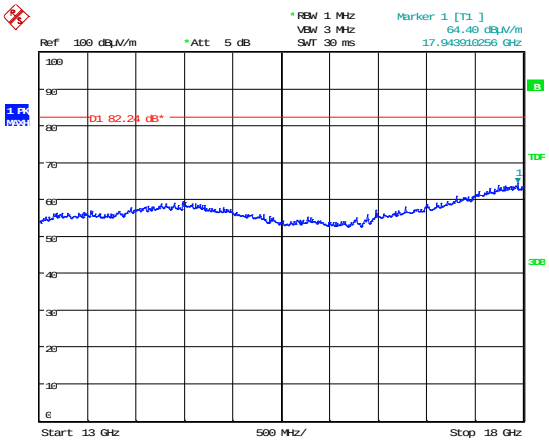




30MHz – 1GHz

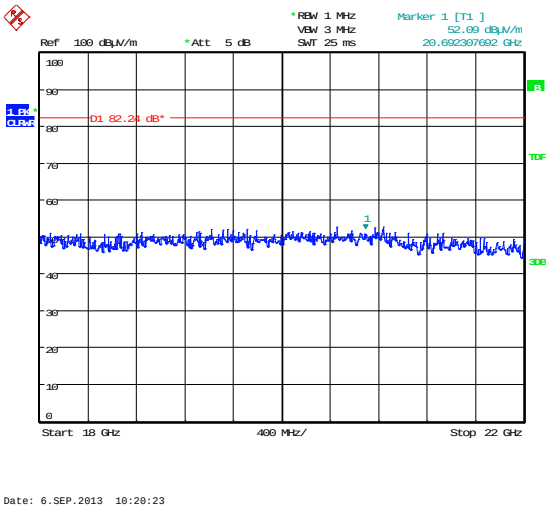
1GHz – 7GHz





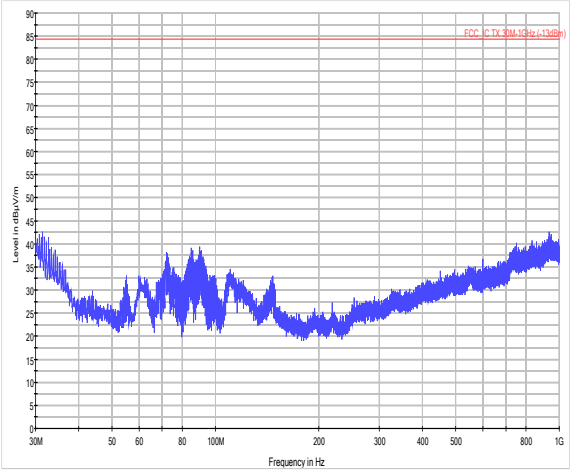
7GHz – 13GHz

13GHz – 18GHz

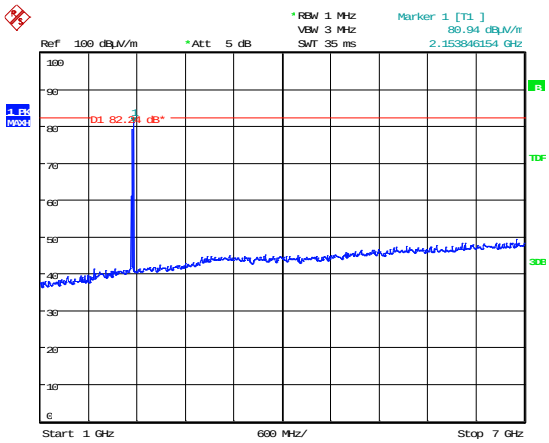


18GHz – 22GHz

2100 MHz – 2132.5 MHz



30MHz – 1GHz



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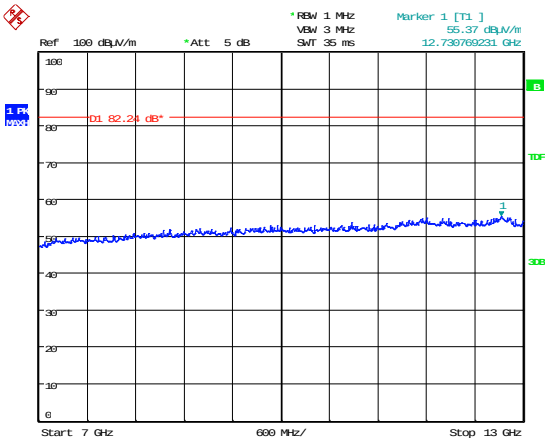
1GHz – 7GHz



