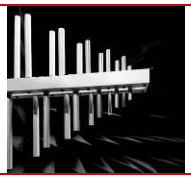
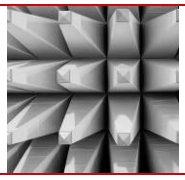

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consulting - testing - certification >>>

TEST REPORT

Test report no.: 1-6965/13-05-18-A

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.cetecom.com
e-mail: ict@cetecom.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01
Area of Testing:
Radio Communications & Compatibility Testing (RCT)

Applicant

Sony Mobile Communications AB
Nya Vattentornet
22188 Lund / SWEDEN
Phone: +46 46 19 30 00
Fax: -/-
Contact: Mikael Nilsson
e-mail: Micke.nilsson@sonymobile.com
Phone: +46 7 03 22 75 03

Manufacturer

Sony Mobile Communications AB
Nya Vattentornet
22188 Lund / SWEDEN

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Tablet PC GPRS/EGPRS 850/900/1800/1900; UMTS HSPA FDDI/II/IV/V/VIII; LTE FDD1/2/3/4/5/7/8/13/17/20; WLAN b/g/n/a/ac; BT 4.0; RFID; A-GPS**
Type name:	**TM-0040-BV**
FCC ID:	**PY7TM-0040**
Frequency:	DTS band 5725 MHz to 5850 MHz (lowest channel 149 – 5745 MHz; highest channel 165 – 5825 MHz)
Technology tested:	WLAN (OFDM/a – mode; ac HT20 / HT40 – mode and ac HT80 – mode)
Antenna:	Integrated antenna
Power supply:	3.7 V DC by Li - polymer battery
Temperature range:	-20°C to +55°C

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorised:

cn=Andreas Luckenbill, o=CETECOM ICT Services GmbH, ou=LUC-111202, email=andreas.luckenbill@cetecom.com, c=DE
2014.01.22 17:44:41 +01'00'

Andreas Luckenbill
Expert

Test performed:

cn=Marco Bertolino, o=CETECOM ICT Services GmbH, ou=BTL-100826, email=marco.bertolino@cetecom.com, c=DE
2014.01.22 17:47:30 +01'00'

Marco Bertolino
Testing Manager

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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2.2 Application details

Date of receipt of order:	2013-12-09
Date of receipt of test item:	2013-12-02
Start of test:	2013-12-23
End of test:	2014-01-06
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15		Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

3.1 Measurement guidance

DTS : KDB 558074	2013-04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

4 Test environment

Temperature:	T_{nom}	+22 °C	during room temperature tests
	T_{max}	+55 °C	during high temperature tests
	T_{min}	-20 °C	during low temperature tests
Relative humidity content:		37 %	
Barometric pressure:		not relevant for this kind of testing	
Power supply:	V_{nom}	3.7 V	DC by Li - polymer battery
	V_{max}	4.2 V	
	V_{min}	3.3 V	

5 Test item

Kind of test item :	**Tablet PC GPRS/EGPRS 850/900/1800/1900; UMTS HSPA FDDI/II/IV/V/VIII; LTE FDD1/2/3/4/5/7/8/13/17/20; WLAN b/g/n/a/ac; BT 4.0; RFID; A-GPS**
Type name :	**TM-0040-BV**
S/N serial number :	**Conducted unit: CB51267QQY** **Radiated units: CB51267Q5X; CB51267Q47**
HW hardware status :	**Prototype build: AP1**
SW software status :	**RF test software**
Frequency band [MHz] :	**DTS band 5725 MHz to 5850MHz** **(lowest channel 149 – 5745 MHz; highest channel 165 – 5825 MHz)**
Type of radio transmission : **Use of frequency spectrum :**	**OFDM**
Type of modulation :	**BPSK, QPSK, 16 – QAM, 64 – QAM and 256 – QAM**
Number of channels :	**5**
Antenna :	**Integrated antenna**
Power supply :	**3.7 V DC by Li - polymer battery**
Temperature range :	**-20°C to +55 °C**

5.1 Additional information

Test setup- and EUT-photos are included in test report: 1-6965/13-05-01_AnnexA
1-6965/13-05-01_AnnexB
1-6965/13-05-01_AnnexD

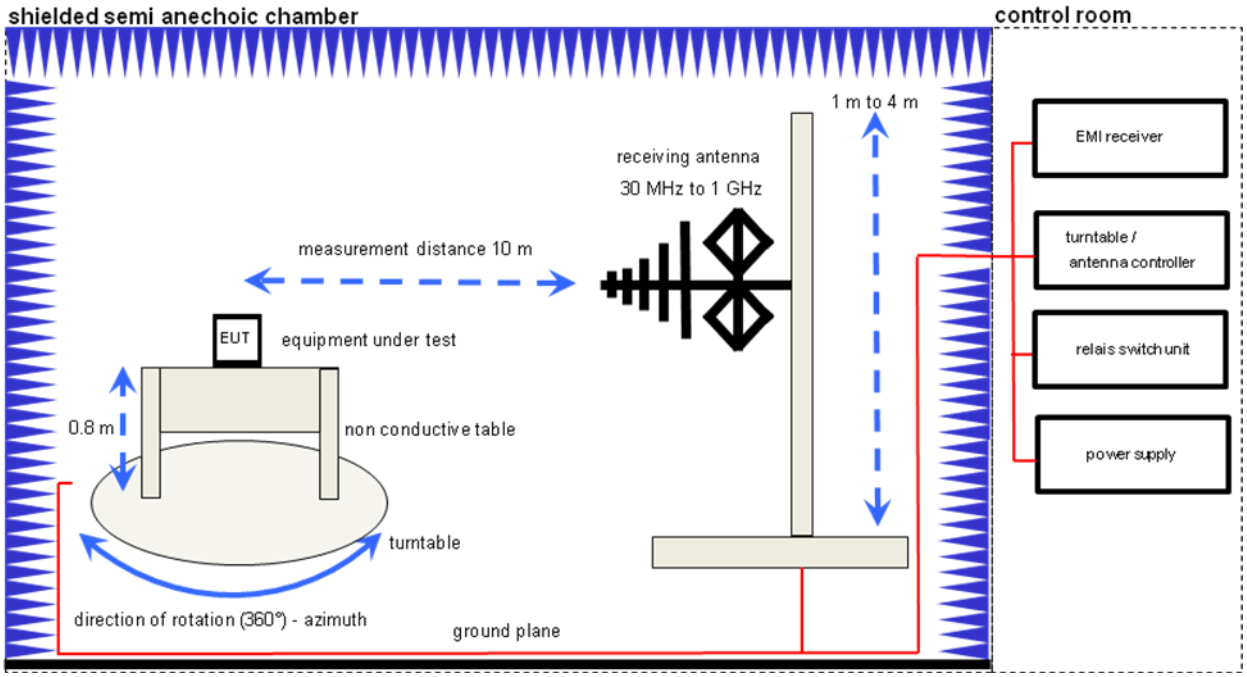
6 Test laboratories sub-contracted

None

7 Description of the test setup

7.1 Radiated measurements chamber F

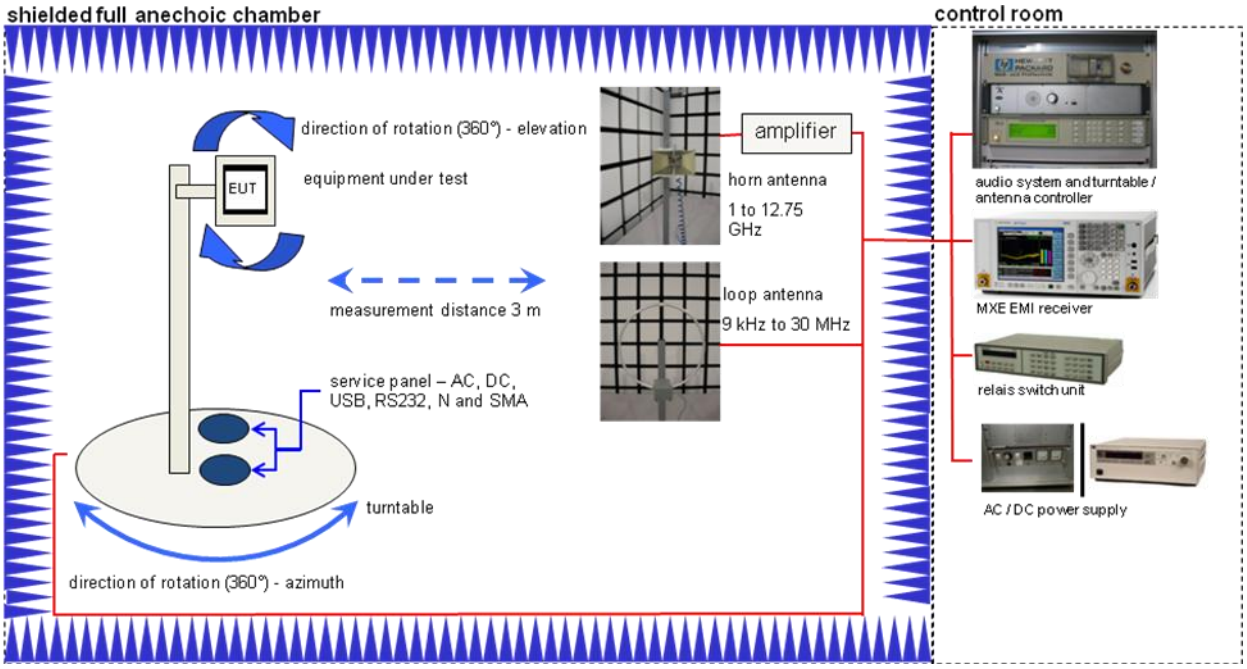
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368
DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2920A04466	300000580
EMI Test Receiver	ESCI 3	R&S	100083	300003312
Amplifier	JS42-00502650-28-5A	MITEQ	1084532	300003379
Antenna Tower	Model 2175	ETS-LINDGREN	64762	300003745
Positioning Controller	Model 2090	ETS-LINDGREN	64672	300003746
Turntable Interface-Box	Model 105637	ETS-LINDGREN	44583	300003747
TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787

