
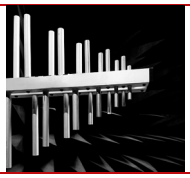
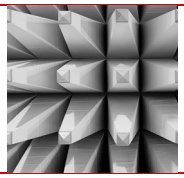

CETECOM™
CETECOM ICT Services
consulting - testing - certification

TEST REPORT

Test report no.: 1-0585/15-01-05

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-00

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
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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-12076-01-00

Applicant

Neratec Solutions AG
Rosswiesstrasse 29
8608 Bubikon / SWITZERLAND
Phone: +41 55 253 20 78
Fax: +41 55 253 20 70
Contact: Michael Aeschbacher
e-mail: michael.aeschbacher@neratec.com
Phone: +41 55 253 20 73

Manufacturer

Neratec Solutions AG
Rosswiesstrasse 29
8608 Bubikon / SWITZERLAND

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

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

Test Item

Kind of test item:	**WLAN modem**
Model name:	**DT50RF MK2**
FCC ID:	**2AEJD-103902-DT50RF**
IC:	**9301A-103902DT50**
Frequency:	UNII bands 5150 MHz to 5250 MHz; 5250 MHz to 5350 MHz; 5470 MHz to 5725 MHz and 5725 MHz to 5850 MHz
Technology tested:	WLAN (OFDM/a-; n HT20- & n HT40-mode)
Antenna:	External Sencity® rail excel antenna – up to 2 x SPA-5600/45/12/10/V
Power supply:	3.3 V DC by external power supply
Temperature range:	-40°C to +85°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 authorized:

cn=Marco Bertolino, o=CETECOM ICT Services GmbH, ou=BTL-150828, email=marco.bertolino@cetecom.com, c=DE
2016.04.26 09:23:58 +02'00'

Marco Bertolino
Lab Manager
Radio Communications & EMC

Test performed:

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2016.04.26 09:11:39 +02'00'

Andreas Luckenbill
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

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

2.2 Application details

Date of receipt of order:	2015-12-02
Date of receipt of test item:	2015-12-02
Start of test:	2015-12-07
End of test:	2016-04-13
Person(s) present during the test:	-/-

3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 15	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	November 2014	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

Guidance	Version	Description
UNII: KDB 789033 D02	v01r01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E
UNII: KDB 905462 D02	v01r02	Compliance measurement procedures for unlicensed - national information infrastructure devices operating in the 5250 - 5350 MHz and 5470 - 5725 MHz bands incorporating dynamic frequency selection
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices
KDB 662911 D01	V02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+23 °C during room temperature tests No tests under extreme conditions required! No tests under extreme conditions required!
Relative humidity content	:		55 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	V_{nom} V_{max} V_{min}	3.3 V DC by external power supply No tests under extreme conditions required! No tests under extreme conditions required!

5 Test item

5.1 General description

Kind of test item	:	WLAN modem
Type identification	:	DT50RF MK2
HMN	:	-/-
PMN	:	DT50RF_MK2
HVIN	:	DT50RF_MK2
FVIN	:	6.6
S/N serial number	:	Conducted unit: 0060010001030016 Radiated unit: 0060010001030021
HW hardware status	:	MK2
SW software status	:	6.6
Frequency band	:	UNII bands 5150 MHz to 5250 MHz; 5250 MHz to 5350 MHz; 5470 MHz to 5725 MHz and 5725 MHz to 5850 MHz
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	BPSK, QPSK, 16 – QAM, 64 – QAM
Antenna	:	External Sencity® rail excel antenna – up to 2 x SPA-5600/45/12/10/V
Power supply	:	3.3 V DC by external power supply
Temperature range	:	-40°C to +85°C

5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report: 1-0585/15-01-01_AnnexA
1-0585/15-01-01_AnnexB
1-0585/15-01-01_AnnexD

6 Test laboratories sub-contracted

None

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

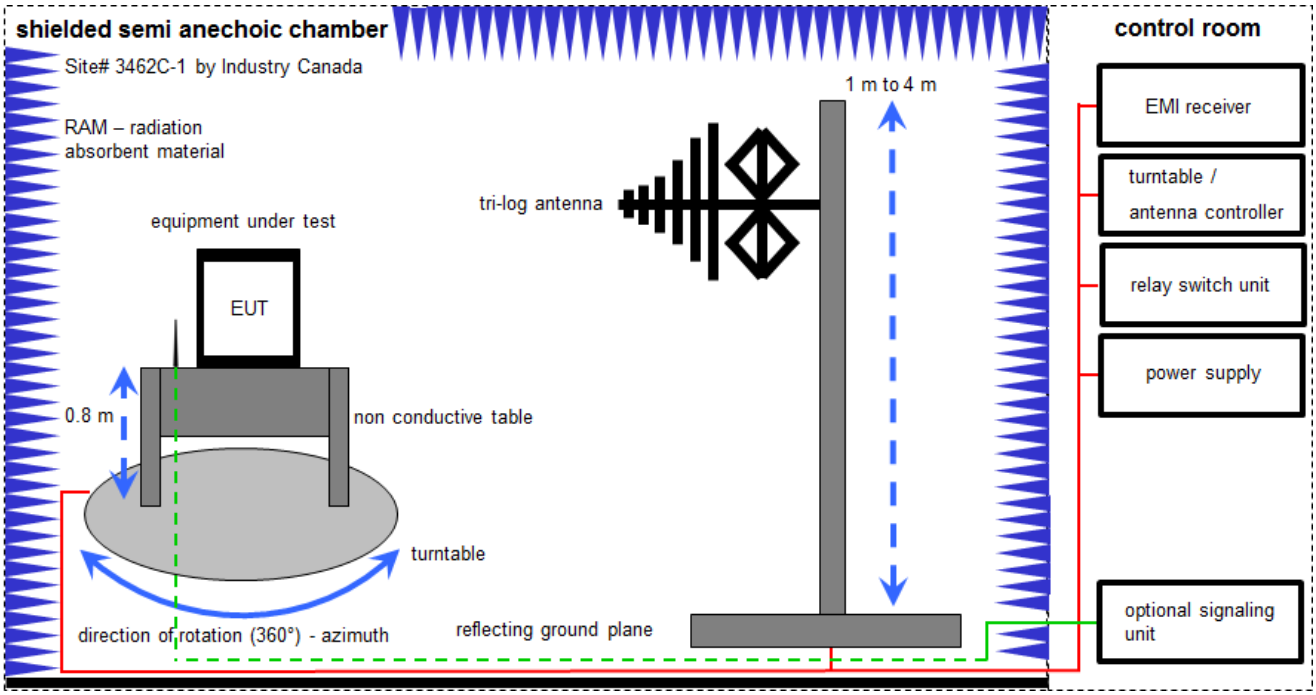
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

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 analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

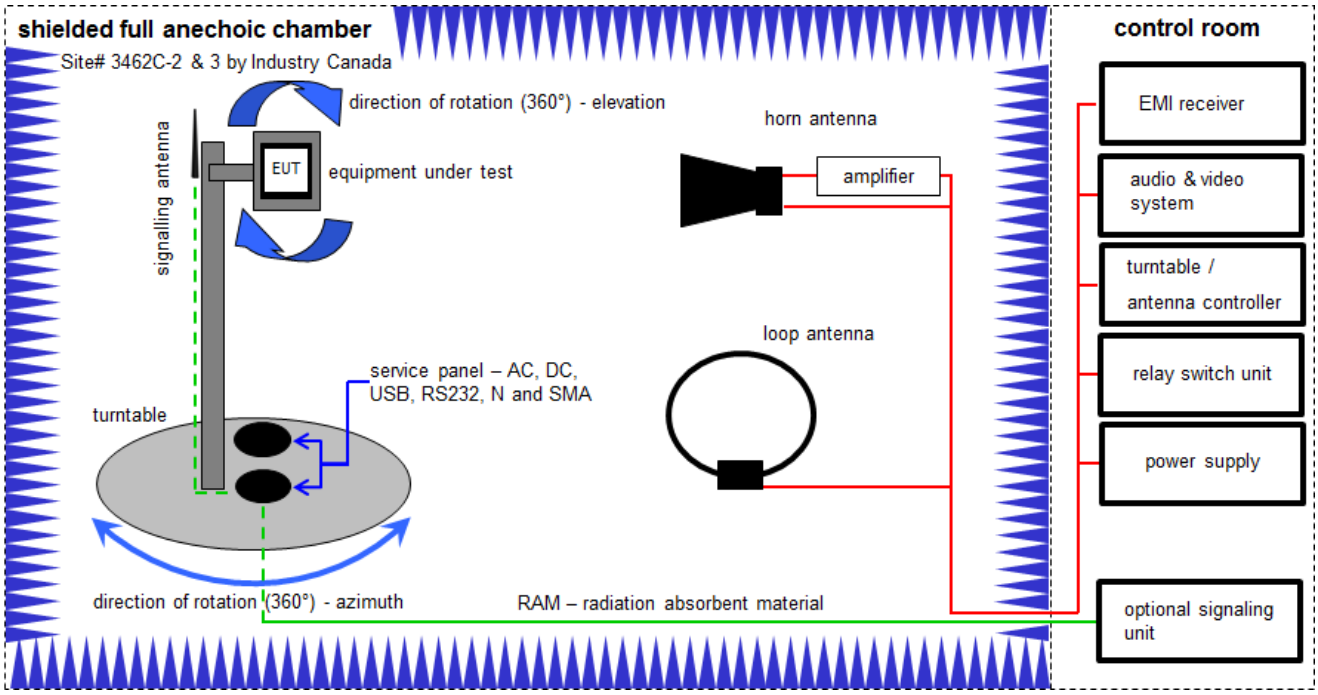
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	26.01.2016	27.01.2017
2	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
3	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
4	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
5	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

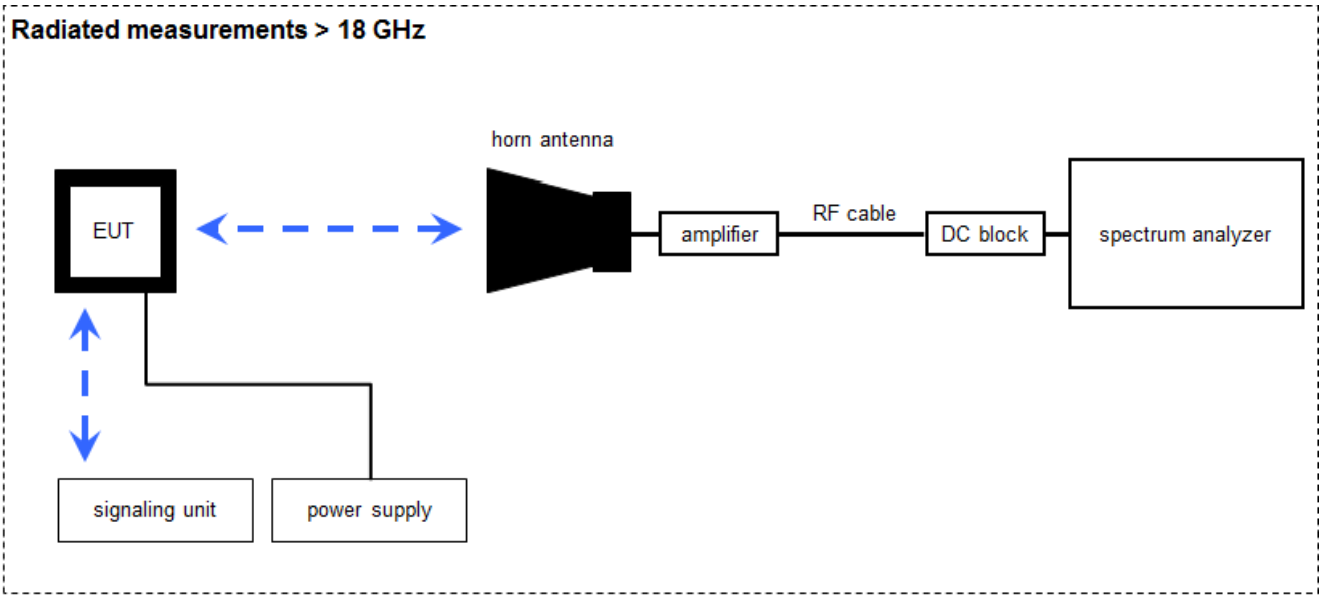
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	Ve	20.01.2015	20.01.2018
2	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vlKl!	20.05.2015	20.05.2017
3	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	A, B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
5	A, B	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
6	A	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne	-/-	-/-
7	A	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
8	A	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
9	A, B	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	k	04.09.2015	04.09.2016
10	C	Signal Analyzer	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
11	C	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
12	C	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
13	C	RF-Cable	ST18/SMAm/SMm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
14	C	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 606844	400001185	ev	-/-	-/-
15	C	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	14.08.2015	14.08.2017

7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

FS = U_R + CA + AF
(FS-field strength; U_R-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

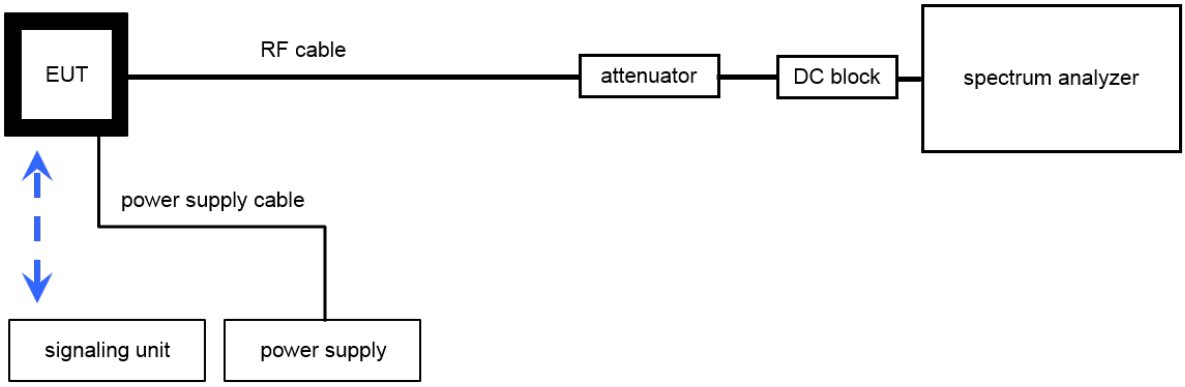
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
2	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
3	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
4	A	RF-Cable	ST18/SMAm/SMm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
5	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 606844	400001185	ev	-/-	-/-
6	A	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8402	300000486	k	10.09.2015	10.09.2017
7	A	Std. Gain Horn Antenna 26.5 to 40.0 GHz	V637	Narda	82-16	300000510	k	14.08.2015	14.08.2017

7.4 Conducted measurements

Conducted measurements normal conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A4523	300004589	ne	-/-	-/-
2	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	2V2403033A4523	300004590	ne	-/-	-/-
3	A	RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
4	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 606844	400001185	ev	-/-	-/-
5	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the premeasurement are maximized by the software by rotating the turntable from 0° to 360°. In case of the 2-axis positioner is used the elevation axis is also rotated from 0° to 360°.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Antenna gain	± 3 dB
Power spectral density	± 1.5 dB
Spectrum bandwidth	± 100 kHz (depends on the used RBW)
Occupied bandwidth	± 100 kHz (depends on the used RBW)
Maximum output power	± 1.5 dB
Minimum emissions bandwidth	± 100 kHz (depends on the used RBW)
Spurious emissions conducted	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB

10 Summary of measurement results

☐	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☒	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS 247, Issue 1	see table	2016-04-22	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	C	NC	NA	NP	Remark
-/-	Output power verification (conducted)	Nominal	Nominal	-/-				-/-
-/-	Antenna gain	Nominal	Nominal	-/-				Declared
U-NII Part 15	Duty cycle	Nominal	Nominal	-/-				-/-
§15.407(a) RSS - 247 (6.2.1) (1) RSS - 247 (6.2.2) (1) RSS - 247 (6.2.3) (1) RSS - 247 (6.2.4) (1)	Maximum output power (conducted & radiated)	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.407(a) RSS - 247 (6.2.1) (1) RSS - 247 (6.2.2) (1) RSS - 247 (6.2.3) (1) RSS - 247 (6.2.4) (1)	Power spectral density	Nominal	Nominal	☒	☐	☐	☐	-/-
RSS - 247 (6.2.4)	Spectrum bandwidth 6dB bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.407(a)	Spectrum bandwidth 26dB bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
RSS Gen clause 6.6	Spectrum bandwidth 99% bandwidth	Nominal	Nominal	-/-				-/-
§15.205 RSS - 247 (6.2.1) (2) RSS - 247 (6.2.2) (2) RSS - 247 (6.2.3) (2) RSS - 247 (6.2.4) (2)	Band edge compliance radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.407(b) RSS - 247 (6.2.1) (2) RSS - 247 (6.2.2) (2) RSS - 247 (6.2.3) (2) RSS - 247 (6.2.4) (2)	TX spurious emissions radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.109 RSS-Gen	RX spurious emissions radiated	Nominal	Nominal	☐	☐	☐	☒	*
§15.209(a) RSS-Gen	Spurious emissions radiated < 30 MHz	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Spurious emissions conducted emissions < 30 MHz	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.407 RSS - 247 (6.3)	DFS	Nominal	Nominal	☐	☐	☐	☒	See report 1-0585/15-01-06 & 07

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

* Test cases performed under the project number: 1-0585/15-02

11 Additional comments

Reference documents: 5G_Shark_Special_12dBi_HuberSuhner

Antennas_DT50RF_Module_Certification

Cetecom_Customer_Questionnaire

Offer_request_Cetecom

PowerSettings_Shark_SPA_5600_45_12_10_V

Special test descriptions: EUT supports 2 TX / RX antennas with 2 spatial streams

Configuration descriptions:

Channel	36	38	40	44	46	48	52	54	56	60	62	64
Center Frequency	5180 MHz	5190 MHz	5200 MHz	5220 MHz	5230 MHz	5240 MHz	5260 MHz	5270 MHz	5280 MHz	5300 MHz	5310 MHz	5320 MHz
a	9		8	9		9	13		13	13		13
n20	9		9	9		9	13		13	13		13
n40		10			10			13			11	

Channel	100	102	104	108	110	112	116	118	120	124	126	128	132	134	136	140
Center Frequency	5500 MHz	5510 MHz	5520 MHz	5540 MHz	5550 MHz	5560 MHz	5580 MHz	5590 MHz	5600 MHz	5620 MHz	5630 MHz	5640 MHz	5660 MHz	5670 MHz	5680 MHz	5700 MHz
a	13		13	13		13	13		13	13		13	13		13	13
n20	13		13	13		13	13		13	13		13	13		13	13
n40		11			13			13			13			13		

Channel	149	151	153	157	159	161	165
Center Frequency	5745 MHz	5755 MHz	5765 MHz	5785 MHz	5795 MHz	5805 MHz	5825 MHz
a	13		13	13		12	11
n20	13		13	13		12	11
n40		13			13		

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

Antennas and transmit operating modes:

☐ Operating mode 1 (single antenna)

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

☒ Operating mode 2 (multiple antennas, no beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*

☐ Operating mode 3 (multiple antennas, with beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.*
  In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

12 Measurement results

12.1 Identify worst case data rate

Measurement:

All modes of the module will be measured with an average power meter or spectrum analyzer to identify the maximum transmission power.

In further tests only the identified worst case modulation scheme or bandwidth will be measured and this mode is used as representative mode for all other modulation schemes.

Additional the band edge compliance test will be performed in the lowest and highest modulation scheme.

Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	3 MHz
Trace mode:	Max hold
Used test setup:	see chapter 7.4 – A
Measurement uncertainty:	see chapter 9

Results:

Modulation	Modulation scheme / bandwidth					
Frequency	5180 MHz	5320 MHz	5500 MH	5700 MHz	5745 MHz	5825 MHz
OFDM / a – mode	6 Mbit/s	6 Mbit/s	6 Mbit/s	6 Mbit/s	6 Mbit/s	6 Mbit/s
OFDM / n HT20 – mode	MCS0	MCS0	MCS0	MCS0	MCS0	MCS0
Frequency	5190 MHz	5310 MHz	5510 MHz	5670 MHz	5755 MHz	5815 MHz
OFDM / n HT40 – mode	MCS0	MCS0	MCS0	MCS0	MCS0	MCS0

12.2 Antenna gain

Limits:

FCC	IC
6 dBi / > 6 dBi output power and power density reduction required	

Results:

T_{nom}	V_{nom}	UNII bands
Gain [dBi] Declared by the manufacturer		12

Product Configuration

Technical Data

Electrical Data

	Band 1	Band 2
Frequency (MHz)	4900 - 5150	5150 - 5935
VSWR	1.6	1.4
Gain (dBi)	12	12
3dB beamwidth (h) (°)	50	42
3dB beamwidth (v) (°)	18	16

Note: output power limit and power spectral density limit shall be reduced by 6 dB.

12.3 Duty cycle

Description:

The duty cycle is necessary to compute the maximum power during an actual transmission. The shown plots and values are to show an example of the measurement procedure. The real value is measured direct during the power measurement or power density measurement. The correction value is shown in each plot of these measurements.

Measurement:

Measurement parameter	
According to: KDB789033 D02, B.	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	10 MHz
Video bandwidth:	10 MHz
Span:	Zero
Trace-Mode:	Video trigger / view / single sweep
Used test setup:	see chapter 7.4 – A
Measurement uncertainty:	see chapter 9

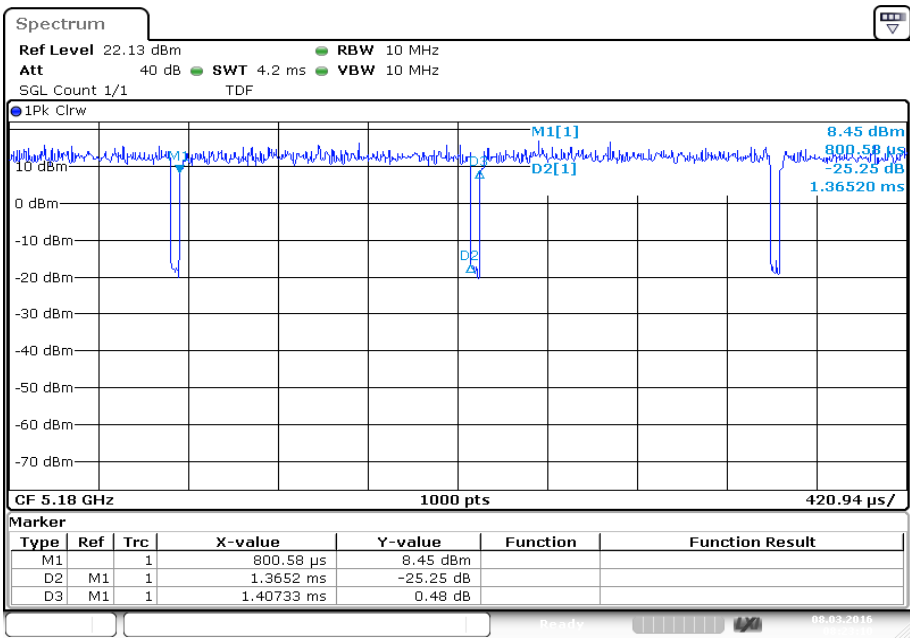
Results:

Duty cycle and correction factor: example for one channel and one antenna port

OFDM / a – mode:	97.01 % duty cycle	=>	0.13 dB
OFDM / n HT20 – mode:	97.00 % duty cycle	=>	0.13 dB
OFDM / n HT40 – mode:	94.91 % duty cycle	=>	0.23 dB

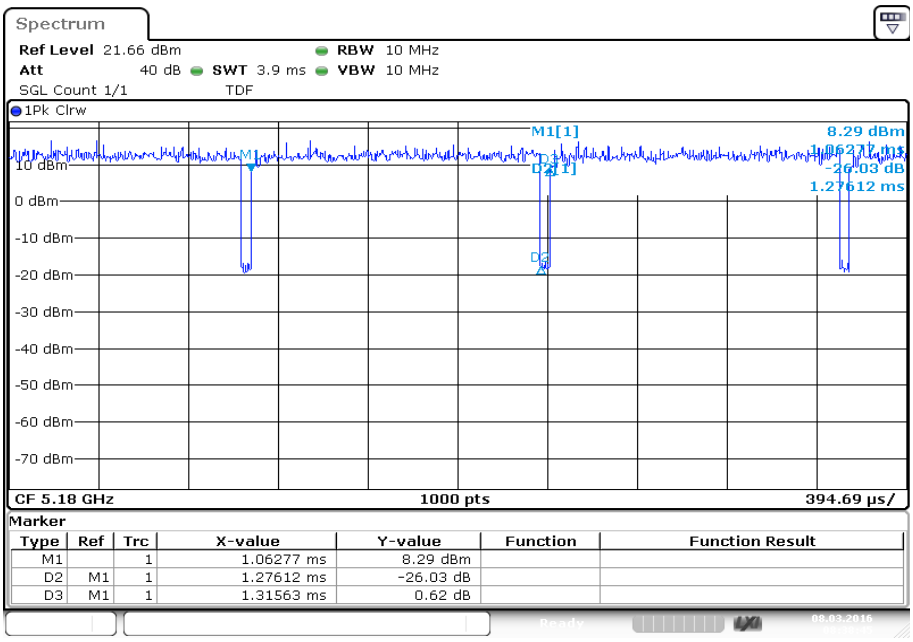
Plots:

Plot 1: duty cycle of the transmitter – OFDM / a – mode



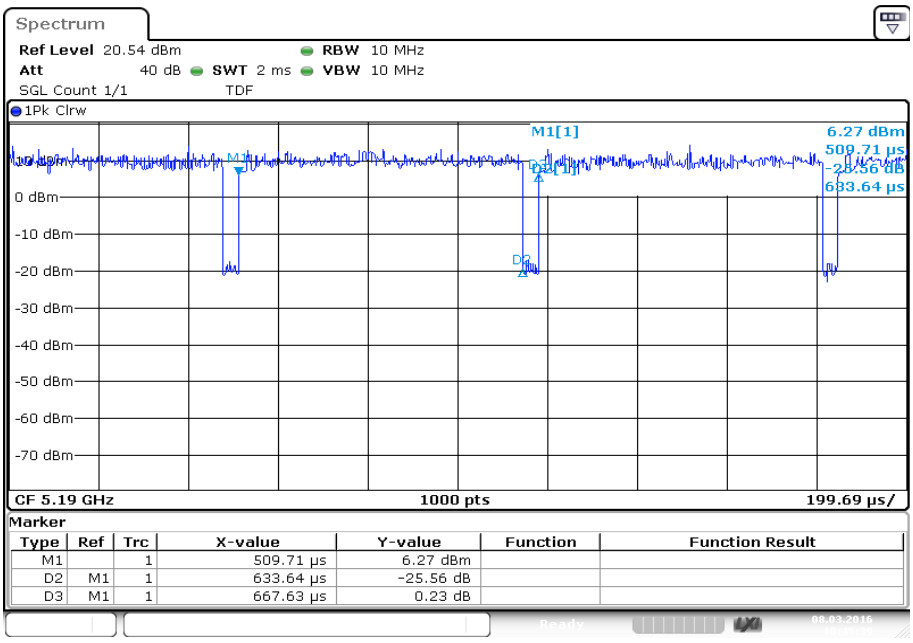
Date: 8.MAR.2016 08:23:10

Plot 2: duty cycle of the transmitter – OFDM / n HT20 – mode



Date: 8.MAR.2016 08:38:46

Plot 3: duty cycle of the transmitter – OFDM / n HT40 – mode



Date: 8.MAR.2016 10:45:40

12.4 Maximum output power conducted

Description:

Measurement of the maximum output power conduced

Measurement:

Measurement parameter	
According to: KDB789033 D02, E.2.e.	
Detector:	RMS
Sweep time:	≥10*(swp points)*(total on/off time)
Resolution bandwidth:	1 MHz
Video bandwidth:	≥ 3 MHz
Span:	> EBW
Trace-Mode:	Max hold
Analyser function	Band power / channel power Interval > 26 dB EBW
Used test setup:	see chapter 7.4 – A
Measurement uncertainty:	see chapter 9

Limits:

Radiated output power	Conducted output power
5.150-5.250 GHz **200 mW** or 10 dBm + 10 log Bandwidth **(IC)** All other bands: Conducted power + 6dBi antenna gain	**250mW 5.150-5.250 GHz (FCC)** The lesser one of **250mW** or 11 dBm + 10 log Bandwidth **5.250-5.350 GHz** **250mW** or 11 dBm + 10 log Bandwidth **5.470-5.725 GHz** (where Bandwidth is the 26dB Bandwidth [MHz]) **1W 5.725-5.85 GHz**
5.150-5.250 GHz **200 mW** or 10 dBm + 10 log Bandwidth **(IC)** All other bands: Conducted power + **12dBi** antenna gain*	**200 mW (EIRP) ≙ 13 mW (cond.) = 11 dBm (cond.)** **250 mW: 24 dBm – 6 dB = 18 dBm = 63 mW** **1 W: 30 dBm – 6 dB = 24 dBm = 250 mW**

Note: all limits shall be reduced by 6 dB because of 12 dBi antenna gain.

Result: antenna port 1

OFDM / a – mode	Maximum output power conducted [dBm]			
Channel	5180 MHz	5200 MHz	5300 MHz	5320 MHz
Including duty cycle correction factor	6.0	5.5	10.0	10.0
Channel	5500 MHz	5600 MHz	5700 MHz	-/-
Including duty cycle correction factor	9.8	10.2	10.6	-/-
Channel	5745 MHz	5785 MHz	5805 MHz	5825 MHz
Including duty cycle correction factor	10.2	10.8	9.6	9.0

OFDM / n HT20 – mode	Maximum output power conducted [dBm]			
Channel	5180 MHz	5200 MHz	5300 MHz	5320 MHz
Including duty cycle correction factor	6.0	6.1	9.9	10.0
Channel	5500 MHz	5600 MHz	5700 MHz	-/-
Including duty cycle correction factor	9.6	10.2	10.3	-/-
Channel	5745 MHz	5785 MHz	5805 MHz	5825 MHz
Including duty cycle correction factor	10.4	9.8	9.4	8.8

OFDM / n HT40 – mode	Maximum output power conducted [dBm]			
Channel	5190 MHz	5230 MHz	5270 MHz	5310 MHz
Including duty cycle correction factor	7.4	7.7	10.3	8.6
Channel	5510 MHz	5550 MHz	5630 MHz	5670 MHz
Including duty cycle correction factor	7.7	10.4	10.3	9.6
Channel	5755 MHz	5795 MHz	-/-	-/-
Including duty cycle correction factor	10.1	10.5	-/-	-/-

Result: antenna port 2

OFDM / a – mode	Maximum output power conducted [dBm]			
Channel	5180 MHz	5200 MHz	5300 MHz	5320 MHz
Including duty cycle correction factor	6.0	5.3	10.0	10.1
Channel	5500 MHz	5600 MHz	5700 MHz	-/-
Including duty cycle correction factor	10.0	10.5	11.1	-/-
Channel	5745 MHz	5785 MHz	5805 MHz	5825 MHz
Including duty cycle correction factor	11.3	11.0	10.3	9.0

OFDM / n HT20 – mode	Maximum output power conducted [dBm]			
Channel	5180 MHz	5200 MHz	5300 MHz	5320 MHz
Including duty cycle correction factor	6.0	6.3	10.1	10.0
Channel	5500 MHz	5600 MHz	5700 MHz	-/-
Including duty cycle correction factor	9.6	10.2	10.8	-/-
Channel	5745 MHz	5785 MHz	5805 MHz	5825 MHz
Including duty cycle correction factor	11.1	9.8	10.1	8.9

OFDM / n HT40 – mode	Maximum output power conducted [dBm]			
Channel	5190 MHz	5230 MHz	5270 MHz	5310 MHz
Including duty cycle correction factor	7.4	7.4	10.7	8.4
Channel	5510 MHz	5550 MHz	5630 MHz	5670 MHz
Including duty cycle correction factor	7.4	9.8	10.2	10.2
Channel	5755 MHz	5795 MHz	-/-	-/-
Including duty cycle correction factor	10.7	10.4	-/-	-/-

Result: antenna port 1 + antenna port 2

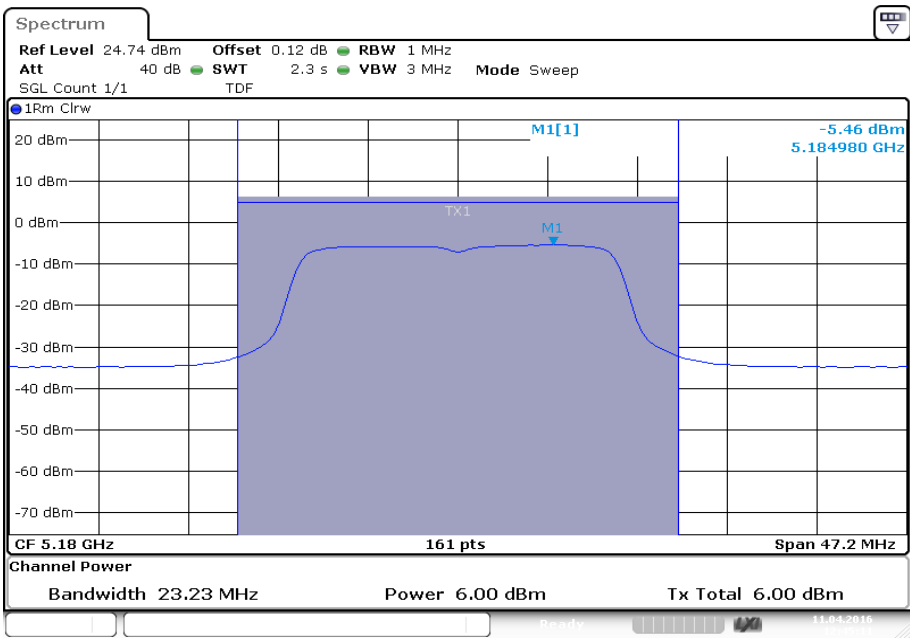
OFDM / a – mode	Maximum output power conducted [dBm]			
Channel	5180 MHz	5200 MHz	5300 MHz	5320 MHz
Including duty cycle correction factor	9.0	8.4	13.0	13.1
Channel	5500 MHz	5600 MHz	5700 MHz	-/-
Including duty cycle correction factor	12.9	13.4	13.9	-/-
Channel	5745 MHz	5785 MHz	5805 MHz	5825 MHz
Including duty cycle correction factor	13.8	13.9	13.0	12.0

OFDM / n HT20 – mode	Maximum output power conducted [dBm]			
Channel	5180 MHz	5200 MHz	5300 MHz	5320 MHz
Including duty cycle correction factor	9.0	9.2	13.0	13.0
Channel	5500 MHz	5600 MHz	5700 MHz	-/-
Including duty cycle correction factor	12.6	13.2	13.6	-/-
Channel	5745 MHz	5785 MHz	5805 MHz	5825 MHz
Including duty cycle correction factor	13.8	12.8	12.8	11.9

OFDM / n HT40 – mode	Maximum output power conducted [dBm]			
Channel	5190 MHz	5230 MHz	5270 MHz	5310 MHz
Including duty cycle correction factor	10.4	10.6	13.5	11.5
Channel	5510 MHz	5550 MHz	5630 MHz	5670 MHz
Including duty cycle correction factor	10.6	13.1	13.3	12.9
Channel	5755 MHz	5795 MHz	-/-	-/-
Including duty cycle correction factor	13.4	13.5	-/-	-/-