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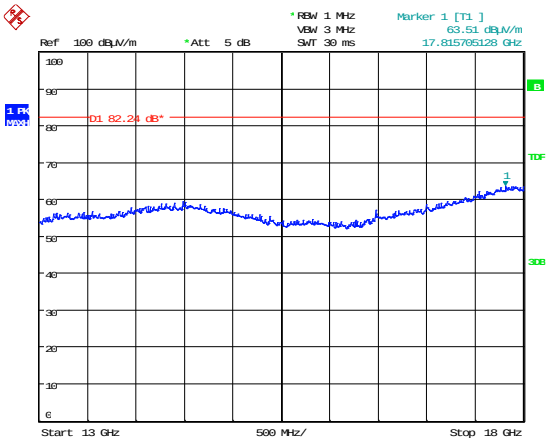
7GHz – 13GHz



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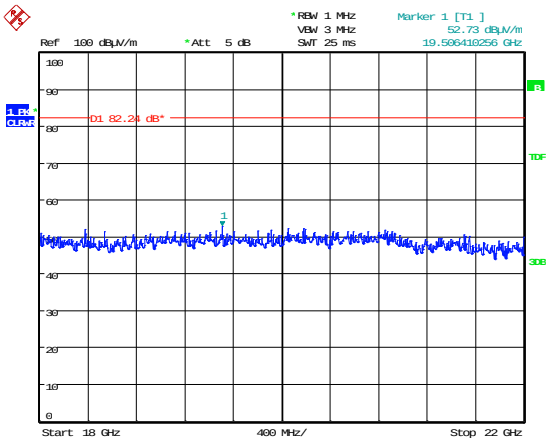
13GHz – 18GHz



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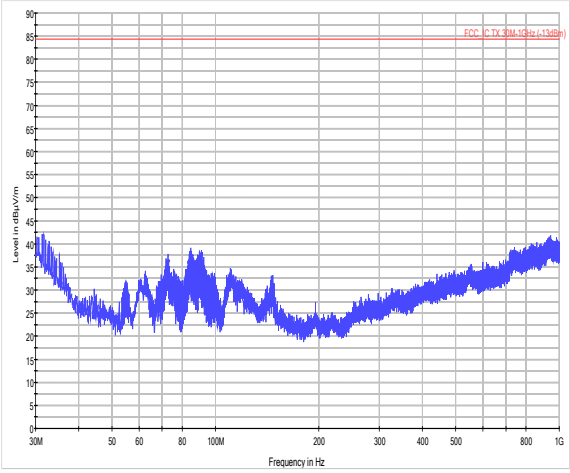
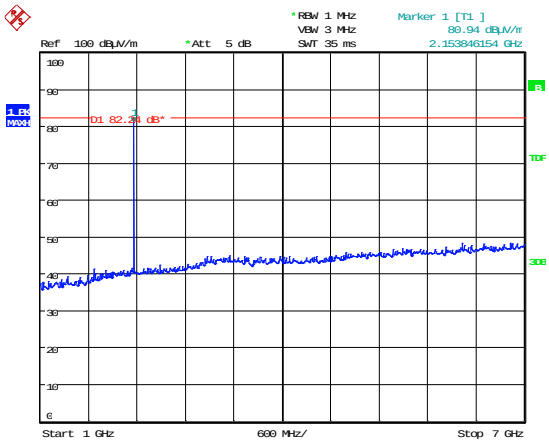
18GHz – 22GHz