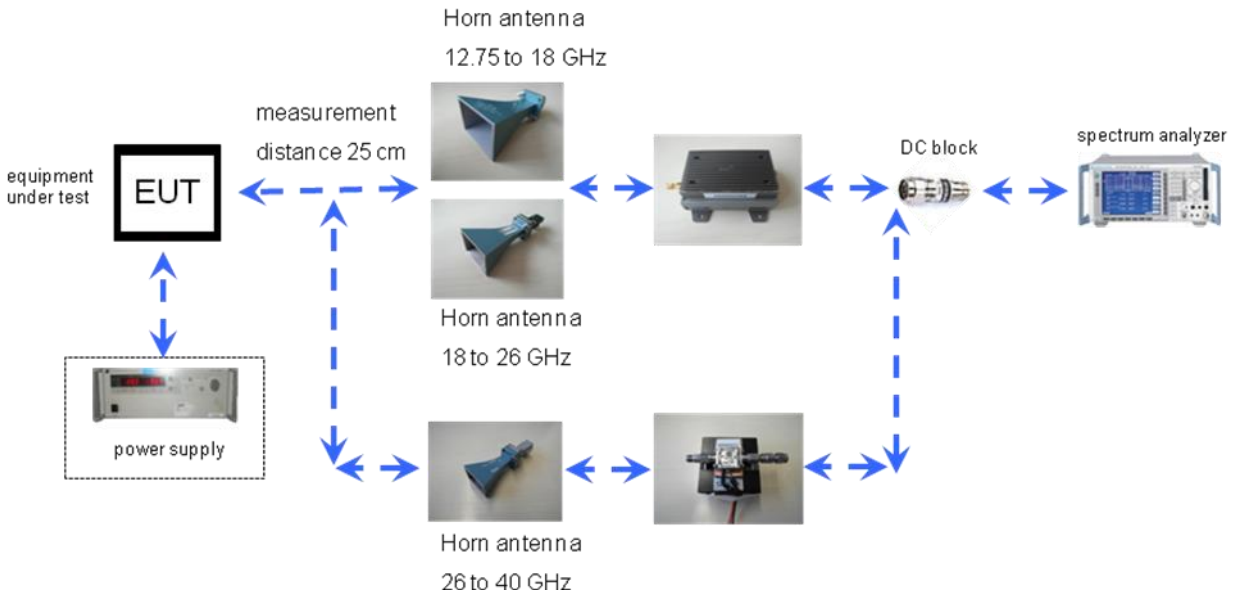
7.2 Radiated measurements chamber C



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405
Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789
Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032
Active Loop Antenna	6502	EMCO	8905-2342	300000256
Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996
Switch / Control Unit	3488A	HP Meßtechnik	*	300000199
Switch / Control Unit	3488A	HP Meßtechnik	2719A15013	300001156
Isolating Transformer	MPL IEC625 Bus Regeltrenntravo	Erfi	91350	300001155
Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997
Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143

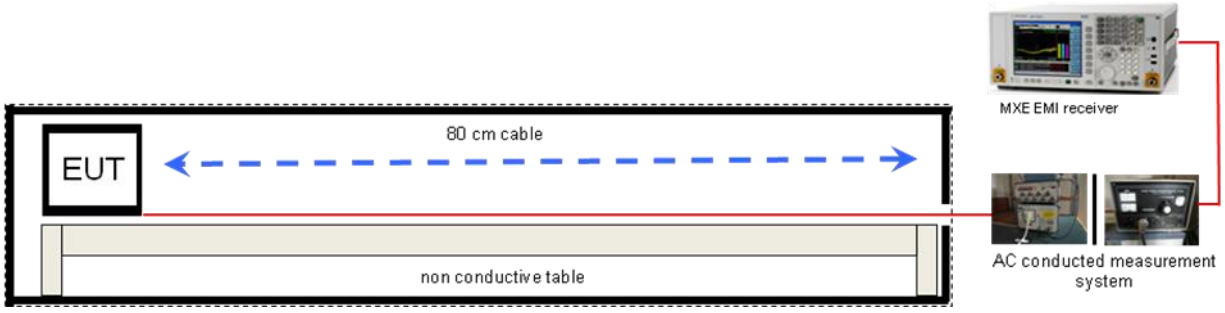
7.3 Radiated measurements 12.75 GHz to 40 GHz



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787
Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442
Std. Gain Horn Antenna 26.5 to 40.0 GHz	637	Narda	GB42110541	300000510
Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP Meßtechnik	00419	300002268
Broadband Low Noise Amplifier 18-50 GHz	CBL18503070-XX	CERNEX	19338	300004273
Spectrum Analyzer 20 Hz - 50 GHz	FSU50	R&S	200012	300003443
Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517

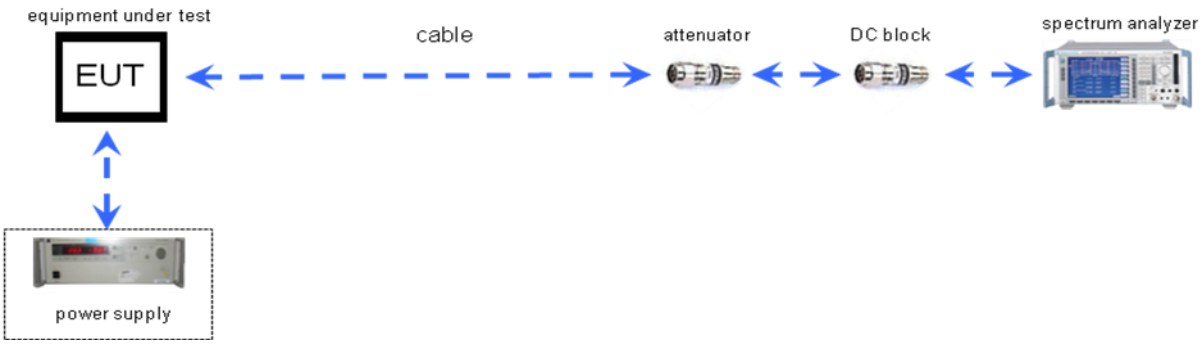
7.4 AC conducted



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405
Isolating Transformer	MPL IEC625 Bus Regeltrenntravo	Erfi	91350	300001155
Switch / Control Unit	3488A	HP Meßtechnik	*	300000199
Switch / Control Unit	3488A	HP Meßtechnik	2719A15013	300001168
Artificial Mains 9 kHz to 30 MHz	ESH3-Z5	R&S	828576/020	300001210

7.5 Conducted measurements



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517

8 Summary of measurement results

☒	**No deviations from the technical specifications were ascertained**
☐	There were deviations from the technical specifications ascertained

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15	Passed	2014-01-22	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	Mode	Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density DTS clause 10.2	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.247(a)(2)	Spectrum bandwidth - 6dB bandwidth DTS clause 8.2	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.247(a)(2)	Spectrum bandwidth - 20dB bandwidth	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.247(b)(3)	Maximum output power DTS clause 9.1.2	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted DTS clause 11.1 & 2	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	Nominal	Nominal	-/-	☒	☐	☐	☐	complies
§15.209(a)	TX spurious emissions radiated < 30 MHz	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted emissions < 30 MHz	Nominal	Nominal	OFDM	☒	☐	☐	☐	complies

Note: NA = Not Applicable; NP = Not Performed

9 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

Test mode:

☐ No test mode available.
Iperf was used to ping another device with the largest support packet size

☒ Special software is used.
EUT is transmitting pseudo random data by itself

10 Measurement results

10.1 Identify worst case

Measurement:

All modes of the module will be measured with an average powermeter to identify the maximum transmission power on low, mid and high channel. In the case that only one or two channels are available, only these will be measured.

In further tests only the identified worst case modulation scheme or bandwidth will be measured.
Additional the band edge compliance test will be performed in the lowest and highest modulation scheme.

Measurement parameters:

Average Power Meter

Results:

Modulation	Modulation scheme / bandwidth		
Frequency	5745 MHz	5785 MHz	5825 MHz
OFDM / a – mode	48 Mbit/s	48 Mbit/s	48 Mbit/s
OFDM / ac – mode HT20	MCS5	MCS5	MCS5
Frequency	5755 MHz		5795 MHz
OFDM / ac – mode HT40	MCS4		MCS6
Frequency	5775 MHz		
OFDM / ac – mode HT80	MCS0		

10.2 Antenna gain

Limits:

FCC	-/-
Antenna Gain	
6 dBi	

Results:

T_{nom}	V_{nom}	lowest channel 5745 MHz	middle channel 5785 MHz	highest channel 5825 MHz
Gain [dBi] Calculated		0.9	0.7	0.3

Result: **Passed**

10.3 Maximum output power

Description:

Measurement of the maximum output power conducted. The measurements are performed using the data rate producing the highest conducted output power. The determination of these data rates was performed at the beginning of the tests.

