
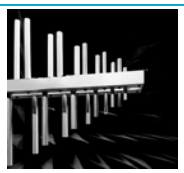
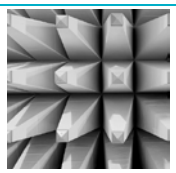

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-3977/22-03-12

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE
Phone: -/-
Contact: Ludovic Bomba
e-mail: ludovic.bomba@sagemcom.com

Manufacturer

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE

Test standard/s

FCC - Title 47 CFR Part 90 S	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 90 S - Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901, and 935-940 MHz Bands

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

Test Item

Kind of test item:	**Gateway**
Model name:	**F5688W**
FCC ID:	**VW3F5688W**
Frequency:	LTE band 26b 814 MHz to 824 MHz
Technology tested:	LTE
Antenna:	Integrated antenna
Power supply:	120 V AC by power mains
Temperature range:	0°C to +50°C

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.

Test report authorized:

cn=Marco Bertolino, o=CTC advanced GmbH, ou=BTL-211209, email=marco.bertolino@ctcadvanced.com, c=DE
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Marco Bertolino
Lab Manager
Radio Communications

Test performed:

cn=Andreas Luckenbill, o=CTC advanced GmbH, ou=LUC-180217, email=andreas.luckenbill@ctcadvanced.com, c=DE
2023.01.17 09:42:17 +01'00'

Andreas Luckenbill
Head of Department
Radio Communications

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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. CTC advanced 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.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.
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In no case this test report can be considered as a Letter of Approval.

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:	2022-12-07
Date of receipt of test item:	2022-09-27
Start of test:*	2022-10-04
End of test:*	2022-12-09
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 90 S	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 90 S - Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901, and 935-940 MHz Bands

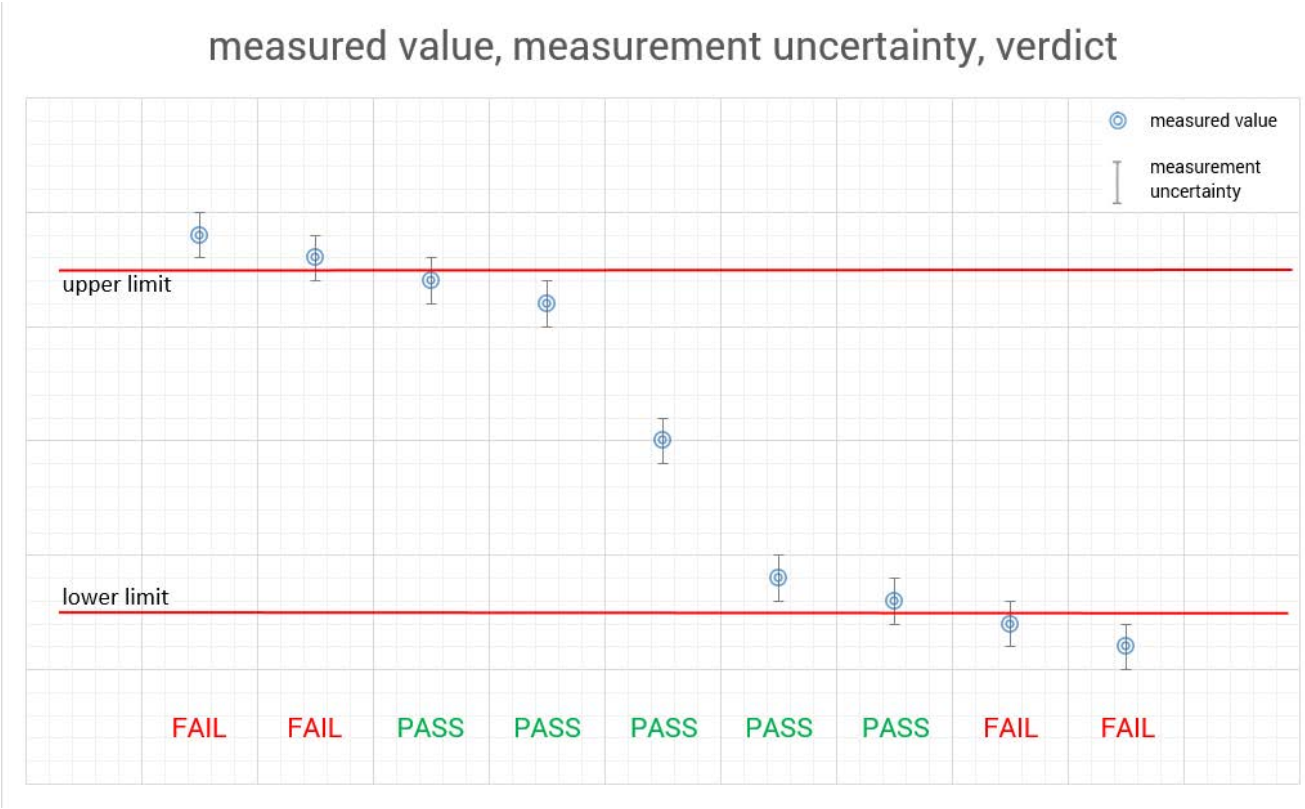
Guidance	Version	Description
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
Power Meas License Systems: KDB 971168 D01	v03r01	Measurement Guidance for Certification of Licensed Digital Transmitters

Accreditation	Description
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

FCC designation number: DE0002

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 8, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+20 °C during room temperature tests +50 °C during high temperature tests 0 °C during low temperature tests
Relative humidity content	:		38 %
Barometric pressure	:		1016 hpa
Power supply	:	V_{nom} V_{max} V_{min}	120 V AC by power mains 138 V AC by external power supply. 102 V AC by external power supply.

6 Test item

6.1 General description

Kind of test item	:	Gateway
Model name	:	F5688W
S/N serial number	:	Radiated unit: QS2212959002899 (IMEI: 359509840135591) – WALSIN QS2212959002968 (IMEI: 359509840060641) – COLFLY QS2212959002883 (IMEI: 359509840060278) – HL Conducted units: IMEI: 359509840061128
Hardware status	:	V1.2
Software status	:	SG520TMDAR02A02M4G_01.001.01.001_V01
Firmware status	:	SG520TMDAR02A02M4G_01.001.01.001_V01
Frequency band	:	LTE band 26b 814 MHz to 824 MHz
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	QPSK, 16 – QAM, 64 – QAM
Antenna	:	Integrated antenna
Power supply	:	120 V AC by power mains
Temperature range	:	0°C to +50°C

6.2 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: 1-3977/22-03-01_AnnexA
1-3977/22-03-01_AnnexB
1-3977/22-03-01_AnnexC

7 Sequence of testing

7.1 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, it is placed on a table with 0.8 m height.
- 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 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 pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- 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.

*)Note: The sequence will be repeated three times with different EUT orientations.

7.2 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.

7.3 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 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).

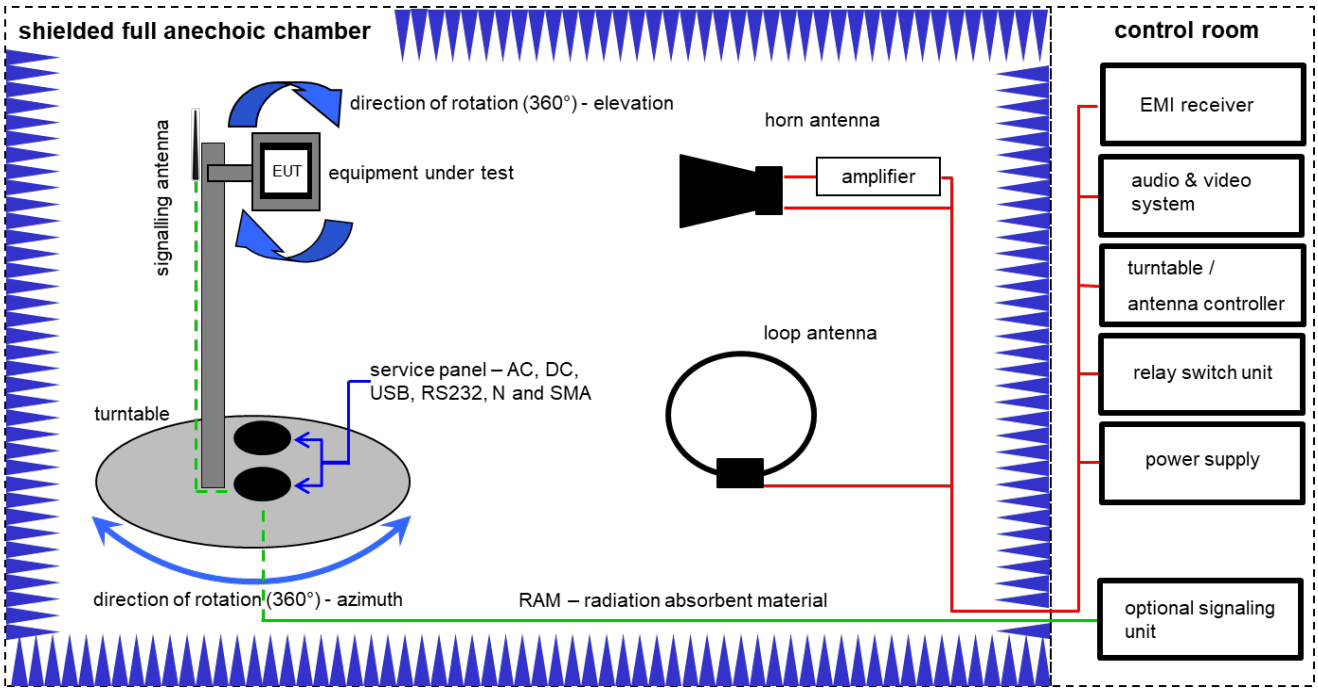
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

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

8.1 Shielded fully anechoic chamber



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

OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

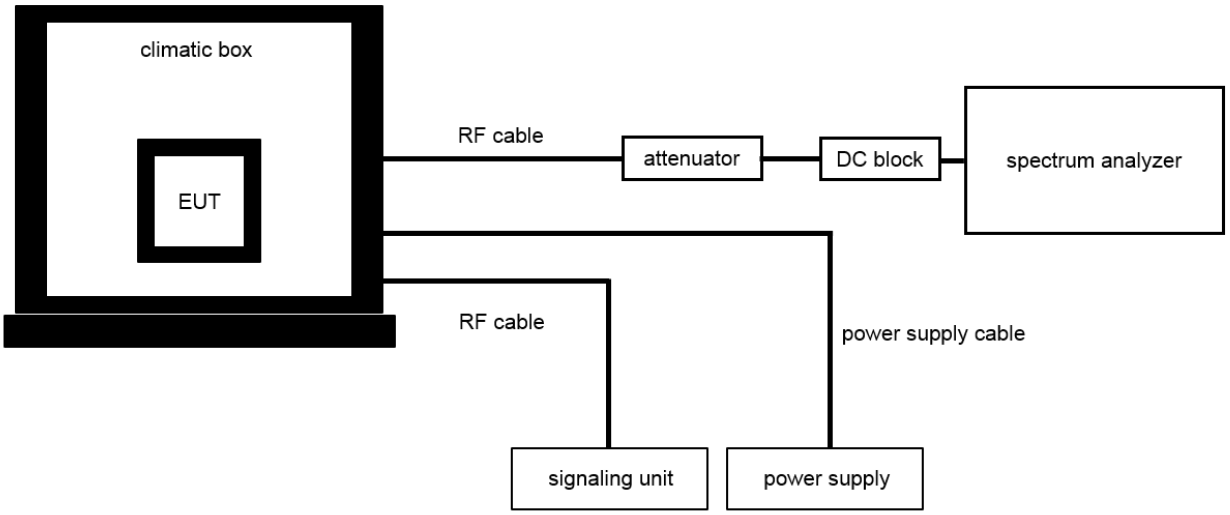
Example calculation:
OP [dBm] = -39.0 [dBm] + 57.0 [dB] - 12.0 [dBi] + (-36.0) [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	01.07.2021	31.07.2023
2	A	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vlKl!	11.02.2022	29.02.2024
4	A	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	09.12.2021	31.12.2022
5	A	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
6	A	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
7	A	High Pass Filter	VHF-3500+	Mini Circuits	-/-	400000193	ne	-/-	-/-
8	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
9	A	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
10	A	NEXIO EMV-Software	BAT EMC V3.21.0.27	EMCO	-/-	300004682	ne	-/-	-/-
11	A	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-

8.2 Conducted measurements normal and extreme conditions

Conducted measurements normal & extreme 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.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	25.01.2022	31.01.2023
2	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH		300004590	ne	-/-	-/-
3	A	RF-Cable	ST18/SMAm/SMAm /72	Huber & Suhner	Batch no. 699714	400001184	ev	-/-	-/-
4	A	DC-Blocker 0.1-40 GHz	8141A	Inmet		400001185	ev	-/-	-/-
5	A	Synchron Power Meter	SPM-4	CTC	1	300005580	ev	-/-	-/-
6	A	RF-Cable	ST18/SMAm/SMAm /36	Huber & Suhner	Batch no. 601494	400001309	ev	-/-	-/-
7	A	Temperature Test Chamber	T-40/50	CTS GmbH	064023	300003540	ev	09.05.2022	31.05.2024

9 Measurement uncertainty

Measurement uncertainty		
Test case	**Uncertainty**	
Antenna gain	± 3 dB	
99 % bandwidth	± RBW	
-26 dB bandwidth	± RBW	
Frequency stability	10^{-6}	
Maximum output power conducted	± 1.56 dB	
Block edge compliance	± 1.56 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.56 dB
	> 7 GHz	± 1.56 dB
	> 18 GHz	± 2.31 dB
	≥ 40 GHz	± 2.97 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	

10 Additional information and comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

EUT selection:

☐ Only one device available

☐ Devices selected by the customer

☒ Devices selected by the laboratory (Randomly)

11 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	FCC: CFR Part 2 & Part 90 S	See table!	2023-01-17	-/-

11.1 Part 90S: LTE band 26b

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	-/-
Frequency Stability	Extreme	Extreme	☒	☐	☐	☐	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
Spurious Emissions Conducted	Nominal	Nominal	☒	☐	☐	☐	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	-/-
Occupied Bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-

Notes:

C	Compliant	**NC**	Not compliant	**NA**	Not applicable	**NP**	Not performed

12 RF measurements

12.1 Description of test setup

For the spurious measurements, we use the substitution method according TIA/EIA 603.

12.2 Results LTE band 26b

The EUT was set to transmit the maximum power.

12.2.1 RF output power

Description:

This paragraph contains conducted average power, ERP and Peak-to-Average Power Ratio measurements for the mobile station.