2100 MHz – 2155.0 MHz

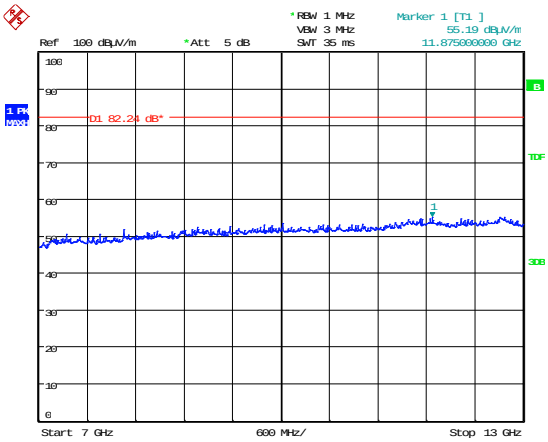




Date: 5.SEP.2013 12:01:54

30MHz – 1GHz

1GHz – 7GHz



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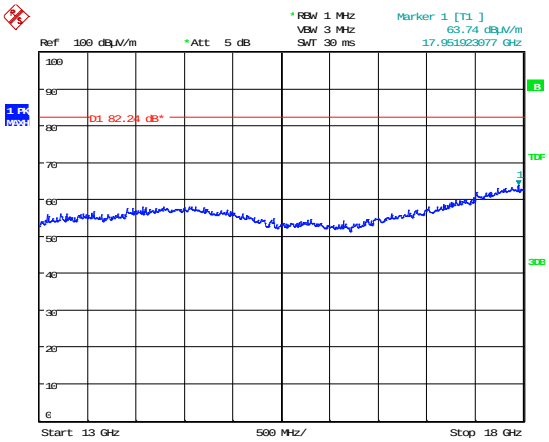
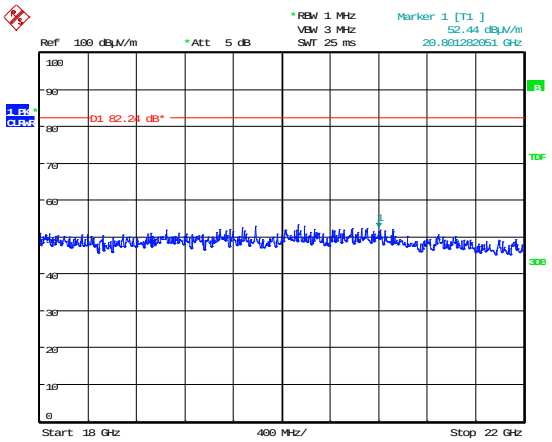