Measurement:

Measurement parameter	
According to: DTS clause 9.1.2	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	40 MHz / 80 MHz / 120 MHz
Measurement type:	Channel power
Integration bandwidth:	75 % power - bandwidth (DTS BW)
Trace-Mode:	Max hold (allow trace to fully stabilize)

Limits:

FCC	-/-
Maximum Output Power	
Conducted: 1.0 W – Antenna Gain max. 6 dBi	

Results: conducted

Frequency	Maximum output power conducted [dBm]		
	Low channel	Middle channel	High channel
OFDM / a – mode Peak output power conducted	14.81	15.01	14.51
OFDM / ac HT20 – mode Peak output power conducted	15.25	15.51	14.97
OFDM / ac HT40 – mode Peak output power conducted	15.47	-/-	15.16
OFDM / ac HT80 – mode Peak output power conducted	-/-	14.92	-/-
Measurement uncertainty	± 1.5 dB (cond.)		

Result: **Passed**

10.4 Power spectral density

Description:

Measurement of the power spectral density of a digital modulated system. The measurement is repeated for both modulations at the lowest, middle and highest channel.

Measurement:

Measurement parameter	
According to: DTS clause 10.2	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 kHz
Video bandwidth:	10 kHz
Span:	40 MHz / 80 MHz / 160 MHz
Trace-Mode:	Max hold (allow trace to fully stabilize)

Limits:

FCC	-/-
Power Spectral Density	
8 dBm (conducted)	

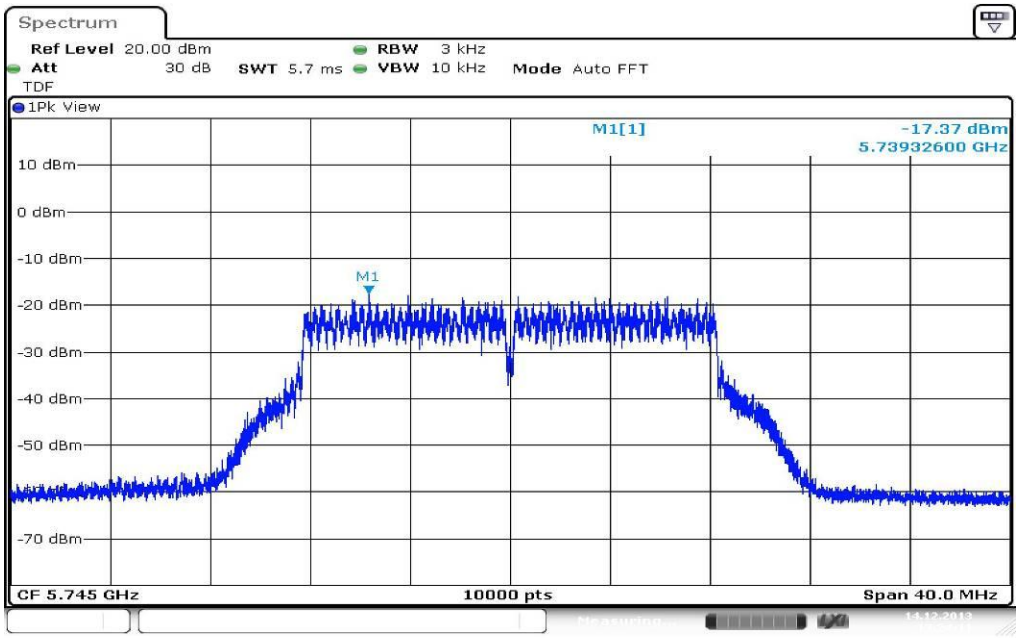
Results:

Modulation	Power spectral density [dBm]		
Frequency	5745 MHz	5785 MHz	5825 MHz
OFDM / a – mode	-17.37	-16.72	-17.75
OFDM / ac – mode HT20	-17.46	-17.18	-17.99
Frequency	5755 MHz	5795 MHz	
OFDM / ac – mode HT40	-20.31	-20.00	
Frequency	5775 MHz		
OFDM / ac – mode HT80	-23.92		
Measurement uncertainty	± 1.5 dB		