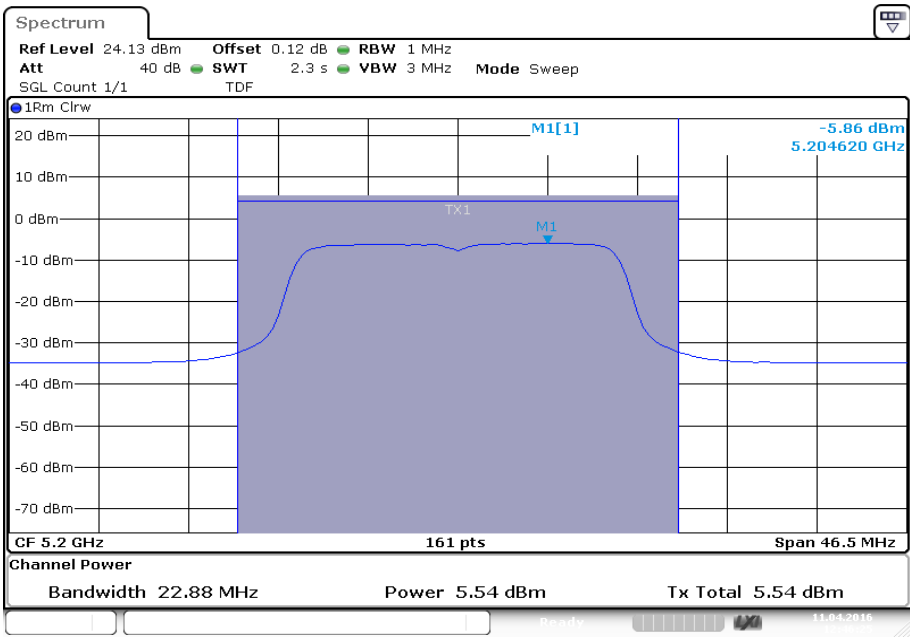
Plots: OFDM / a – mode, antenna port 1

Plot 1: 5180 MHz



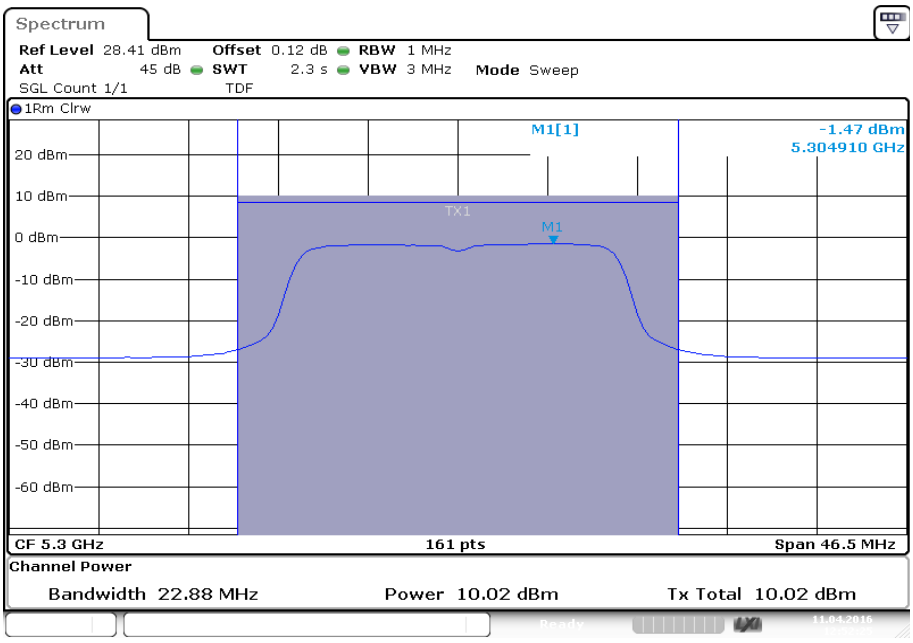
Date: 11.APR.2016 12:45:12

Plot 2: 5200 MHz



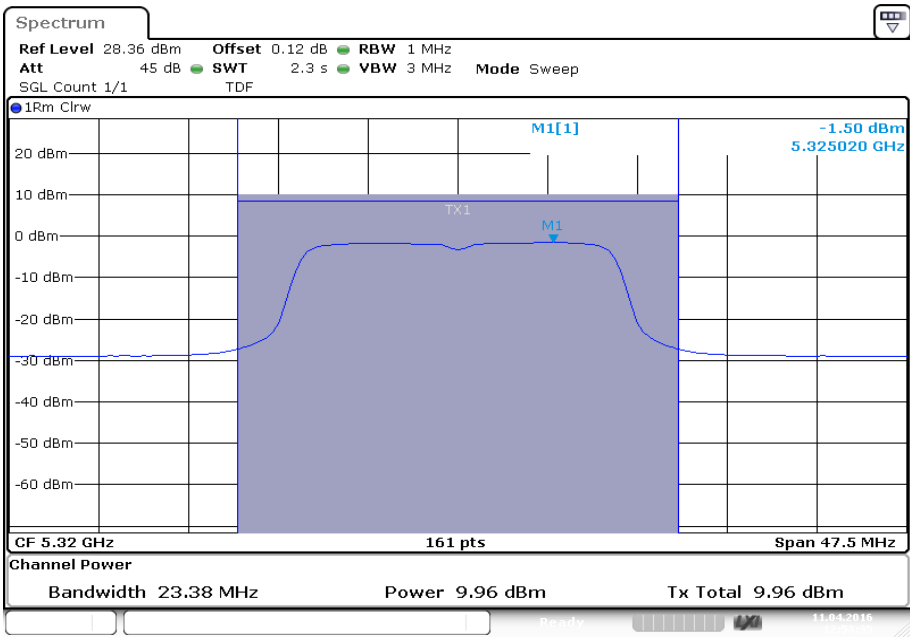
Date: 11.APR.2016 12:46:26

Plot 3: 5300 MHz



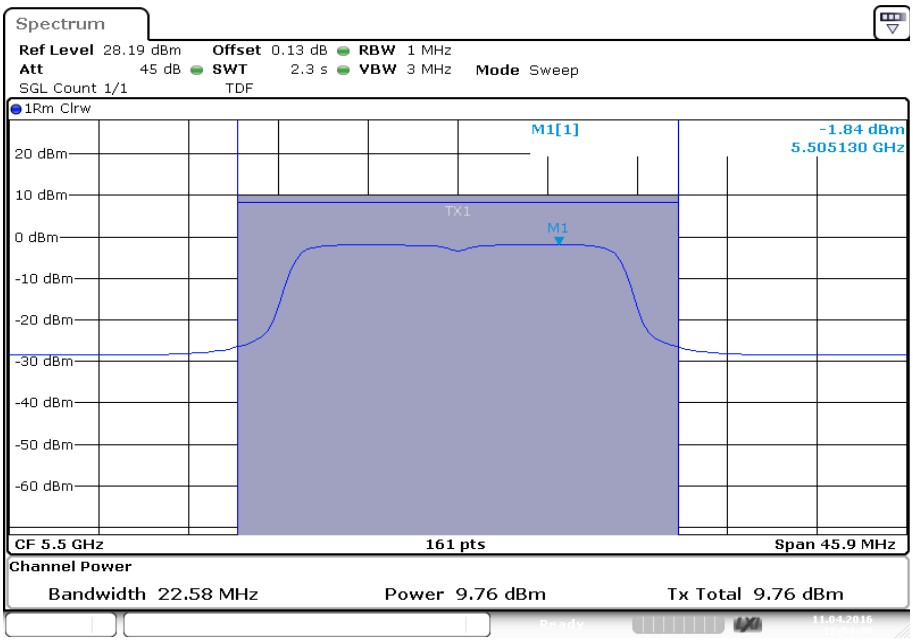
Date: 11.APR.2016 12:52:25

Plot 4: 5320 MHz



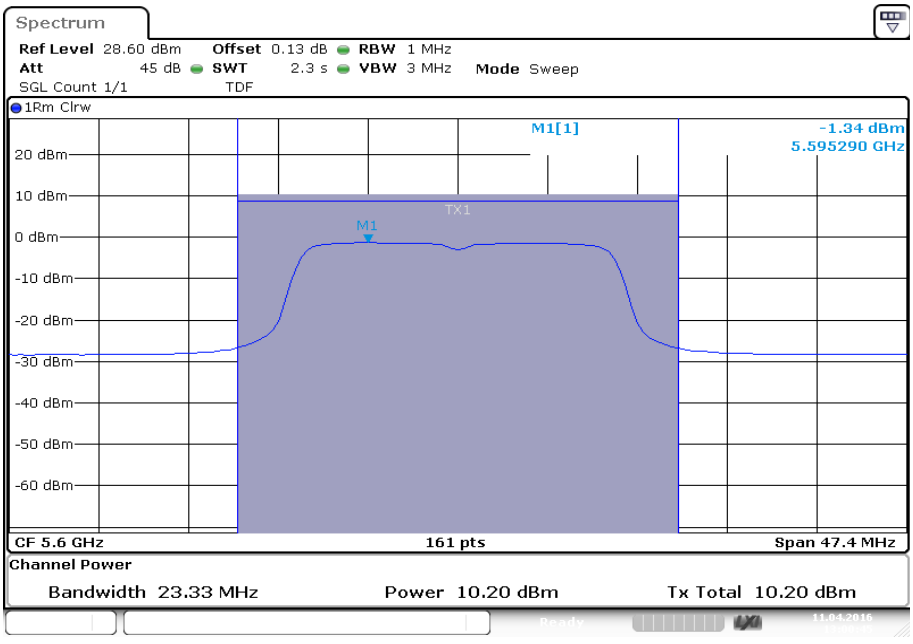
Date: 11.APR.2016 12:53:36

Plot 5: 5500 MHz



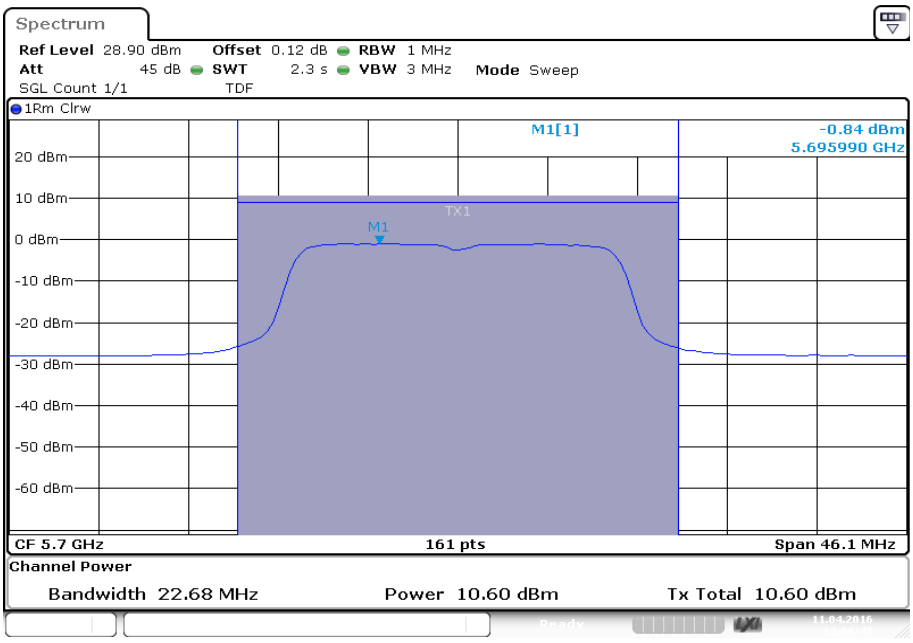
Date: 11.APR.2016 12:54:49

Plot 6: 5600 MHz



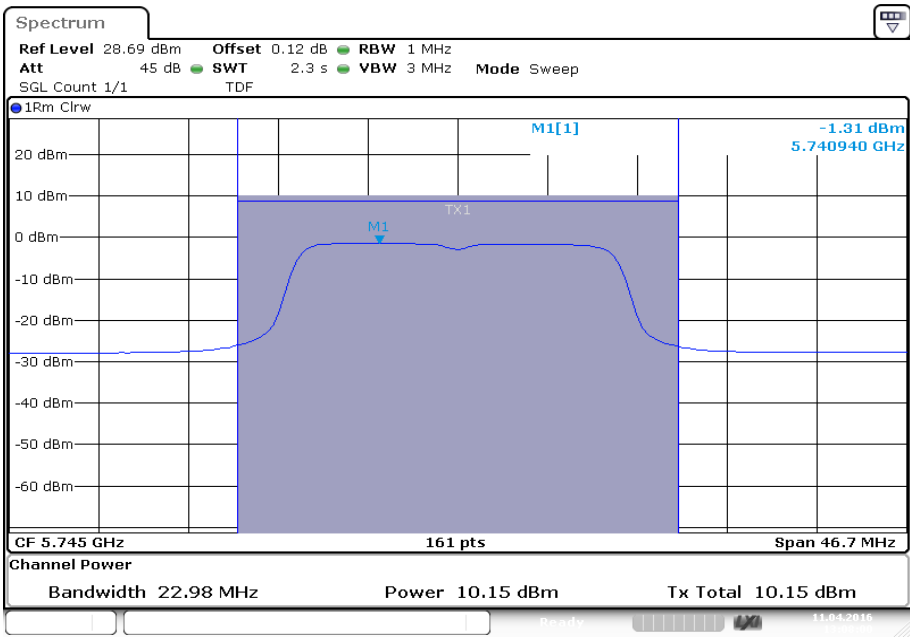
Date: 11.APR.2016 13:00:46

Plot 7: 5700 MHz



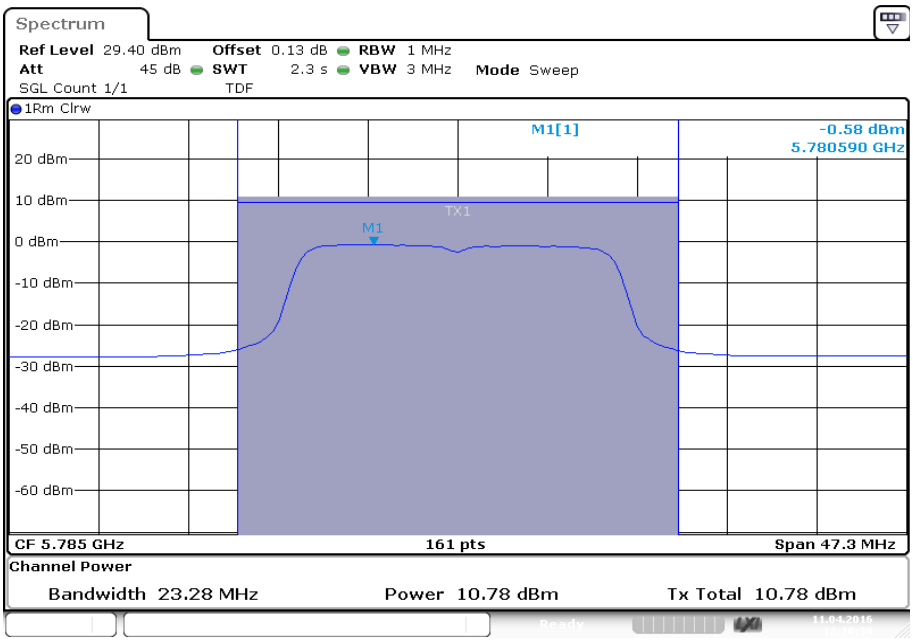
Date: 11.APR.2016 13:06:48

Plot 8: 5745 MHz



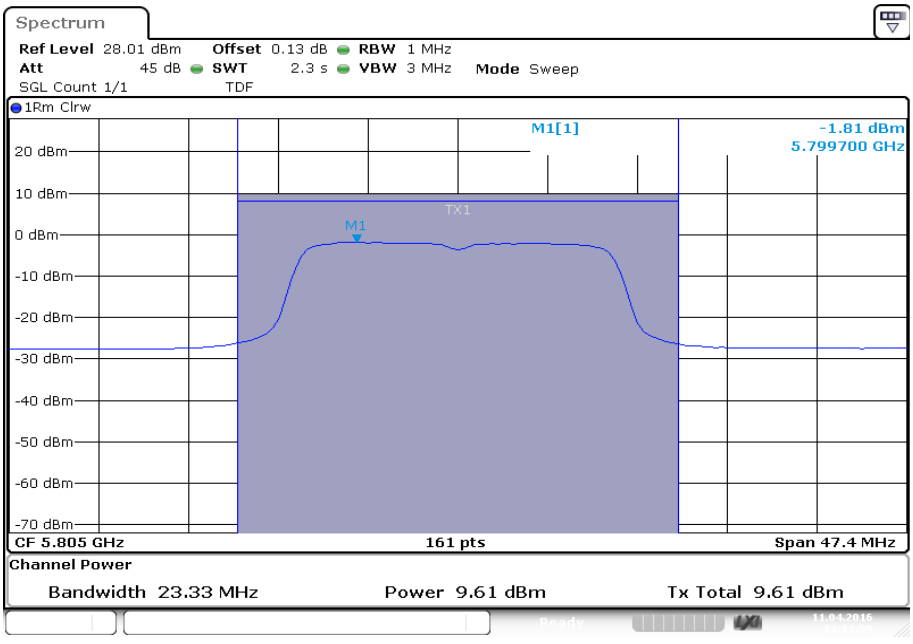
Date: 11.APR.2016 13:08:00

Plot 9: 5785 MHz



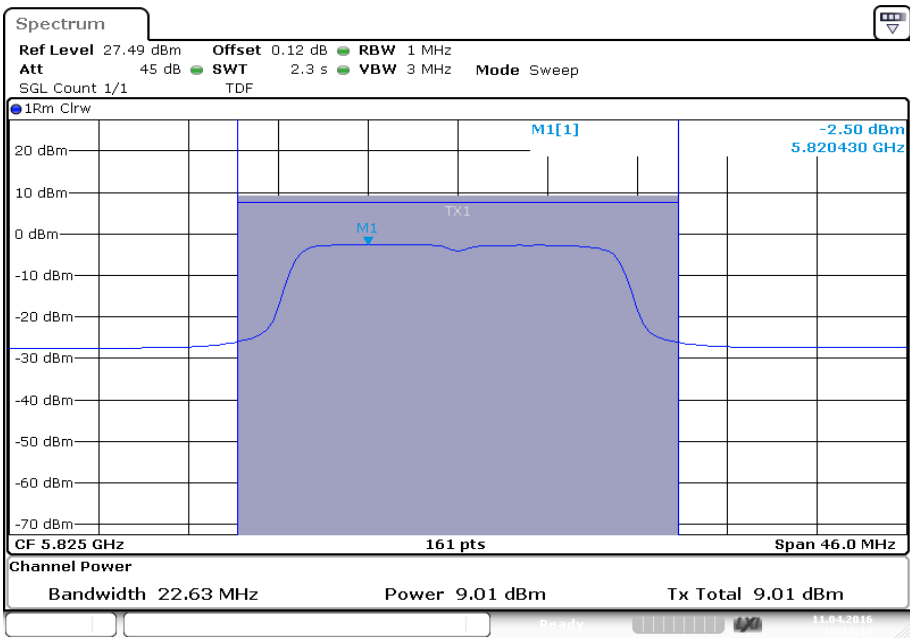
Date: 11.APR.2016 13:10:40

Plot 10: 5805 MHz



Date: 11.APR.2016 13:11:59

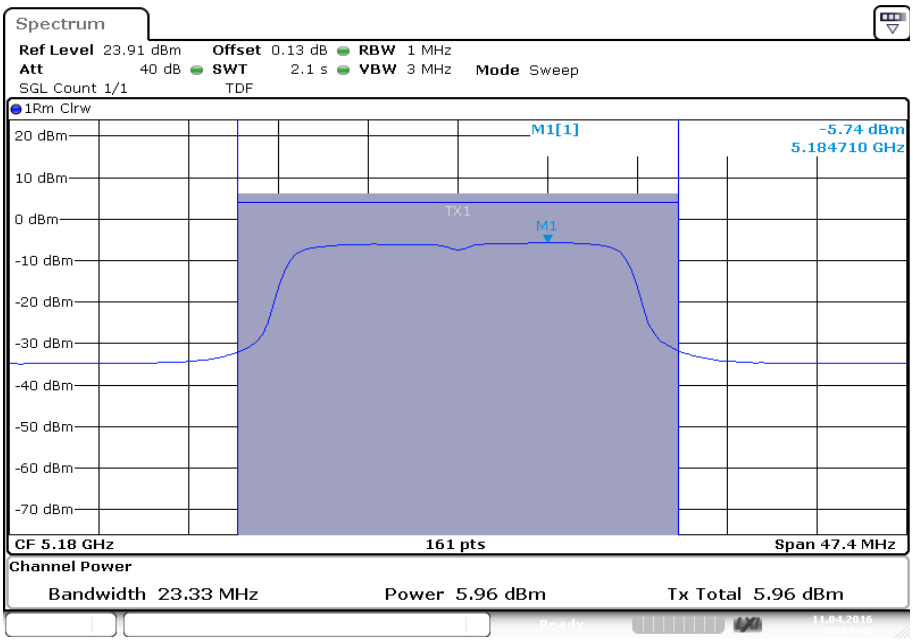
Plot 11: 5825 MHz



Date: 11.APR.2016 13:13:18

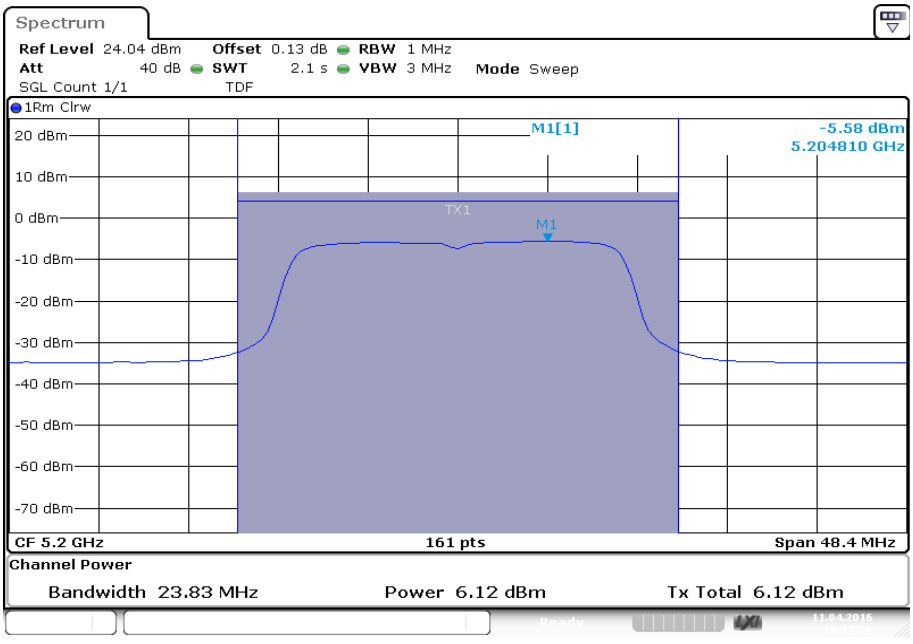
Plots: OFDM / n HT20 – mode, antenna port 1