Date: 5.SEP.2013 14:49:05

7GHz – 13GHz

13GHz – 18GHz



Date: 6.SEP.2013 10:18:10

18GHz – 22GHz

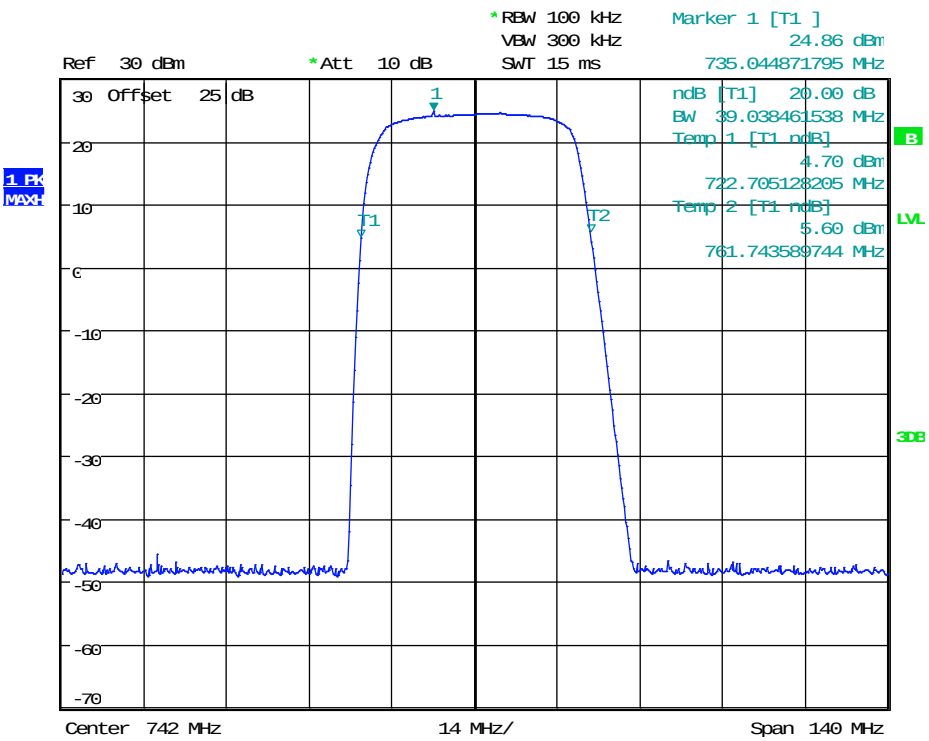
B7 Passband Gain & Bandwidth

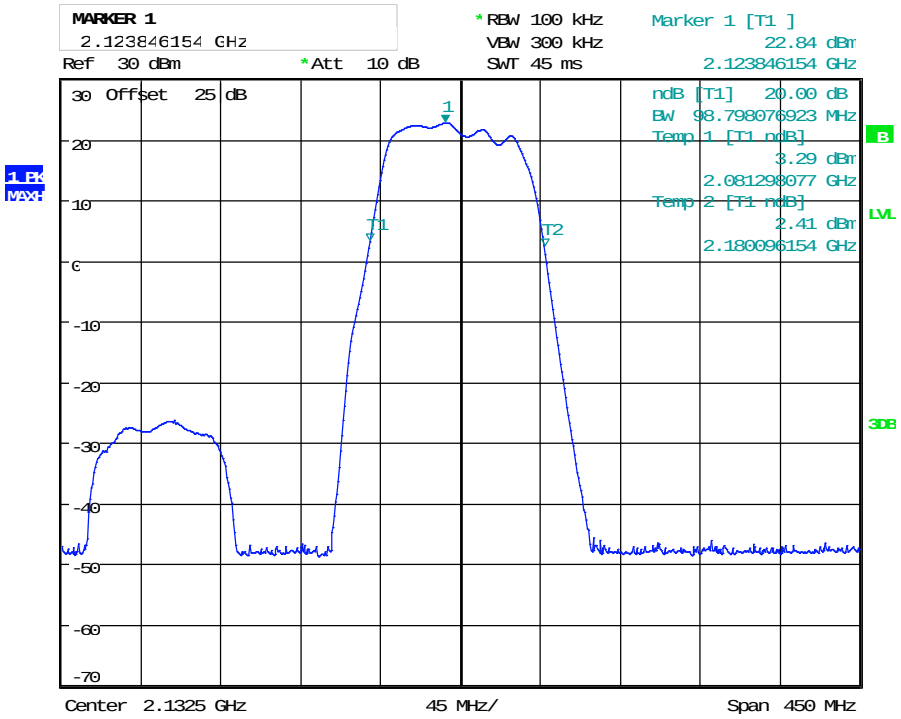
Test Details:	
Measurement standard	D.3 Policies + Procedures (k) of KDB 935210 D02 Signal Boosters Certification v02
EUT sample number	S03
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

BAND	Frequency MHz	fl	fh	20 dB Bandwidth
700 MHz	728 – 756 MHz	722.705128 MHz	761.743589 MHz	39.04 MHz
1700 MHz	2110 – 2115 MHz	2081.298077 MHz	2180.096154 MHz	98.79 MHz

See below for plots showing passband gain & bandwidth

With the aid of a CW Swept signal generator and spectrum analyser, the bandwidth and frequency response of the open channel (i.e. at the point where the gain has fallen by 20 dB) is measured. This measurement shows the gain-versus-frequency response of the open channel from the midband frequency f_0 of the channel up to at least f_0 + 250% of the 20 dB bandwidth.




MARKER 1
2.123846154 GHz
Ref 30 dBm
*Att 10 dB
*RBW 100 kHz
VBW 300 kHz
SWT 45 ms
Marker 1 [T1]
22.84 dBm
2.123846154 GHz
ndB [T1] 20.00 dB
BW 98.798076923 MHz
Temp 1 [T1 ndB]
3.29 dBm
2.081298077 GHz
Temp 2 [T1 ndB]
2.41 dBm
2.180096154 GHz
30 Offset 25 dB
1 PK
MAX
B
LVL
3DB
T1
T2
Center 2.1325 GHz
45 MHz/
Span 450 MHz

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
S01	MBF2307-2317-15XX	
S02	OMU	

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 active, operating at maximum gain and output power

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 : S01 & S02
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Server / Donor	Coaxial	2m	Measurement System
Power	Multi core	1.5m	AC Mains

Sample : S01 & S02
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Server / Donor	Coaxial	2m	Measurement System
Power	Multi core	1.5m	AC Mains

* Only connected during setup.

