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DATE: 10 February 2016

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Runcom Technologies Ltd.

Equipment under test:

CPE (Customer Premises Equipment)

CPE-O-R-WS

Tested by: _____
M. Zohar

Approved by: _____
D. Shidlowsky

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Measurement/Technical Report for
Runcom Technologies Ltd.

CPE (Customer Premises Equipment)

CPE-O-R-WS

FCC ID: XYMCPETVWS-1

This report concerns:	Original Grant:	X
	Class I Change:	
	Class II Change:	
Equipment type:	WGF - White Space Device with Geo-Location-Fixed	
Limits used:	47CFR15 Section 15.709	

Measurement procedure used is ANSI C63.4-2003 and KDB 416721 D01 White Space Test Procedure v03.

Application for Certification
prepared by:
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1. General Information

1.1 *Administrative Information*

Manufacturer:	Runcom Technologies Ltd.
Manufacturer's Address:	11 Moshe Levi St. Rishon Le Zion 75658 Israel Tel: +972-3-952-8440 Fax: +972-3-952-8805
Manufacturer's Representative:	Tzvi Marcu
Equipment Under Test (E.U.T):	CPE (Customer Premises Equipment)
Equipment Model No.:	CPE-O-R-WS
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	June 9, 2015
Start of Test:	June 9, 2015
End of Test:	November 24, 2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	FCC Part 15, Subpart H, Section 15.709

1.2 *List of Accreditations*

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site Nos. IC 4025A-1, IC 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 *Product Description*

The TV White Space (TVWS) system is a broadband wireless access solution that Runcom offers to its customers.

The purpose of Runcom's TVWS solution is to provide Point-to-Multipoint Broadband Internet services to locations that are hard to reach by standard wireless solutions.

The Target customers for this TVWS solution are Wireless Internet Services Providers (WISPs) in rural and remote areas that need to provide broad band Internet services to customers that are beyond trees, hills or other obstacles that prevent from the standard Line of Sight (LOS) wireless solutions to provide a reliability connectivity.

The CPE-O-R-WS is the component in the TVWS solution that is installed at the customer houses/premises. It is connected on one side to the Internet cloud via wireless (through the Base Station) and on the other side to the customer's terminals (such as computers, laptops, WiFi AP's, video games, appliances, etc) that needs IP connectivity.

1.4 Test Methodology

Conducted and radiated testing was performed according to the procedures ANSI C63.4: 2003 and KDB 416721 D01 White Space Test Procedure v03. Radiated testing was performed at an antenna to EUT distance of 1 and 3 meters.

1.5 *Test Facility*

Radiated emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

1.6 *Measurement Uncertainty*

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) 0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.44 dB

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.98 dB

2. System Test Configuration

2.1 *Justification*

The E.U.T. was tested in installation position with power strength and modulation reflecting actual set up.

For purposes of testing a link was created between the E.U.T. and the base station.

The E.U.T. was also tested for and complies with Part 15, subpart B, class B limits following the DoC procedure.

2.2 *EUT Exercise Software*

No special exercise software was used.

2.3 *Special Accessories*

No special accessories were needed to achieve compliance.

2.4 *Equipment Modification*

No modifications were necessary in order to achieve compliance.

2.5 *Configuration of Tested System*

Mode of operation:
The E.U.T. was transmitted continuously at selected channels.
The output power was varied from the minimum to the maximum realizable levels and set to the desired level.
During all the tests the E.U.T. continuously transmitted a modulated signal.

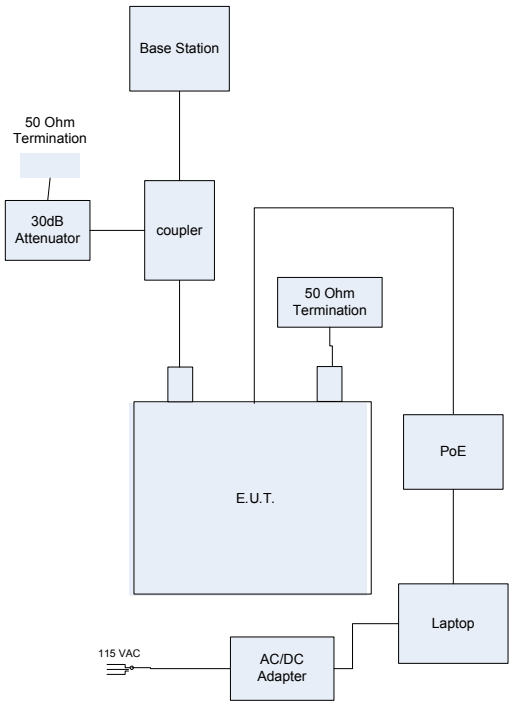

Figure 1. Configuration of Tested System - Conducted

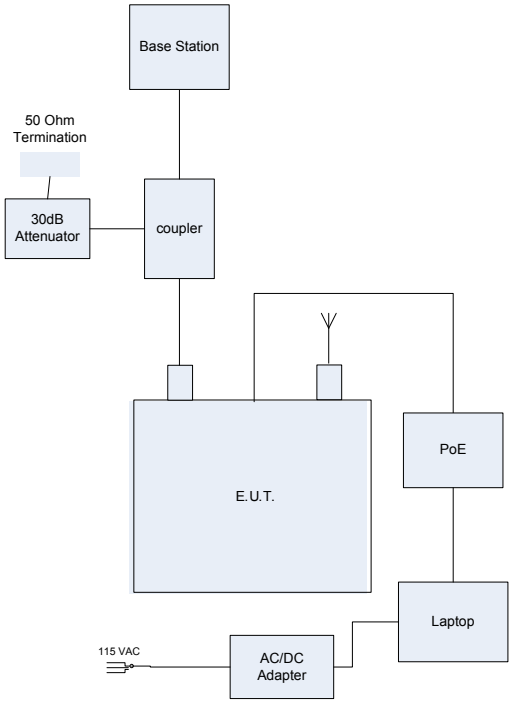

Figure 2. Configuration of Tested System – Radiated

3. Conducted & Radiated Measurement Test Set-up Photo

Figure 3. Conducted Emission Test

Figure 4. Spurious Radiated Emission Test – 9kHz-30MHz

Figure 5. Spurious Radiated Emission Test – 602MHz-628MHz

Figure 6. Spurious Radiated Emission Test – 1-7GHz

Figure 7. Spurious Radiated Emission Test – 30MHz-1GHz

4. Conducted Emission From AC Mains

4.1 *Test Specification*

FCC Part 15, Subpart C, Section 15.207

4.2 *Test Procedure*

The E.U.T operation mode and test setup are as described in Section 2.5 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room (see Section 3), with the E.U.T placed on an 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 µHn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in the photograph, *Figure 3. Conducted Emission Test*.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver via a 3.5" floppy disk and are displayed on the receiver's spectrum display.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

The E.U.T was tested in Tx mode.

4.3 *Test Results*

JUDGEMENT: Passed by 1.67 dB

The margin between the emission levels and the specification limit is, in the worst case, 6.45dB for the phase line at 0.150 MHz and 1.67 dB at 0.154 MHz for the neutral line.

The EUT met the F.C.C. Part 15, Subpart C specification requirements.

The details of the highest emissions are given in *Figure 8* to *Figure 11*.

Conducted Emission

E.U.T Description	CPE (Customer Premises Equipment)
Type	CPE-O-R-WS
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Phase
Detectors:	Peak, Quasi-peak, Average
Power Operation:	PoE From Laptop

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	150 kHz	59.54	-6.45
2	Average	190 kHz	40.85	-13.18
1	Quasi Peak	258 kHz	46.64	-14.84
2	Average	258 kHz	27.88	-23.61
2	Average	466 kHz	28.46	-18.11
1	Quasi Peak	474 kHz	36.52	-19.91
2	Average	898 kHz	21.99	-24.00
1	Quasi Peak	1.178 MHz	24.62	-31.37
1	Quasi Peak	1.474 MHz	25.53	-30.46
2	Average	2.114 MHz	20.29	-25.71
1	Quasi Peak	3.506 MHz	27.14	-28.85
2	Average	3.534 MHz	20.85	-25.14
1	Quasi Peak	4.042 MHz	28.09	-27.90
2	Average	4.706 MHz	22.42	-23.57
1	Quasi Peak	6.47 MHz	28.68	-31.31
2	Average	6.766 MHz	23.13	-26.86
2	Average	10.794 MHz	21.00	-28.99
1	Quasi Peak	13.418 MHz	24.35	-35.65
1	Quasi Peak	23.87 MHz	31.70	-28.29
2	Average	24.35 MHz	27.08	-22.91

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Figure 8. Detectors: Peak, Quasi-peak, AVERAGE – Phase

Note: Delta Limit refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description	CPE (Customer Premises Equipment)
Type	CPE-O-R-WS
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Phase
Detectors:	Peak, Quasi-peak, Average