Plot 1: 5180 MHz



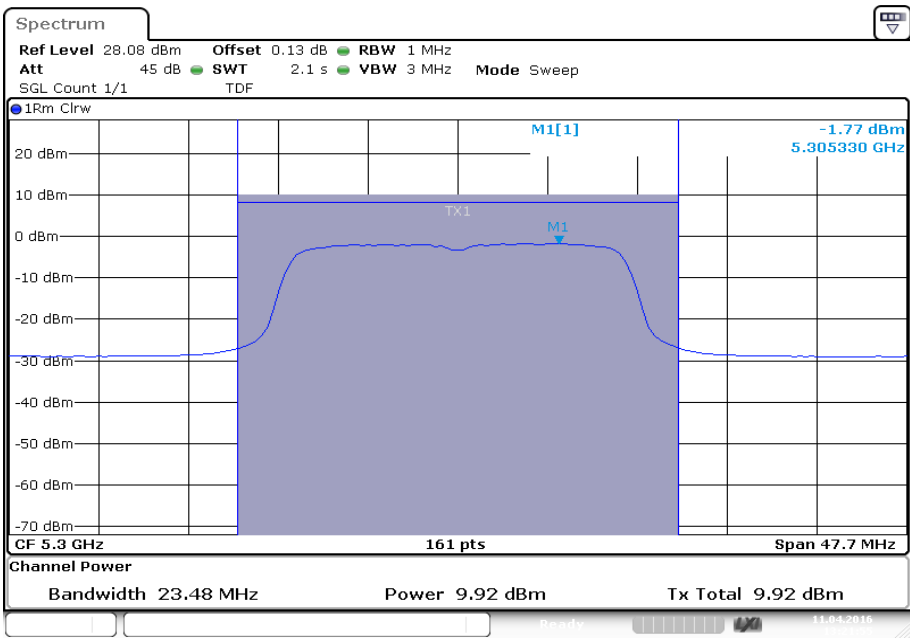
Date: 11.APR.2016 13:14:42

Plot 2: 5200 MHz



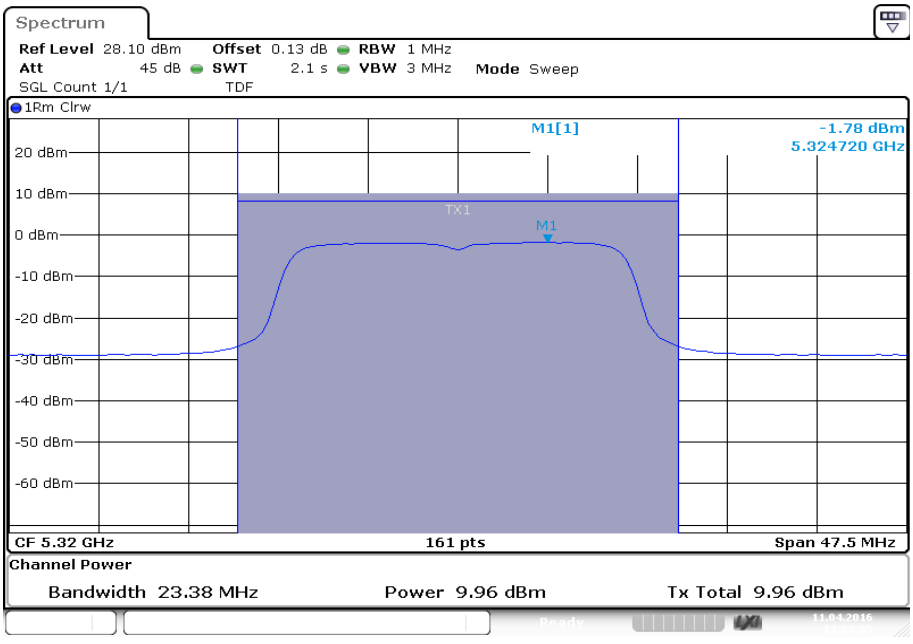
Date: 11.APR.2016 13:15:56

Plot 3: 5300 MHz



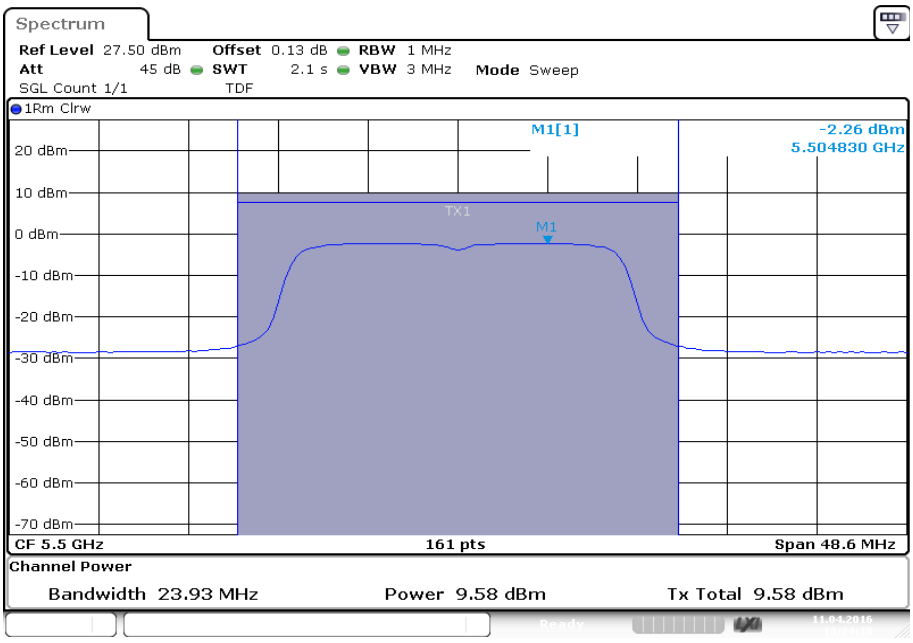
Date: 11.APR.2016 13:21:55

Plot 4: 5320 MHz



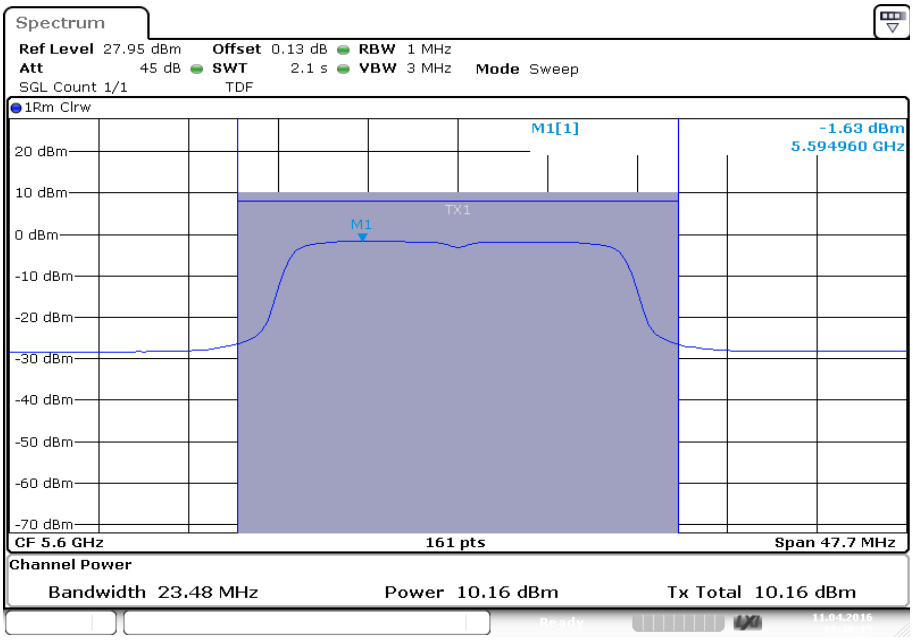
Date: 11.APR.2016 13:23:06

Plot 5: 5500 MHz



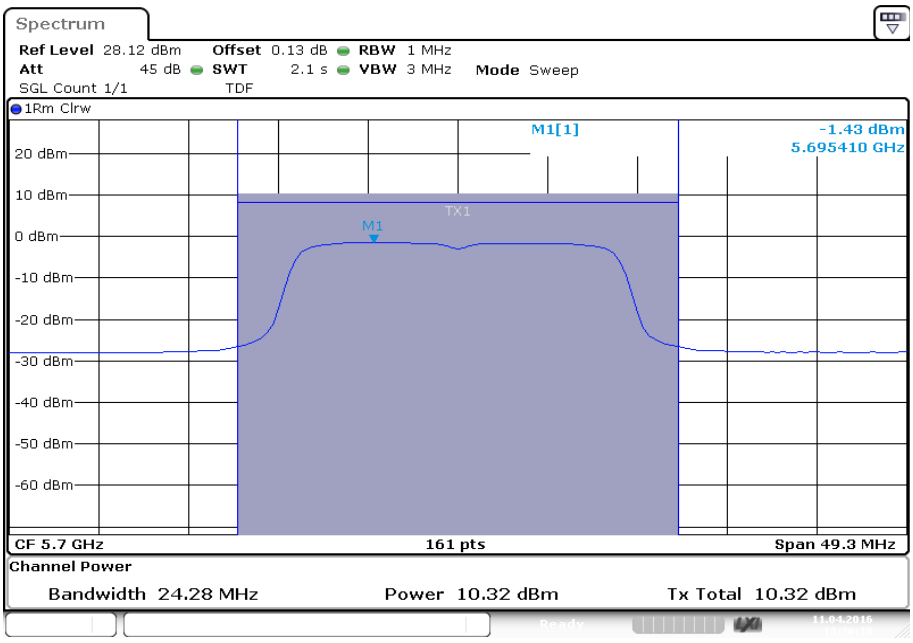
Date: 11.APR.2016 13:24:19

Plot 6: 5600 MHz



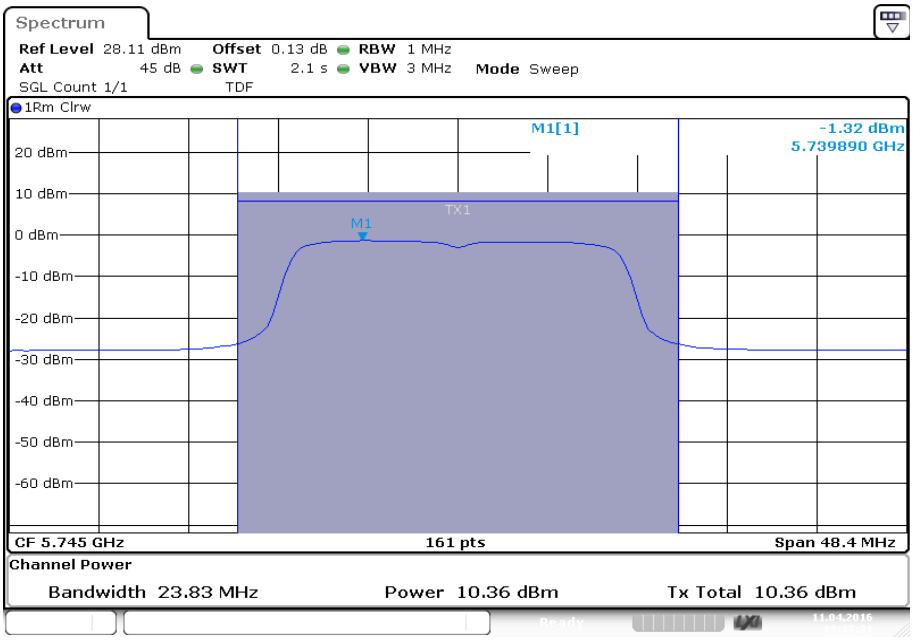
Date: 11.APR.2016 13:30:16

Plot 7: 5700 MHz



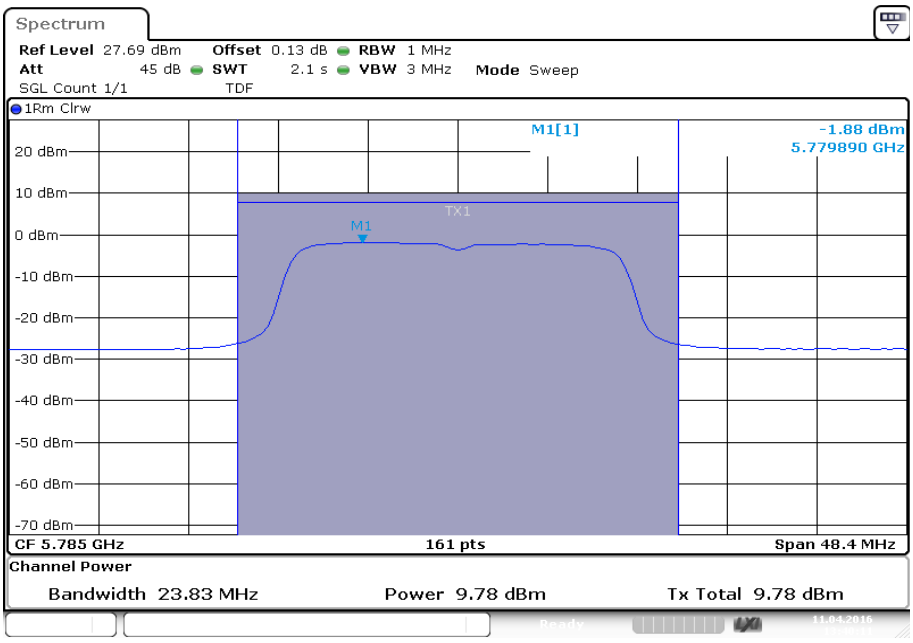
Date: 11.APR.2016 13:36:19

Plot 8: 5745 MHz



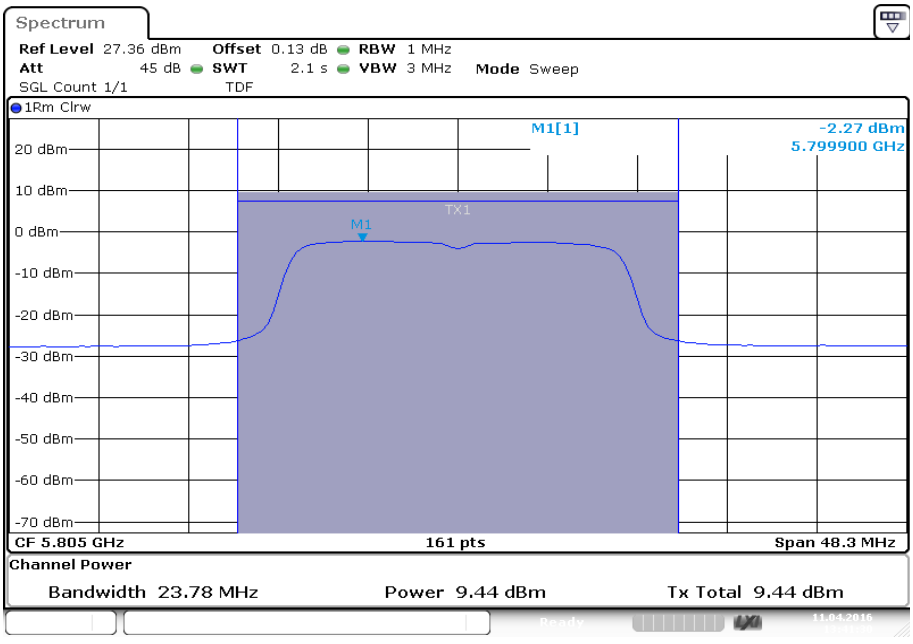
Date: 11.APR.2016 13:37:32

Plot 9: 5785 MHz



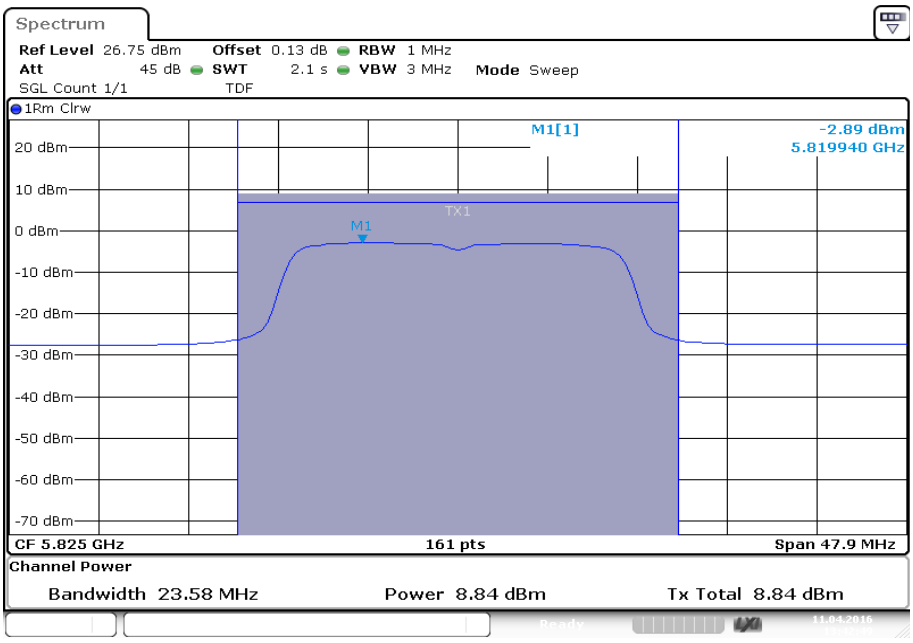
Date: 11.APR.2016 13:40:11

Plot 10: 5805 MHz



Date: 11.APR.2016 13:41:30

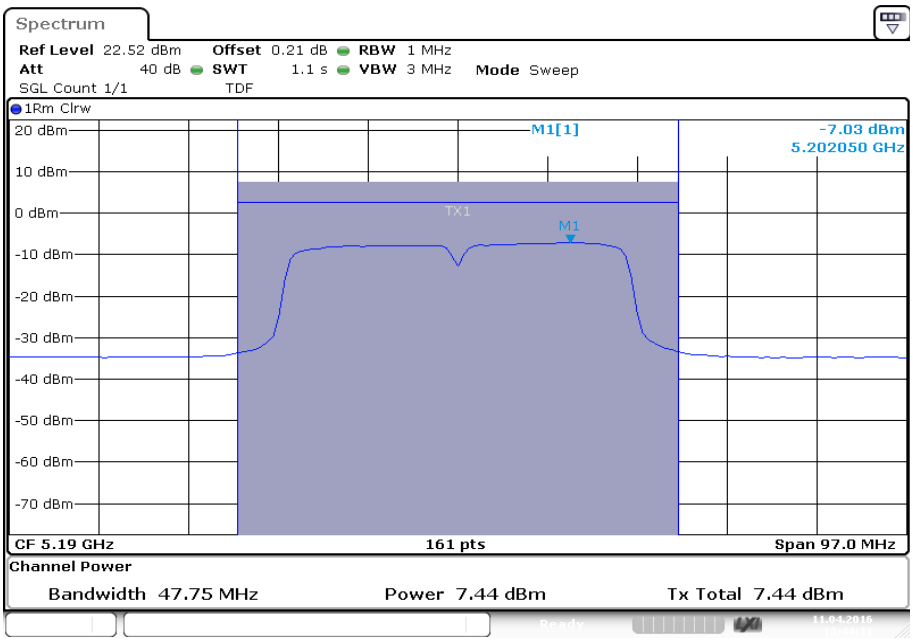
Plot 11: 5825 MHz



Date: 11.APR.2016 13:42:49

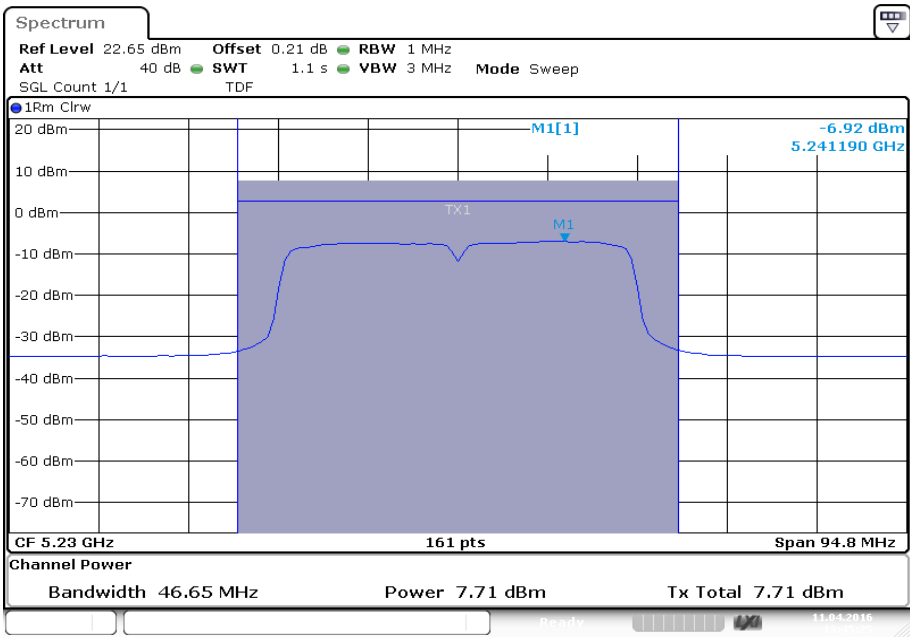
Plots: OFDM / n HT40 – mode, antenna port 1