C5 Details of Equipment Used

TRaC No	Equipment Type	Equipment Description	Manufacturer	Last Cal	Cal Period	Due For Cal
UH003	ESHS10	Receiver	R&S	08/05/2013	12	08/05/2014
UH004	ESVS10	Receiver	R&S	11/02/2013	12	11/02/2014
UH028	UHALP 9108	Log Periodic Ant	Schwarbeck	08/07/2013	24	08/07/2015
UH029	VHBA 9123	Bicone Antenna	Schwarbeck	19/08/2013	24	19/08/2015
UH093	CBL6112B	Bilog	Chase	08/07/2013	24	08/07/2015
UH187	ESHS10	Receiver	R&S	11/02/2013	12	11/02/2014
UH191	CBL611/A	Bilog	Chase	13/12/2012	24	13/12/2014
UH281	FSU46	Spectrum Analyser	R&S	06/03/2013	12	06/03/2014
UH387	ATS	Chamber 1	Rainford EMC	04/07/2013	12	04/07/2014
UH388	ATS	Chamber 2	Rainford EMC	04/07/2013	12	04/07/2014
UH405	FSU26	Spectrum Analyser	R&S	20/03/2013	12	20/03/2014
UH420	CBL6112	Bilog	Chase	06/07/2012	24	06/07/2014
L138	3115	1-18GHz Horn	EMCO	17/10/2013	24	17/10/2015
L139	3115	1-18GHz Horn	EMCO	20/09/2013	24	20/09/2015
L193	VHA 9103 balu	Bicone Antenna	Chase	19/06/2012	24	19/06/2014
L176	2042	Signal Generator	Marconi	20/11/2012	12	20/11/2013
L254	2042	Signal Generator	Marconi	19/12/2012	12	19/12/2013
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
L415	ESVS20	Receiver	R&S	27/08/2013	12	27/08/2014
L572	8449B	Pre Amp	Agilent	12/12/2012	24	12/12/2014
REF916	SMBV100A	Signal Generator	R&S	23/07/2012	12	23/07/2013
REF940	ATS	Radio Chamber - PP	Rainford EMC	09/07/2013	12	09/07/2014
REF976	34405a	Multimeter	Agilent	26/04/2013	12	26/04/2014
REF977	SH4141	High Pass Filter	BSC	25/02/2013	24	25/02/2015

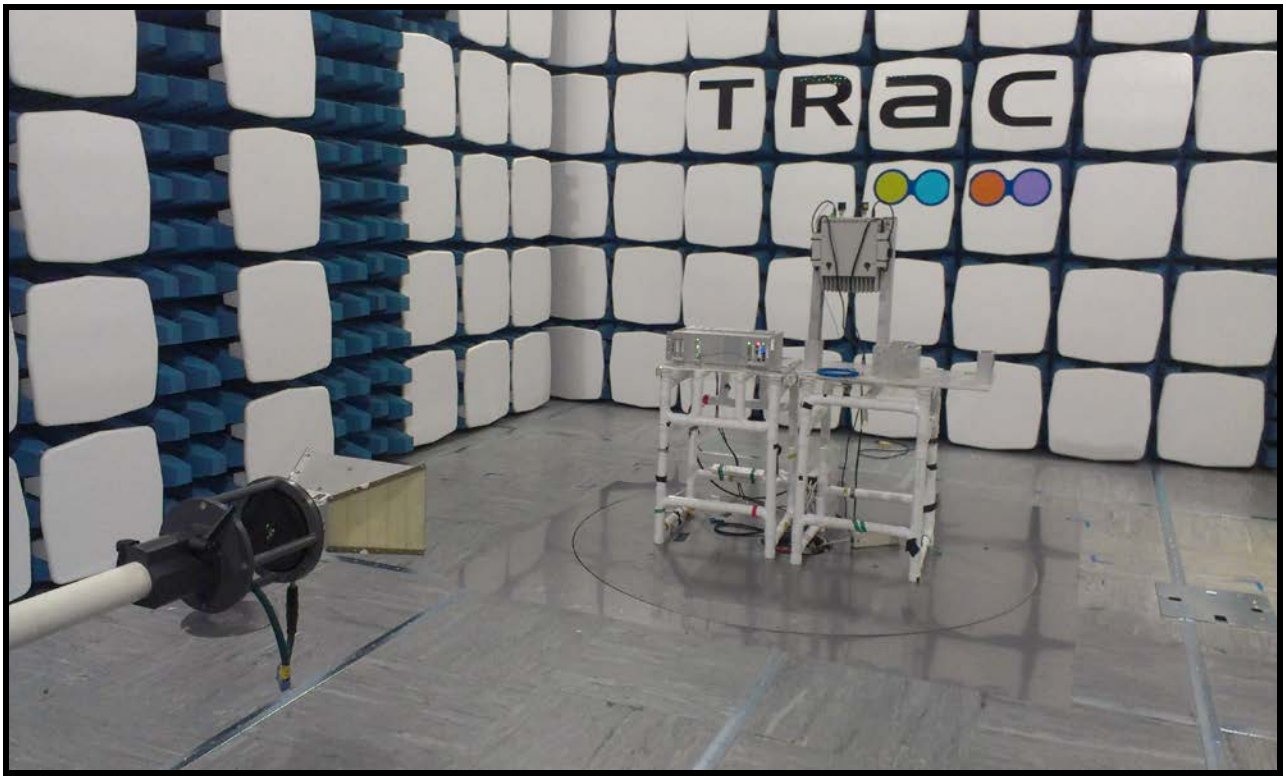
Appendix D: Additional Information

No additional information is included within this test report.