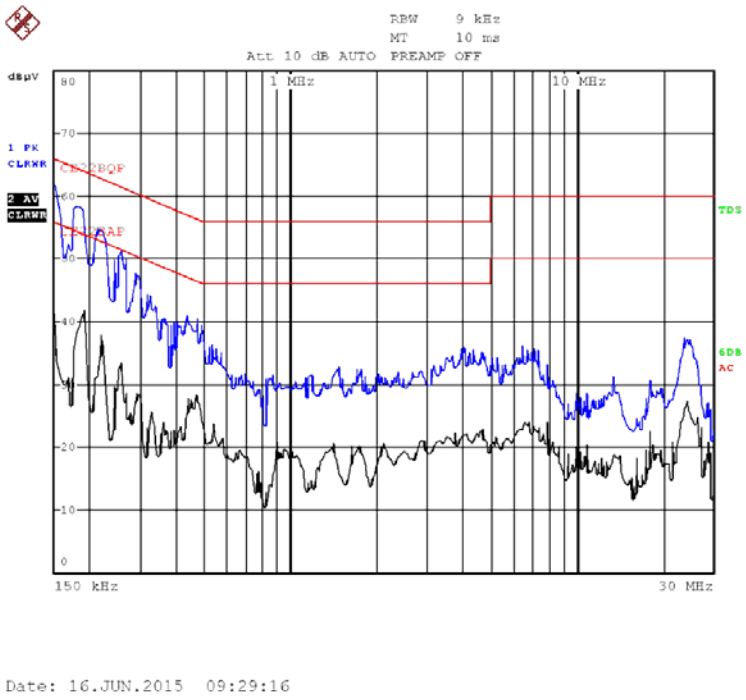

Figure 9. Detectors: Peak, Quasi-peak, Average – Phase

Conducted Emission

E.U.T Description	CPE (Customer Premises Equipment)
Type	CPE-O-R-WS
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Neutral
Detectors:	Peak, Quasi-peak, Average

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	154 kHz	64.10	-1.67
2	Average	190 kHz	41.81	-12.21
1	Quasi Peak	258 kHz	48.18	-13.31
2	Average	302 kHz	30.00	-20.17
1	Quasi Peak	458 kHz	35.22	-21.50
2	Average	458 kHz	24.94	-21.78
2	Average	898 kHz	22.21	-23.78
1	Quasi Peak	1.074 MHz	26.93	-29.06
1	Quasi Peak	1.686 MHz	27.68	-28.31
2	Average	1.882 MHz	17.25	-28.74
1	Quasi Peak	3.55 MHz	31.68	-24.31
2	Average	3.59 MHz	24.23	-21.76
1	Quasi Peak	4.578 MHz	33.45	-22.54
2	Average	4.986 MHz	25.86	-20.13
2	Average	6.626 MHz	27.63	-22.37
1	Quasi Peak	7.01 MHz	34.71	-25.28
2	Average	10.682 MHz	19.91	-30.08
1	Quasi Peak	13.222 MHz	24.39	-35.61
2	Average	23.998 MHz	25.96	-24.03
1	Quasi Peak	24.646 MHz	30.04	-29.96

Date: 16.JUN.2015 09:23:54

Figure 10. Detectors: Peak, Quasi-peak, AVERAGE- Neutral

Note: Delta Limit refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description	CPE (Customer Premises Equipment)
Type	CPE-O-R-WS
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Neutral
Detectors:	Peak, Quasi-peak, Average

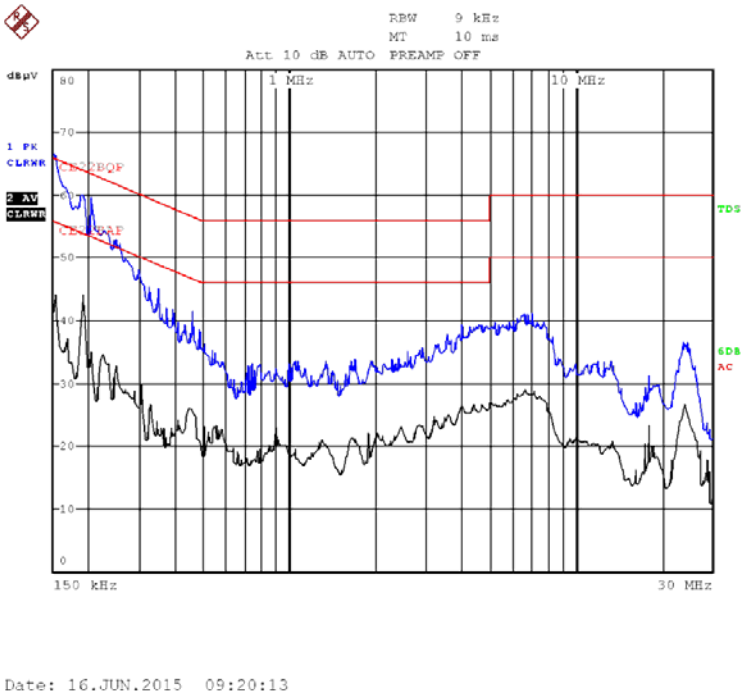

Figure 11 Detectors: Peak, Quasi-peak, Average - Neutral

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4.4 *Test Equipment Used; Conducted Emission*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
LISN	Fischer	FCC-LISN-25A	127	March 16, 2015	1 year
Transient Limiter	HP	11947A	3107A03041	May 13, 2015	1 year
EMI Receiver	Rohde & Schwarz	ESCI7	100724	January 4, 2015	1 year

Figure 12 Test Equipment Used

5. Band Edge

5.1 *Test Specification*

FCC Part 15, Subpart H, Section 15.709 (c)(2)

5.2 *Test Procedure*

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable
(cable loss = 0.3 dB). The spectrum analyzer was set to 100 kHz resolution BW. The below was measured by the spectrum analyzer:

Maximum power level below 469.95 MHz and above 476.05 MHz for operational frequency of 473.00 MHz;

Maximum power level below 583.95 and above 590.05 MHz for operational frequency of 587.00 MHz;

Maximum power level below 691.95 MHz and above 698.05 MHz for operational frequency of 695.00 MHz.

5.3 *Test Results*

JUDGEMENT: Passed

For additional information see *Figure 13* to *Figure 38.*

Chain #	Band	Modulation	Operation Frequency (MHz)	Reading (dBm)	Limit (dBm)	Margin (dB)
Chain 1	Lower	16QAM	473.00	-45.3	-42.8	-2.5
			587.00	-43.6	-42.8	-0.8
			695.00	-44.8	-42.8	-2.0
		QPSK	473.00	-44.3	-42.8	-1.5
			587.00	-43.7	-42.8	-0.9
			695.00	-44.6	-42.8	-1.8
Chain 1	Upper	16QAM	473.00	-44.3	-42.8	-1.5
			587.00	-43.9	-42.8	-1.1
			695.00	-44.9	-42.8	-2.1
		QPSK	473.00	-43.6	-42.8	-0.8
			587.00	-43.6	-42.8	-0.8
			695.00	-44.5	-42.8	-1.7

Figure 13 Band Edge Chain 1

Chain #	Band	Modulation	Operation Frequency (MHz)	Reading (dBm)	Limit (dBm)	Margin (dB)
Chain 2	Lower	16QAM	473.00	-44.1	-42.8	-1.3
			587.00	-43.4	-42.8	-0.6
			695.00	-44.3	-42.8	-1.5
		QPSK	473.00	-45.4	-42.8	-2.6
			587.00	-44.0	-42.8	-1.2
			695.00	-44.9	-42.8	-2.1
Chain 2	Upper	16QAM	473.00	-43.9	-42.8	-1.1
			587.00	-43.0	-42.8	-0.2
			695.00	-44.4	-42.8	-1.6
		QPSK	473.00	-44.6	-42.8	-1.8
			587.00	-44.1	-42.8	-1.3
			695.00	-45.1	-42.8	-2.3