Plot 1: 5190 MHz



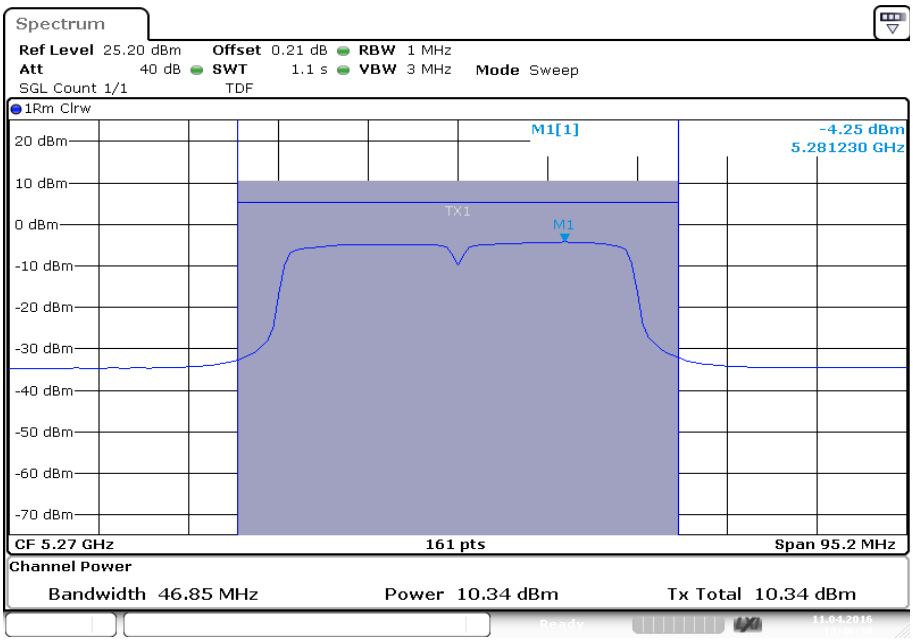
Date: 11.APR.2016 13:44:12

Plot 2: 5230 MHz



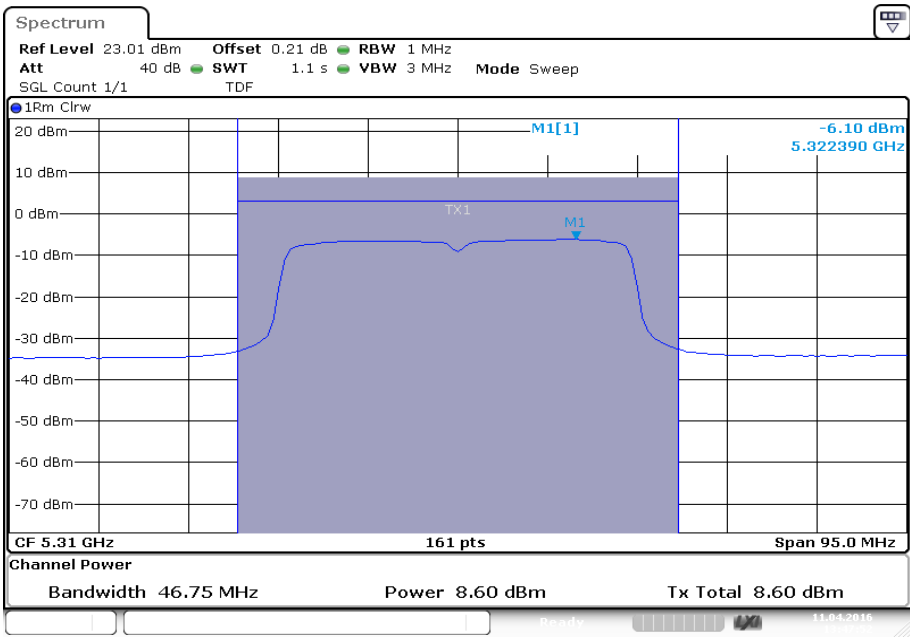
Date: 11.APR.2016 13:45:25

Plot 3: 5270 MHz



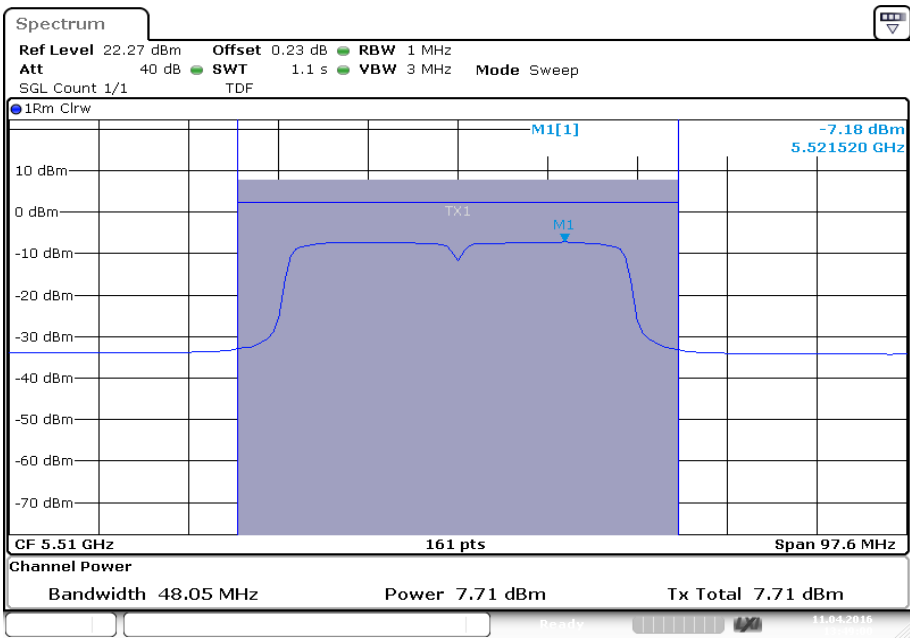
Date: 11.APR.2016 13:46:39

Plot 4: 5310 MHz



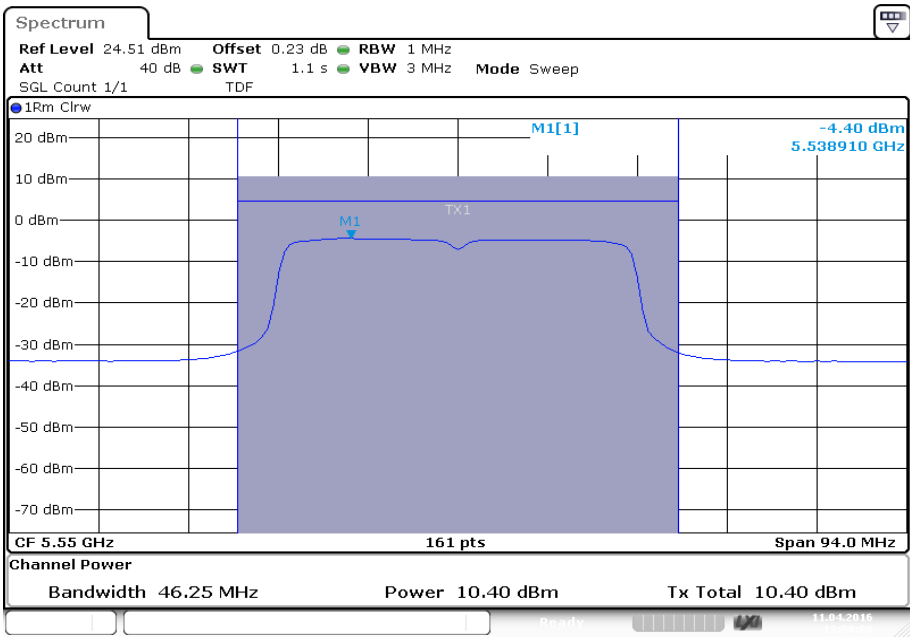
Date: 11.APR.2016 13:47:53

Plot 5: 5510 MHz



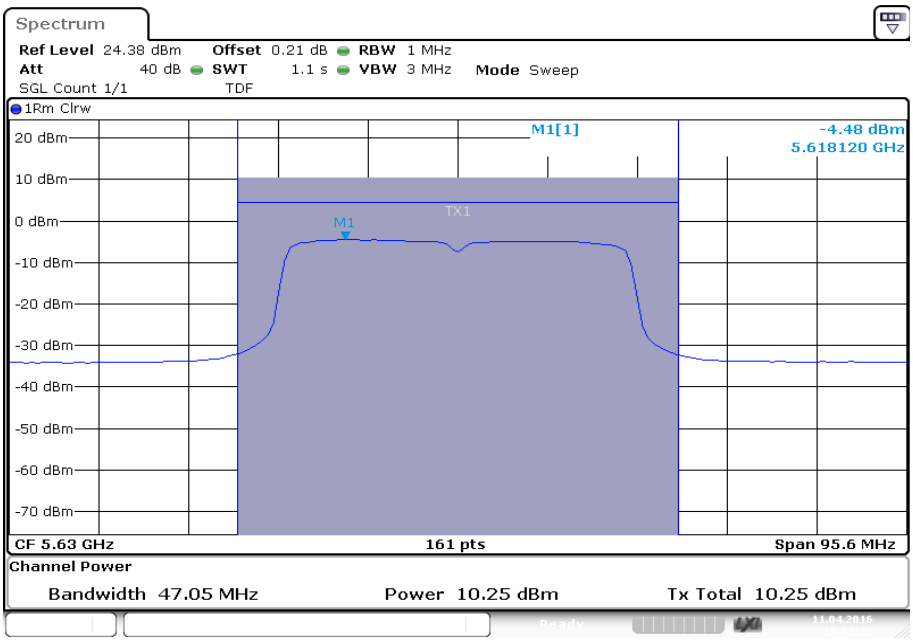
Date: 11.APR.2016 13:49:01

Plot 6: 5550 MHz



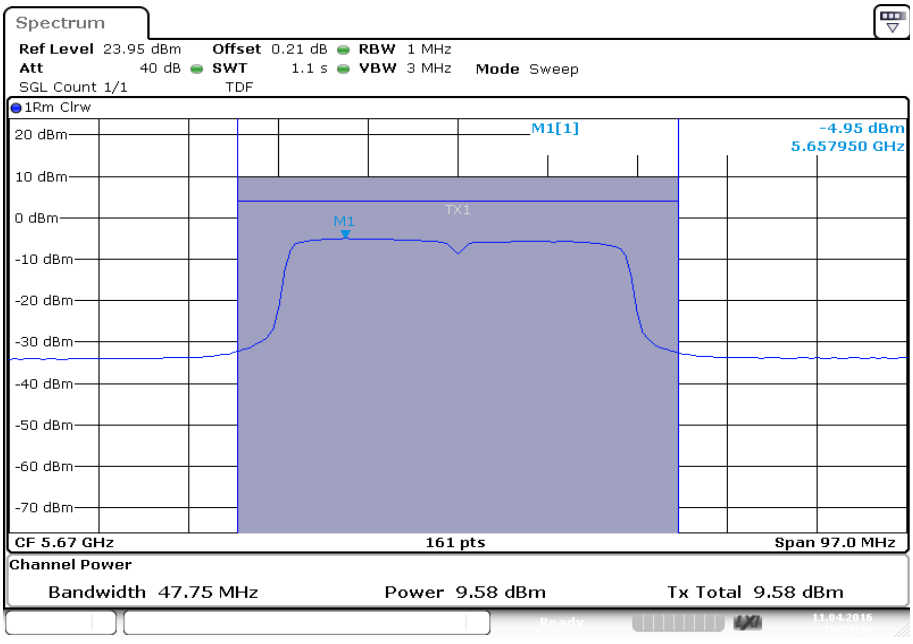
Date: 11.APR.2016 13:50:08

Plot 7: 5630 MHz



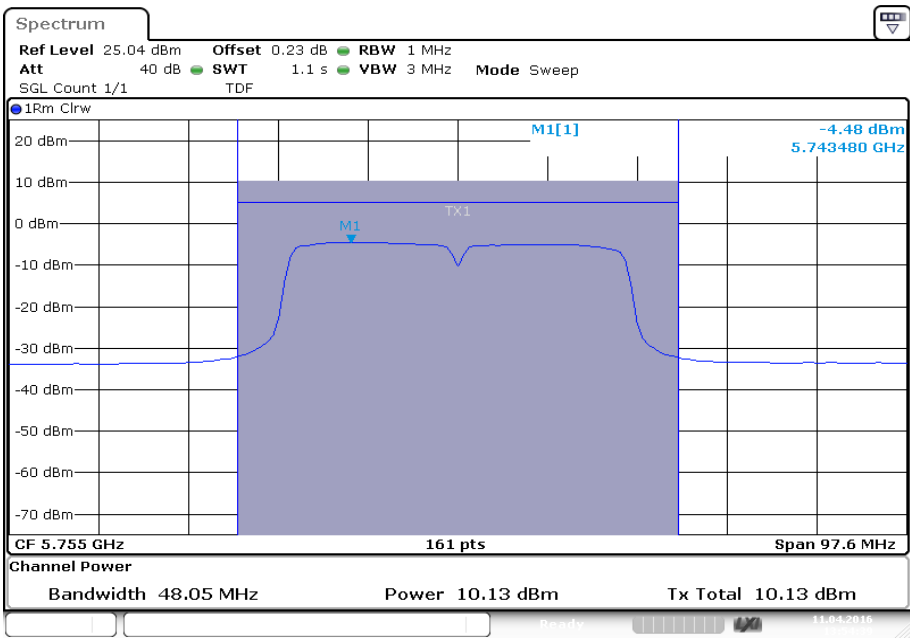
Date: 11.APR.2016 13:52:23

Plot 8: 5670 MHz



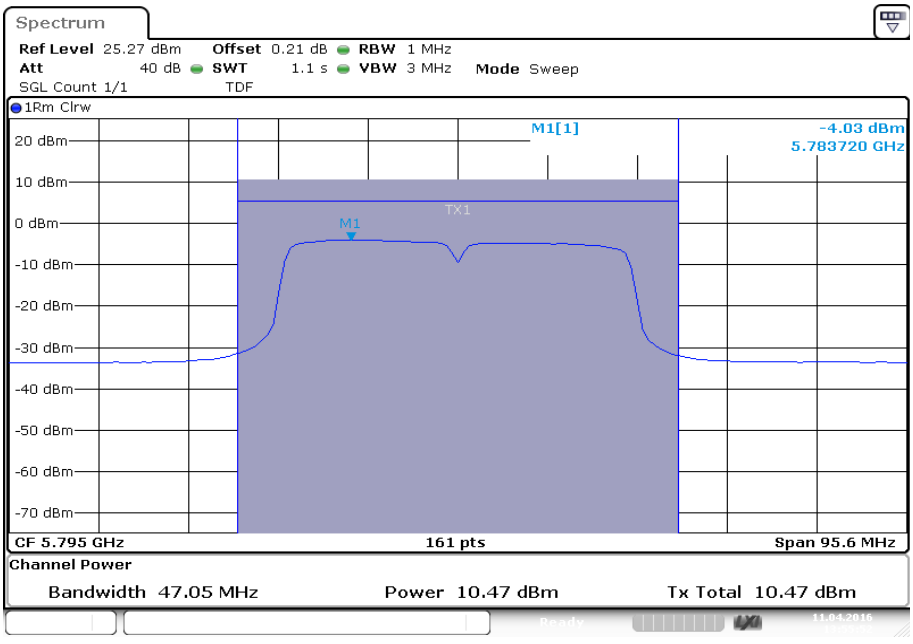
Date: 11.APR.2016 13:53:30

Plot 9: 5755 MHz



Date: 11.APR.2016 13:54:39

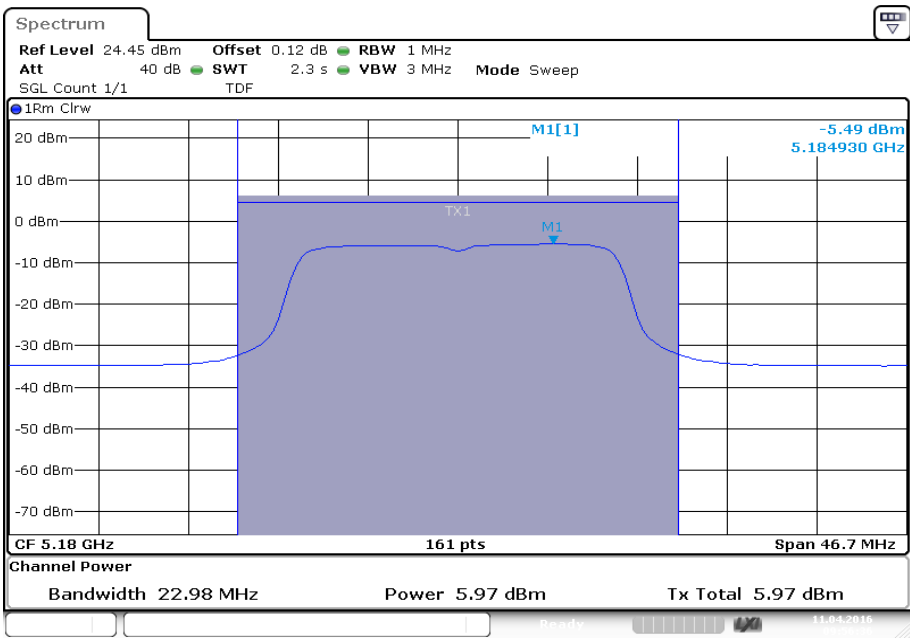
Plot 10: 5795 MHz



Date: 11.APR.2016 13:55:52

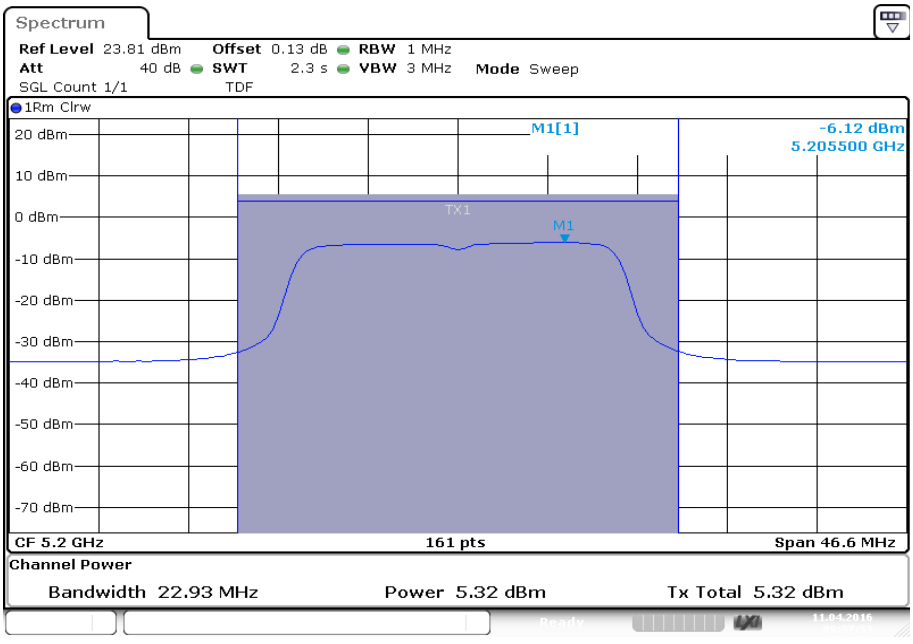
Plots: OFDM / a – mode, antenna port 2

Plot 1: 5180 MHz



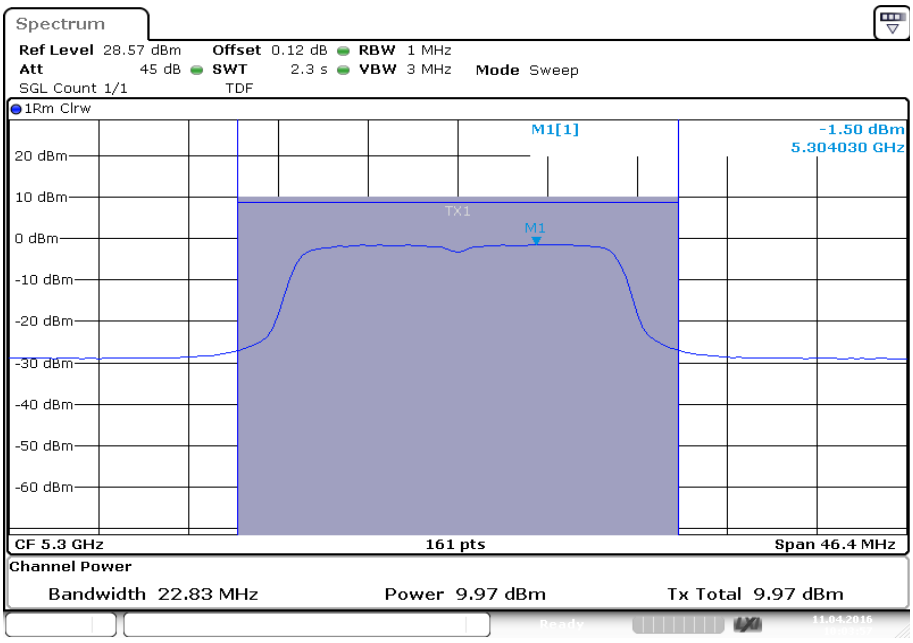