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	40 MHz
Used equipment:	See chapter 7.1 setup A & 7.4 setup A
Measurement uncertainty:	see chapter 9
Measurement procedure:	FCC: § 2.1046

Limits:

FCC
§ 90.635
b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).
Power: **50 ERP** PAPR: **-/-**

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**	**Average Output Power (dBm) 64-QAM**	**Average Output Power (dBm) 256-QAM**
1.4	20407 / 824.7	1 RB low	22.1	21.4	20.3	-/-
		1 RB mid	22.2	21.4	20.4	-/-
		1 RB high	22.1	21.4	20.4	-/-
		50% RB low	22.2	21.2	20.2	-/-
		50% RB mid	22.3	21.3	20.3	-/-
		50% RB high	22.2	21.3	20.3	-/-
		100% RB	21.1	20.2	19.2	-/-
	20525 / 836.5	1 RB low	21.1	21.3	21.4	-/-
		1 RB mid	22.2	21.4	20.4	-/-
		1 RB high	22.2	21.4	20.3	-/-
		50% RB low	22.2	21.2	20.2	-/-
		50% RB mid	22.2	21.2	20.3	-/-
		50% RB high	22.2	21.3	20.2	-/-
		100% RB	21.2	20.3	19.2	-/-
	20643 / 848.3	1 RB low	22.0	21.3	20.3	-/-
		1 RB mid	22.2	21.4	20.5	-/-
		1 RB high	22.2	21.4	20.4	-/-
		50% RB low	22.1	21.2	20.1	-/-
		50% RB mid	22.1	21.2	20.3	-/-
		50% RB high	22.2	21.3	20.3	-/-
		100% RB	21.2	20.3	19.3	-/-
3	20415 / 825.5	1 RB low	22.0	21.4	20.3	-/-
		1 RB mid	22.2	21.3	20.4	-/-
		1 RB high	22.1	21.3	20.2	-/-
		50% RB low	21.1	20.2	19.2	-/-
		50% RB mid	21.2	20.3	19.3	-/-
		50% RB high	21.3	20.3	19.3	-/-
		100% RB	21.2	20.2	19.3	-/-
	20525 / 836.5	1 RB low	22.0	21.4	20.3	-/-
		1 RB mid	22.3	21.5	20.4	-/-
		1 RB high	22.1	21.4	20.5	-/-
		50% RB low	21.1	20.2	19.2	-/-
		50% RB mid	21.2	20.3	19.3	-/-
		50% RB high	21.2	20.3	19.3	-/-
		100% RB	21.2	20.2	19.3	-/-
	20635 / 847.5	1 RB low	22.0	21.3	20.3	-/-
		1 RB mid	22.2	21.7	20.4	-/-
		1 RB high	22.1	21.4	20.5	-/-
		50% RB low	21.2	20.3	19.3	-/-

Output Power (conducted)						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**	**Average Output Power (dBm) 64-QAM**	**Average Output Power (dBm) 256-QAM**
		50% RB mid	21.2	20.3	19.3	-/-
		50% RB high	21.3	20.3	19.3	-/-
		100% RB	21.2	20.2	19.3	-/-
5	20425 / 826.5	1 RB low	22.0	21.3	20.3	-/-
		1 RB mid	22.3	21.7	20.6	-/-
		1 RB high	22.2	21.5	20.3	-/-
		50% RB low	21.1	20.1	19.0	-/-
		50% RB mid	21.2	20.3	19.3	-/-
		50% RB high	21.2	20.3	19.3	-/-
		100% RB	21.2	20.2	19.3	-/-
	20525 / 836.5	1 RB low	22.0	21.4	20.4	-/-
		1 RB mid	22.3	21.6	20.3	-/-
		1 RB high	22.2	21.5	20.4	-/-
		50% RB low	21.1	20.2	19.1	-/-
		50% RB mid	21.3	20.3	19.3	-/-
		50% RB high	21.3	20.3	19.2	-/-
		100% RB	21.2	20.2	19.2	-/-
	20625 / 846.5	1 RB low	22.1	21.4	20.5	-/-
		1 RB mid	22.2	21.6	20.5	-/-
		1 RB high	22.2	21.5	20.3	-/-
		50% RB low	21.1	20.2	19.1	-/-
		50% RB mid	21.3	20.3	19.3	-/-
		50% RB high	21.2	20.3	19.2	-/-
		100% RB	21.2	20.3	19.2	-/-
10	20450 / 829.0	1 RB low	22.1	21.2	20.2	-/-
		1 RB mid	22.2	21.4	20.4	-/-
		1 RB high	21.9	21.3	20.2	-/-
		50% RB low	21.0	20.0	19.1	-/-
		50% RB mid	21.2	20.3	19.3	-/-
		50% RB high	21.3	20.2	19.2	-/-
		100% RB	21.1	20.1	19.2	-/-
	20525 / 836.5	1 RB low	22.1	21.2	20.3	-/-
		1 RB mid	22.2	21.5	20.4	-/-
		1 RB high	22.0	21.2	20.2	-/-
		50% RB low	21.1	20.1	19.1	-/-
		50% RB mid	21.3	20.2	19.3	-/-
		50% RB high	21.2	20.2	19.2	-/-
		100% RB	21.2	20.2	19.2	-/-
	20600 / 844.0	1 RB low	22.0	21.2	20.3	-/-
		1 RB mid	22.3	21.6	20.4	-/-
		1 RB high	21.9	21.2	20.2	-/-
		50% RB low	21.1	20.1	19.1	-/-

Output Power (conducted)						
Bandwidth (MHz)	Channel No. / Frequency (MHz)	Resource block allocation	Average Output Power (dBm) QPSK	Average Output Power (dBm) 16-QAM	Average Output Power (dBm) 64-QAM	Average Output Power (dBm) 256-QAM
		50% RB mid	21.3	20.3	19.3	-/-
		50% RB high	21.2	20.2	19.3	-/-
		100% RB	21.1	20.1	19.1	-/-

The radiated output power is measured in the mode with the highest conducted output power.

Output Power (ERP)					
Bandwidth (MHz)	Frequency (MHz)	Average Output Power (dBm) QPSK	Average Output Power (dBm) 16-QAM	Average Output Power (dBm) 64-QAM	Average Output Power (dBm) 256-QAM
1.4	824.7	24.2	23.3	22.3	-/-
	836.5	24.1	23.3	23.3	-/-
	848.3	24.1	23.3	22.4	-/-
3	825.5	24.1	23.3	22.3	-/-
	836.5	24.2	23.4	22.4	-/-
	847.5	24.1	23.6	22.4	-/-
5	826.5	24.2	23.6	22.5	-/-
	836.5	24.2	23.5	22.3	-/-
	846.5	24.1	23.5	22.4	-/-
10	829.0	24.1	23.3	22.3	-/-
	836.5	24.1	23.4	22.3	-/-
	844.0	24.2	23.5	22.3	-/-

Peak to Average ratio						
Bandwidth (MHz)	Channel No. / Frequency (MHz)	Resource block allocation	Peak to Average ratio (dB) QPSK	Peak to Average ratio (dB) 16-QAM	Peak to Average ratio (dB) 64-QAM	Peak to Average ratio (dB) 256-QAM
1.4	20407 / 824.7	1 RB low	5.0	5.7	6.6	-/-
		1 RB mid	4.8	5.7	6.6	-/-
		1 RB high	4.9	5.6	6.6	-/-
		50% RB low	4.8	5.7	6.6	-/-
		50% RB mid	4.8	5.7	6.6	-/-
		50% RB high	4.8	5.7	6.6	-/-

Peak to Average ratio						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Peak to Average ratio (dB) QPSK**	**Peak to Average ratio (dB) 16-QAM**	**Peak to Average ratio (dB) 64-QAM**	**Peak to Average ratio (dB) 256-QAM**
		100% RB	5.6	6.5	6.9	-/-
	20525 / 836.5	1 RB low	6.0	6.0	5.9	-/-
		1 RB mid	5.1	5.9	6.9	-/-
		1 RB high	5.2	6.1	7.0	-/-
		50% RB low	5.0	6.1	7.0	-/-
		50% RB mid	5.1	6.1	6.9	-/-
		50% RB high	5.1	6.1	7.0	-/-
		100% RB	5.9	6.9	7.1	-/-
	20643 / 848.3	1 RB low	5.3	6.2	7.0	-/-
		1 RB mid	5.2	6.0	7.0	-/-
		1 RB high	5.2	6.0	7.0	-/-
		50% RB low	5.3	6.1	7.0	-/-
		50% RB mid	5.2	6.1	6.8	-/-
		50% RB high	5.2	6.1	6.8	-/-
		100% RB	5.9	6.8	7.0	-/-
3	20415 / 825.5	1 RB low	4.3	5.1	6.1	-/-
		1 RB mid	4.3	5.1	6.1	-/-
		1 RB high	4.3	5.2	6.3	-/-
		50% RB low	5.2	6.2	6.6	-/-
		50% RB mid	5.2	6.1	6.6	-/-
		50% RB high	5.2	6.1	6.8	-/-
		100% RB	5.2	6.2	6.8	-/-
	20525 / 836.5	1 RB low	4.4	5.2	6.2	-/-
		1 RB mid	4.4	5.3	6.2	-/-
		1 RB high	4.5	5.4	6.3	-/-
		50% RB low	5.4	6.3	6.8	-/-
		50% RB mid	5.4	6.3	7.0	-/-
		50% RB high	5.4	6.3	7.1	-/-
		100% RB	5.4	6.4	7.0	-/-
	20635 / 847.5	1 RB low	4.5	5.4	6.3	-/-
		1 RB mid	4.5	5.3	6.4	-/-
		1 RB high	4.5	5.3	6.3	-/-
		50% RB low	5.5	6.4	7.0	-/-
		50% RB mid	5.4	6.4	6.9	-/-
		50% RB high	5.4	6.4	6.9	-/-
		100% RB	5.5	6.5	7.0	-/-
5	20425 / 826.5	1 RB low	4.3	5.0	6.1	-/-
		1 RB mid	4.3	4.9	6.0	-/-
		1 RB high	4.5	5.2	6.3	-/-
		50% RB low	5.2	6.2	6.8	-/-
		50% RB mid	5.2	6.2	6.9	-/-
		50% RB high	5.3	6.3	6.8	-/-

Peak to Average ratio						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Peak to Average ratio (dB) QPSK**	**Peak to Average ratio (dB) 16-QAM**	**Peak to Average ratio (dB) 64-QAM**	**Peak to Average ratio (dB) 256-QAM**
		100% RB	5.4	6.3	6.8	-/-
	20525 / 836.5	1 RB low	4.4	5.1	6.1	-/-
		1 RB mid	4.4	5.1	6.4	-/-
		1 RB high	4.6	5.3	6.3	-/-
		50% RB low	5.4	6.3	6.9	-/-
		50% RB mid	5.4	6.3	6.8	-/-
		50% RB high	5.4	6.4	7.0	-/-
		100% RB	5.5	6.4	7.0	-/-
	20625 / 846.5	1 RB low	4.5	5.2	6.2	-/-
		1 RB mid	4.5	5.2	6.3	-/-
		1 RB high	4.5	5.2	6.3	-/-
		50% RB low	5.4	6.5	6.9	-/-
		50% RB mid	5.4	6.4	7.0	-/-
		50% RB high	5.4	6.4	7.0	-/-
		100% RB	5.5	6.4	7.0	-/-
10	20450 / 829.0	1 RB low	4.3	5.1	6.1	-/-
		1 RB mid	4.4	5.2	6.2	-/-
		1 RB high	4.5	5.3	6.4	-/-
		50% RB low	5.4	6.3	6.8	-/-
		50% RB mid	5.4	6.3	6.9	-/-
		50% RB high	5.4	6.4	6.9	-/-
		100% RB	5.6	6.4	6.9	-/-
	20525 / 836.5	1 RB low	4.3	5.1	6.1	-/-
		1 RB mid	4.4	5.2	6.3	-/-
		1 RB high	4.5	5.5	6.5	-/-
		50% RB low	5.4	6.3	6.8	-/-
		50% RB mid	5.4	6.4	6.9	-/-
		50% RB high	5.5	6.4	6.9	-/-
		100% RB	5.5	6.4	6.9	-/-
	20600 / 844.0	1 RB low	4.3	5.1	6.1	-/-
		1 RB mid	4.4	5.2	6.3	-/-
		1 RB high	4.5	5.5	6.3	-/-
		50% RB low	5.4	6.3	6.8	-/-
		50% RB mid	5.4	6.4	6.9	-/-
		50% RB high	5.5	6.5	6.9	-/-
		100% RB	5.5	6.4	6.8	-/-

12.2.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to a R&S CMW500 Wideband Radio Communication Tester.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom}, connected to the CMW500 on the center channel with channel bandwidth of 10 MHz, measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 15 minutes at each temperature, unpowered, before making measurements.
5. Re-measure carrier frequency at room temperature with V_{nom}. Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Test setup:	See chapter 8.2 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1055

Limits:

FCC
§ 90.213 (Mobile Station, 814 – 824 MHz)
The carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table 1 to §90.213(a).
± 2.5 ppm

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
102	4	0.0054
120	5	0.0061
138	5	0.0061

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-4	-0.0049
-20	-6	-0.0074
-10	-5	-0.0061
± 0	-6	-0.0074
10	-5	-0.0061
20	5	0.0061
30	7	0.0086
40	-6	-0.0074
50	7	0.0086

12.2.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2014 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 844 MHz. Measurement made up to 9 GHz. The resolution bandwidth is set as outlined in Part 90. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to lowest, middle and highest channels of the LTE band 26b.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 s
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter 7.1 setup A & 7.2 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1053

Limits:

FCC
§ 90.691 (a)(2)
For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.
-13 dBm

Results:

QPSK:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

16-QAM:

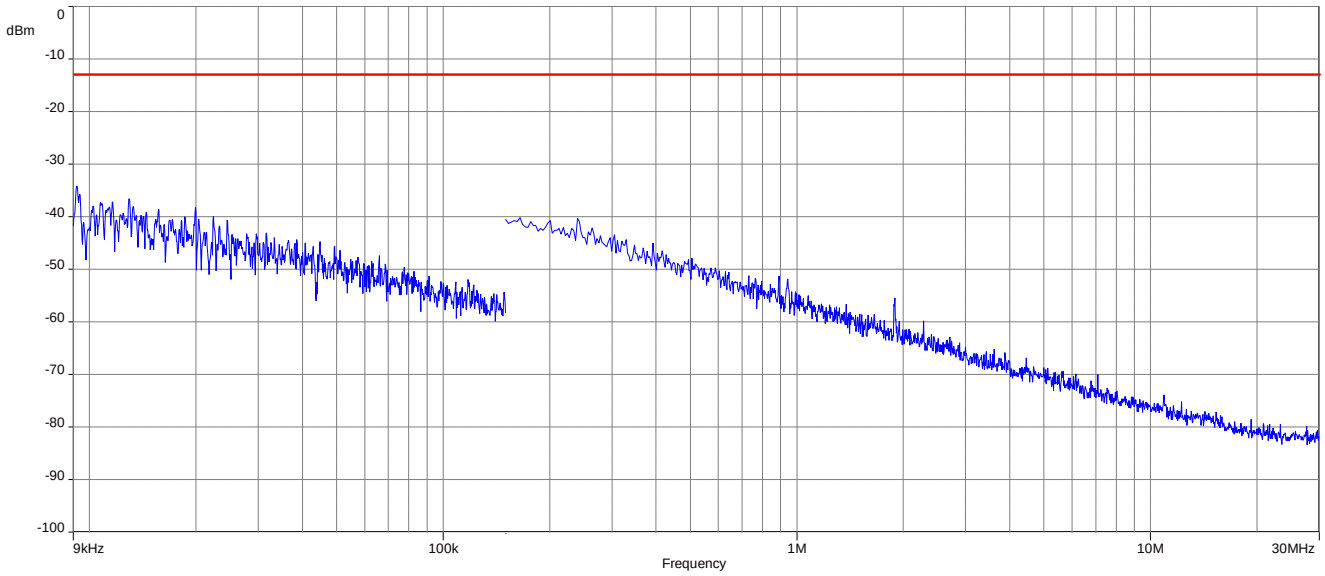
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