Figure 14 Band Edge Chain 2

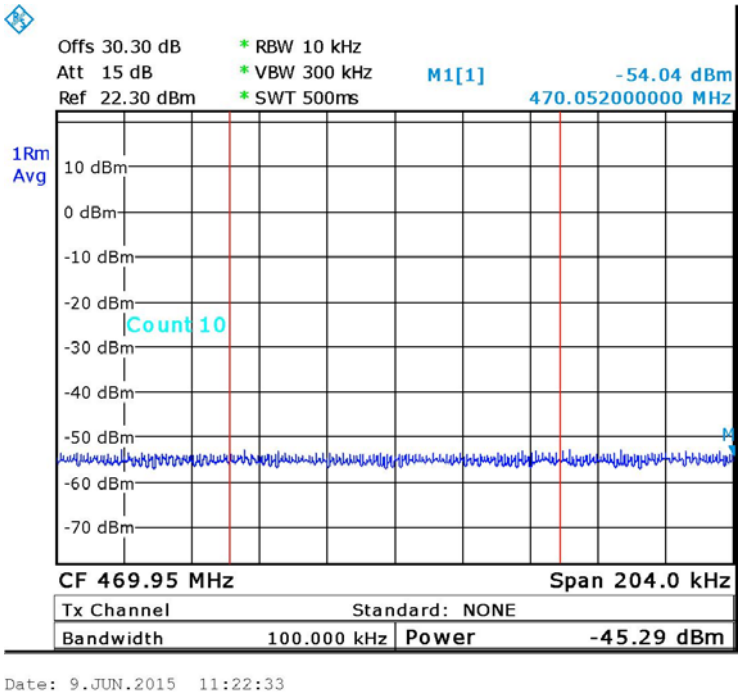


Figure 15. Chain 1 – Lower - 16QAM – 473MHz

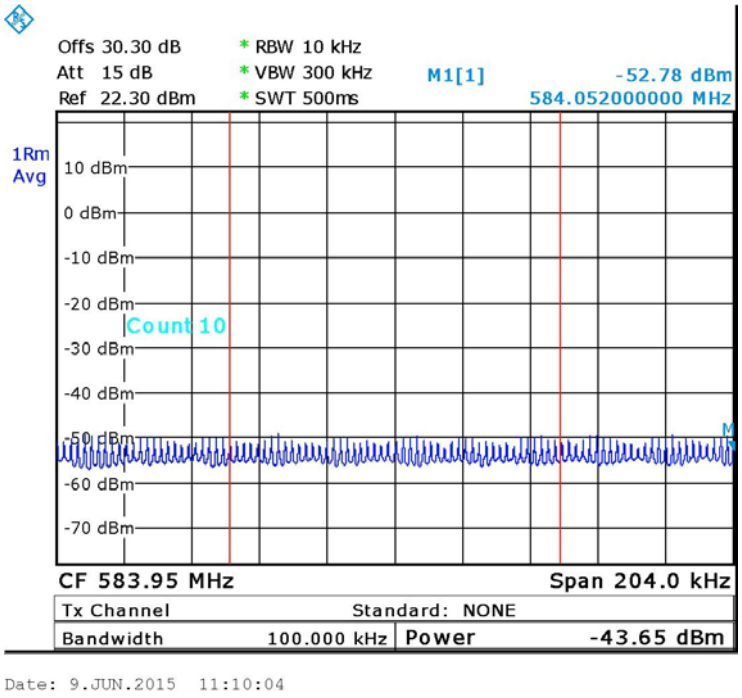
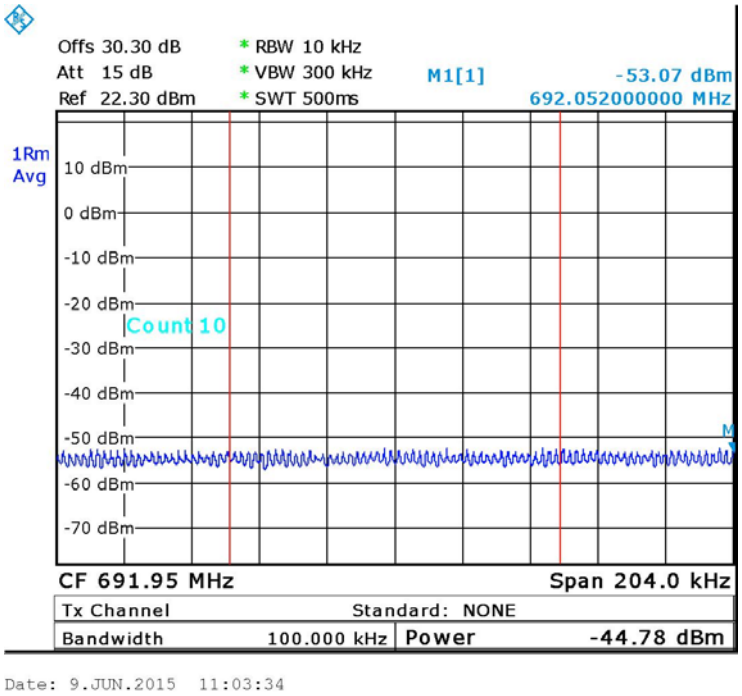


Figure 16. . Chain1 – Lower - 16QAM – 587MHz



Date: 9.JUN.2015 11:03:34

Figure 17. Chain 1 – Lower - 16QAM – 695MHz

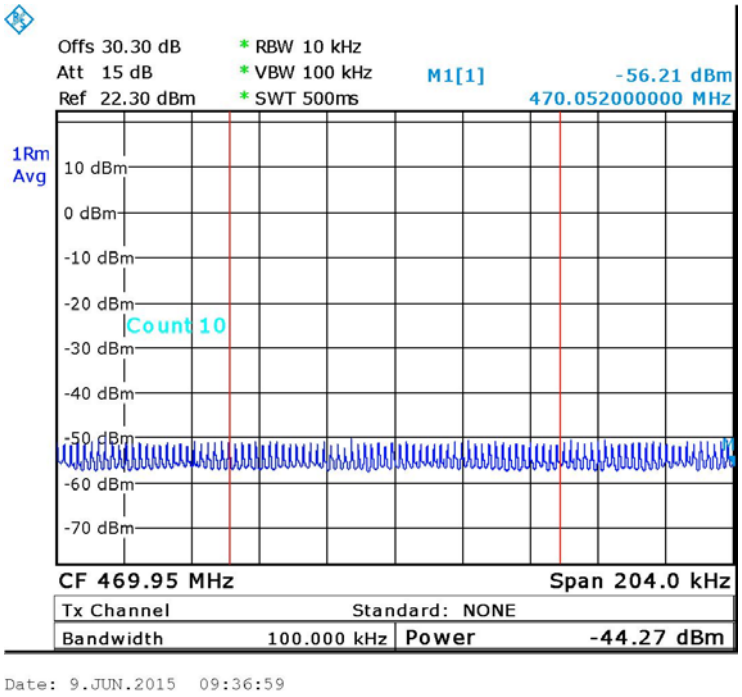


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Figure 18. Chain1 – Lower - QPSK – 473MHz

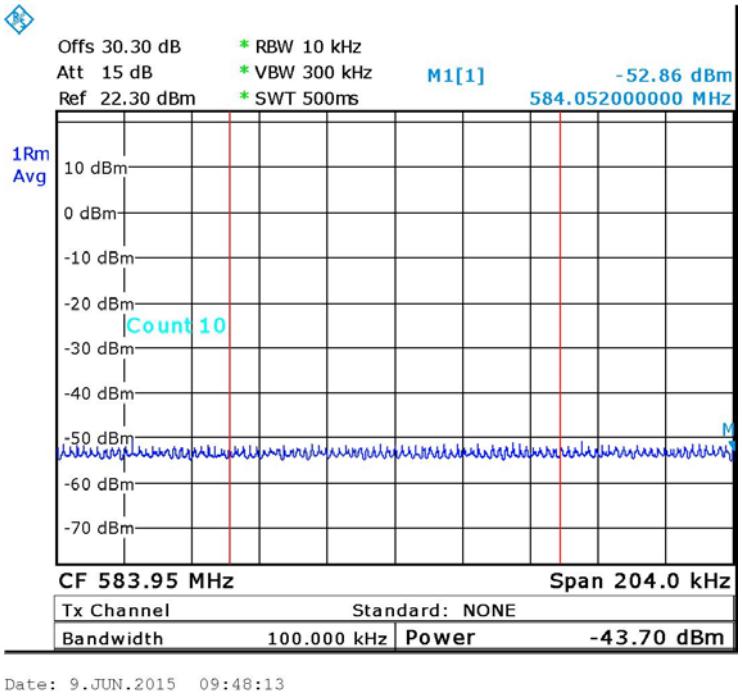

Figure 19. . Chain1 – Lower - QPSK – 587MHz

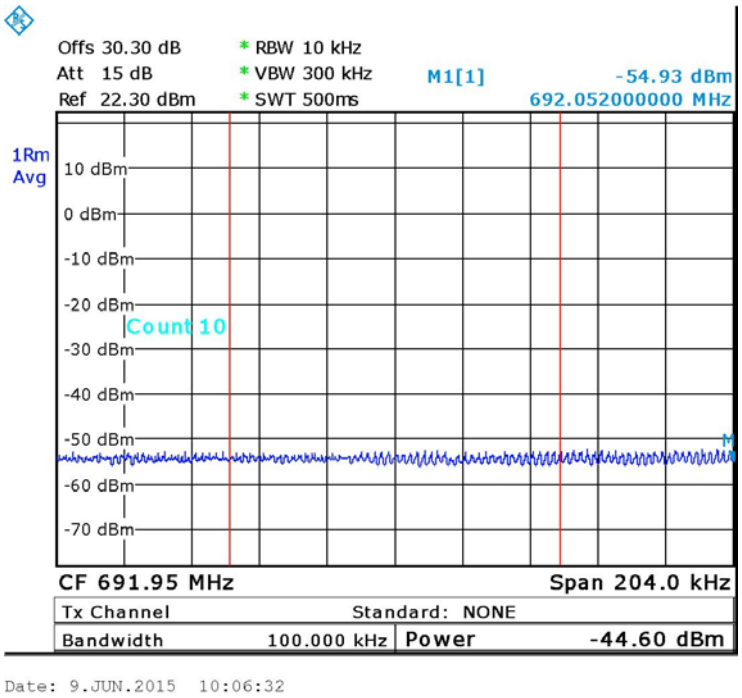

Figure 20. Chain1 – Lower - QPSK – 695MHz

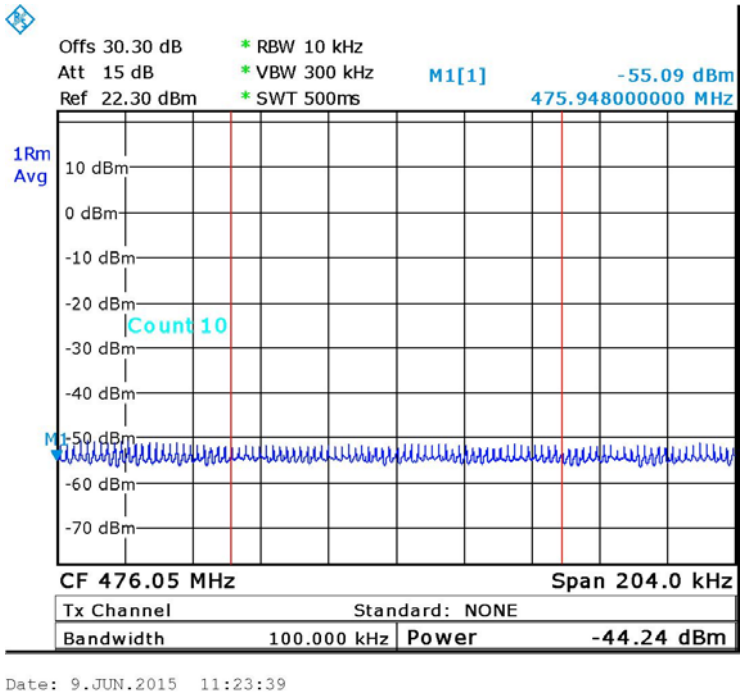

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Figure 21. Chain1 – Upper - 16QAM – 473MHz