Result: **Passed**

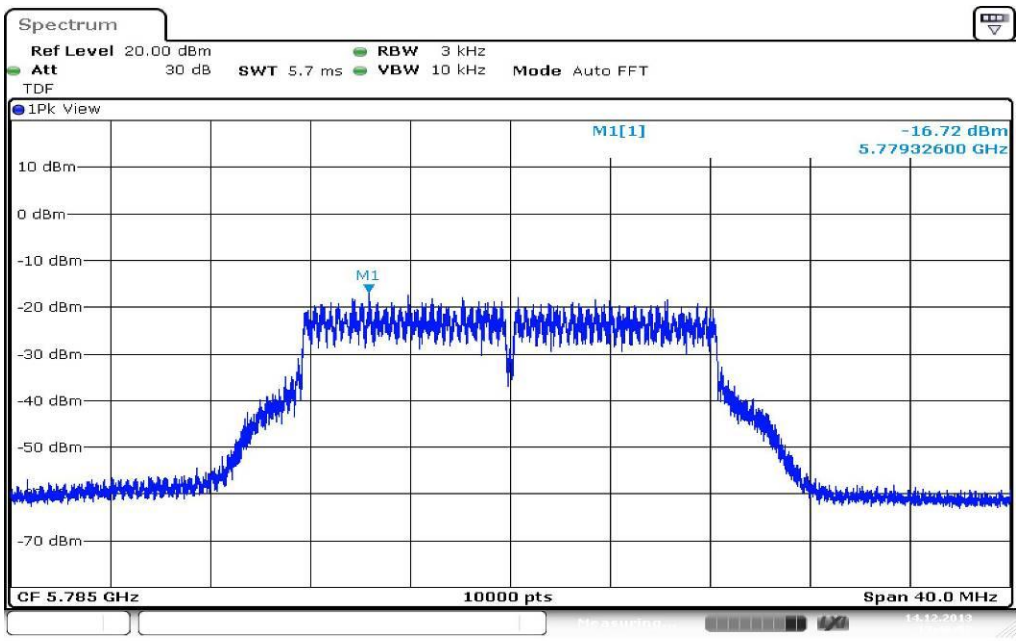
Plots: OFDM / a – mode

Plot 1: TX mode, lowest channel



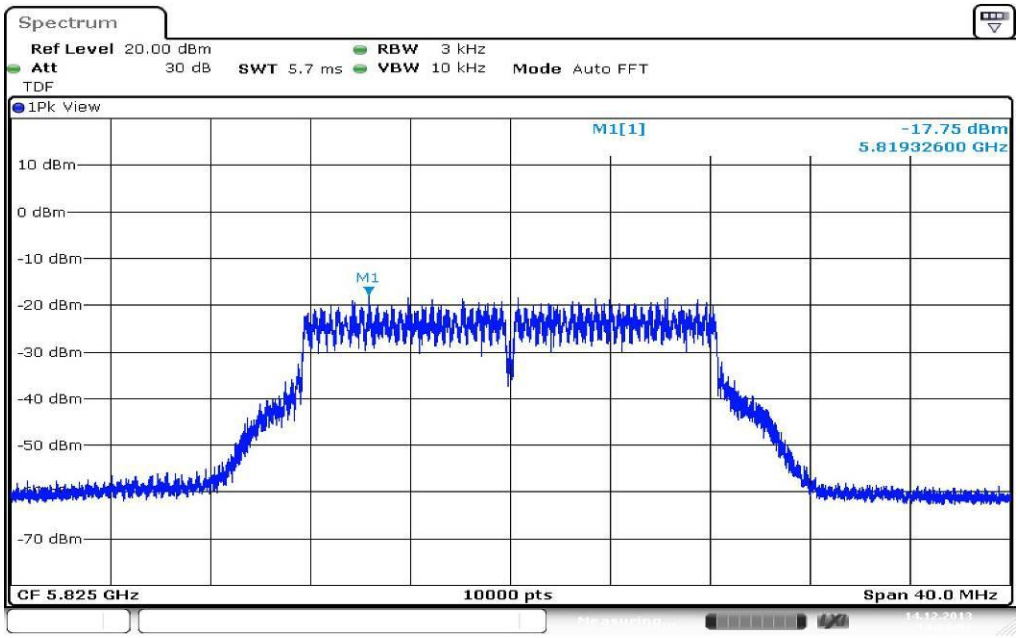
Date: 14.DEC.2013 13:24:11

Plot 2: TX mode, middle channel



Date: 14.DEC.2013 13:46:07

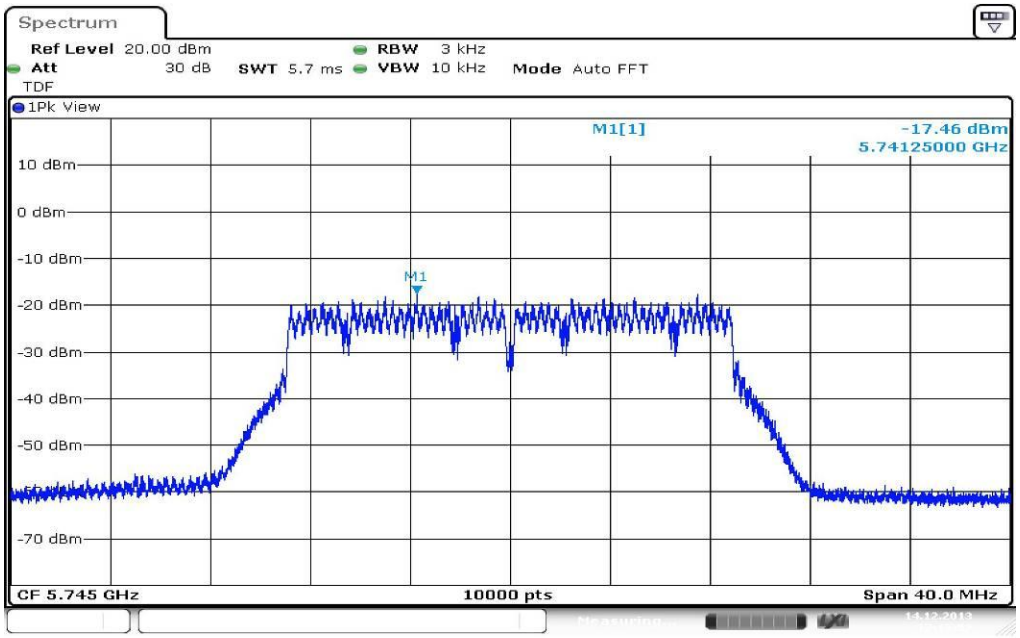
Plot 3: TX mode, highest channel



Date: 14.DEC.2013 14:08:03

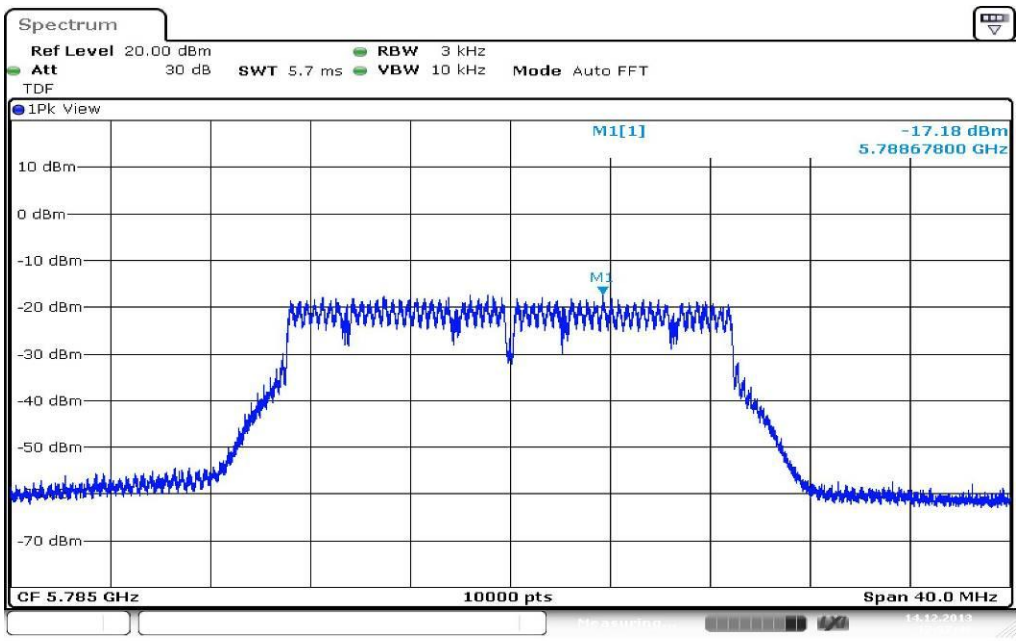
Plots: OFDM / ac – mode HT20

Plot 1: TX mode, lowest channel



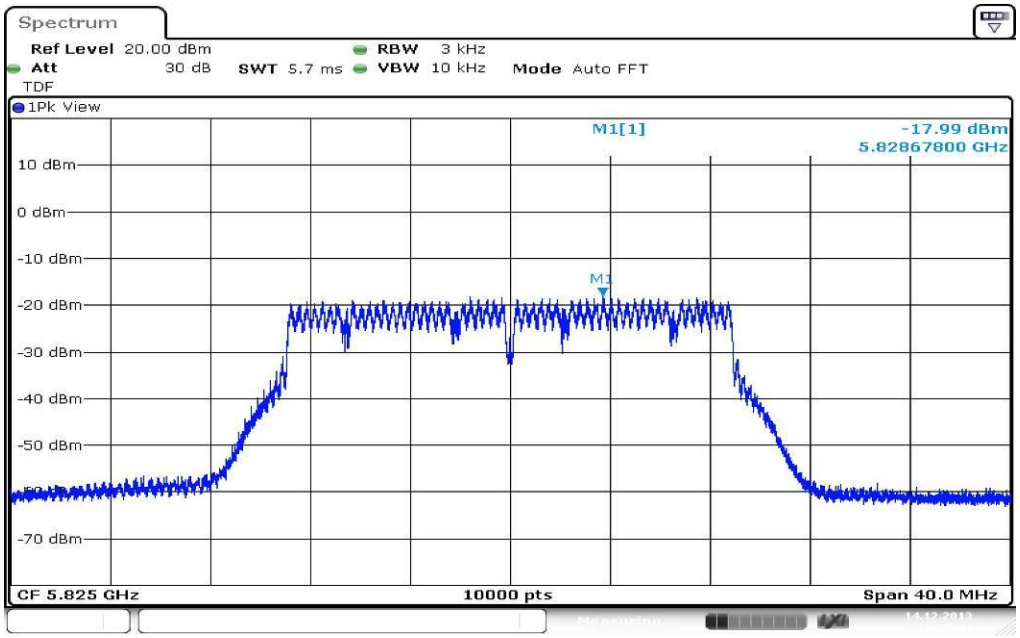
Date: 14.DEC.2013 17:15:53

Plot 2: TX mode, middle channel



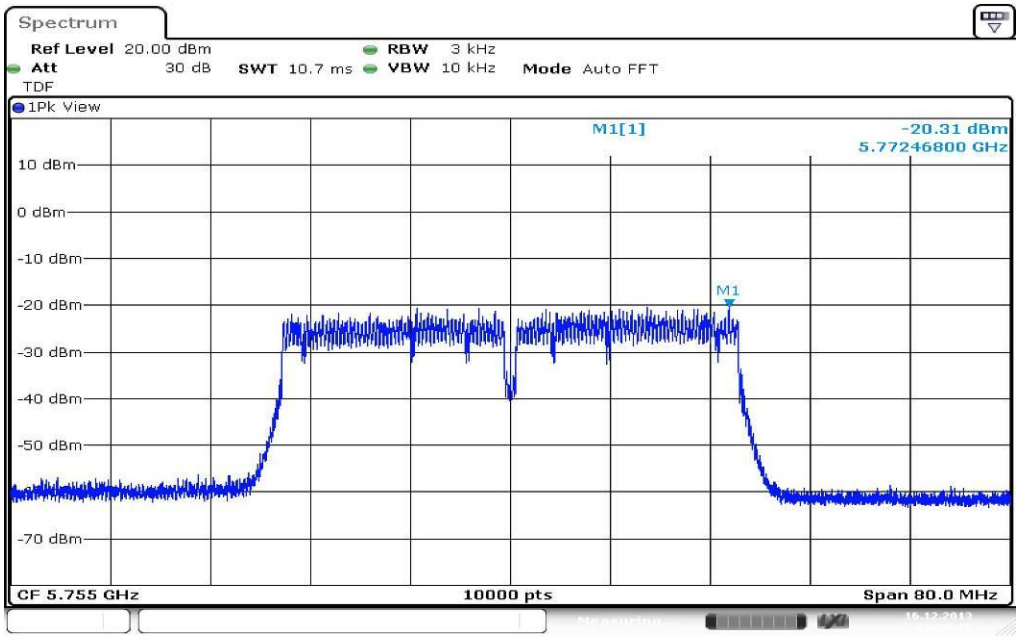
Date: 14.DEC.2013 17:37:49

Plot 3: TX mode, highest channel



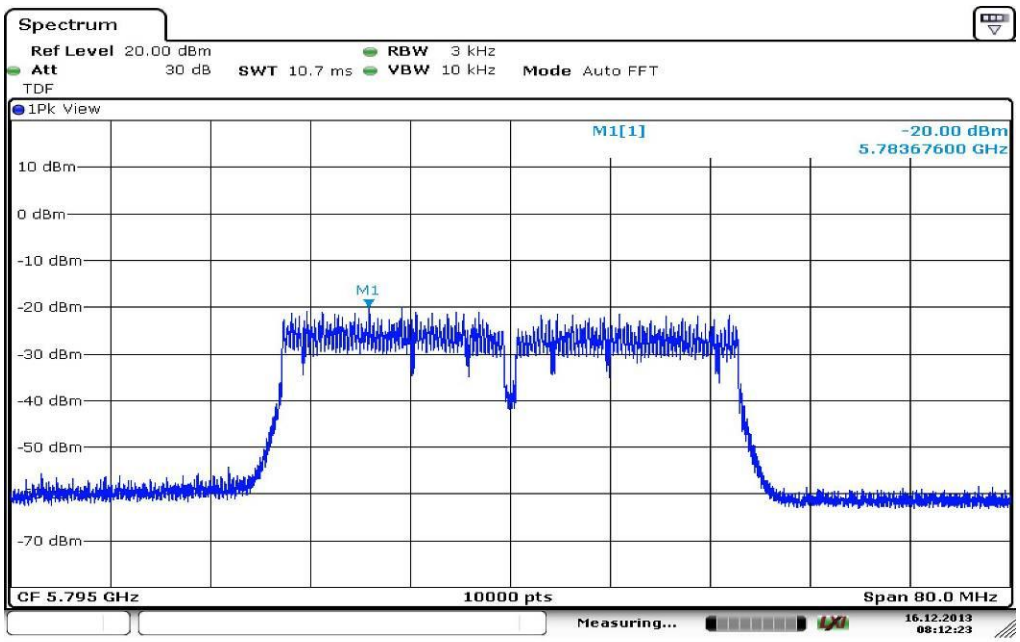
Plots: OFDM / ac – mode HT40

Plot 1: TX mode, lowest channel



Date: 16.DEC.2013 07:50:27

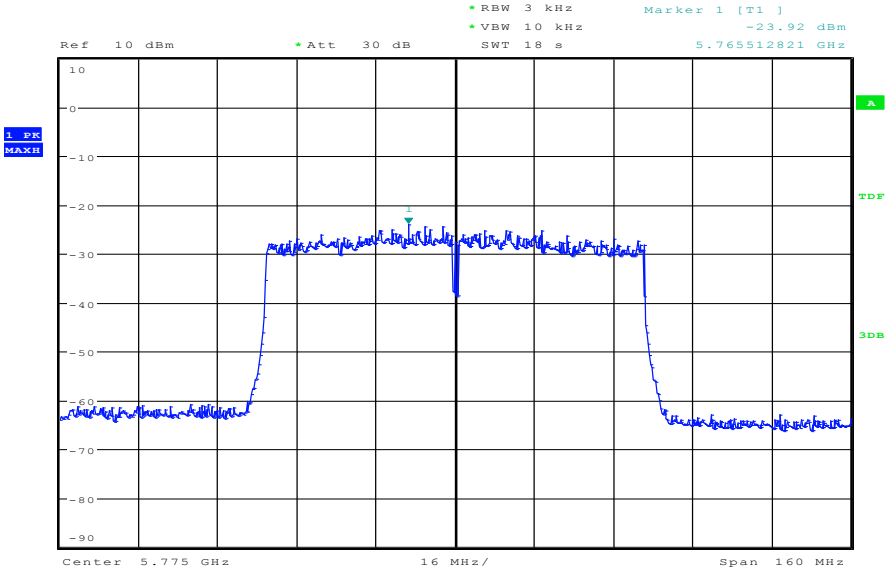
Plot 2: TX mode, highest channel



Date: 16.DEC.2013 08:12:24

Plots: OFDM / ac – mode HT80

Plot 1: TX mode, lowest channel



Date: 7.JAN.2014 09:53:11

10.5 DTS bandwidth

Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
According to: DTS clause 8.2	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	40 MHz / 80 MHz / 160 MHz