64-QAM:

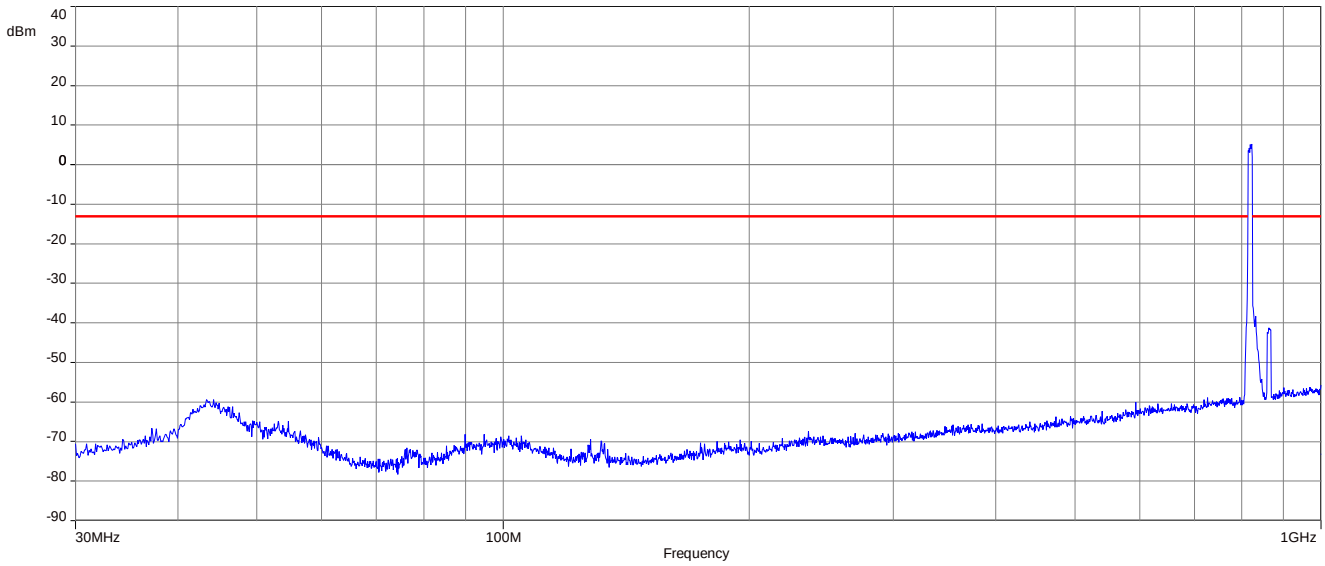
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

Plots:

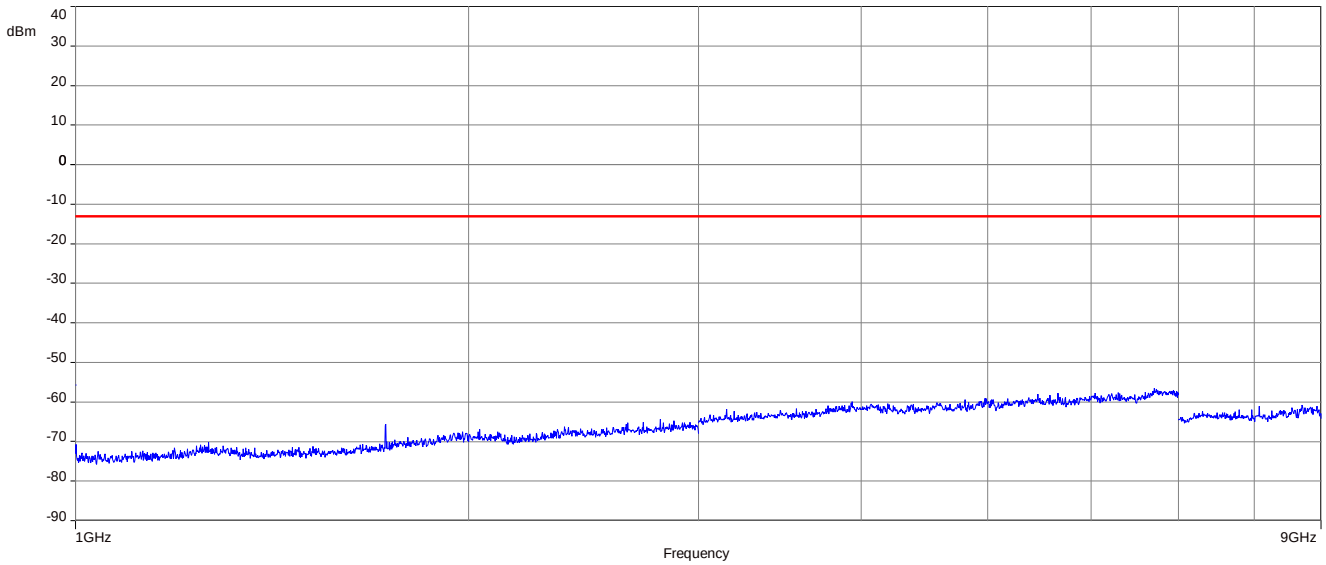
Plot 1: QPSK - Middle channel (9 kHz - 30 MHz)



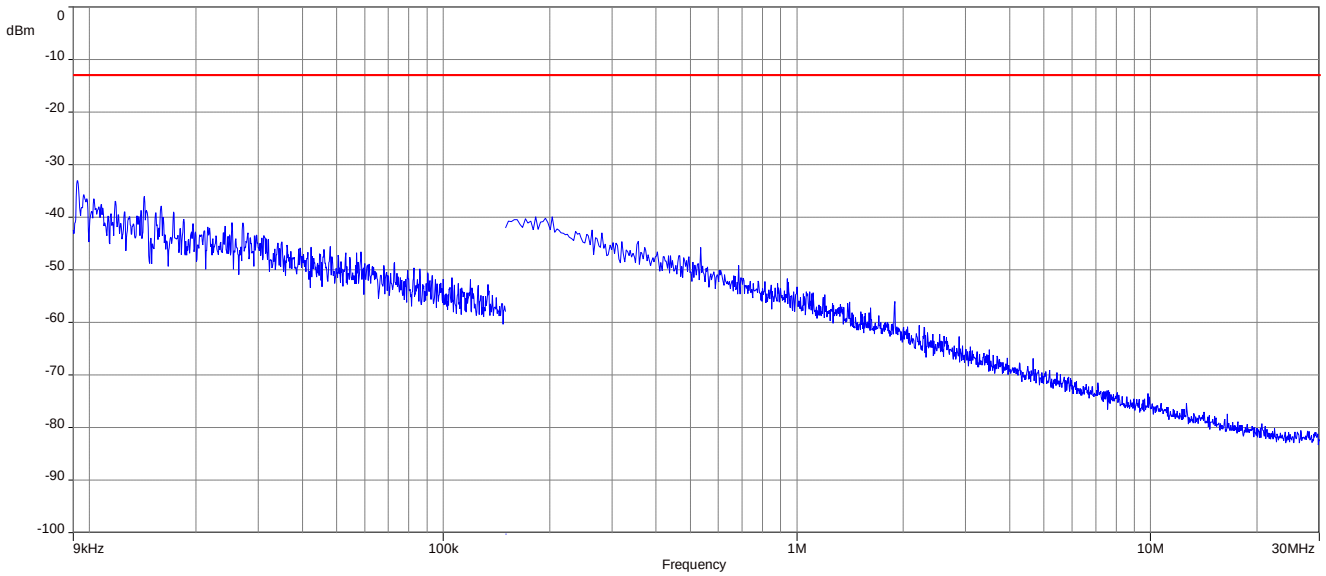
Plot 2: QPSK - Middle channel (30 MHz – 1 GHz)



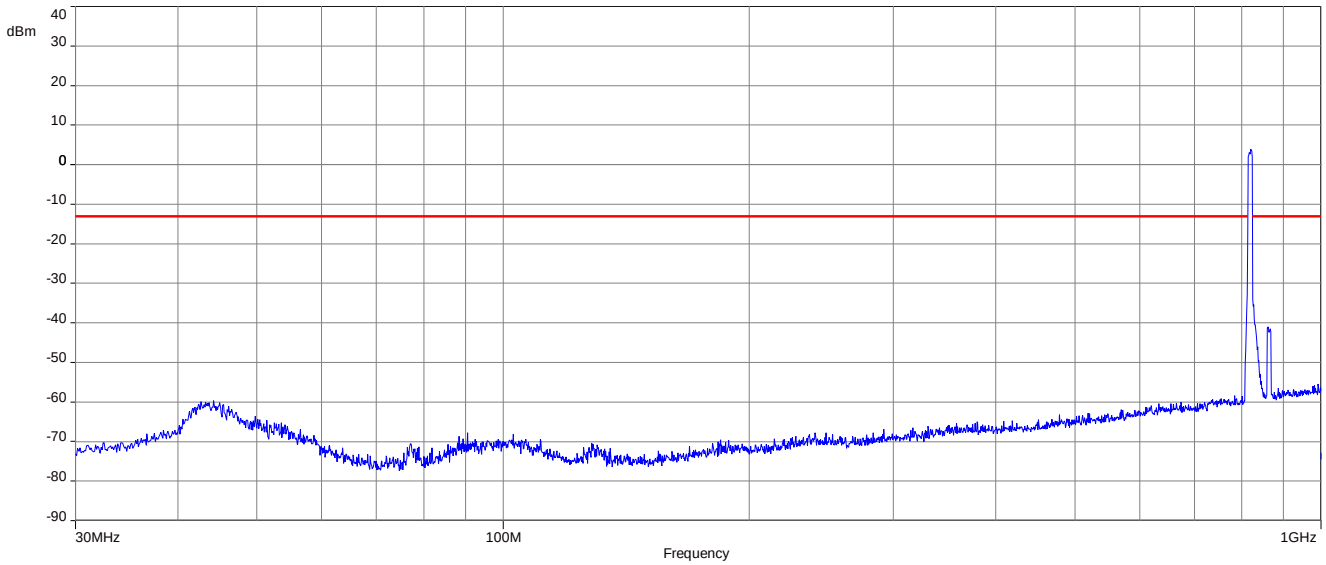
Plot 3: QPSK - Middle channel (1 GHz – 9 GHz)



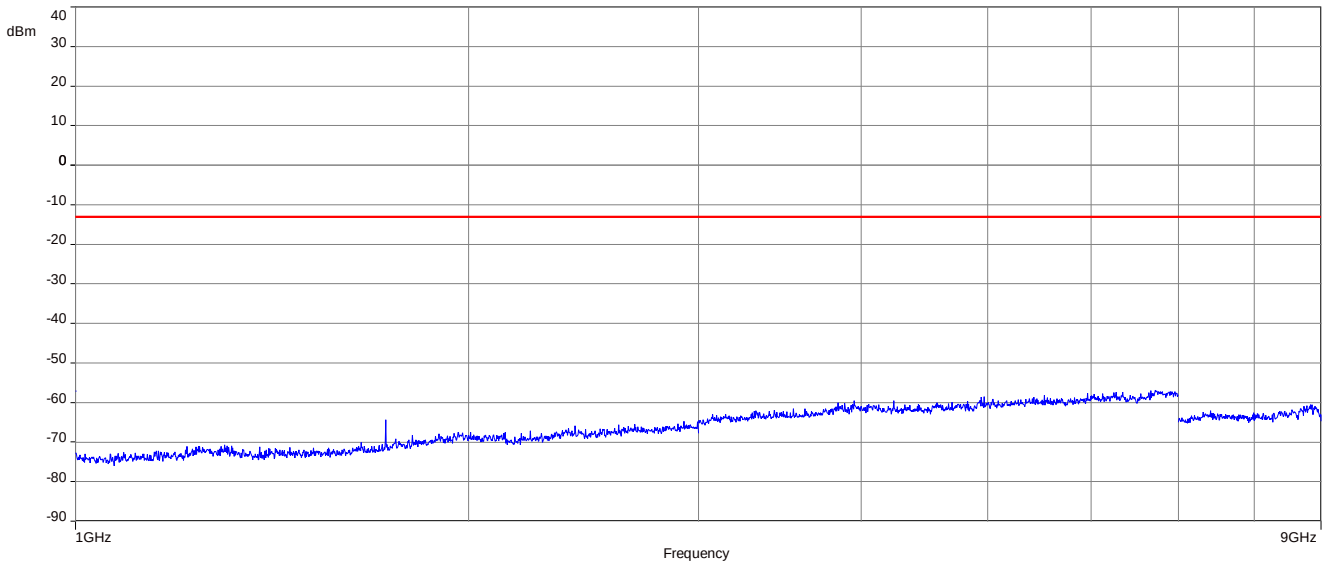
Plot 4: 16-QAM - Middle channel (9 kHz - 30 MHz)



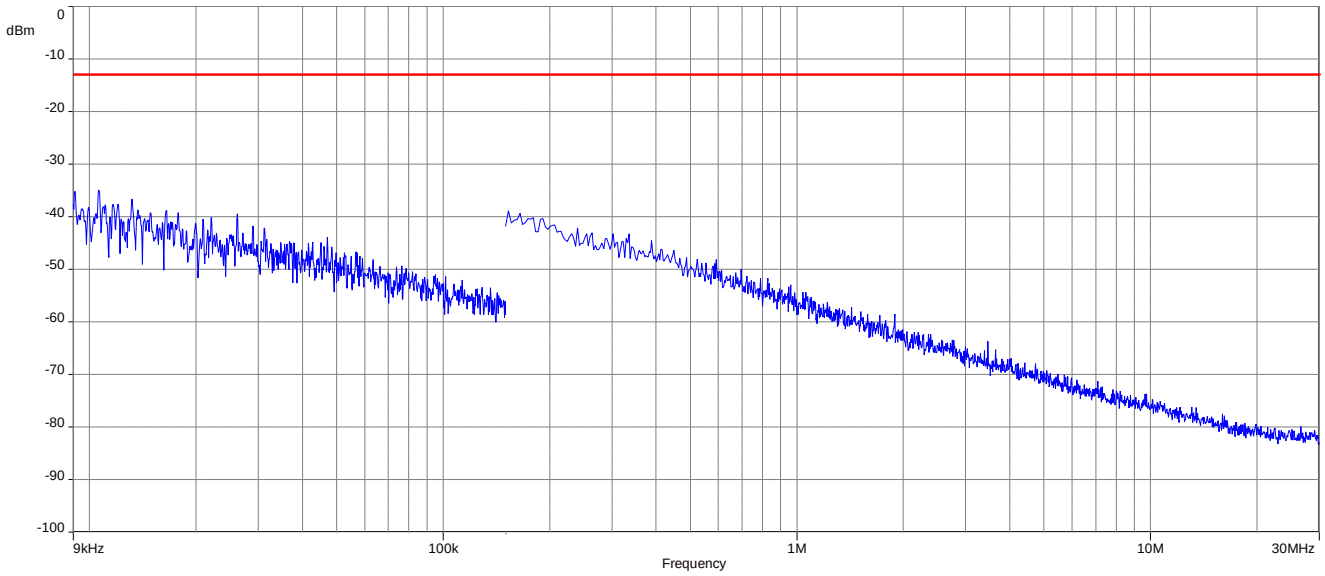
Plot 5: 16-QAM - Middle channel (30 MHz – 1 GHz)