Date: 11.APR.2016 09:56:36

Plot 2: 5200 MHz



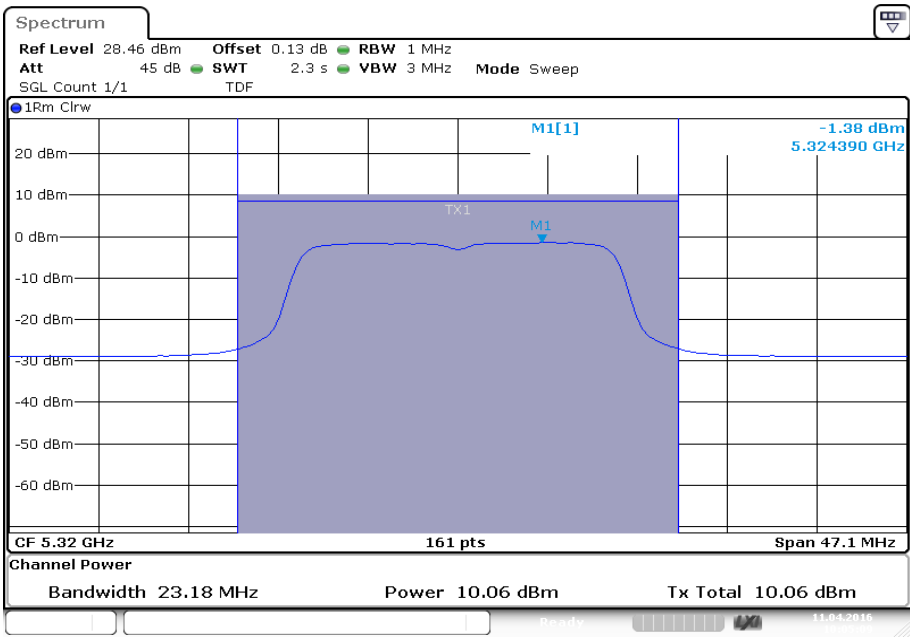
Date: 11.APR.2016 09:57:54

Plot 3: 5300 MHz



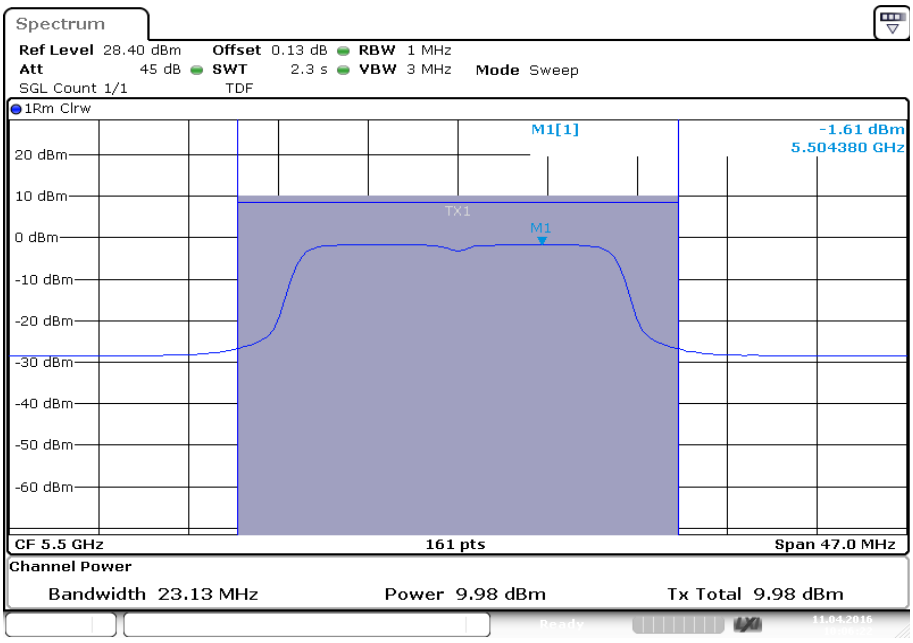
Date: 11.APR.2016 10:03:58

Plot 4: 5320 MHz



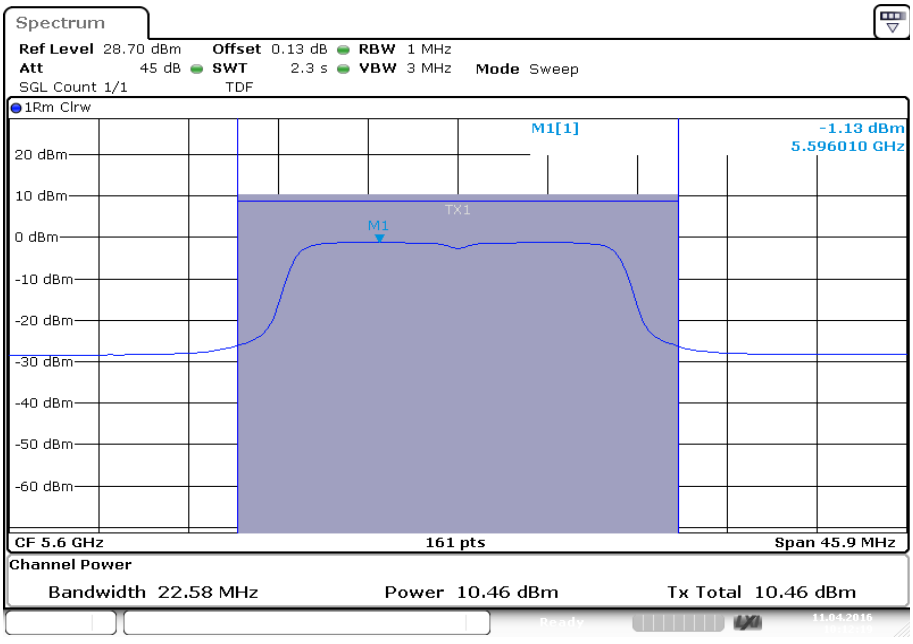
Date: 11.APR.2016 10:05:09

Plot 5: 5500 MHz



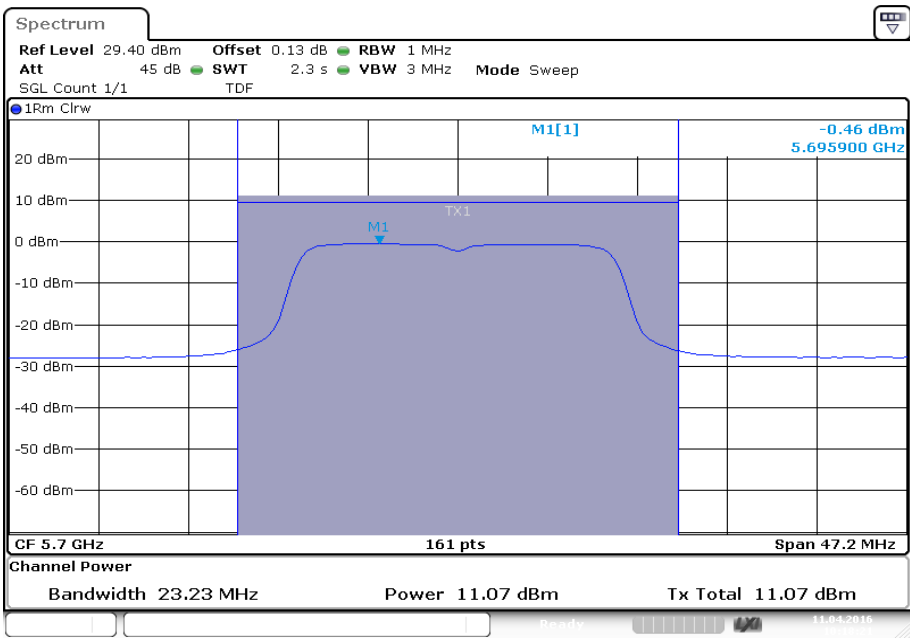
Date: 11.APR.2016 10:06:23

Plot 6: 5600 MHz



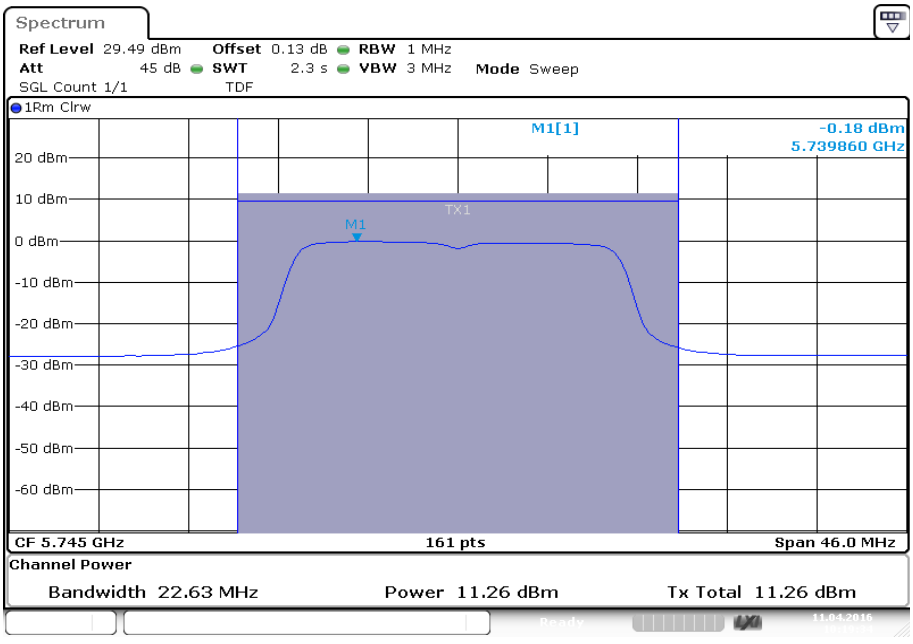
Date: 11.APR.2016 10:12:20

Plot 7: 5700 MHz



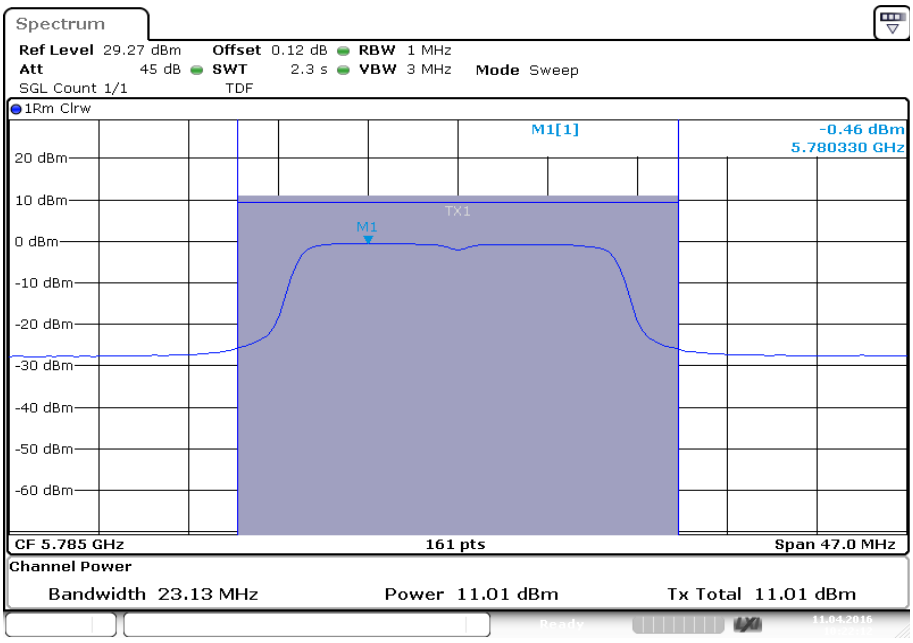
Date: 11.APR.2016 10:18:22

Plot 8: 5745 MHz



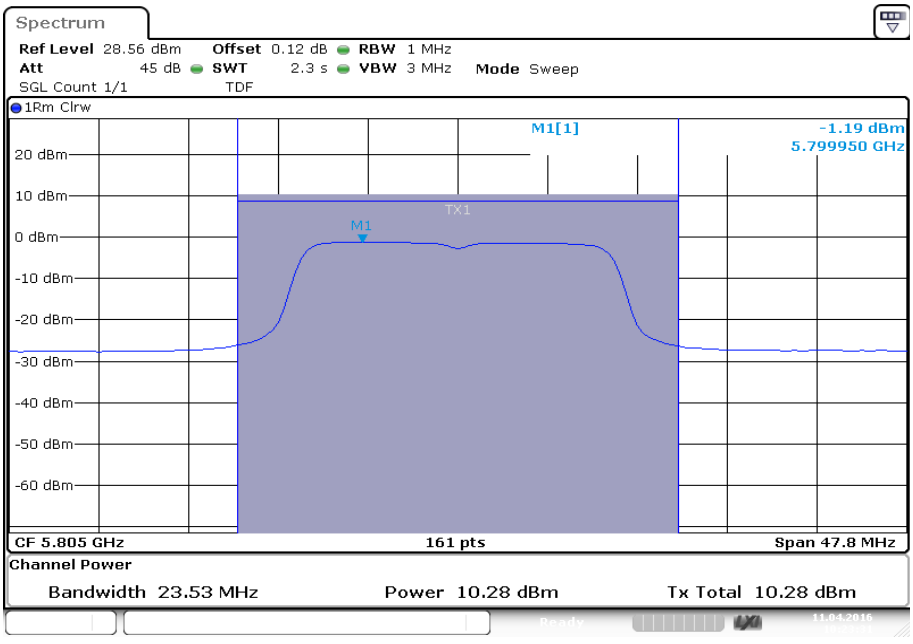
Date: 11.APR.2016 10:19:34

Plot 9: 5785 MHz



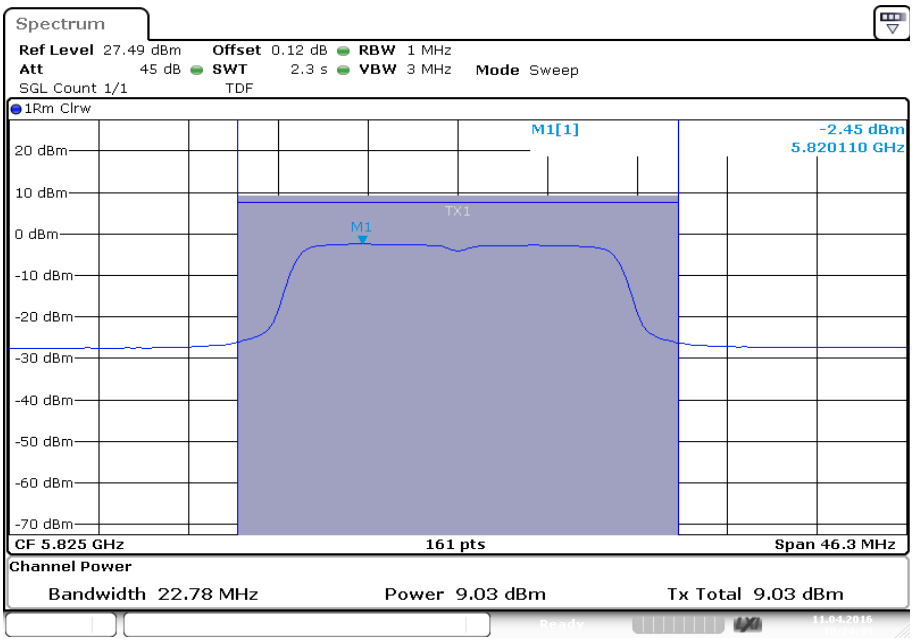
Date: 11.APR.2016 10:22:13

Plot 10: 5805 MHz



Date: 11.APR.2016 10:23:32

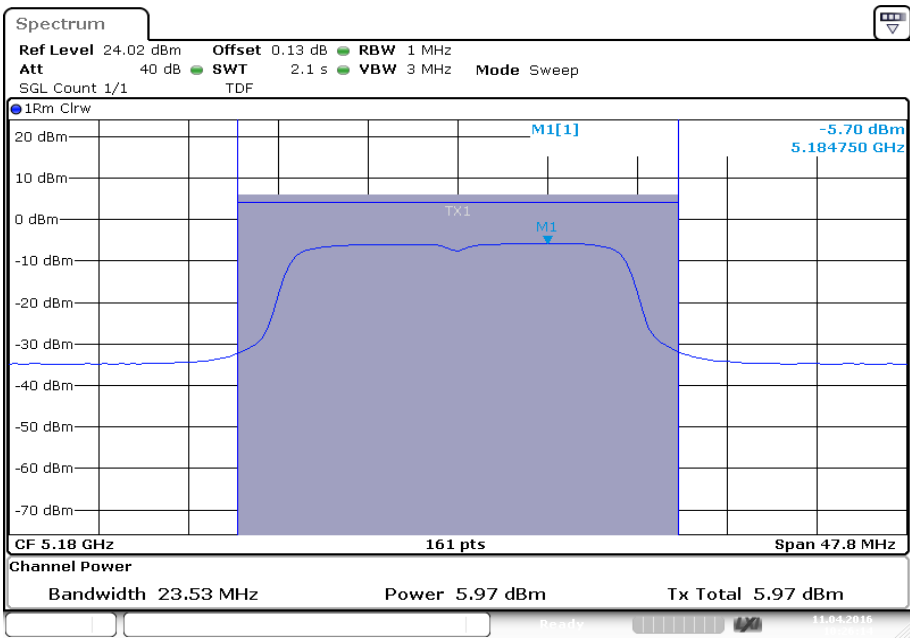
Plot 11: 5825 MHz



Date: 11.APR.2016 10:24:50

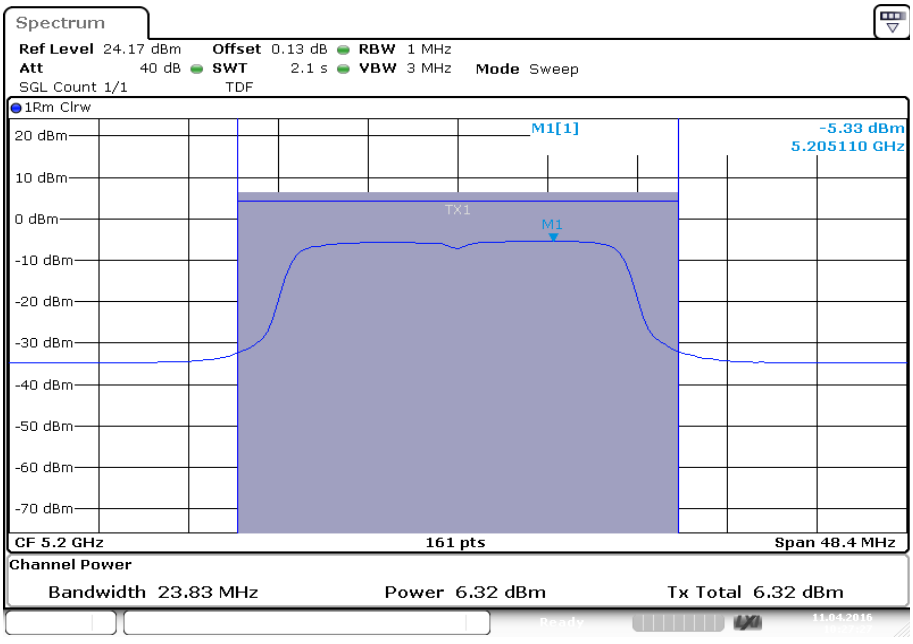
Plots: OFDM / n HT20 – mode, antenna port 2