Measurement procedure:	Measurement of the 75% bandwidth using the integration function of the analyzer
Trace-Mode:	Max hold (allow trace to stabilize)

Limits:

FCC	-/-
Spectrum Bandwidth – 6 dB	
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

Modulation	6 dB bandwidth [MHz]		
Frequency	Lowest channel	Middle channel	Highest channel
OFDM / a – mode	12.43	12.29	12.36
OFDM / ac – mode HT20	13.30	13.17	13.24
OFDM / ac – mode HT40	27.17		27.41
OFDM / ac – mode HT80	53.33		
Measurement uncertainty	± RBW		

Result: **Passed**

10.6 Occupied bandwidth

Description:

Measurement of the 20 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 - 5% of the used span
Video bandwidth:	≥ 3 x RBW
Span:	Complete signal
Measurement procedure:	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace-Mode:	Max hold (allow trace to stabilize)

Limits:

-/-	-/-
Spectrum Bandwidth – 20 dB	
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

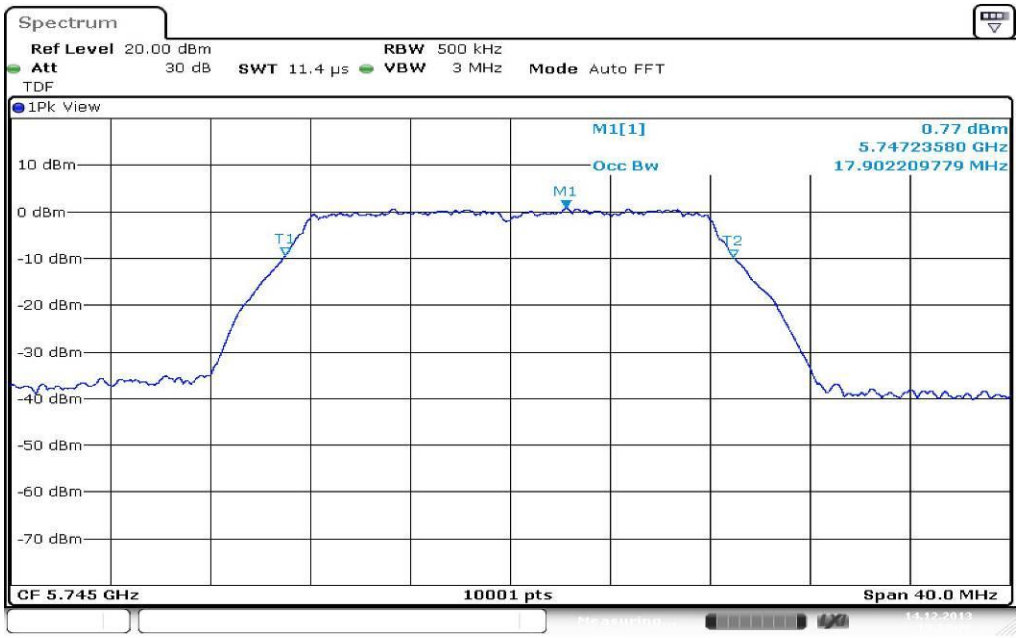
Results:

Modulation	20 dB bandwidth [MHz]		
Frequency	Lowest channel	Middle channel	Highest channel
OFDM / a – mode	17.90	17.82	17.86
OFDM / ac – mode HT20	18.39	18.30	18.41
OFDM / ac – mode HT40	36.72		36.79
OFDM / ac – mode HT80	78.80		
Measurement uncertainty	± RBW		