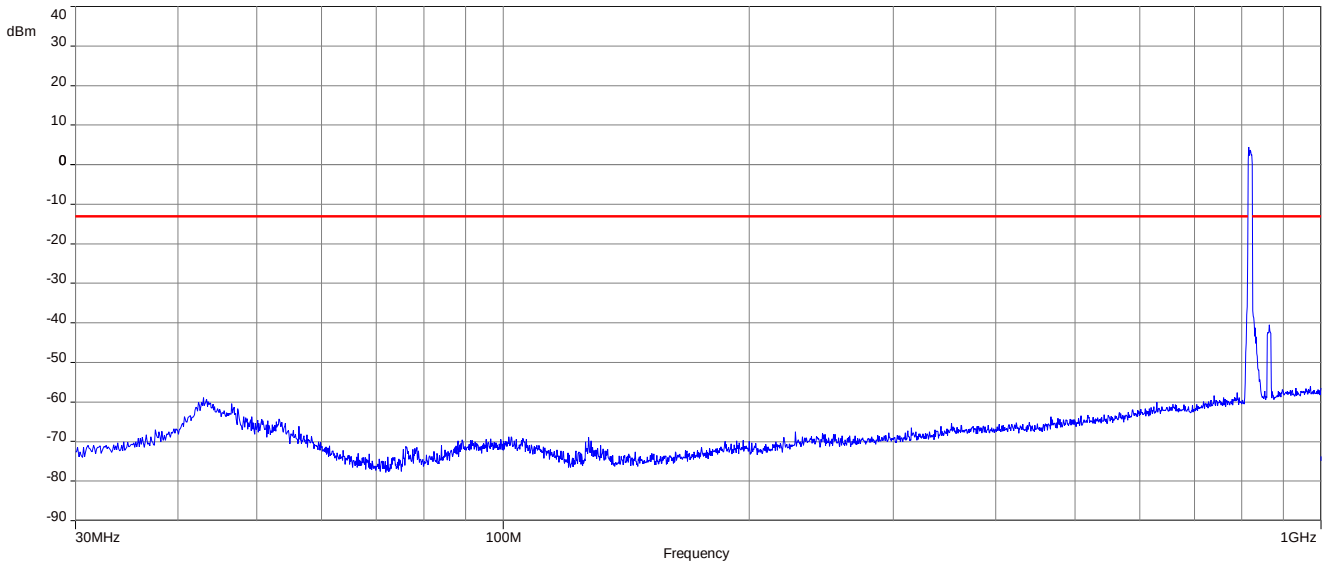
Plot 6: 16-QAM - Middle channel (1 GHz – 9 GHz)



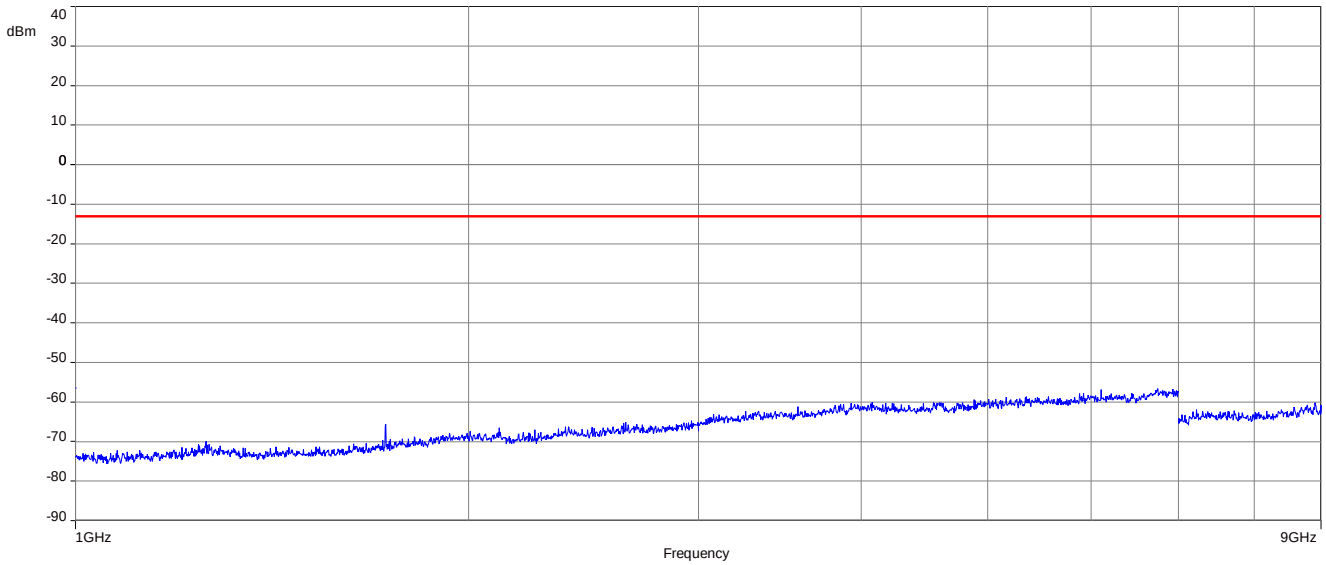
Plot 7: 64-QAM - Middle channel (9 kHz - 30 MHz)



Plot 8: 64-QAM - Middle channel (30 MHz – 1 GHz)



Plot 9: 64-QAM - Middle channel (1 GHz – 9 GHz)



12.2.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From § 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency.

2. Determine mobile station transmits frequencies: below outlines, the band edge frequencies pertinent to conducted emissions testing.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 8.5 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1051

Limits:

FCC
§ 90.691 (a)(2)
For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.
-13 dBm

Results:

QPSK:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

16-QAM:

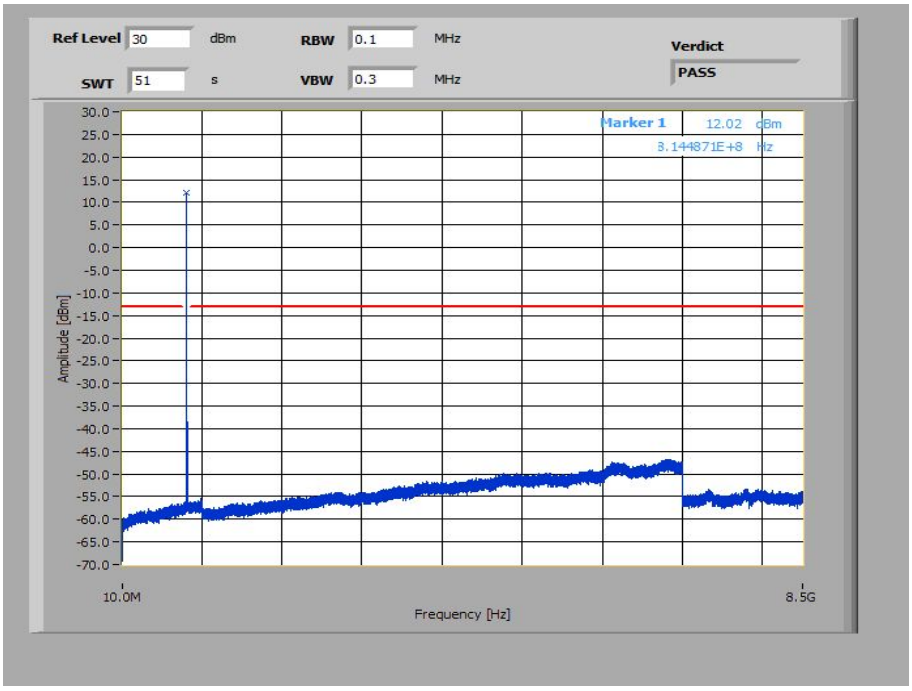
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

64-QAM:

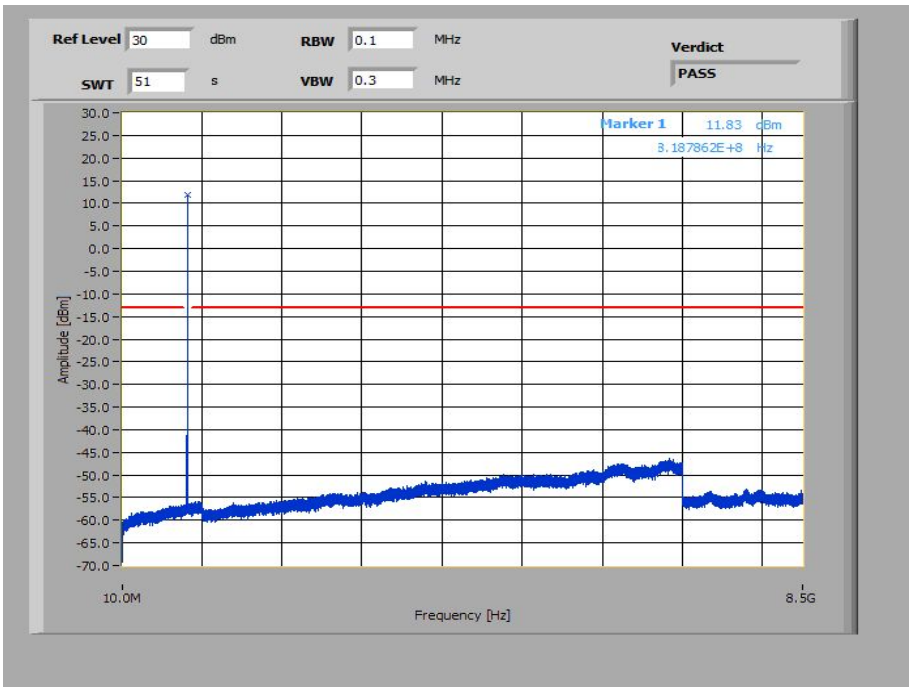
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

Plots:

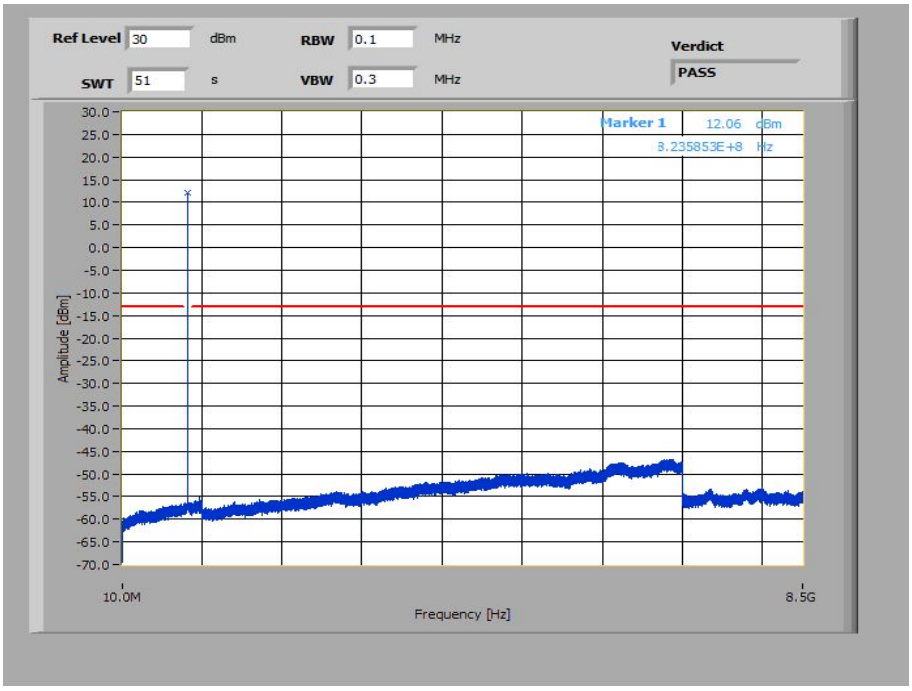
Plot 1: 1.4 MHz – QPSK - Lowest Channel (10 MHz – 8.5 GHz)



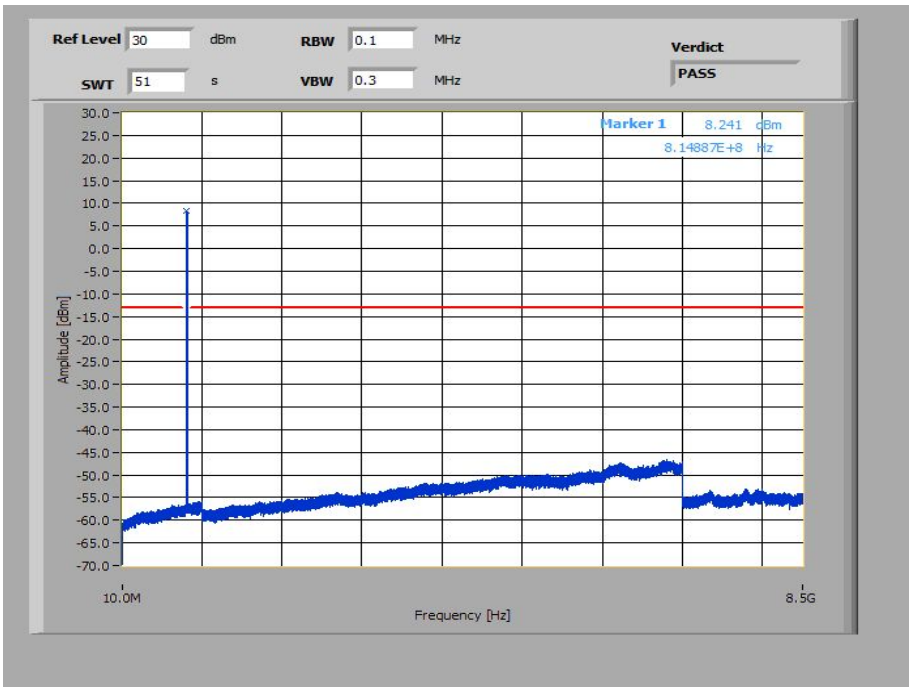
Plot 2: 1.4 MHz – QPSK - Middle Channel (10 MHz – 8.5 GHz)