Plot 1: 5180 MHz



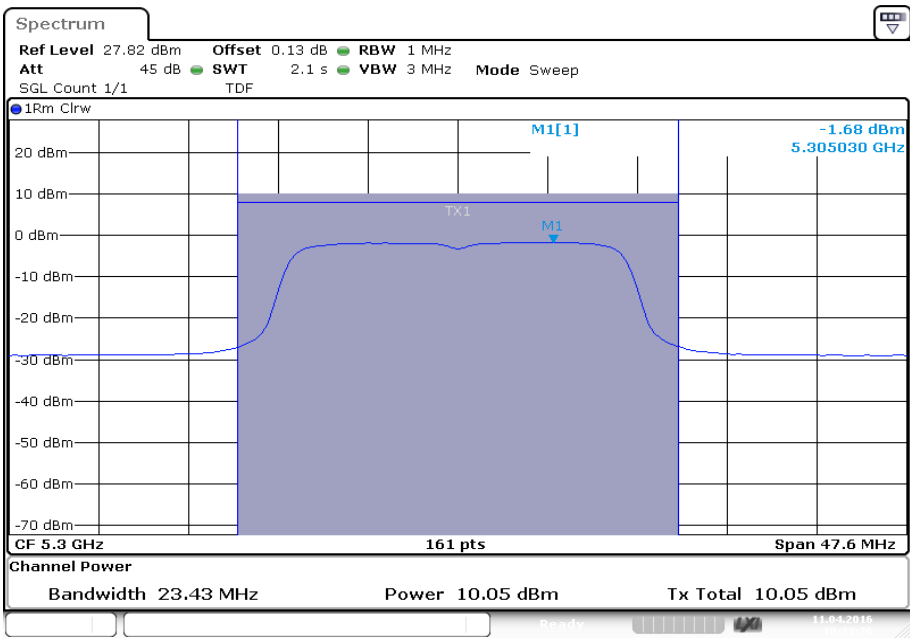
Date: 11.APR.2016 10:26:14

Plot 2: 5200 MHz



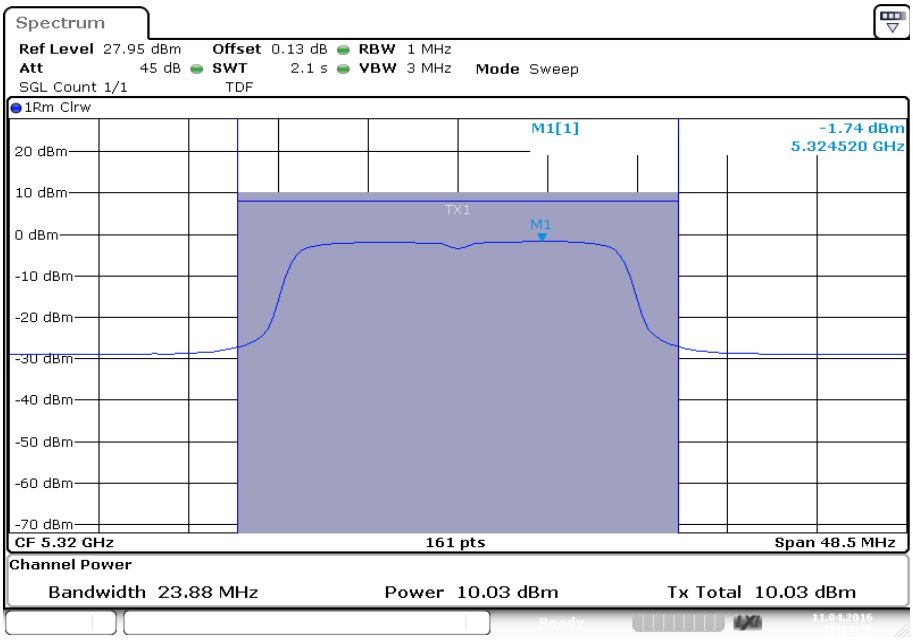
Date: 11.APR.2016 10:27:28

Plot 3: 5300 MHz



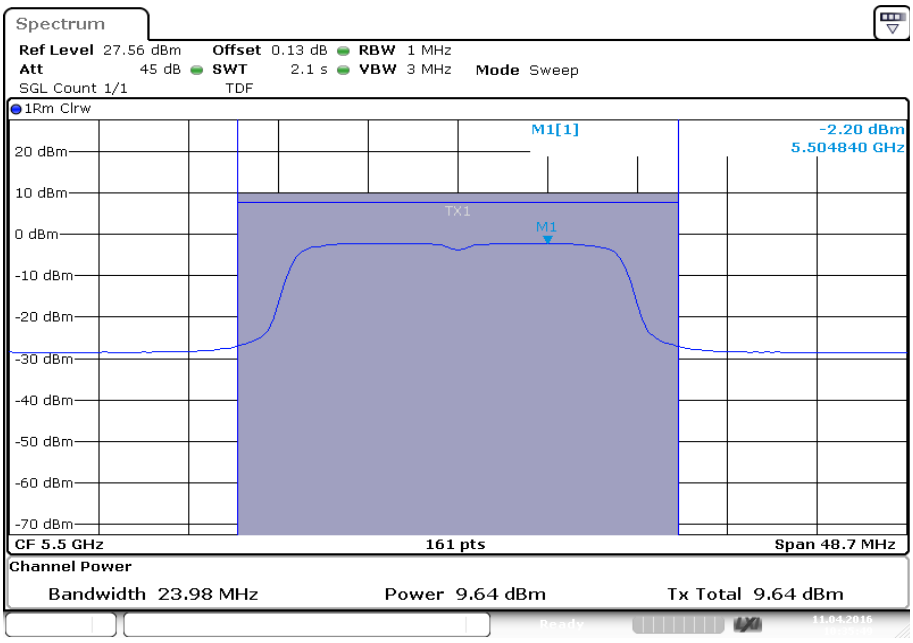
Date: 11.APR.2016 10:33:27

Plot 4: 5320 MHz



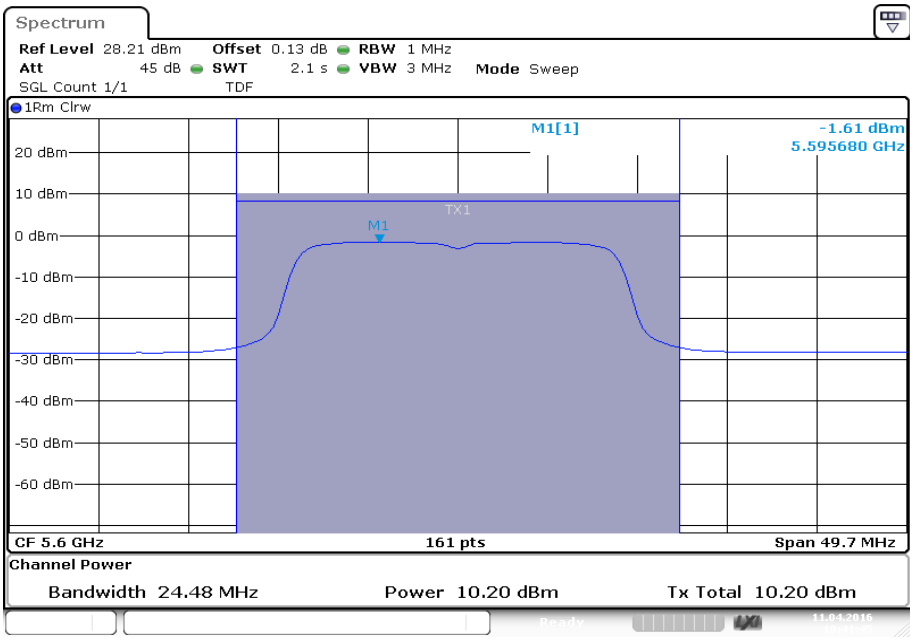
Date: 11.APR.2016 10:34:37

Plot 5: 5500 MHz



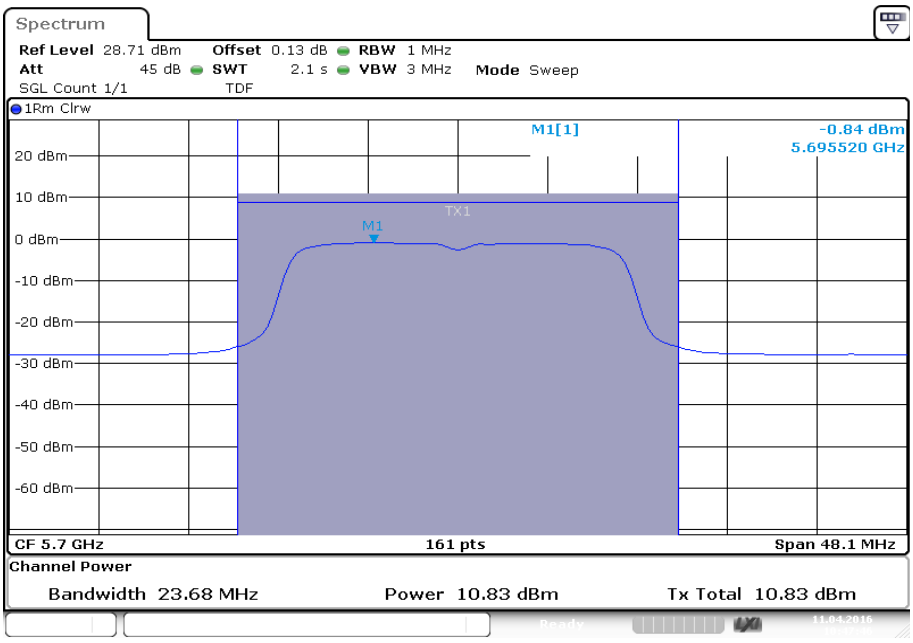
Date: 11.APR.2016 10:35:50

Plot 6: 5600 MHz



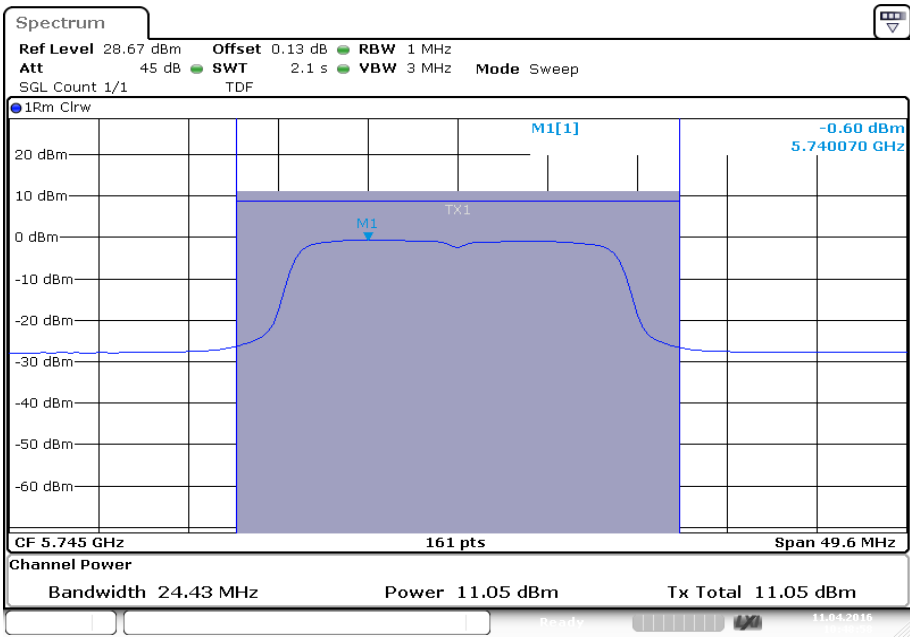
Date: 11.APR.2016 10:41:45

Plot 7: 5700 MHz



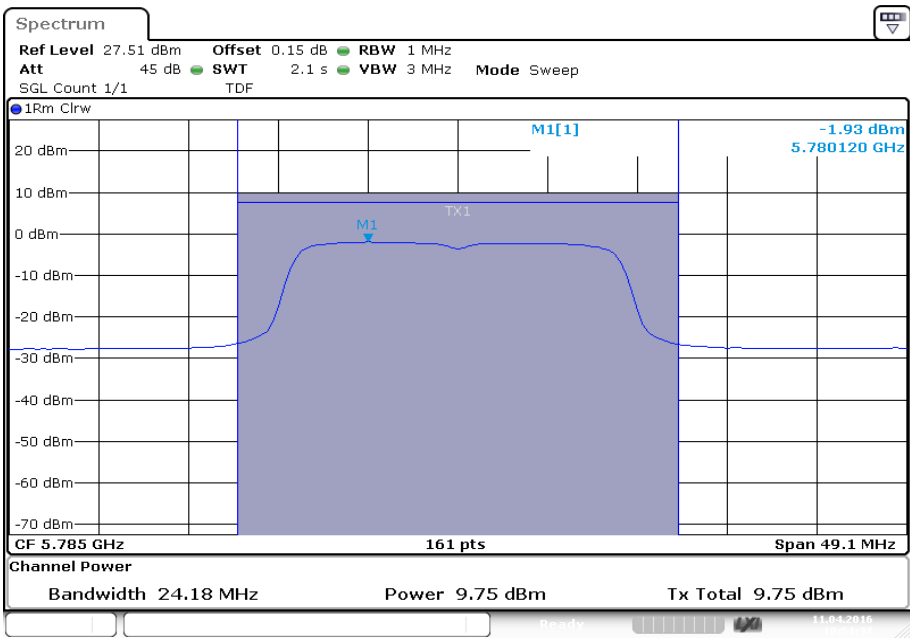
Date: 11.APR.2016 10:47:47

Plot 8: 5745 MHz



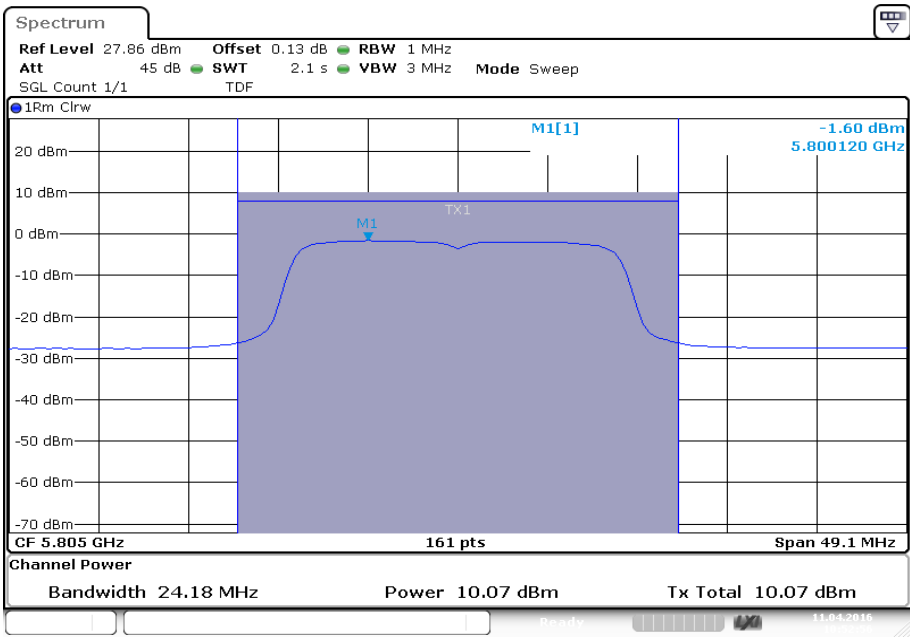
Date: 11.APR.2016 10:48:59

Plot 9: 5785 MHz



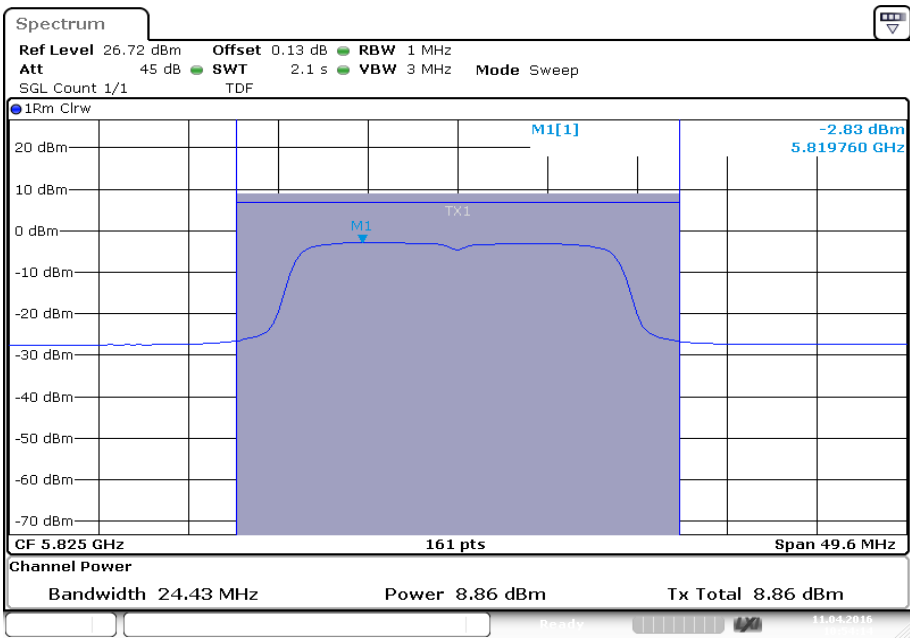
Date: 11.APR.2016 10:51:38

Plot 10: 5805 MHz



Date: 11.APR.2016 10:52:57

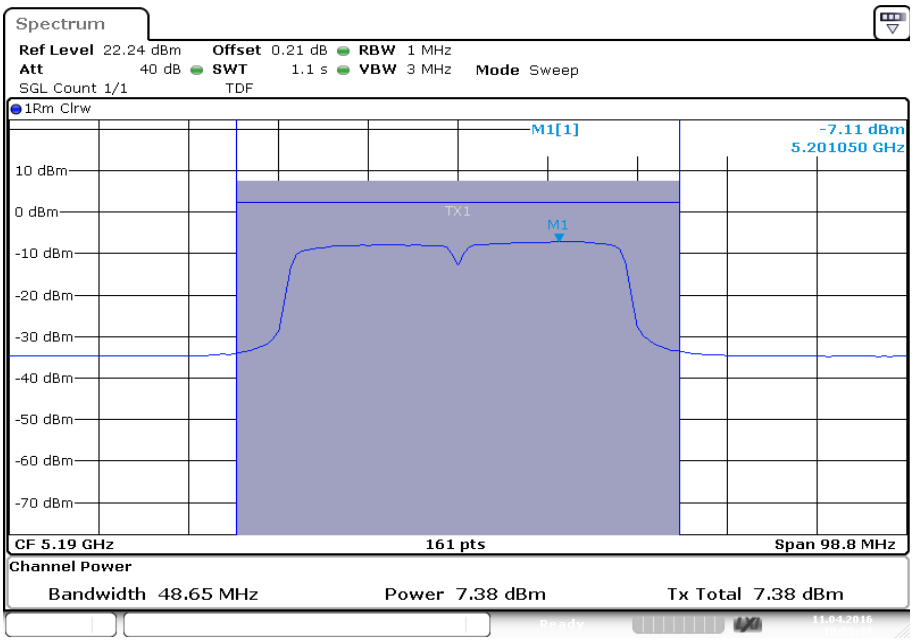
Plot 11: 5825 MHz



Date: 11.APR.2016 10:54:15

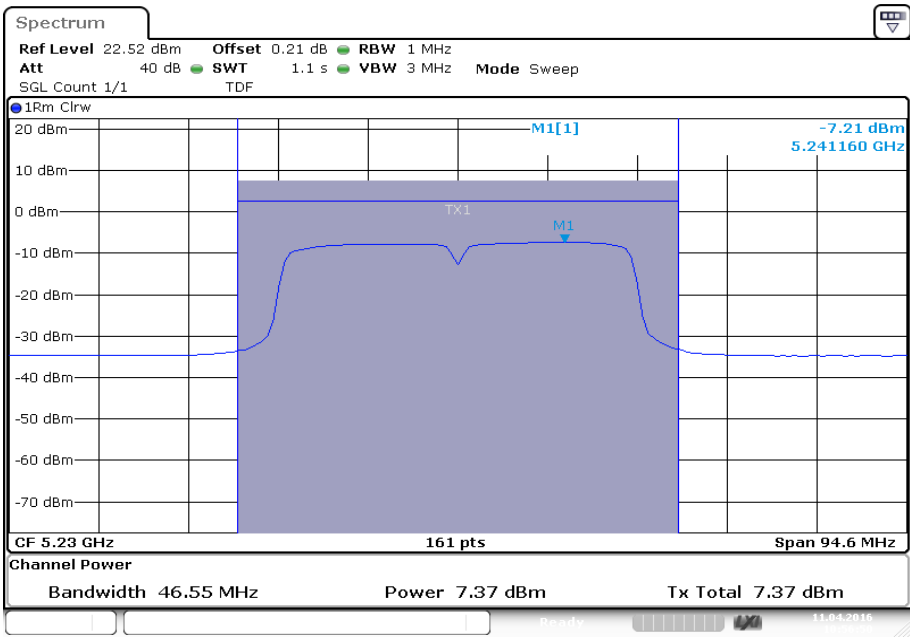
Plots: OFDM / n HT40 – mode, antenna port 2

Plot 1: 5190 MHz



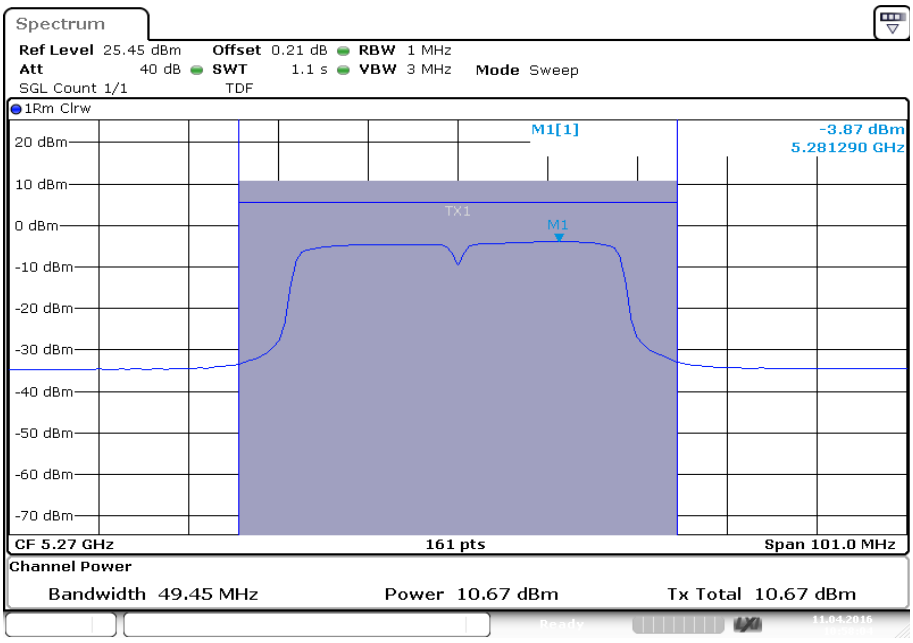
Date: 11.APR.2016 10:55:37

Plot 2: 5230 MHz



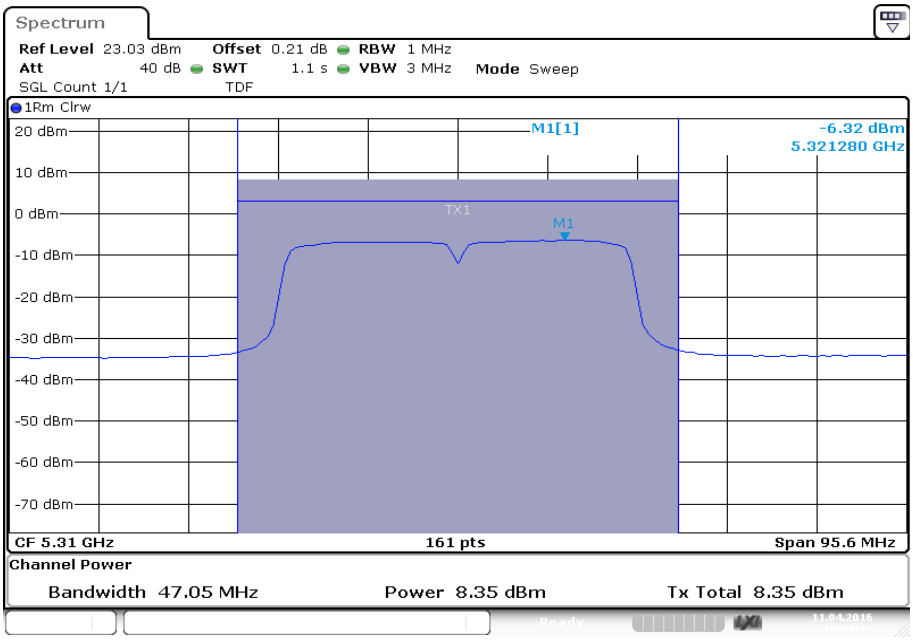
Date: 11.APR.2016 10:56:51

Plot 3: 5270 MHz



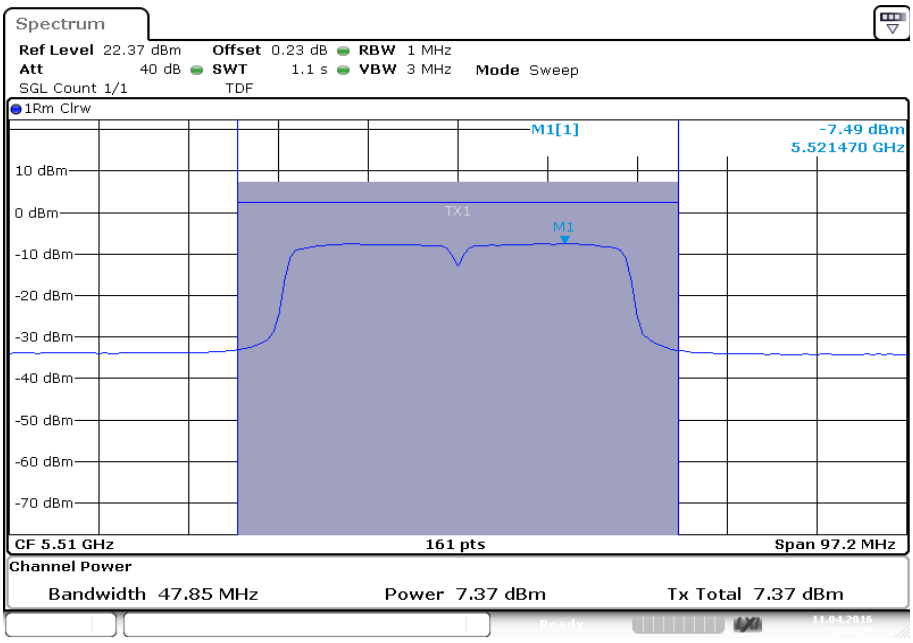
Date: 11.APR.2016 10:58:04

Plot 4: 5310 MHz



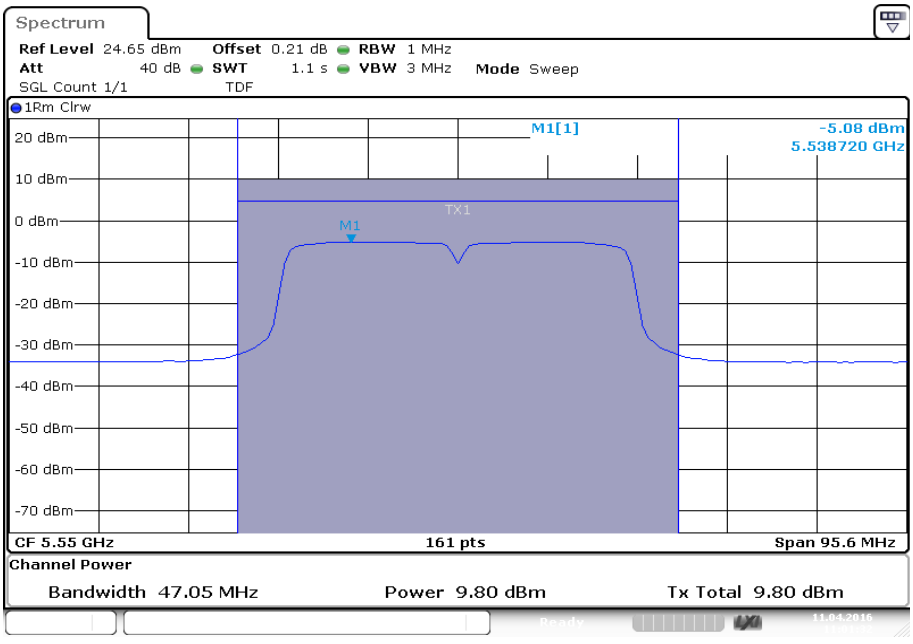
Date: 11.APR.2016 10:59:18

Plot 5: 5510 MHz



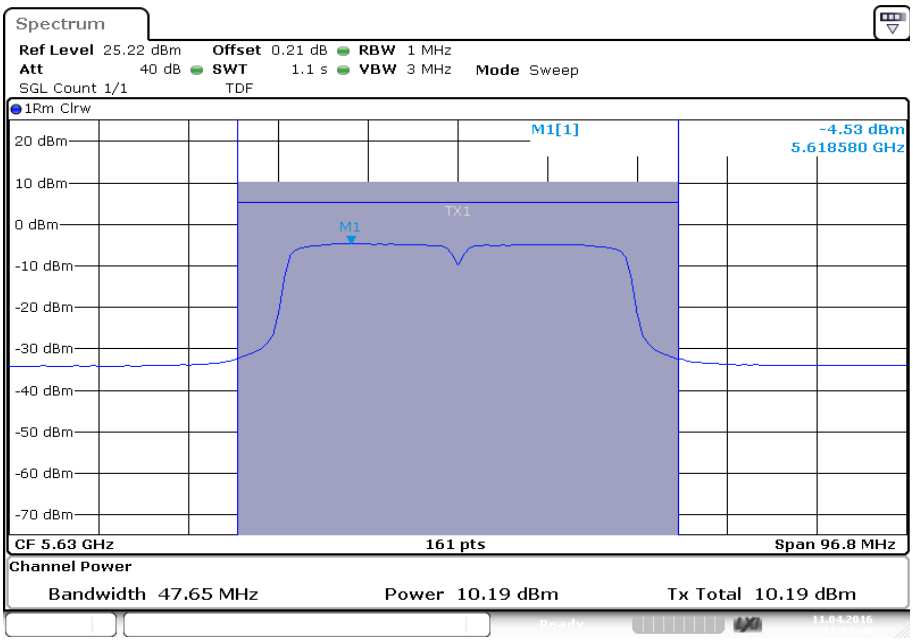
Date: 11.APR.2016 11:00:25

Plot 6: 5550 MHz



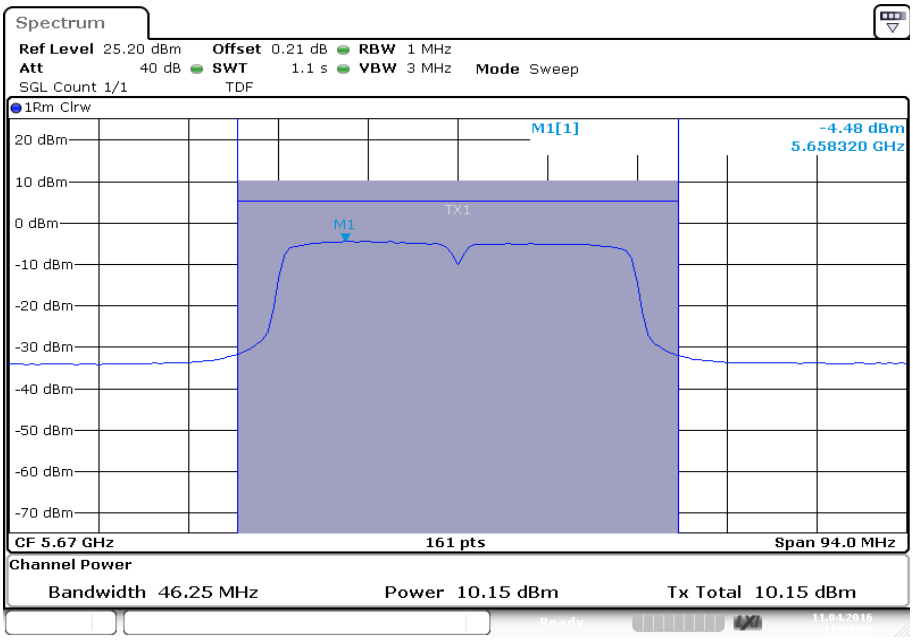
Date: 11.APR.2016 11:01:33