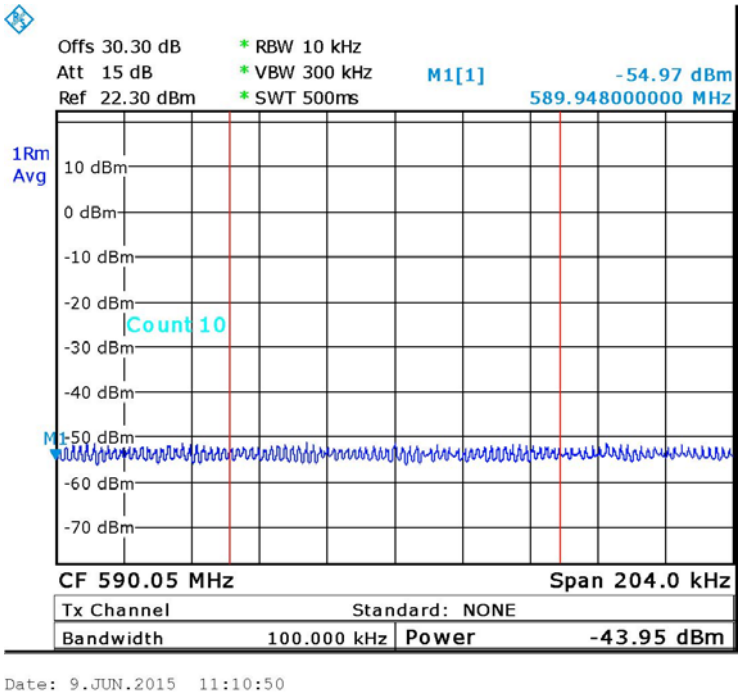
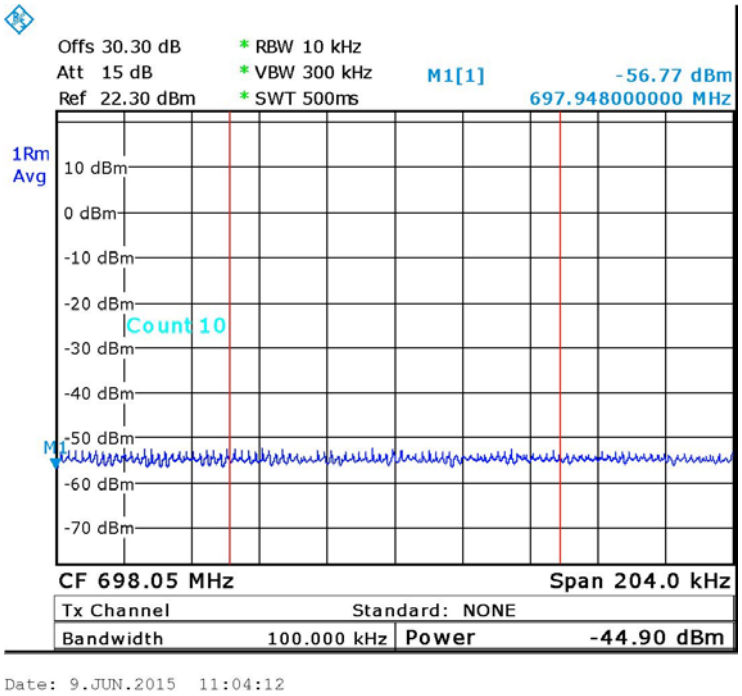
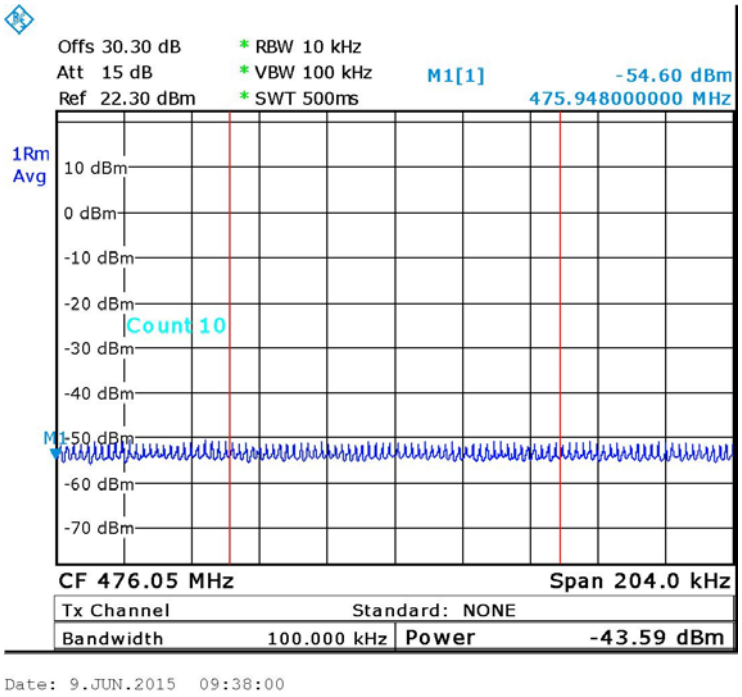


Figure 22. . Chain1 – Upper - 16QAM – 587MHz



Date: 9.JUN.2015 11:04:12

Figure 23. Chain1 – Upper - 16QAM – 695MHz



Date: 9.JUN.2015 09:38:00

Figure 24. Chain1 – Upper - QPSK – 473MHz

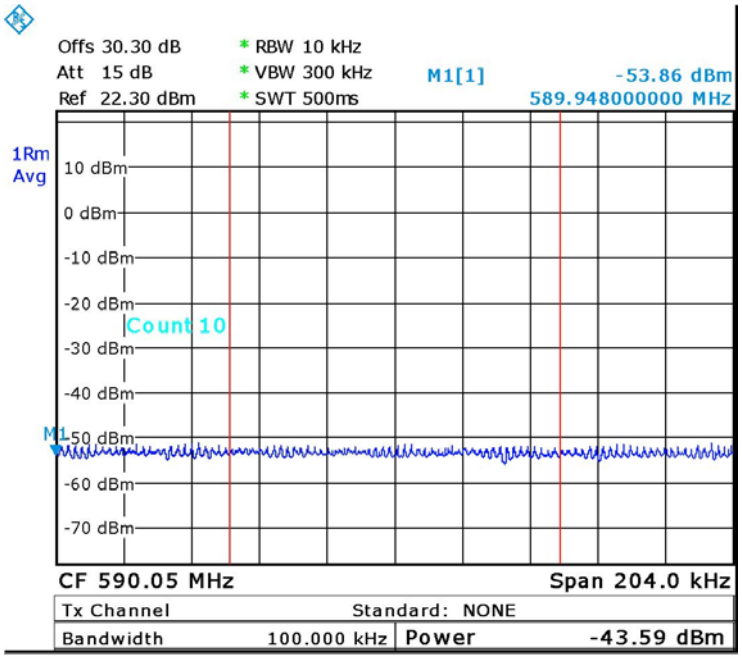


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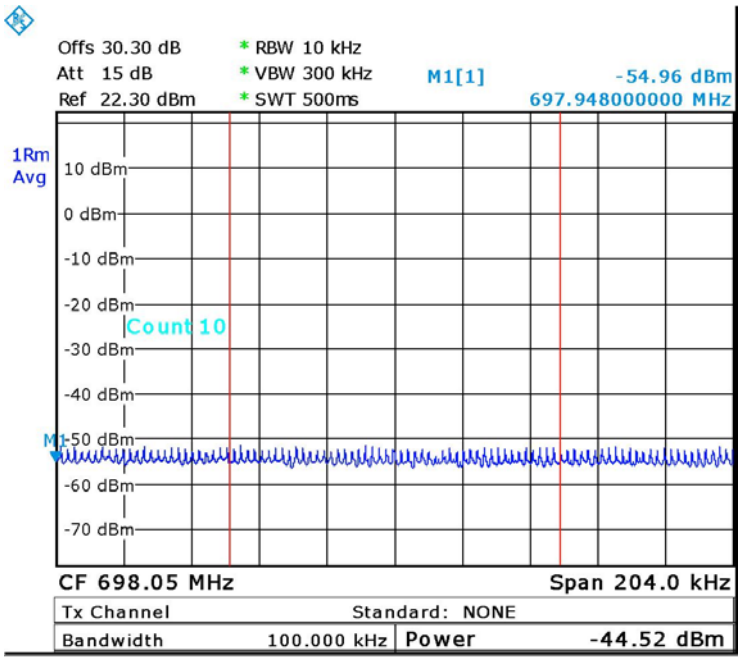
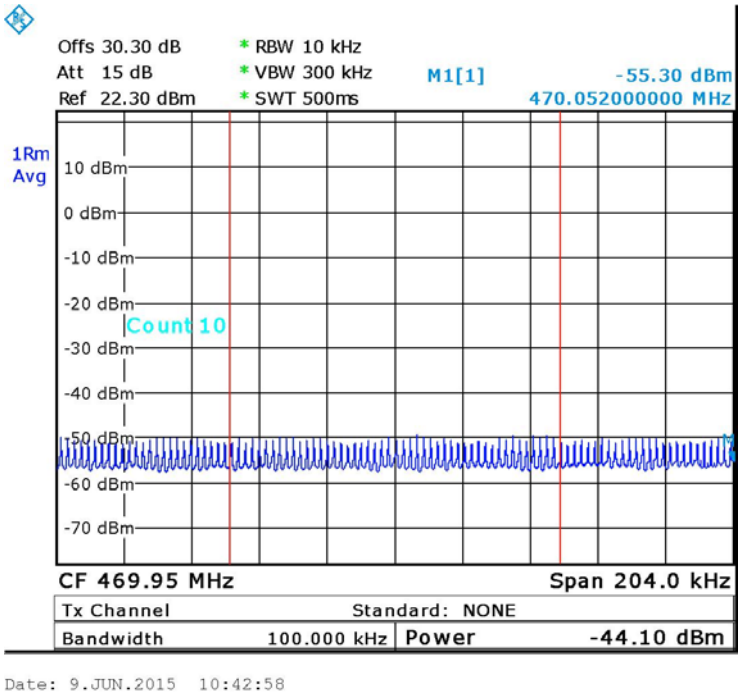
Figure 25. Chain1 – Upper - QPSK – 587MHz