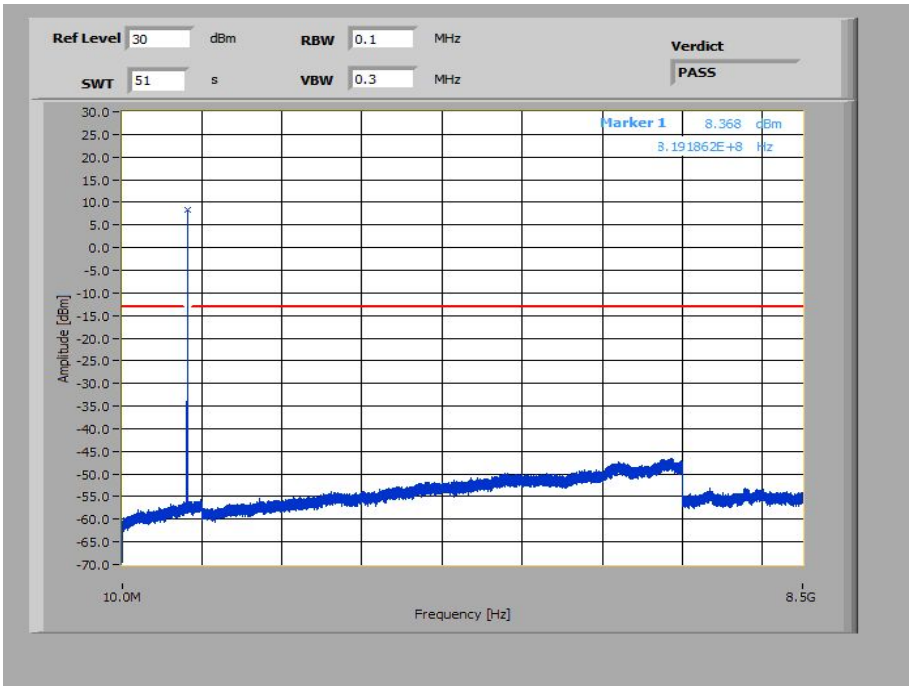
Plot 3: 1.4 MHz – QPSK - Highest Channel (10 MHz – 8.5 GHz)



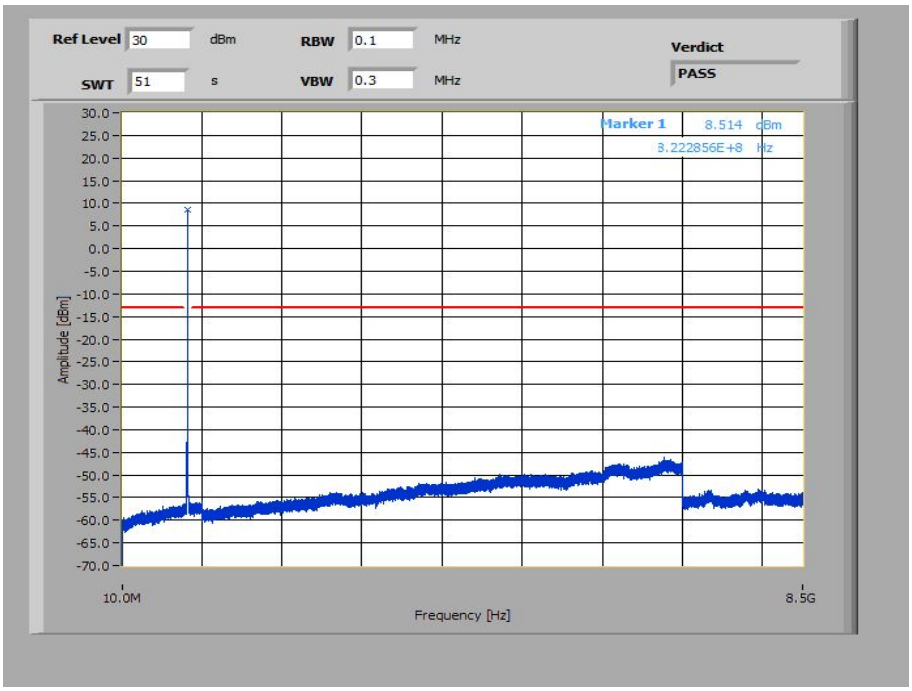
Plot 4: 3 MHz – QPSK - Lowest Channel (10 MHz – 8.5 GHz)



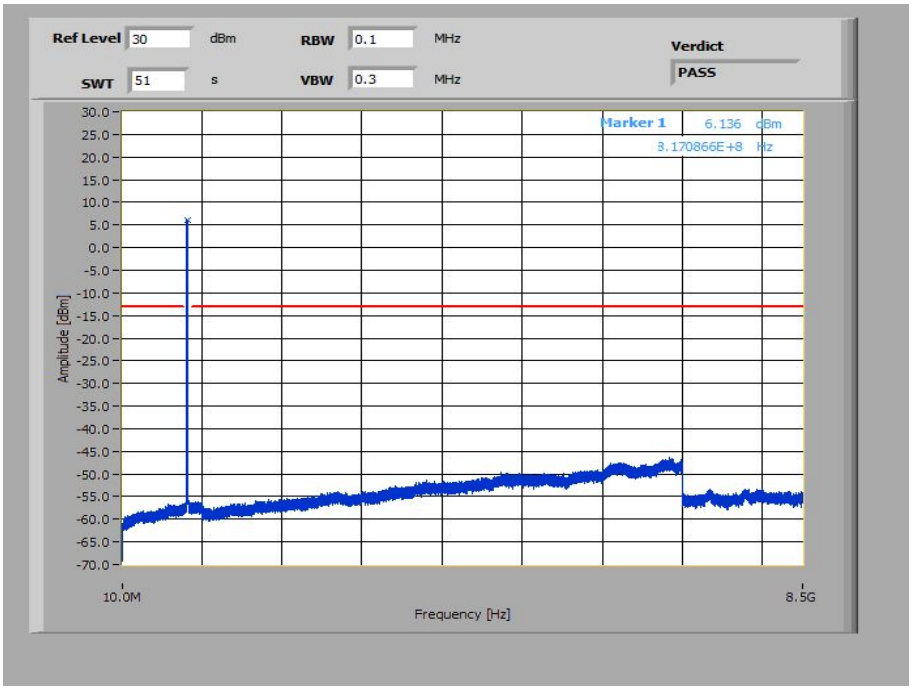
Plot 5: 3 MHz – QPSK - Middle Channel (10 MHz – 8.5 GHz)



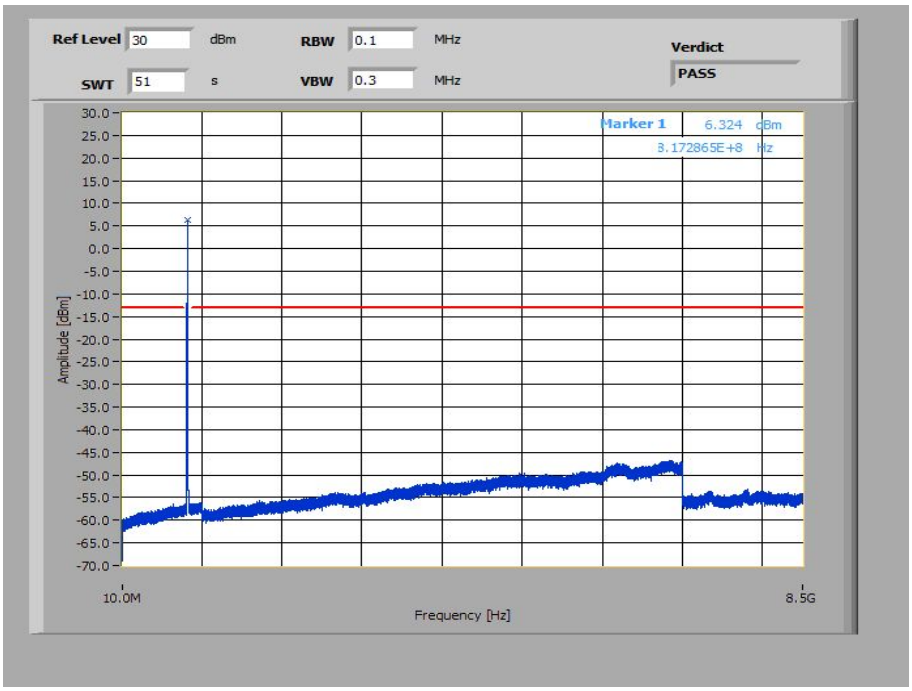
Plot 6: 3 MHz – QPSK - Highest Channel (10 MHz – 8.5 GHz)



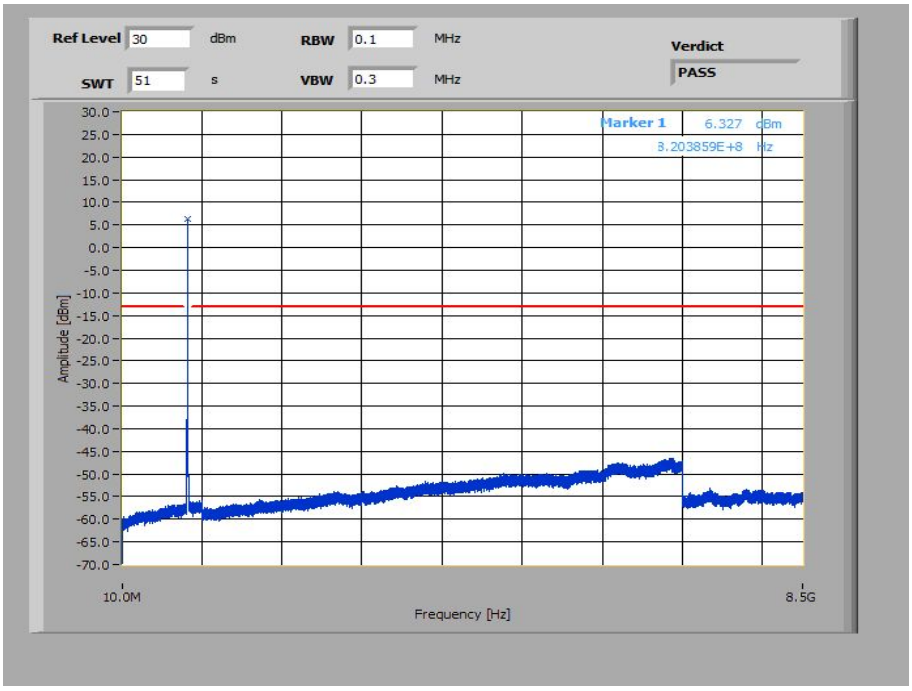
Plot 7: 5 MHz – QPSK - Lowest Channel (10 MHz – 8.5 GHz)



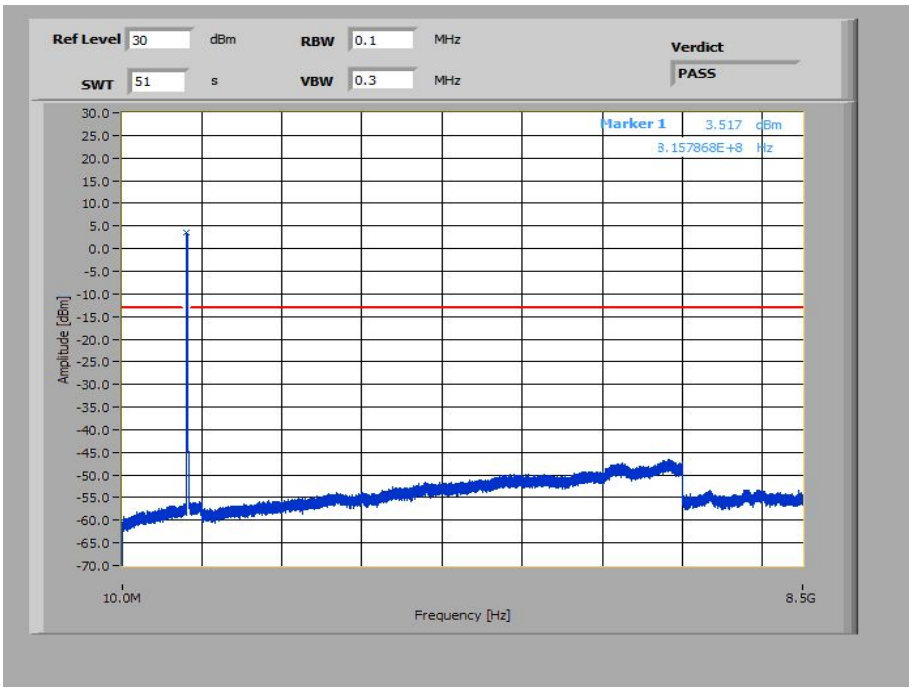
Plot 8: 5 MHz – QPSK - Middle Channel (10 MHz – 8.5 GHz)



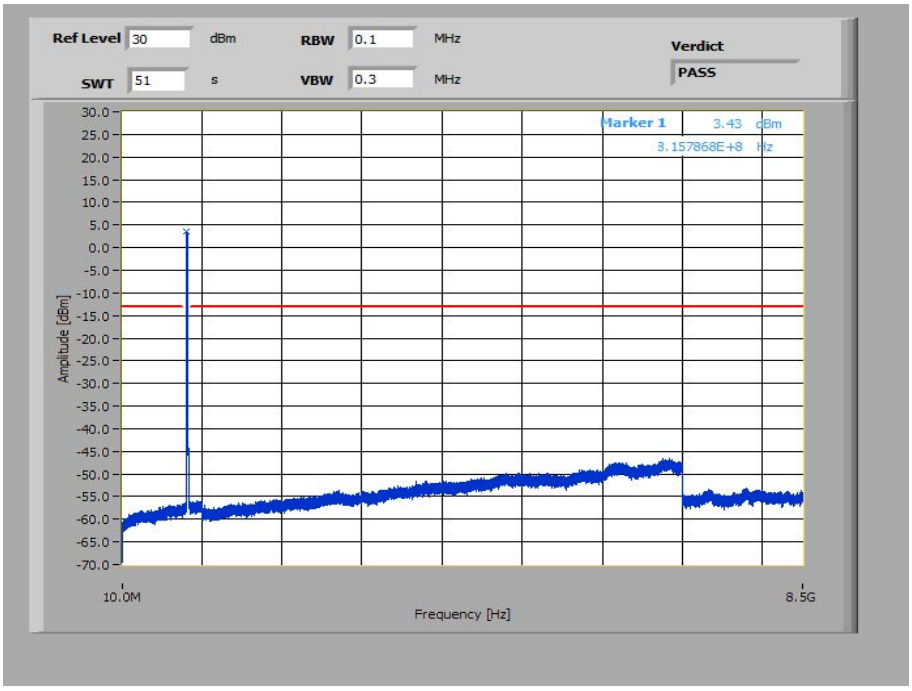
Plot 9: 5 MHz – QPSK - Highest Channel (10 MHz – 8.5 GHz)



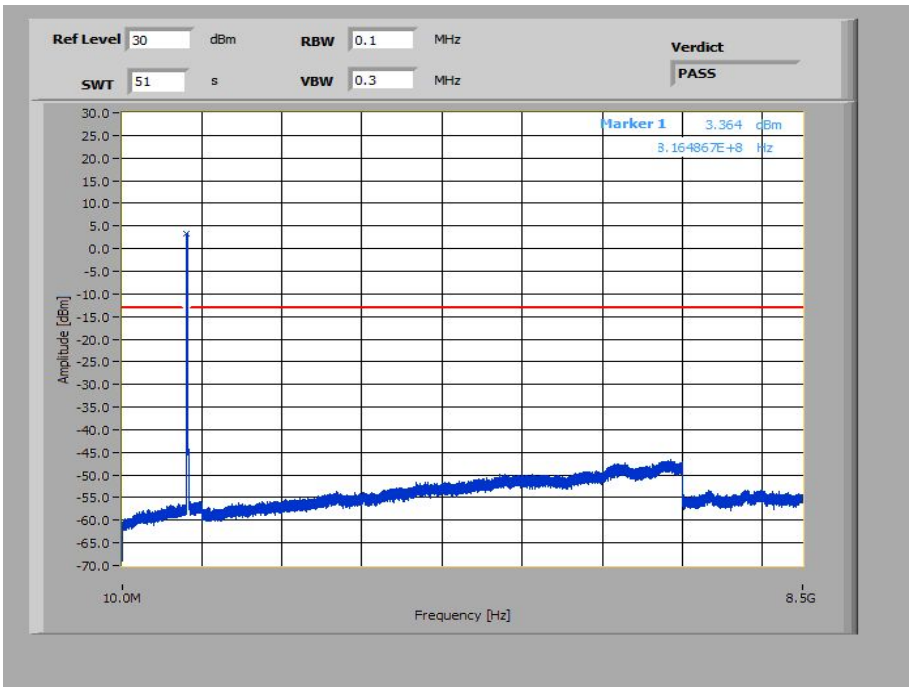
Plot 10: 10 MHz – QPSK - Lowest Channel (10 MHz – 8.5 GHz)