Plot 7: 5630 MHz



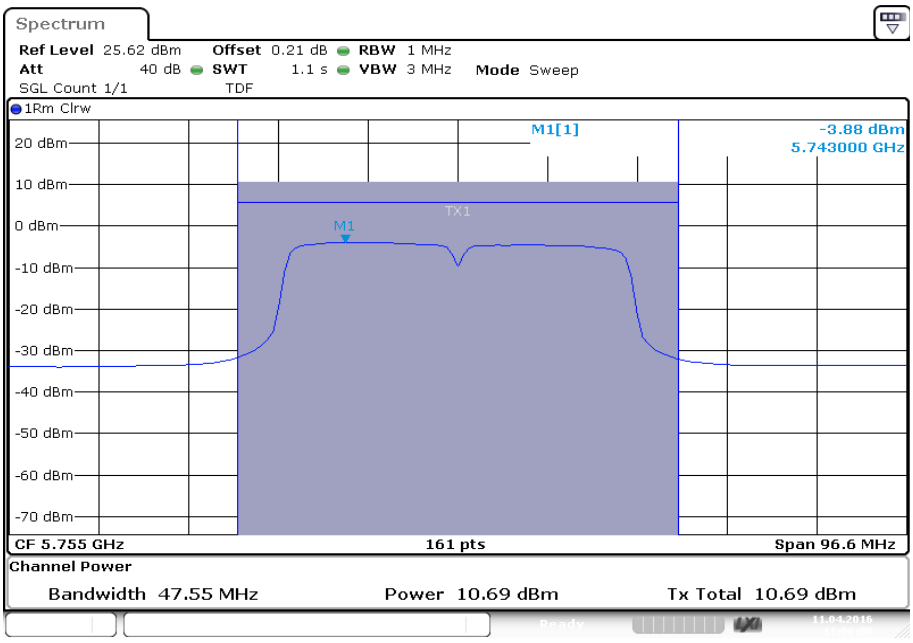
Date: 11.APR.2016 11:03:47

Plot 8: 5670 MHz



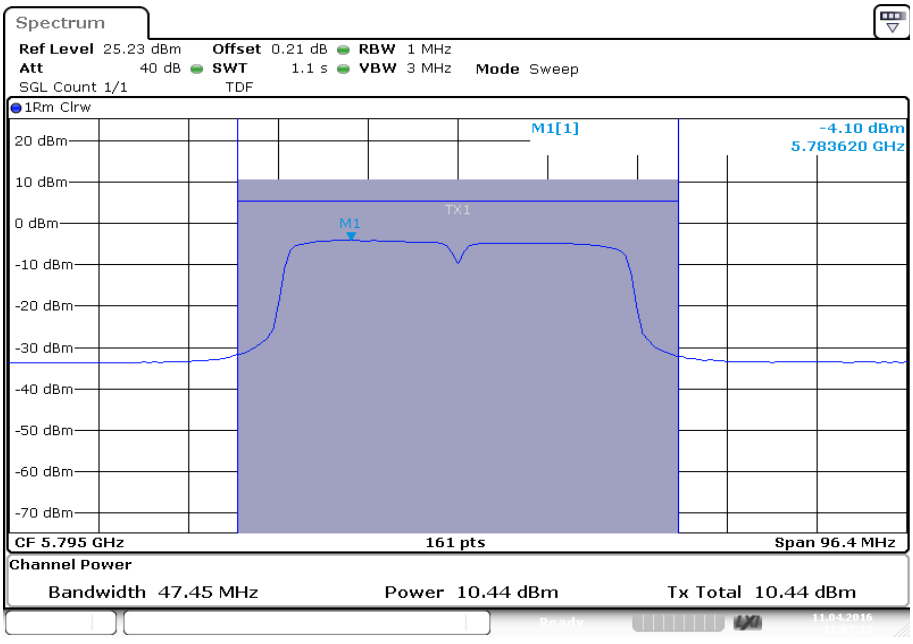
Date: 11.APR.2016 11:04:53

Plot 9: 5755 MHz



Date: 11.APR.2016 11:06:00

Plot 10: 5795 MHz



Date: 11.APR.2016 11:07:13

12.5 Power spectral density

Description:

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

Measurement:

Measurement parameter	
According to: KDB789033 D02, F.	
Detector:	RMS
Sweep time:	≥10*(swp points)*(total on/off time)
Resolution bandwidth:	1 MHz (500 kHz for 5.8 GHz band)
Video bandwidth:	≥ 3xRBW
Span:	> EBW
Trace-Mode:	Max hold
Used test setup:	see chapter 7.4 – A
Measurement uncertainty:	see chapter 9

Limits:

Power Spectral Density
FCC power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5150 – 5250 MHz)* → **5dBm** power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5250 – 5350 MHz)* → **5dBm** power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5470 – 5725 MHz)* → **5dBm** power spectral density conducted ≤ 30 dBm in any 500 kHz band (band 5725 – 5850 MHz)* → **24dBm** **IC** power spectral density **e.i.r.p. ≤ 10 dBm** in any 1 MHz band (band 5150 – 5250 MHz) power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5250 – 5350 MHz)* → **5dBm** power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5470 – 5725 MHz)* → **5dBm** power spectral density conducted ≤ 30 dBm in any 500 kHz band (band 5725 – 5850 MHz)* → **24dBm**

*limit shall be reduced by 6 dB because of the 12dBi antenna gain.

Results plots are shown in sub chapter 12.4.