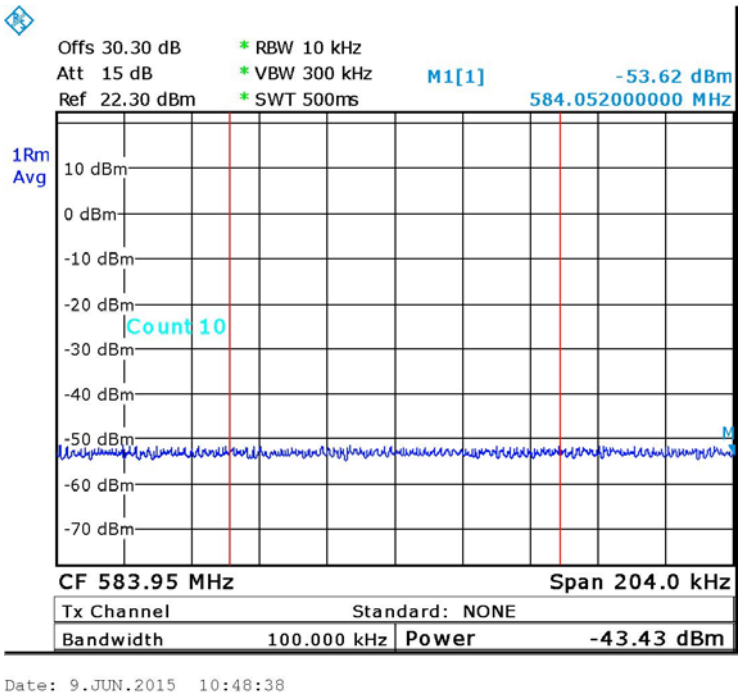
Date: 9.JUN.2015 10:07:18

Figure 26. Chain1 – Upper - QPSK – 695MHz



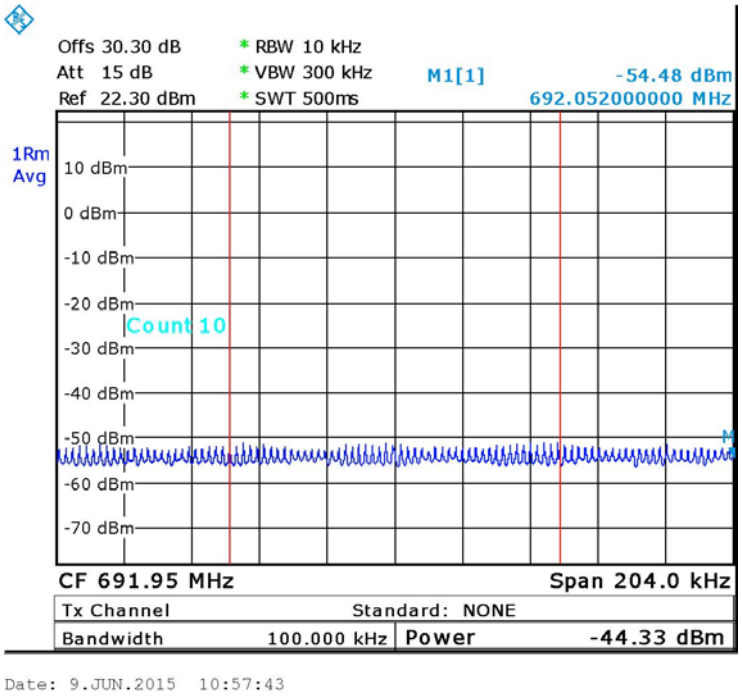
Date: 9.JUN.2015 10:42:58

Figure 27. Chain 2 – Lower - 16QAM – 473MHz



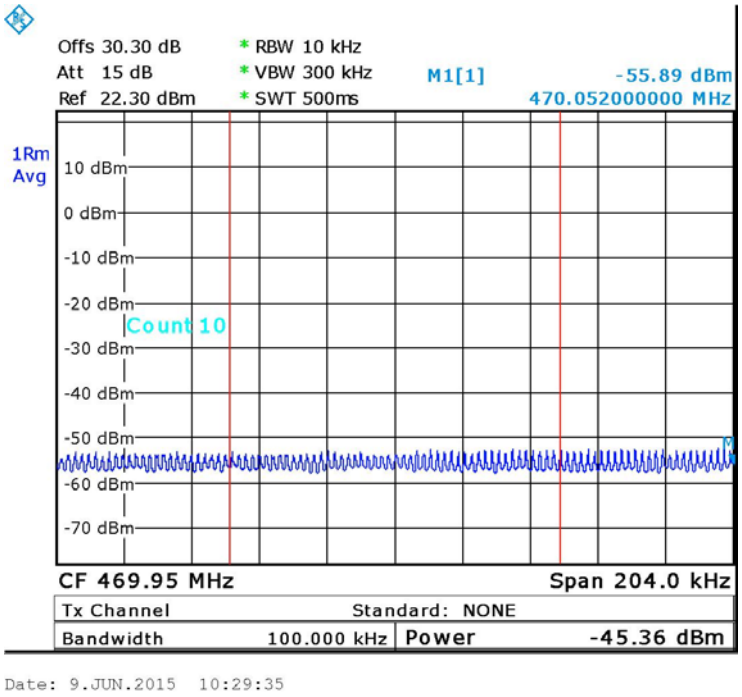
Date: 9.JUN.2015 10:48:38

Figure 28. . Chain 2 – Lower - 16QAM – 587MHz



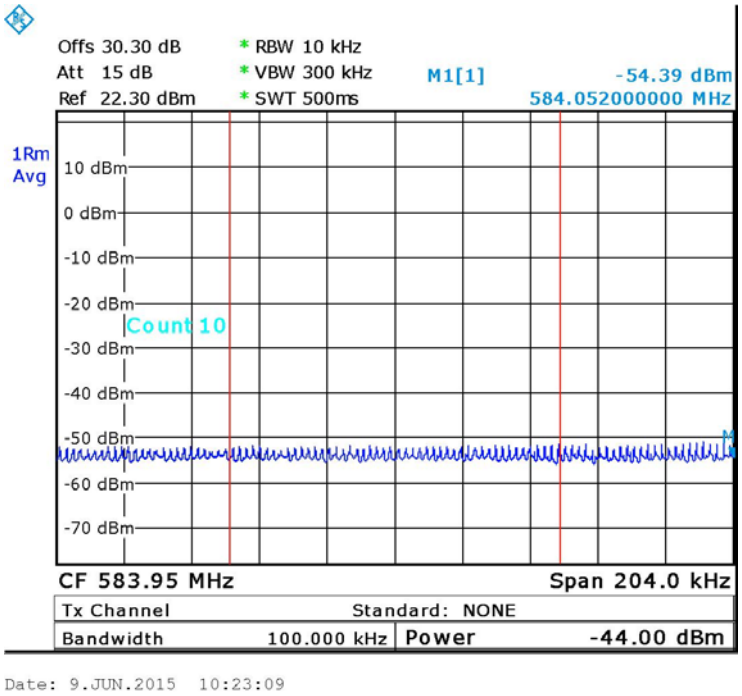
Date: 9.JUN.2015 10:57:43

Figure 29. Chain 2 – Lower - 16QAM – 695MHz



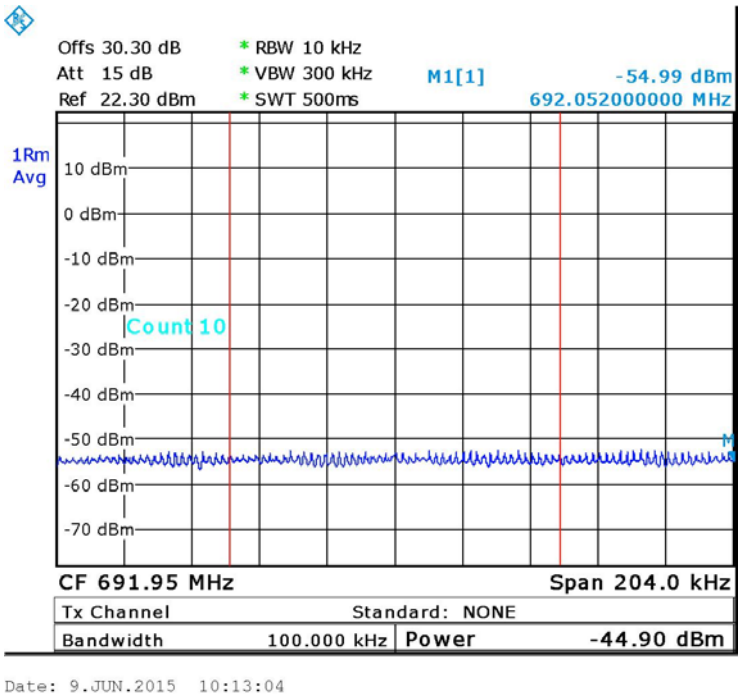
Date: 9.JUN.2015 10:29:35

Figure 30. Chain 2 – Lower - QPSK – 473MHz



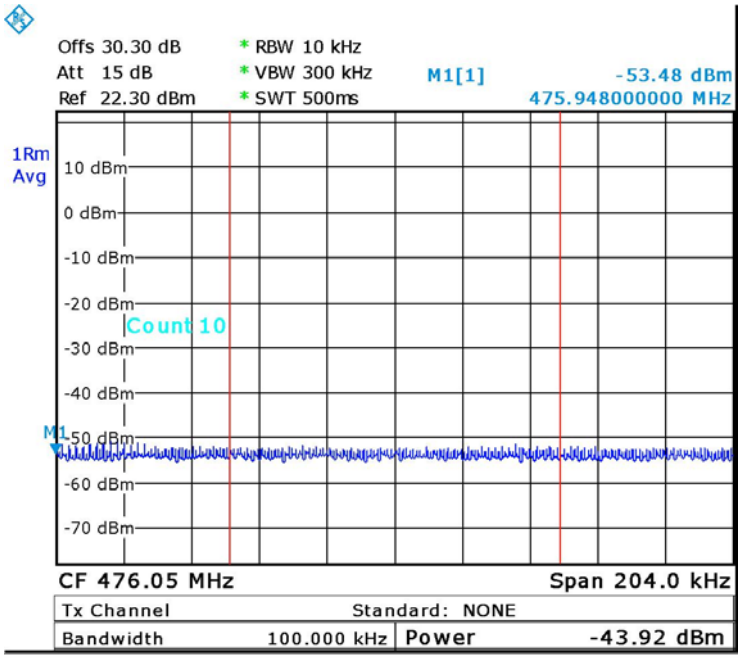
Date: 9.JUN.2015 10:23:09

Figure 31. . Chain 2 –Lower - QPSK – 587MHz



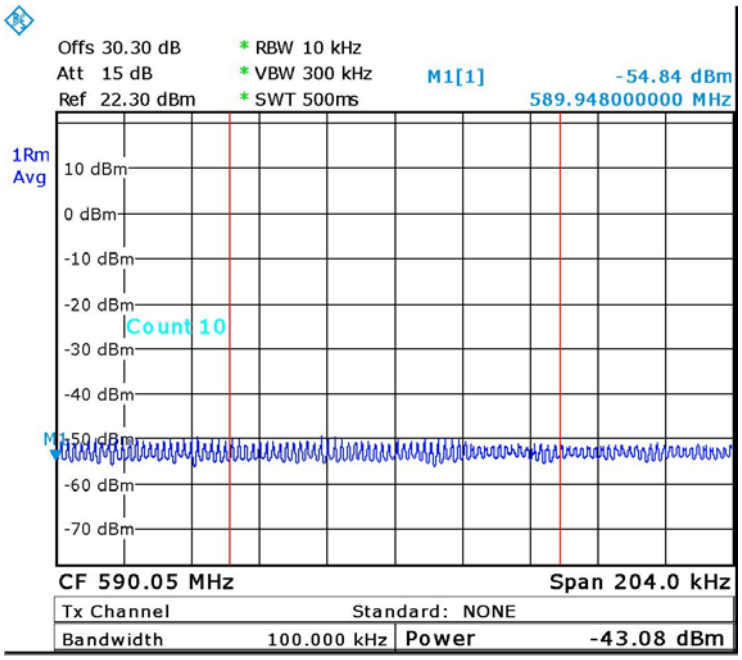
Date: 9.JUN.2015 10:13:04

Figure 32. Chain 2 – Lower - QPSK – 695MHz