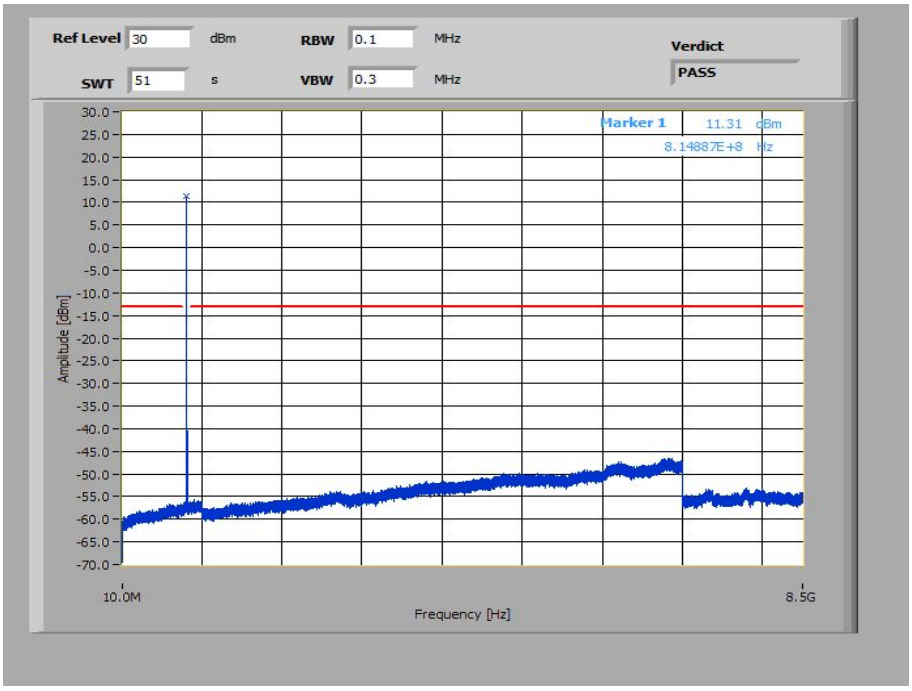
Plot 11: 10 MHz – QPSK - Middle Channel (10 MHz – 8.5 GHz)



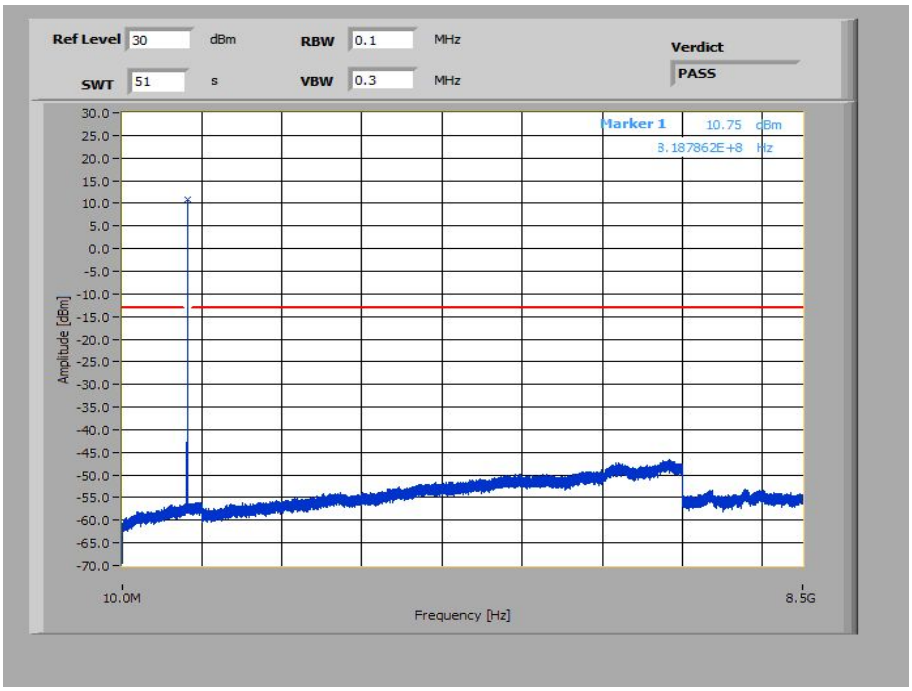
Plot 12: 10 MHz – QPSK - Highest Channel (10 MHz – 8.5 GHz)



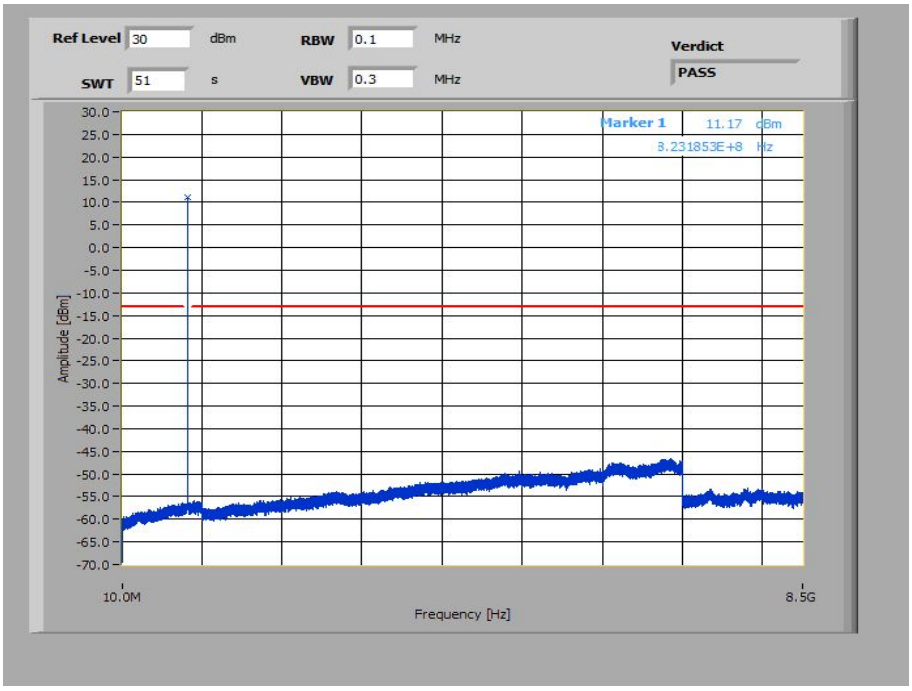
Plot 13: 1.4 MHz – 16-QAM - Lowest Channel (10 MHz – 8.5 GHz)



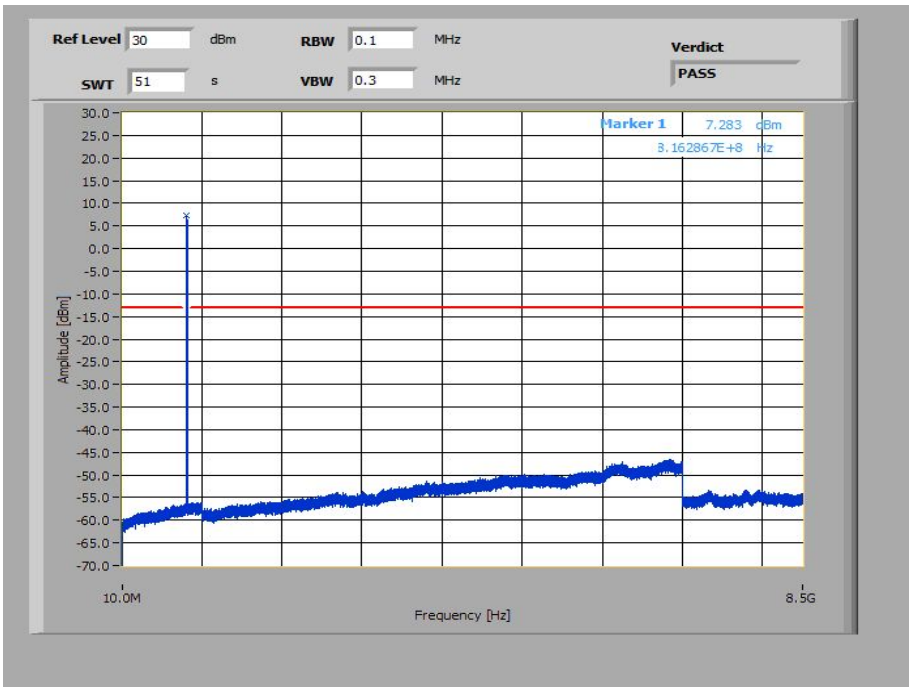
Plot 14: 1.4 MHz – 16-QAM - Middle Channel (10 MHz – 8.5 GHz)



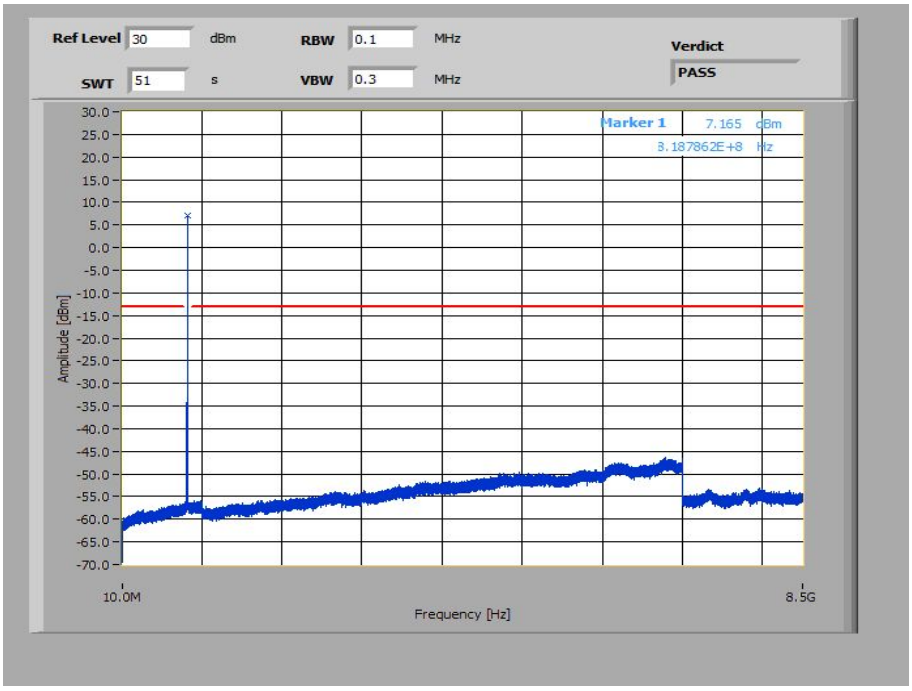
Plot 15: 1.4 MHz – 16-QAM - Highest Channel (10 MHz – 8.5 GHz)



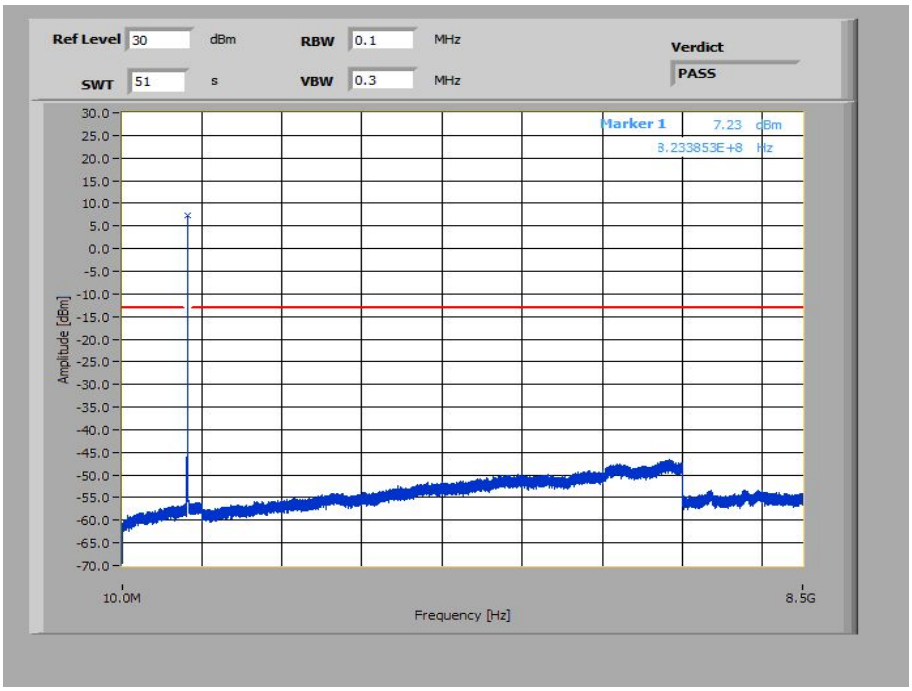
Plot 16: 3 MHz – 16-QAM - Lowest Channel (10 MHz – 8.5 GHz)



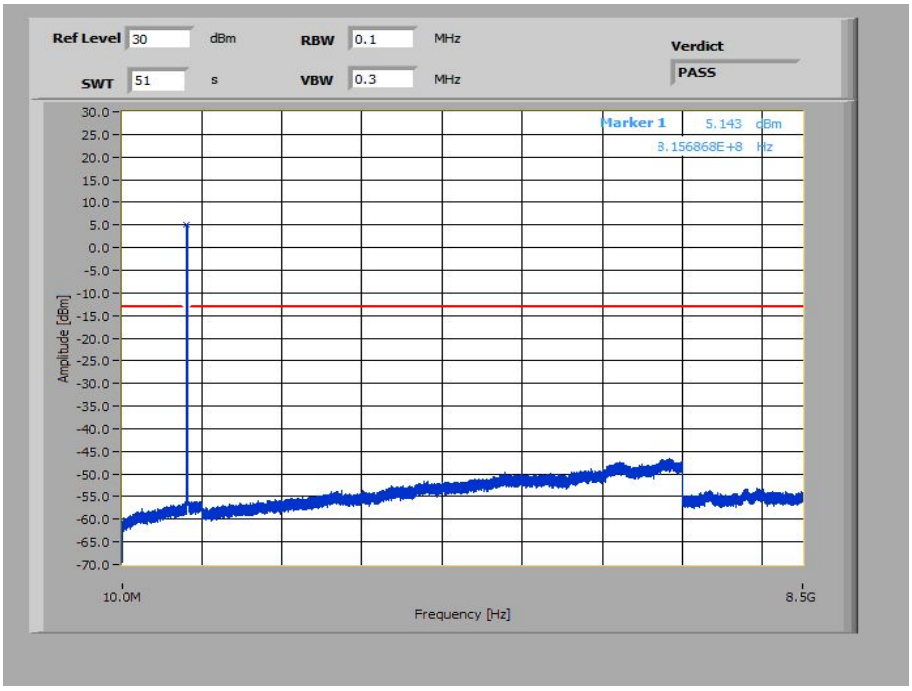
Plot 17: 3 MHz – 16-QAM - Middle Channel (10 MHz – 8.5 GHz)