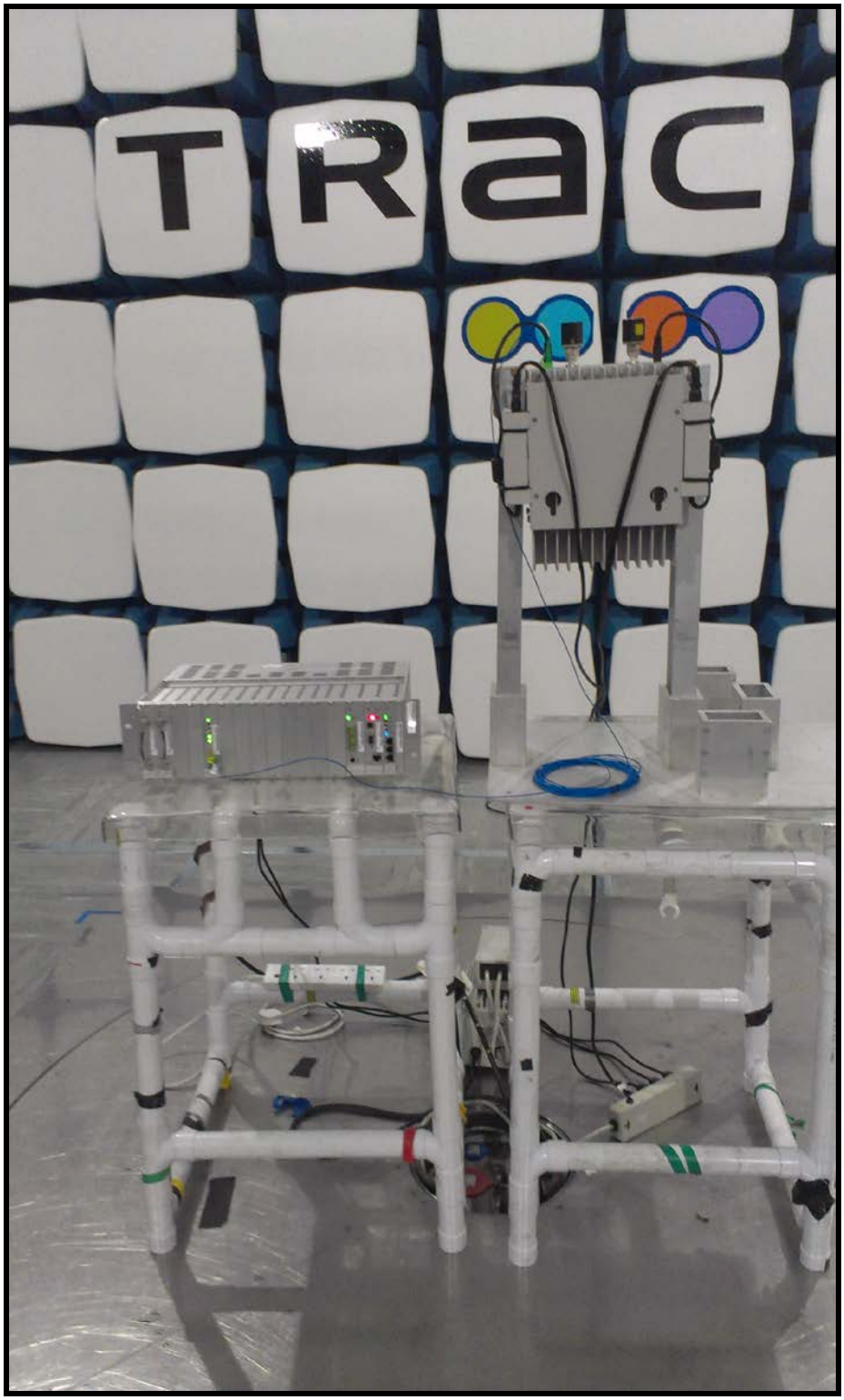
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Over view.
2. Radiated electric field emissions arrangement: close up.



Photograph 1



Photograph 2

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