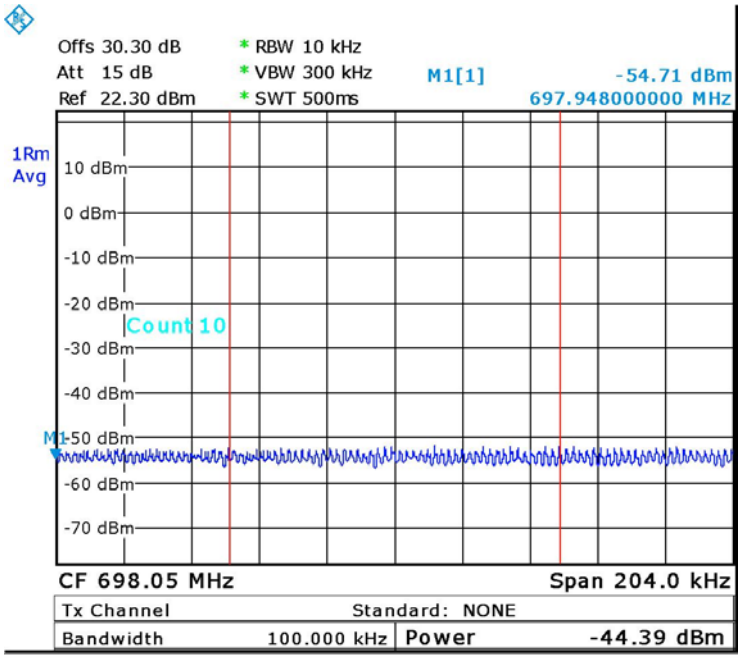
Date: 9.JUN.2015 10:43:51

Figure 33. Chain 2 – Upper - 16QAM – 473MHz



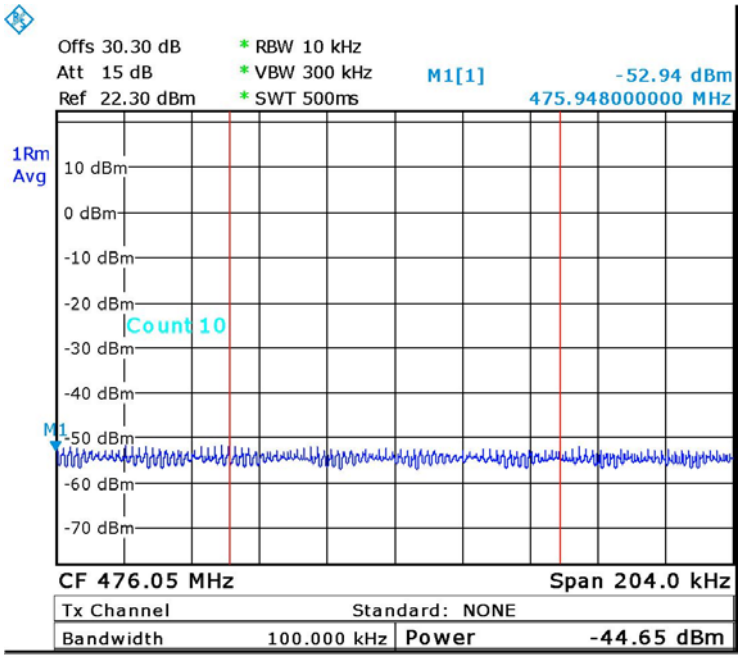
Date: 9.JUN.2015 10:49:29

Figure 34. . Chain 2 – Upper - 16QAM – 587MHz



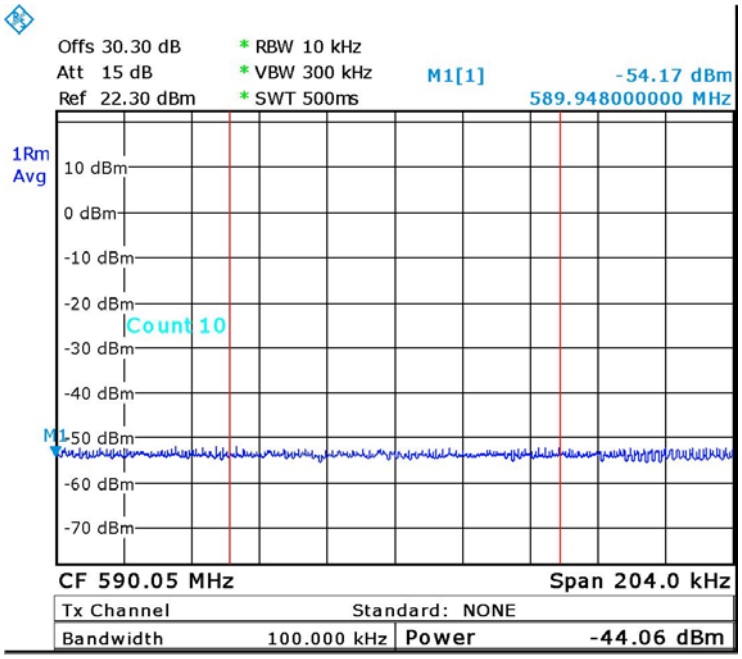
Date: 9.JUN.2015 10:58:33

Figure 35. Chain 2 – Upper - 16QAM – 695MHz



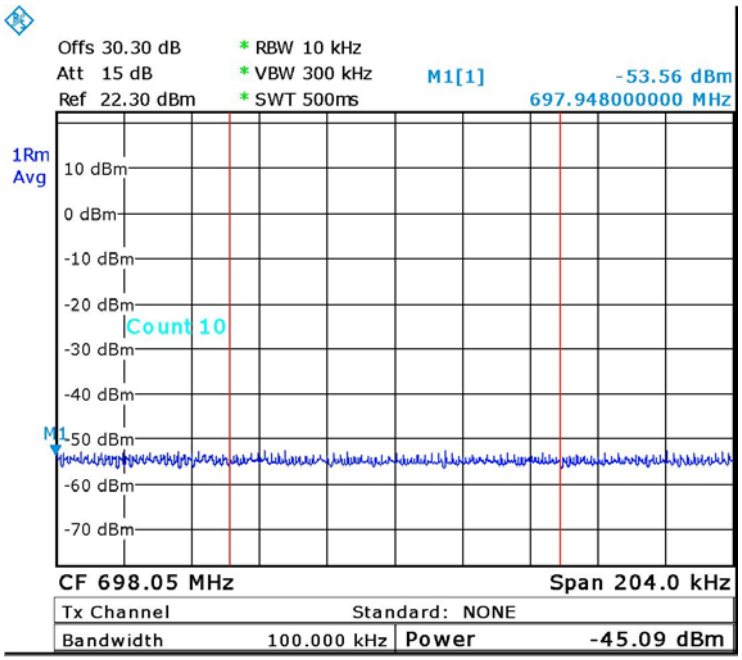
Date: 9.JUN.2015 10:30:16

Figure 36. Chain 2 – Upper - QPSK – 473MHz



Date: 9.JUN.2015 10:23:46

Figure 37. . Chain 2 – Upper - QPSK – 587MHz



Date: 9.JUN.2015 10:14:07

Figure 38. Chain 2 – Upper - QPSK – 695MHz

5.4 *Test Equipment Used; Band Edge*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
30 dB attenuator	BIRD	8304-N30DB	-	June 2, 2015	1 year
Coupler	Macom	96341	2025-6006-10	-	-