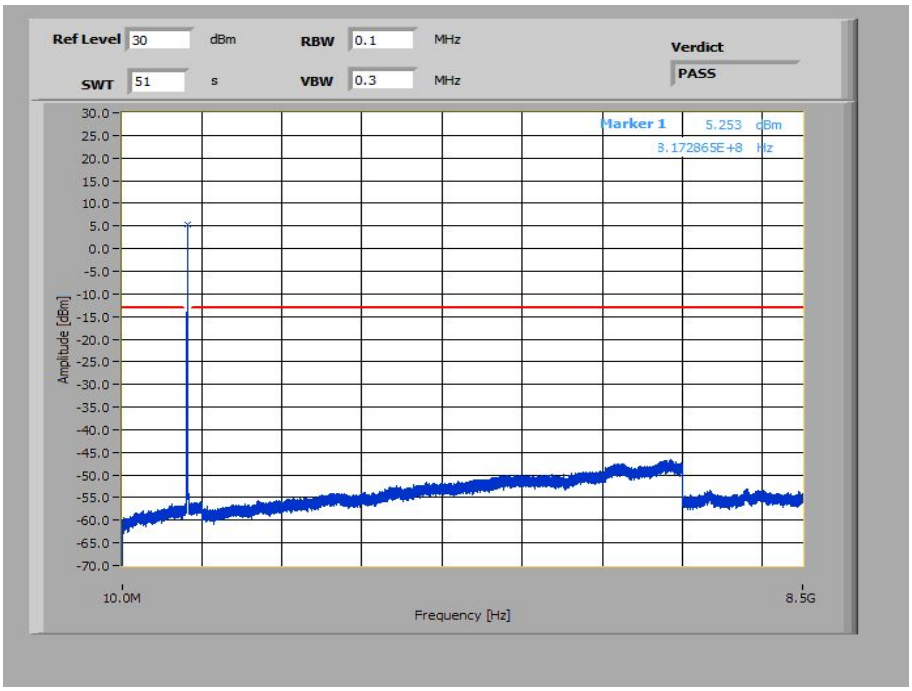
Plot 18: 3 MHz – 16-QAM - Highest Channel (10 MHz – 8.5 GHz)



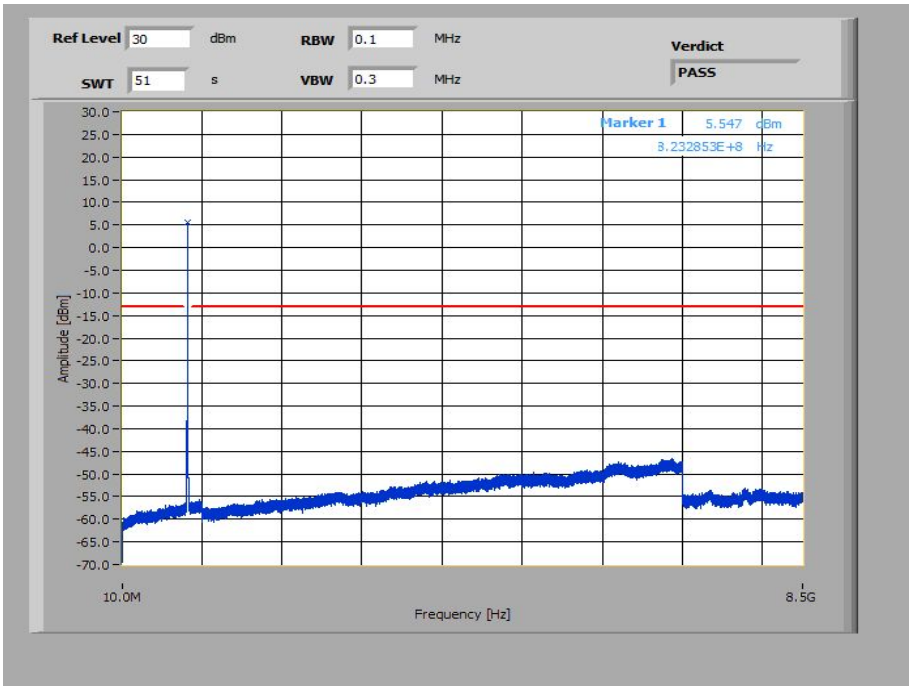
Plot 19: 5 MHz – 16-QAM - Lowest Channel (10 MHz – 8.5 GHz)



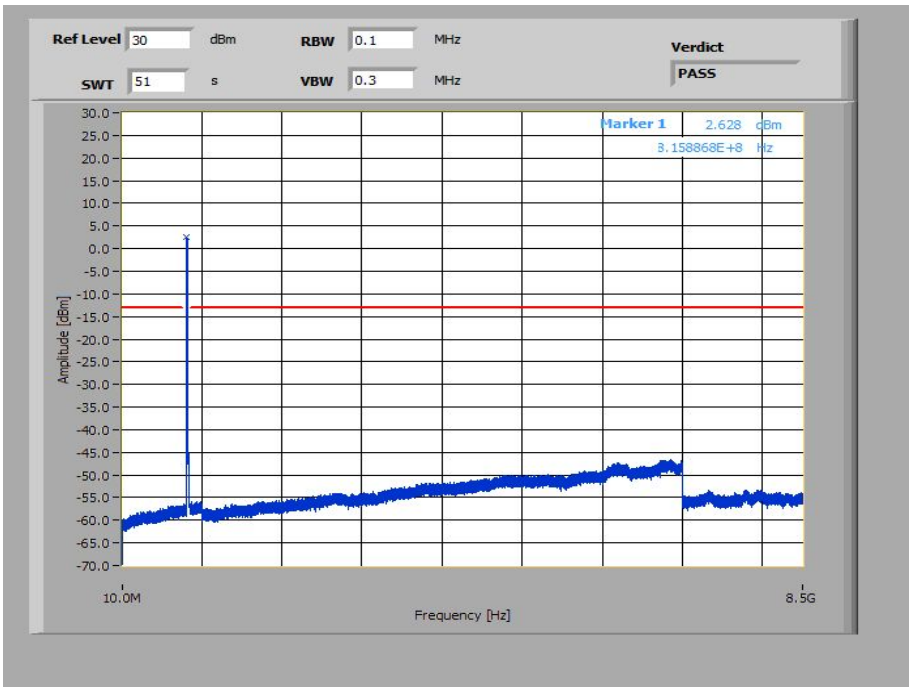
Plot 20: 5 MHz – 16-QAM - Middle Channel (10 MHz – 8.5 GHz)



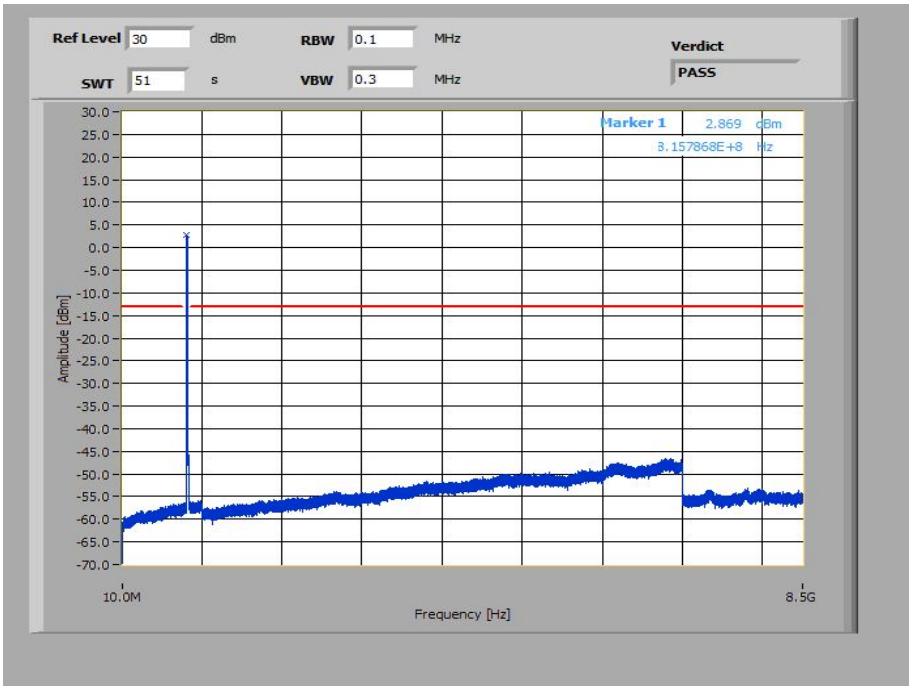
Plot 21: 5 MHz – 16-QAM - Highest Channel (10 MHz – 8.5 GHz)



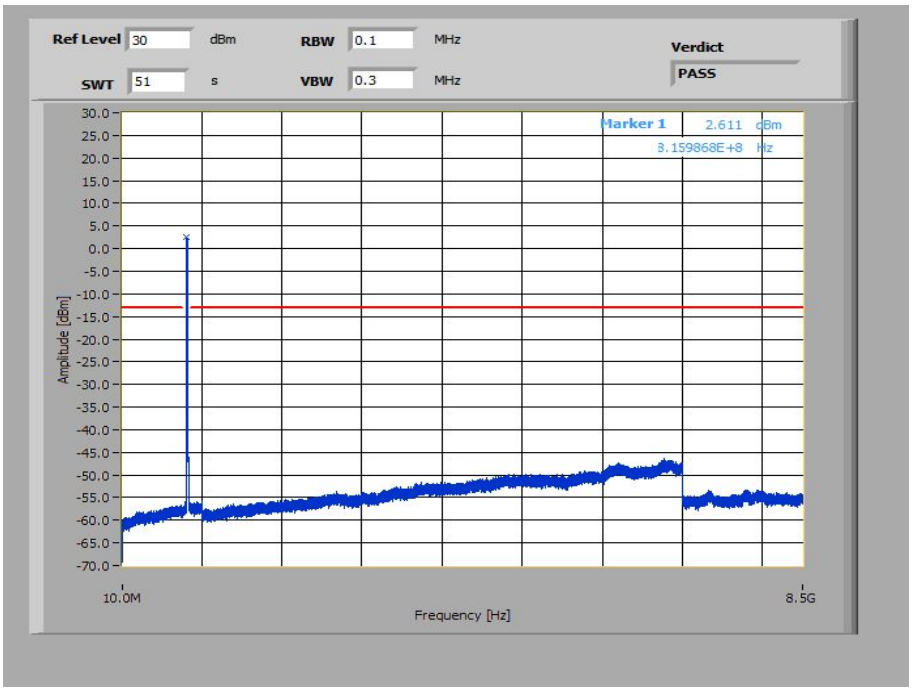
Plot 22: 10 MHz – 16-QAM - Middle Channel (10 MHz – 8.5 GHz)



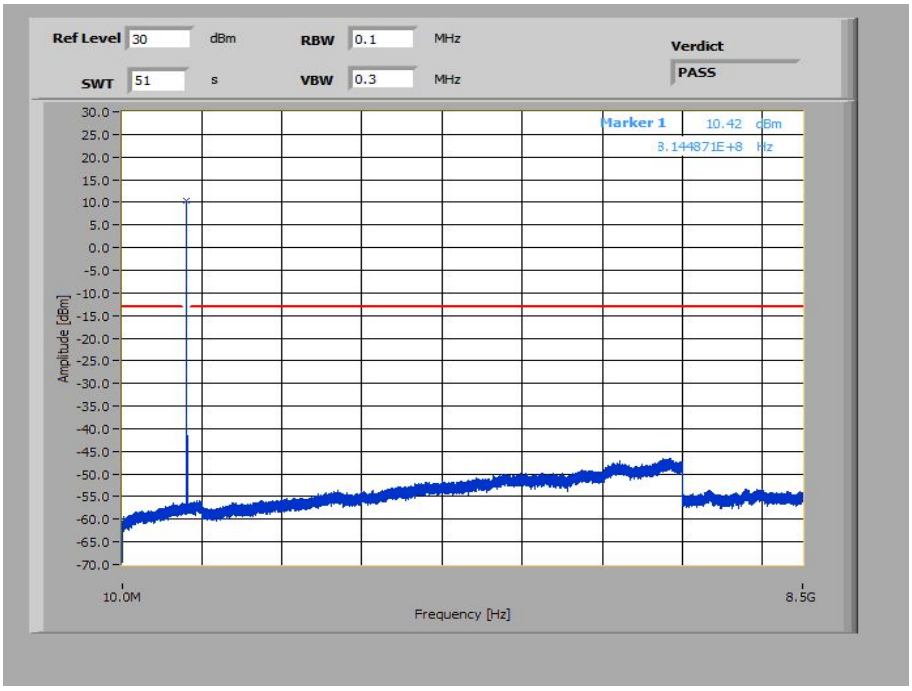
Plot 23: 1.4 MHz – 64-QAM - Lowest Channel (10 MHz – 8.5 GHz)



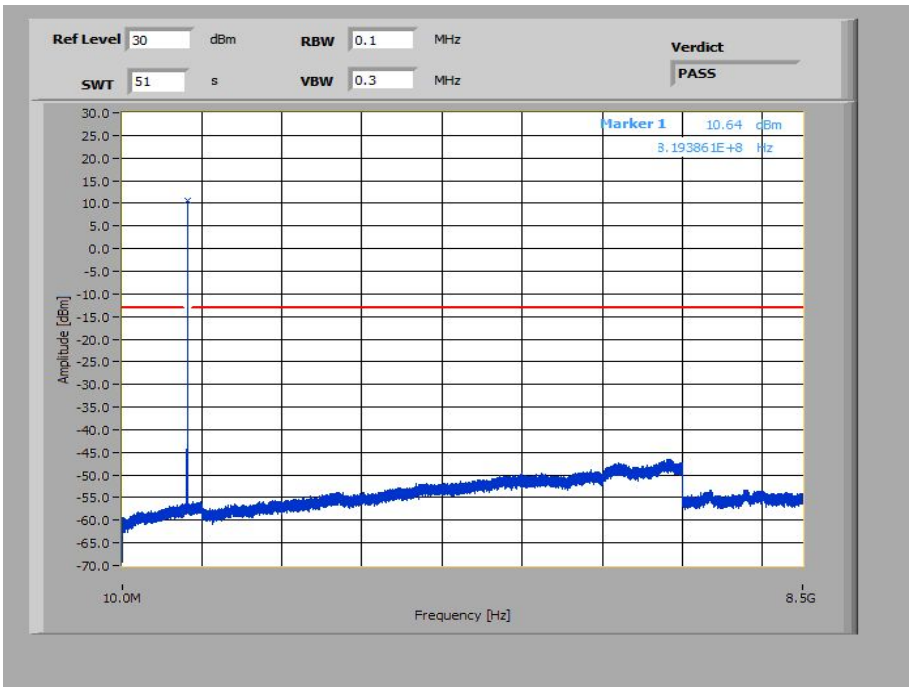
Plot 24: 1.4 MHz – 64-QAM - Middle Channel (10 MHz – 8.5 GHz)