Result: **Passed**

Plots: OFDM / a – mode

Plot 1: TX mode, lowest channel

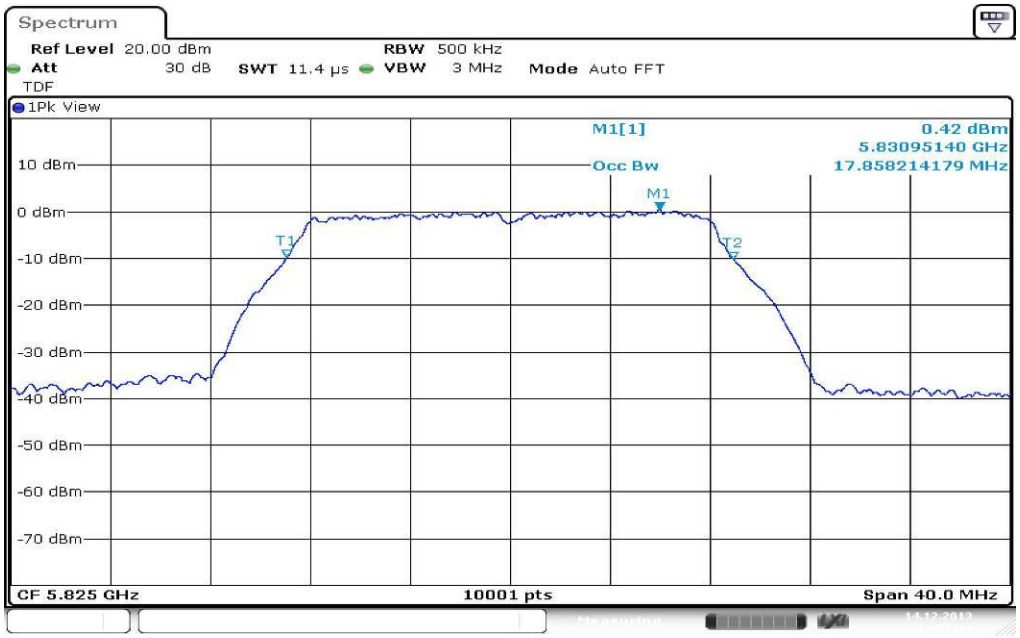


Date: 14.DEC.2013 13:23:23

Plot 2: TX mode, middle channel

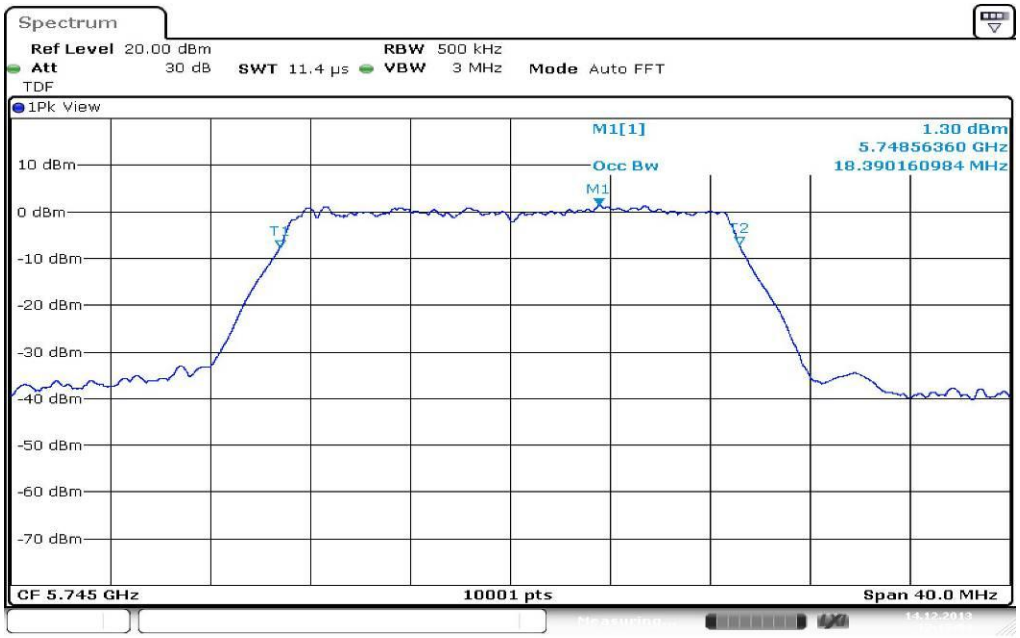
Date: 14.DEC.2013 13:45:19

Plot 3: TX mode, highest channel



Plots: OFDM / ac – mode HT20

Plot 1: TX mode, lowest channel

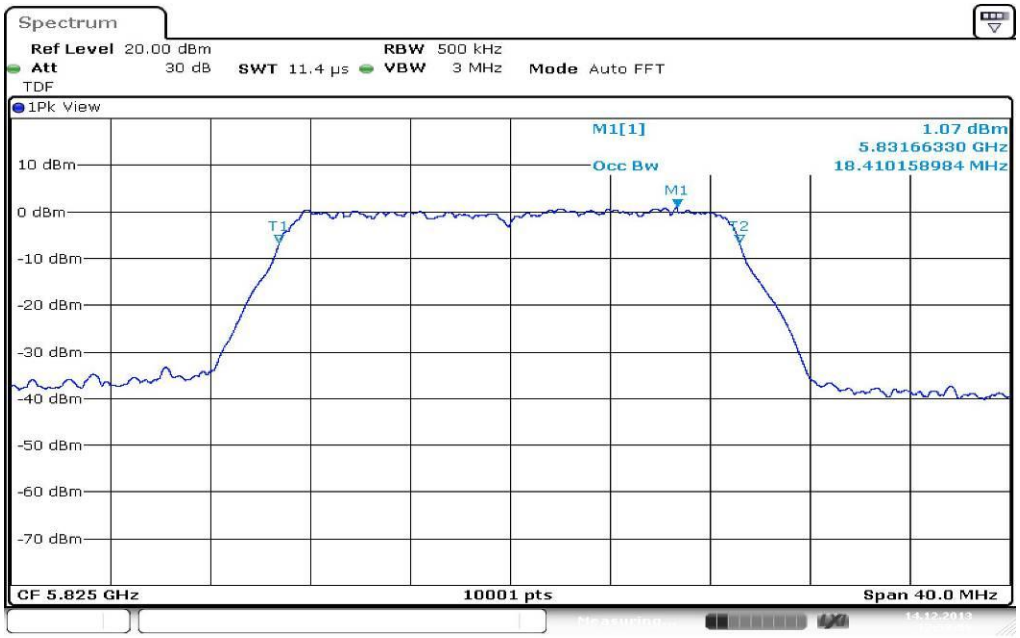


Date: 14.DEC.2013 17:15:04

Plot 2: TX mode, middle channel

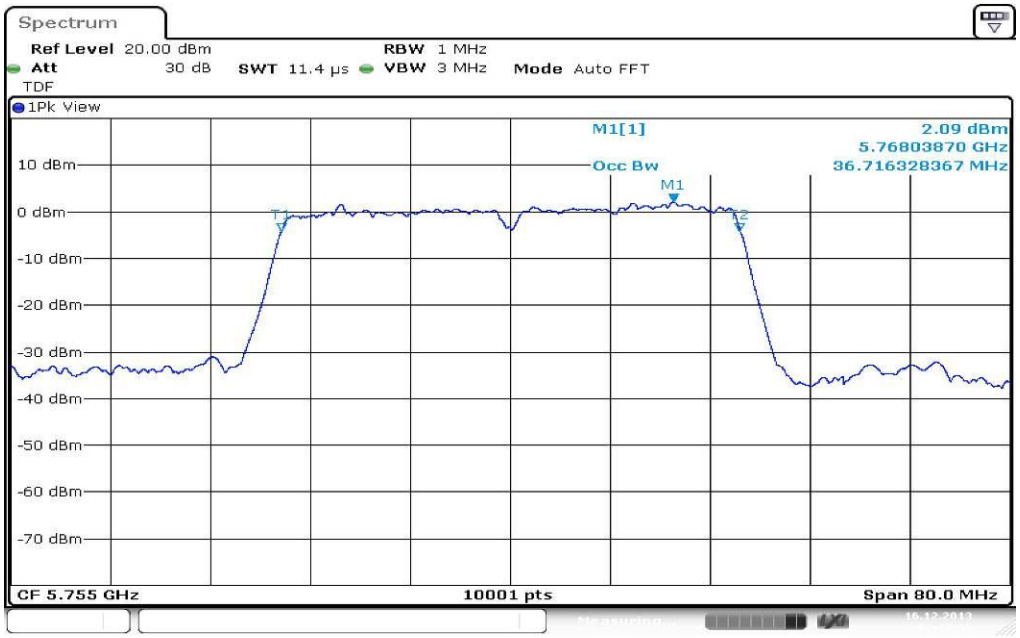
Date: 14.DEC.2013 17:37:00

Plot 3: TX mode, highest channel



Plots: OFDM / ac – mode HT40

Plot 1: TX mode, lowest channel



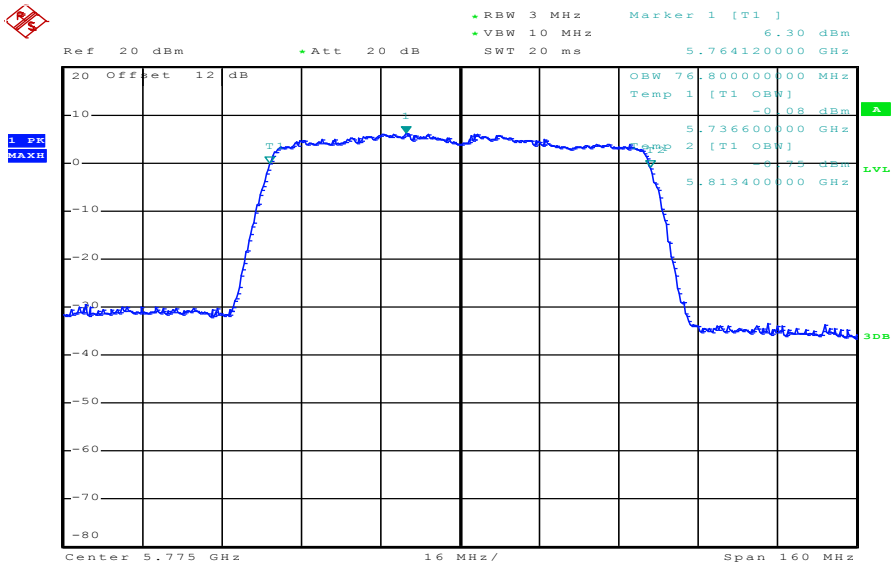
Date: 16.DEC.2013 07:49:39

Plot 2: TX mode, highest channel

Date: 16.DEC.2013 08:11:36

Plots: OFDM / ac – mode HT80

Plot 1: TX mode, mid channel



Date: 7.JAN.2014 13:43:28

10.7 TX spurious emissions conducted

Description:

Measurement of the conducted spurious emissions in transmit mode The measurement is performed at the lowest, middle and highest channel. The measurement is repeated for all modulations.

Measurement:

Measurement parameter	
According to: DTS clause 11.1 & 2	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	500 kHz
Span:	9 kHz to 25 GHz
Trace-Mode:	Max Hold

Limits:

FCC	-/-
TX Spurious Emissions Conducted	
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required	

Results: OFDM / a – mode

TX Spurious Emissions Conducted					
OFDM / a – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
5745		-3.49	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
5785		-3.17	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
5825		-3.74	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
Measurement uncertainty		± 3 dB			

Result: **Passed**

Results: OFDM / ac – mode HT20

TX Spurious Emissions Conducted					
OFDM / ac – mode HT20					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
5745		-4.13	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
5785		-3.44	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
5825		-4.34	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
Measurement uncertainty		± 3 dB			

Result: **Passed**

Results: OFDM / ac – mode HT40

TX Spurious Emissions Conducted					
OFDM / ac – mode HT40					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
5755		-6.43	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
5785		-6.74	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
Measurement uncertainty		± 3 dB			

Result: **Passed**

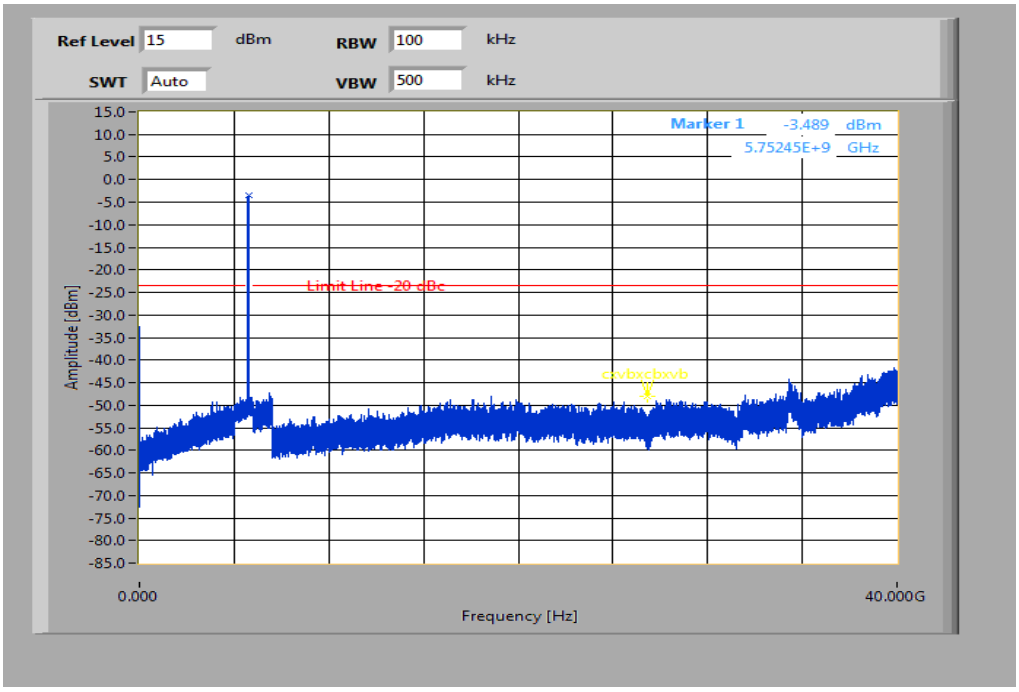
Results: OFDM / ac – mode HT80

TX Spurious Emissions Conducted					
OFDM / ac – mode HT80					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
5775		-10.22	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
Measurement uncertainty		± 3 dB			