Figure 39 Test Equipment Used

6. Adjacent-Channel

6.1 *Test Specification*

FCC Part 15, Subpart H, Section 15.709(c)(2)

6.2 *Test Procedure*

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30 dB) and an appropriate coaxial cable
(cable loss = 0.3 dB). The spectrum analyzer was set to 100 kHz resolution BW.

The adjacent channel emission limit applies in any 100 kHz band segment within either the lower or upper adjacent 6 MHz channels relative to the operating channel.

A sweep time of 500msec was used for 1msec per trace point.

The E.U.T was evaluated in 3 operational frequencies: 473.00 MHz, 587.00 MHz and 695.00 MHz.

6.3 *Test Results*

JUDGEMENT: Passed

For additional information see *Figure 40* to *Figure 65*.

Chain #	Adjacent channel	Modulation	Operation Frequency (MHz)	Reading (dBm)	Limit (dBm)	Margin (dB)
Chain 1	Lower	16QAM	473.00	-54.6	-42.8	-11.8
			587.00	-55.9	-42.8	-13.1
			695.00	-47.6	-42.8	-4.8
		QPSK	473.00	-57.7	-42.8	-14.9
			587.00	-59.0	-42.8	-16.2
			695.00	-58.0	-42.8	-15.2
Chain 1	Upper	16QAM	473.00	-53.9	-42.8	-11.1
			587.00	-53.9	-42.8	-11.1
			695.00	-50.7	-42.8	-7.9
		QPSK	473.00	-58.7	-42.8	-15.9
			587.00	-57.7	-42.8	-14.9
			695.00	-58.8	-42.8	-16.0

Figure 40 Band Edge Chain 1

Chain #	Adjacent channel	Modulation	Operation Frequency (MHz)	Reading (dBm)	Limit (dBm)	Margin (dB)
Chain 2	Lower	16QAM	473.00	-53.5	-42.8	-10.7
			587.00	-55.9	-42.8	-13.1
			695.00	-56.9	-42.8	-14.1
		QPSK	473.00	-57.8	-42.8	-15.0
			587.00	-58.4	-42.8	-15.6
			695.00	-58.1	-42.8	-15.3
Chain 2	Upper	16QAM	473.00	-54.6	-42.8	-11.8
			587.00	-56.7	-42.8	-13.9
			695.00	-55.4	-42.8	-12.6
		QPSK	473.00	-58.6	-42.8	-15.8
			587.00	-57.7	-42.8	-14.9
			695.00	-58.6	-42.8	-15.8

Figure 41 Band Edge Chain 2

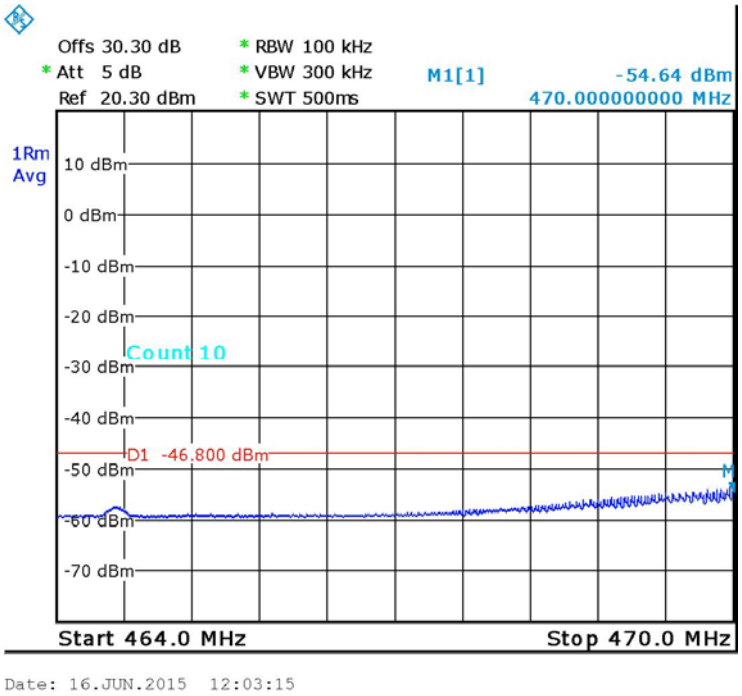


Figure 42. Chain 1 – Lower - 16QAM – 473MHz

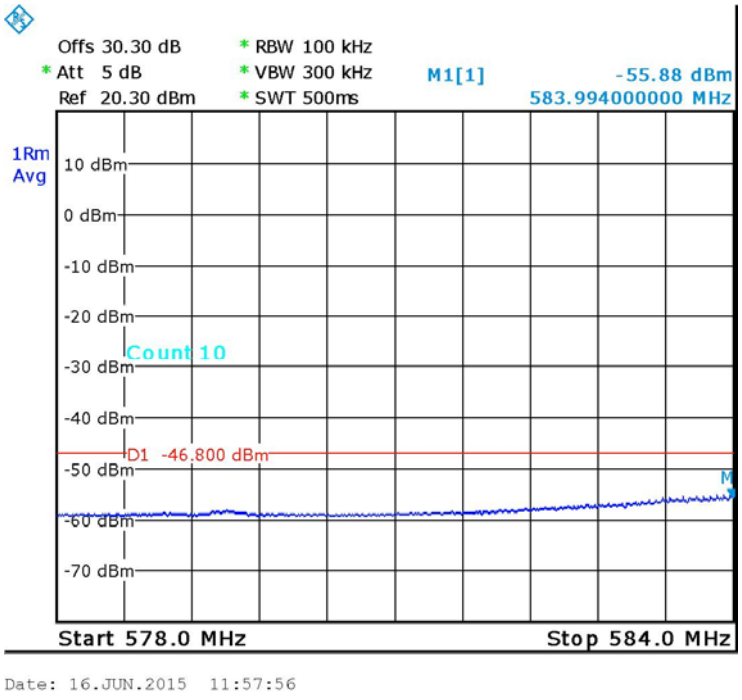
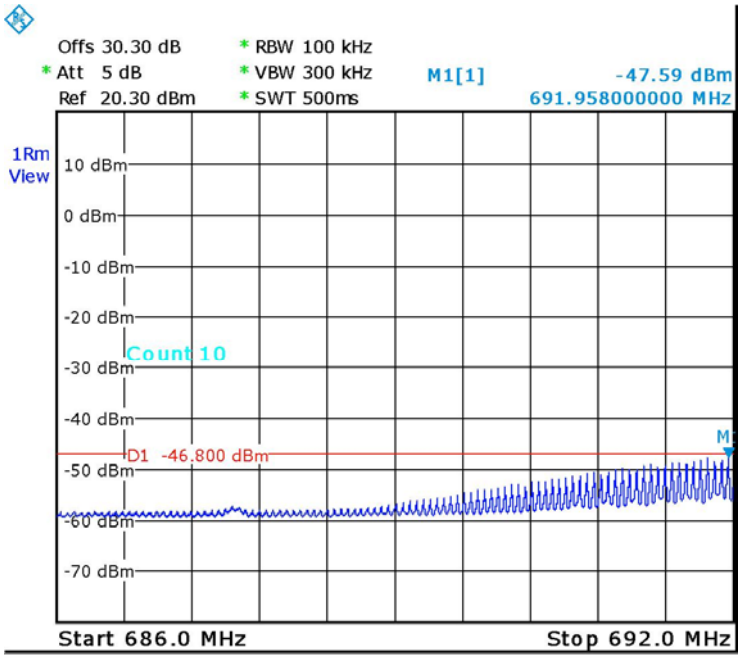
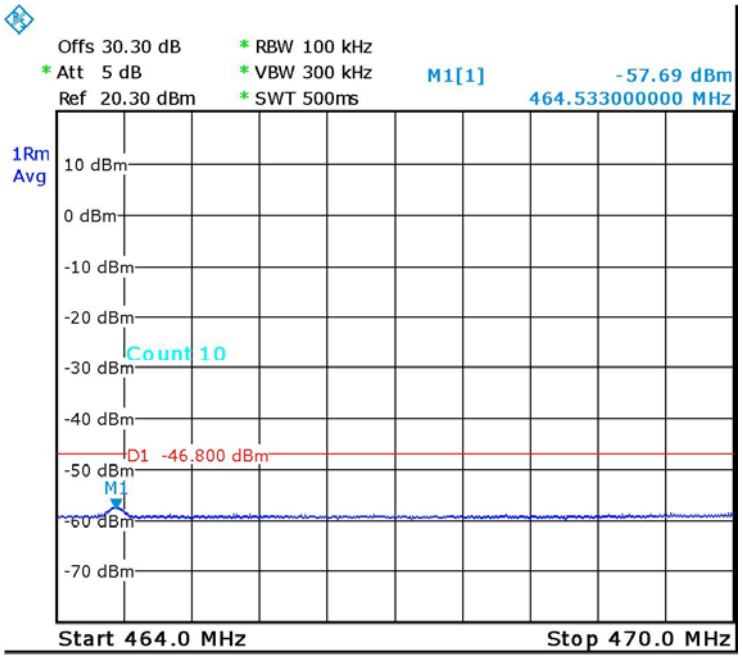