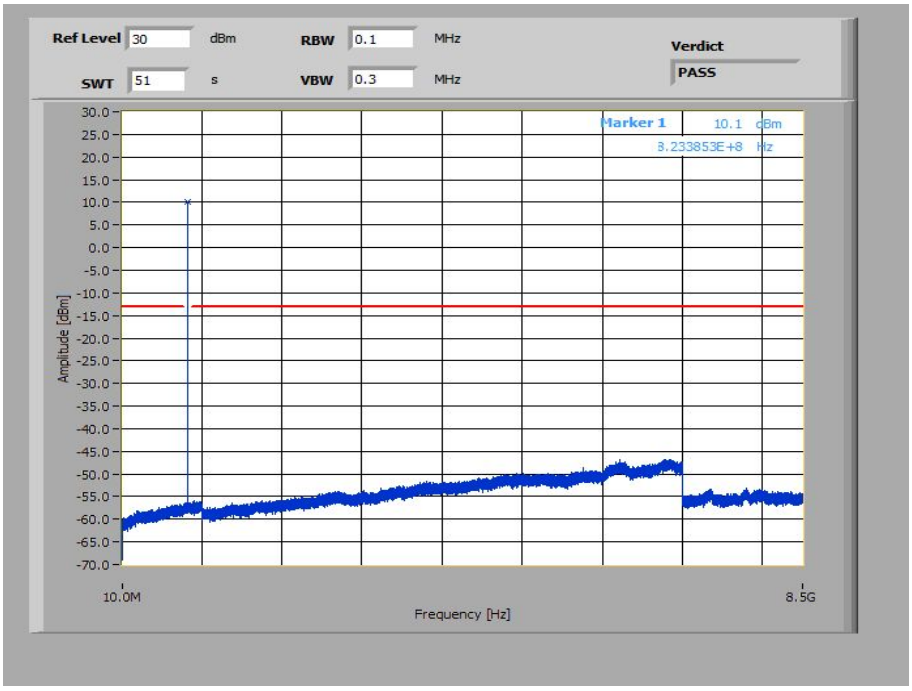
Plot 25: 1.4 MHz – 64-QAM - Highest Channel (10 MHz – 8.5 GHz)



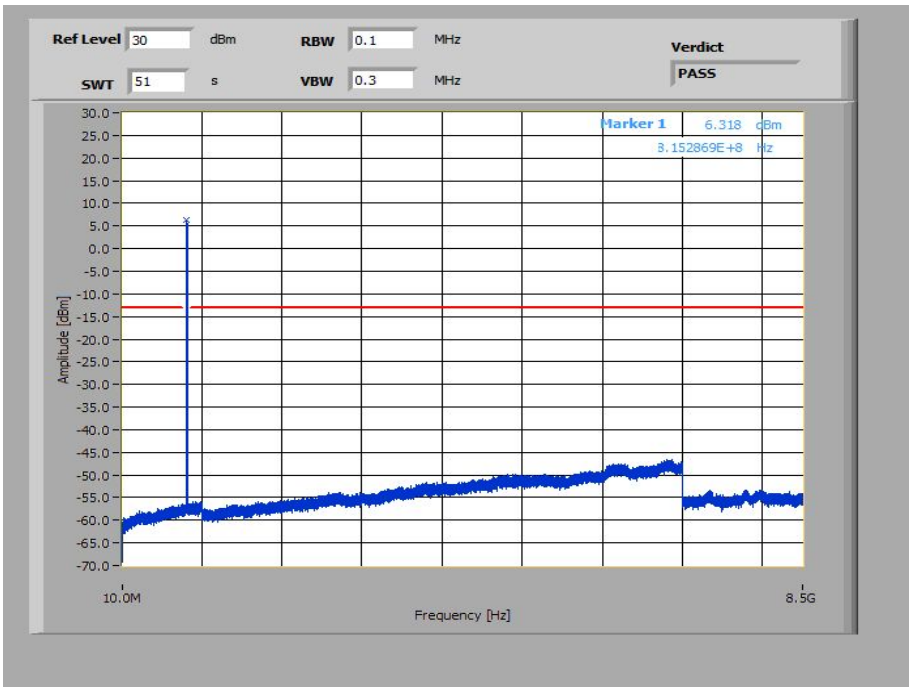
Plot 26: 3 MHz – 64-QAM - Lowest Channel (10 MHz – 8.5 GHz)



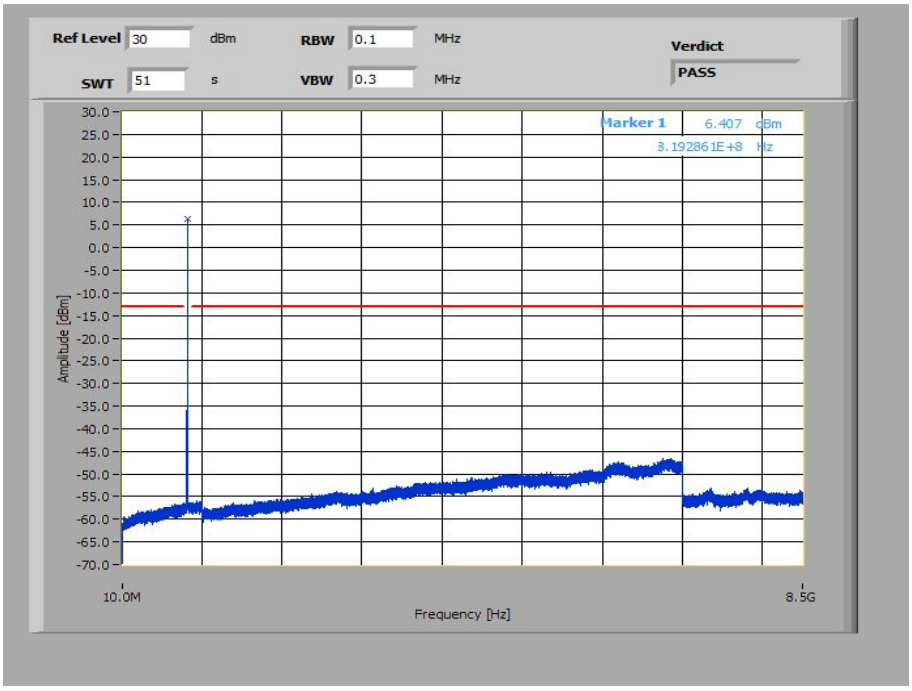
Plot 27: 3 MHz – 64-QAM - Middle Channel (10 MHz – 8.5 GHz)



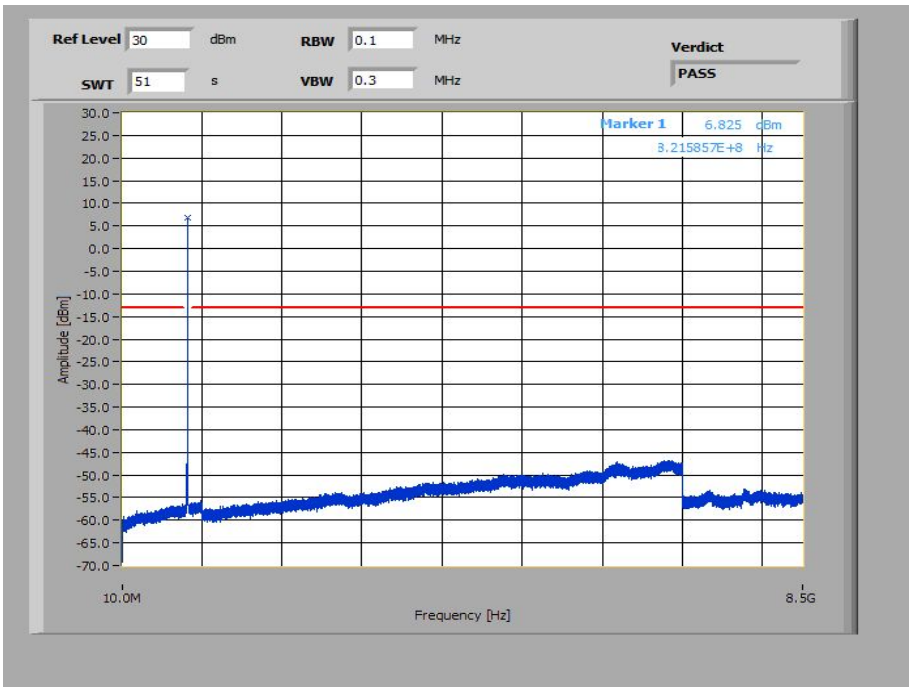
Plot 28: 3 MHz – 64-QAM - Highest Channel (10 MHz – 8.5 GHz)



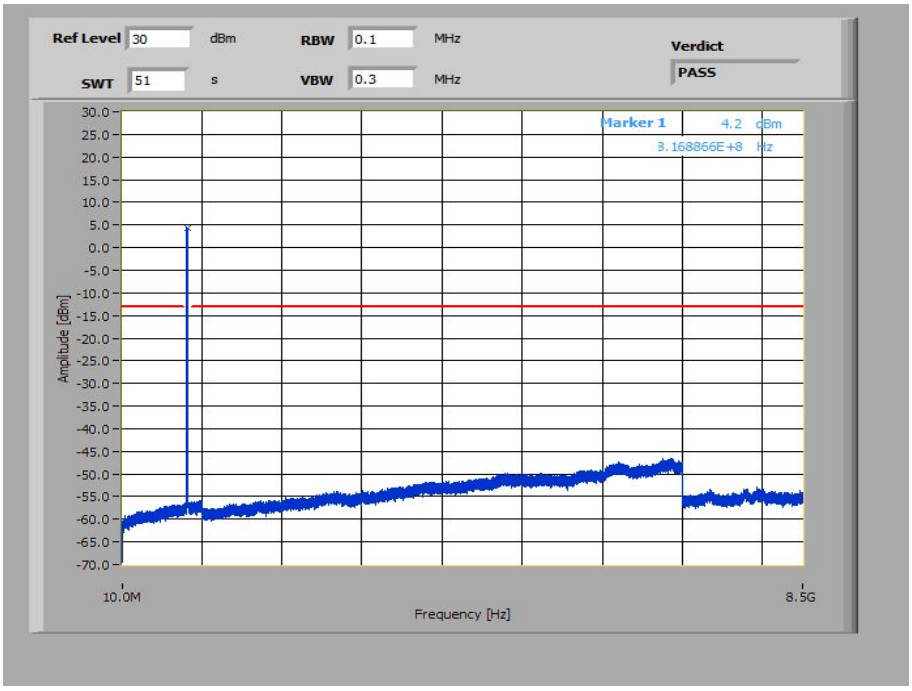
Plot 29: 5 MHz – 64-QAM - Lowest Channel (10 MHz – 8.5 GHz)



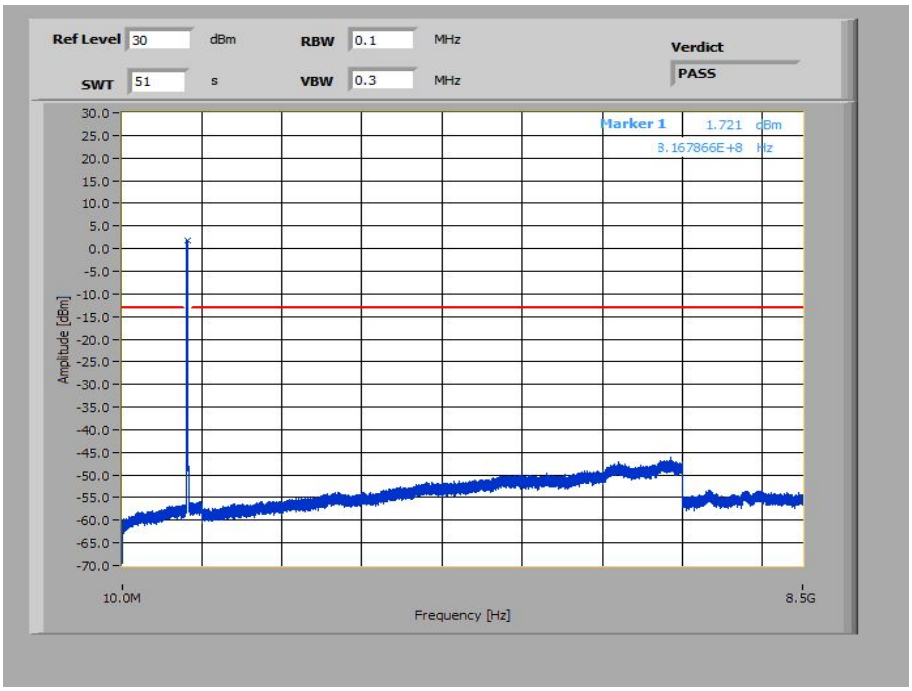
Plot 30: 5 MHz – 64-QAM - Middle Channel (10 MHz – 8.5 GHz)



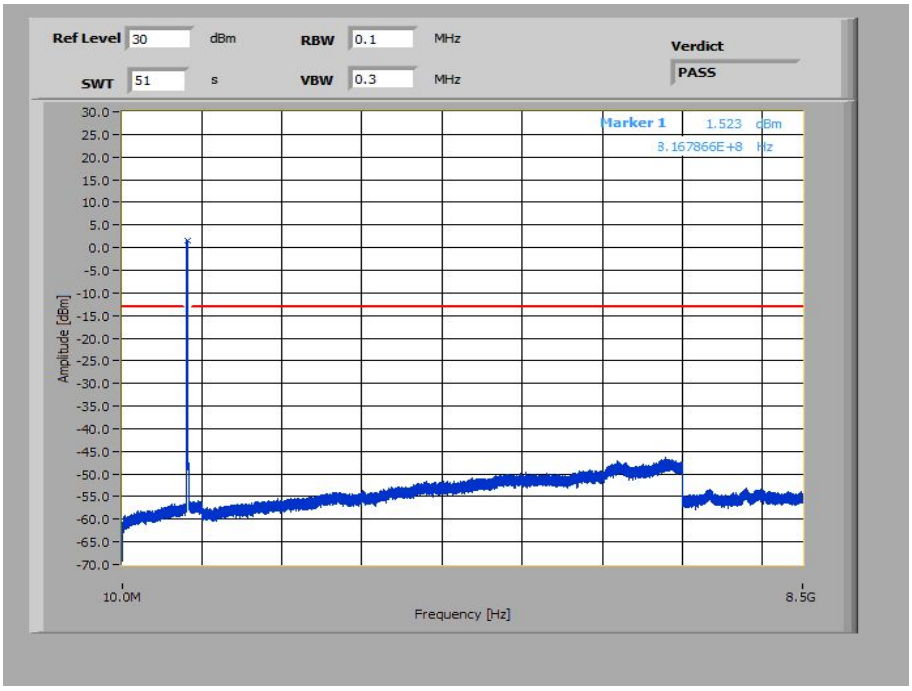
Plot 31: 5 MHz – 64-QAM - Highest Channel (10 MHz – 8.5 GHz)



Plot 32: 10 MHz – 64-QAM - Lowest Channel (10 MHz – 8.5 GHz)



Plot 33: 10 MHz – 64-QAM - Middle Channel (10 MHz – 8.5 GHz)



Plot 34: 10 MHz – 64-QAM - Highest Channel (10 MHz – 8.5 GHz)