Result: **Passed**

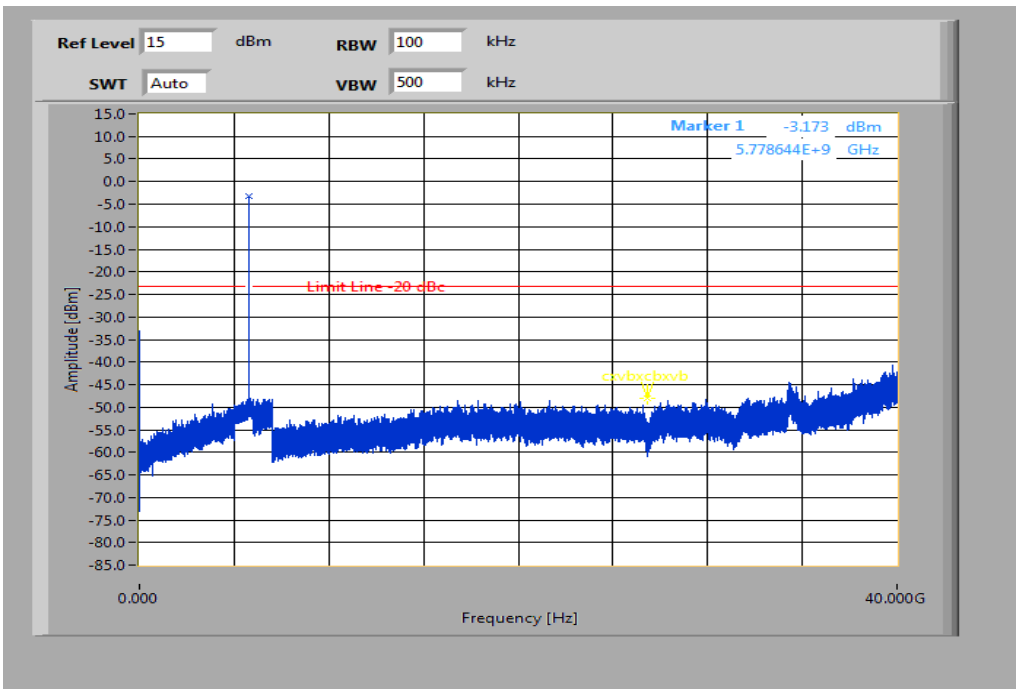
Plots: **OFDM / a – mode**

Plot 1: TX mode, lowest channel, up to 40 GHz



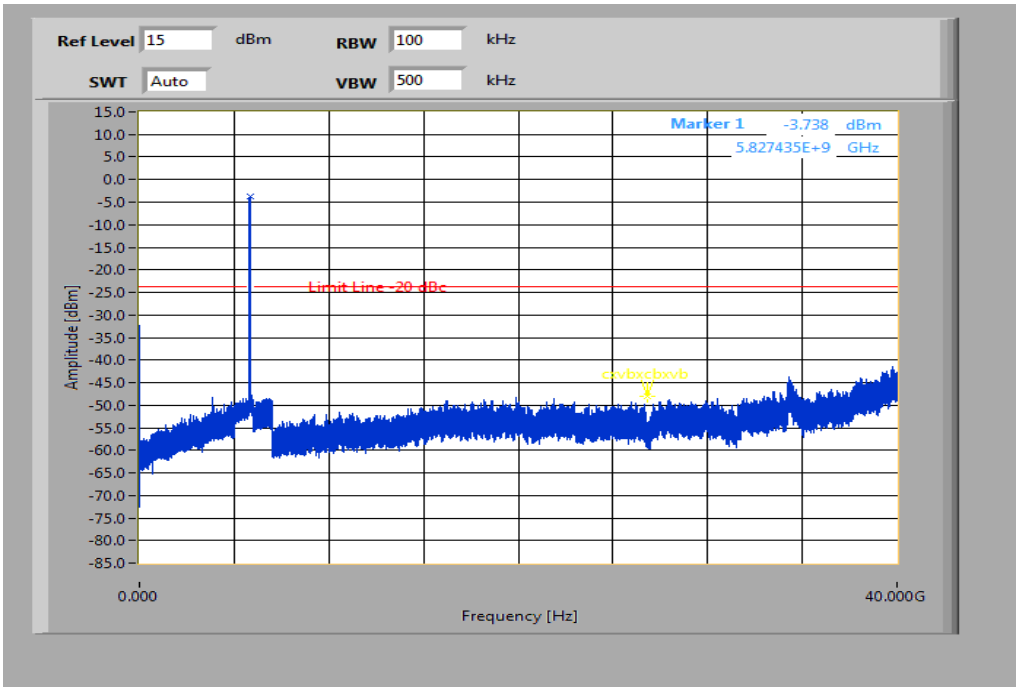
The peak at the beginning of the plot is the LO from the SA.

Plot 2: TX mode, middle channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.

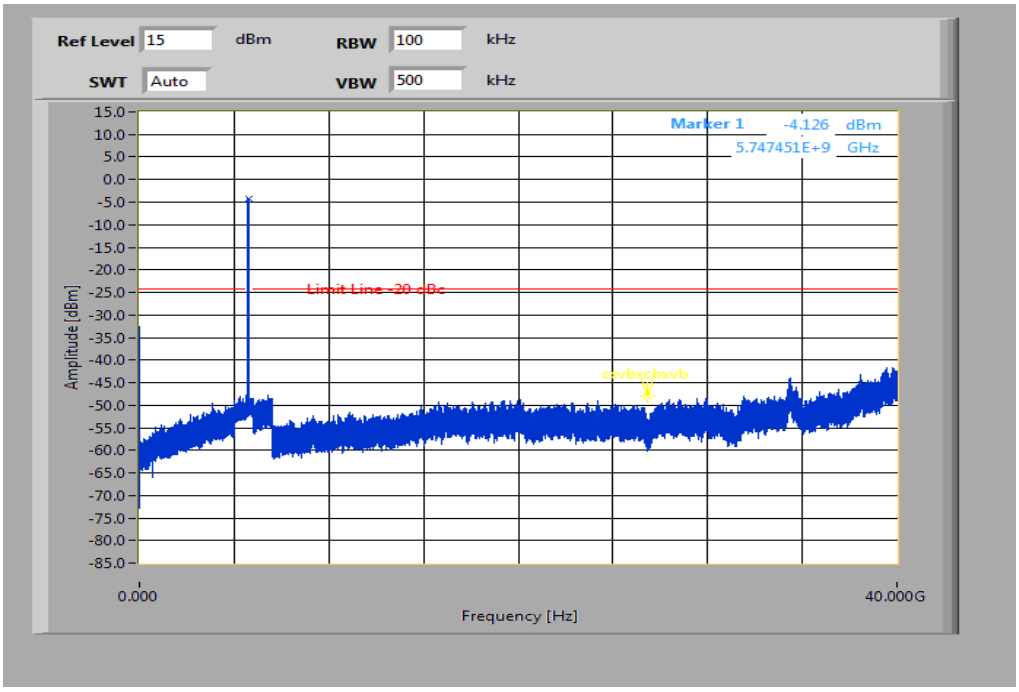
Plot 3: TX mode, highest channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.

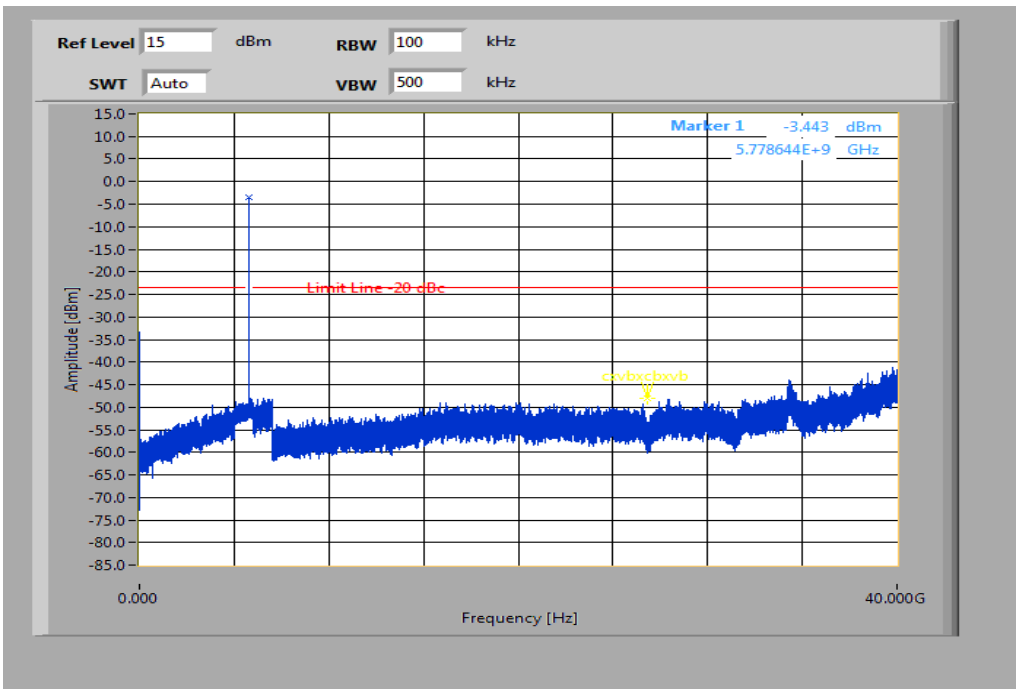
Plots: **OFDM / n/ac – mode HT20**

Plot 1: TX mode, lowest channel, up to 40 GHz



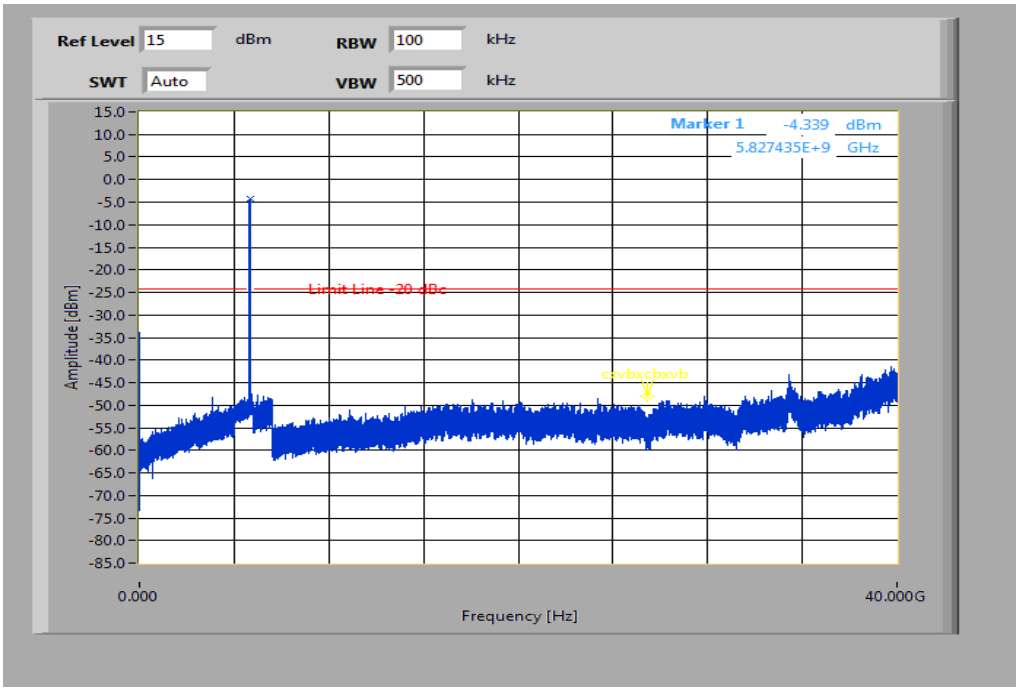
The peak at the beginning of the plot is the LO from the SA.

Plot 2: TX mode, middle channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.

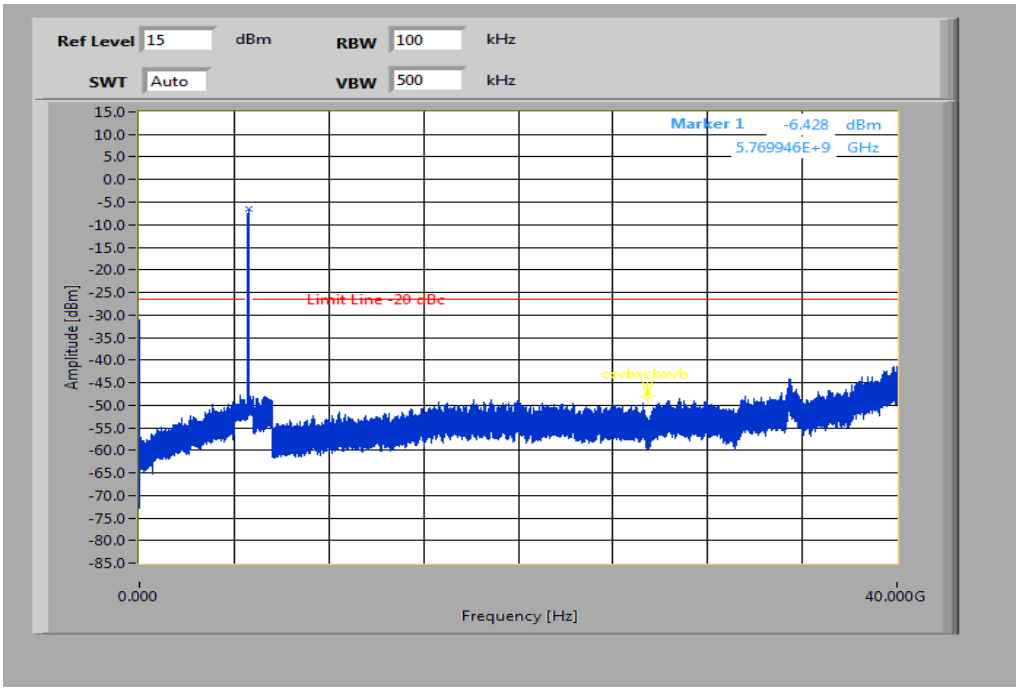
Plot 3: TX mode, highest channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.

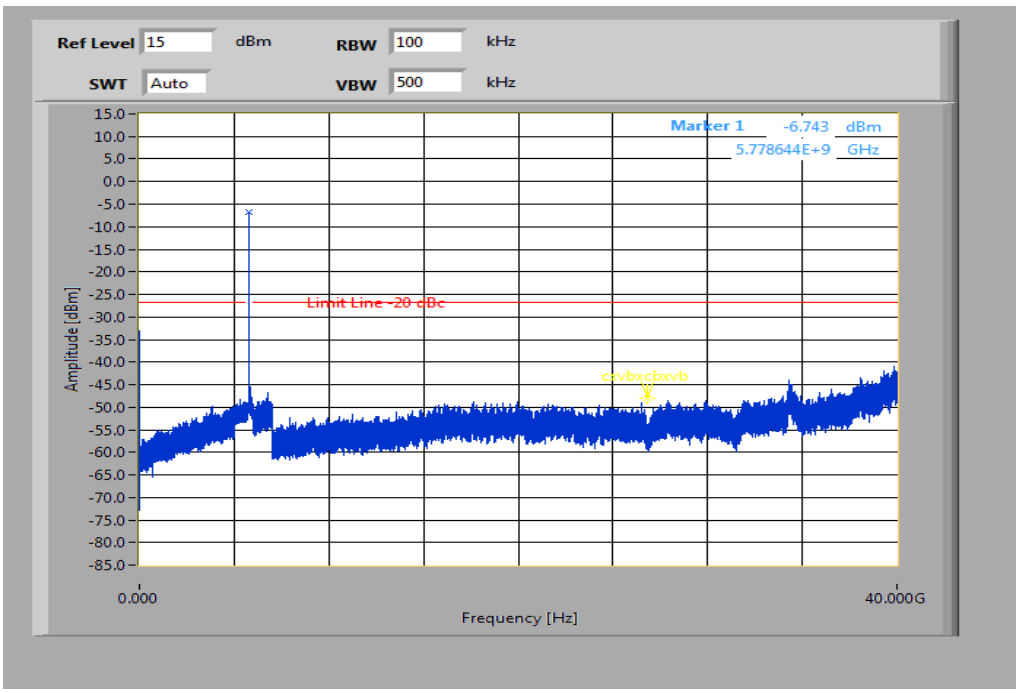
Plots: **OFDM / n/ac – mode HT40**

Plot 1: TX mode, lowest channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.

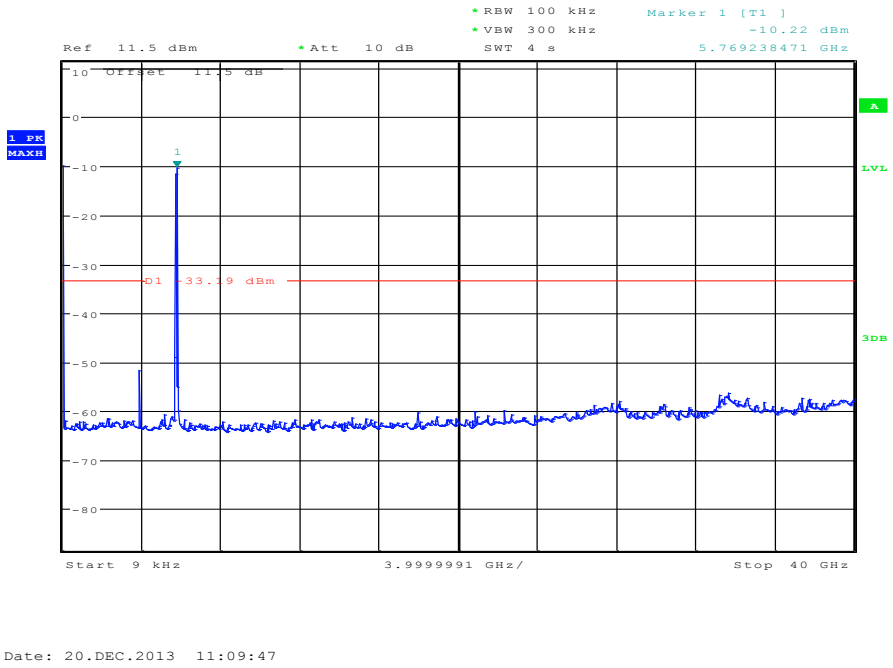
Plot 2: TX mode, highest channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.

Plots: **OFDM / ac – mode HT80**

Plot 1: TX mode, lowest channel, up to 40 GHz



The peak at the beginning of the plot is the LO from the SA.