Figure 43. Chain 1 – Lower - 16QAM – 587MHz



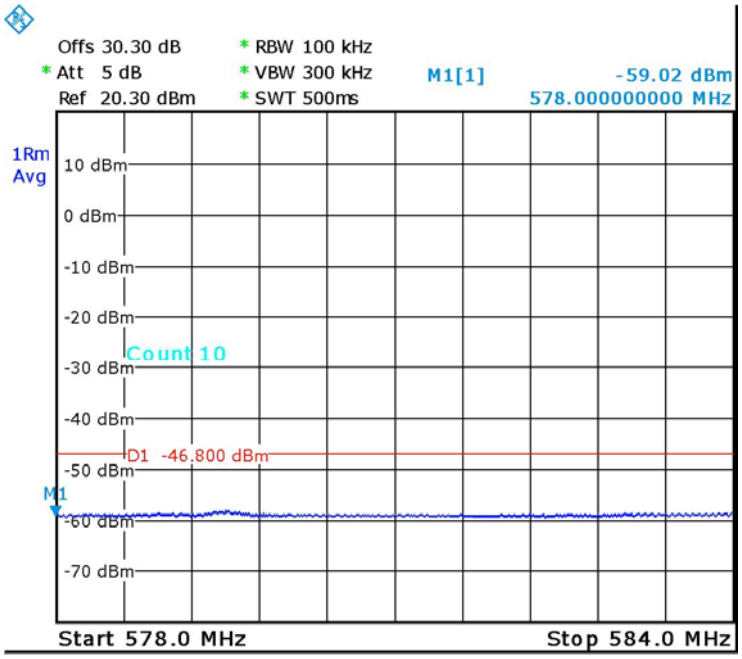
Date: 16.JUN.2015 11:41:28

Figure 44. Chain 1 – Lower - 16QAM – 695MHz



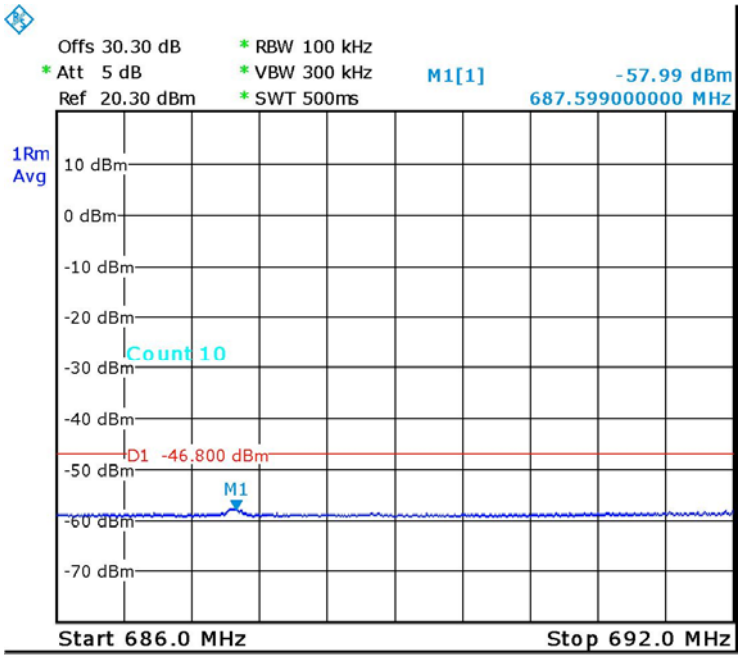
Date: 16.JUN.2015 11:18:47

Figure 45. Chain 1 – Lower - QPSK – 473MHz



Date: 16.JUN.2015 11:25:31

Figure 46. Chain 1 – Lower - QPSK – 587MHz



Date: 16.JUN.2015 11:36:28

Figure 47. Chain 1 – Lower - QPSK – 695MHz

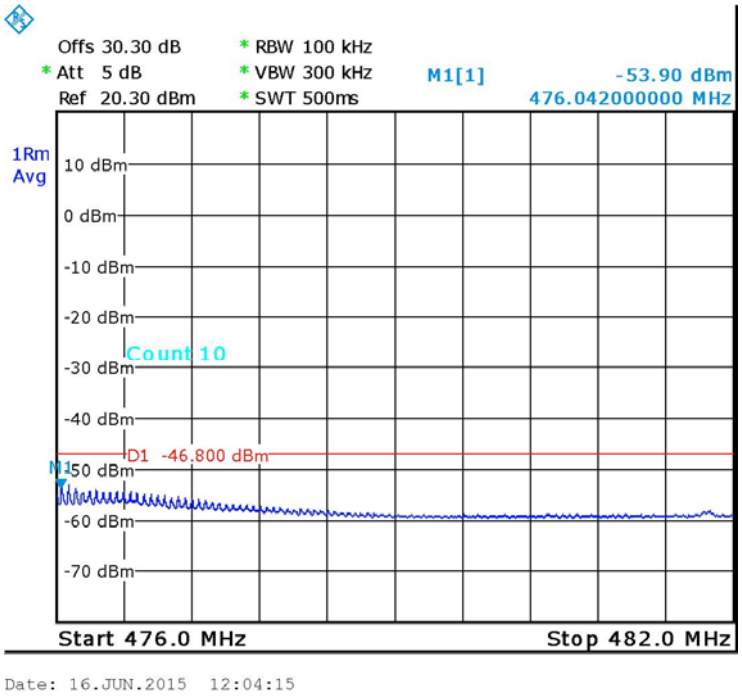


Figure 48. Chain 1 – Upper - 16QAM – 473MHz

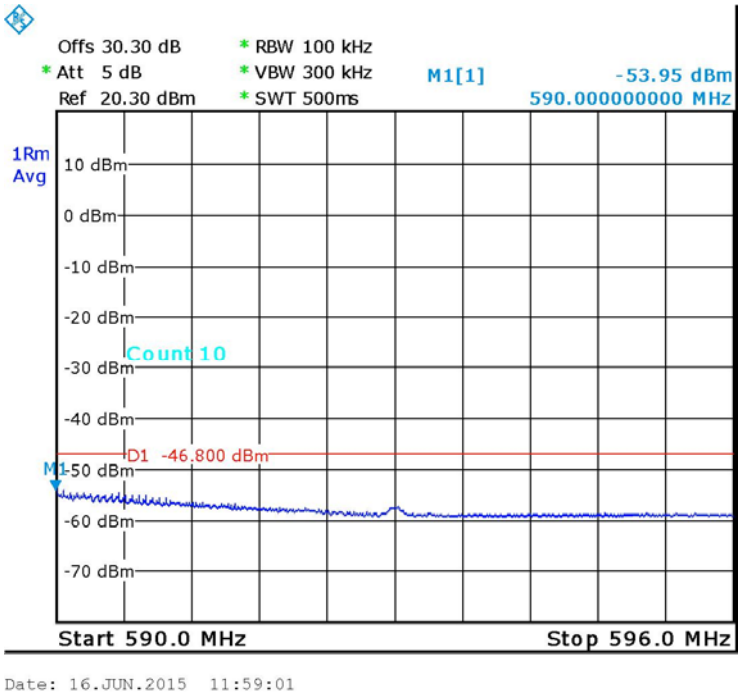
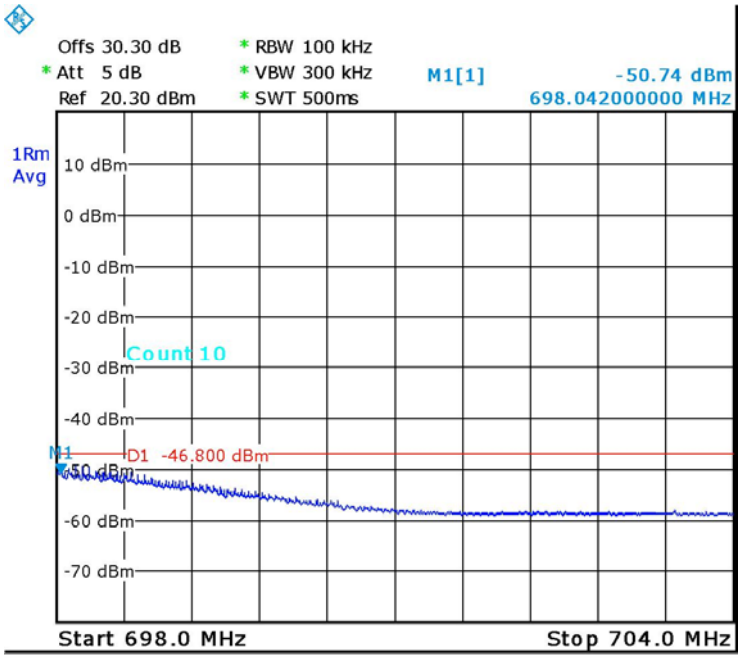
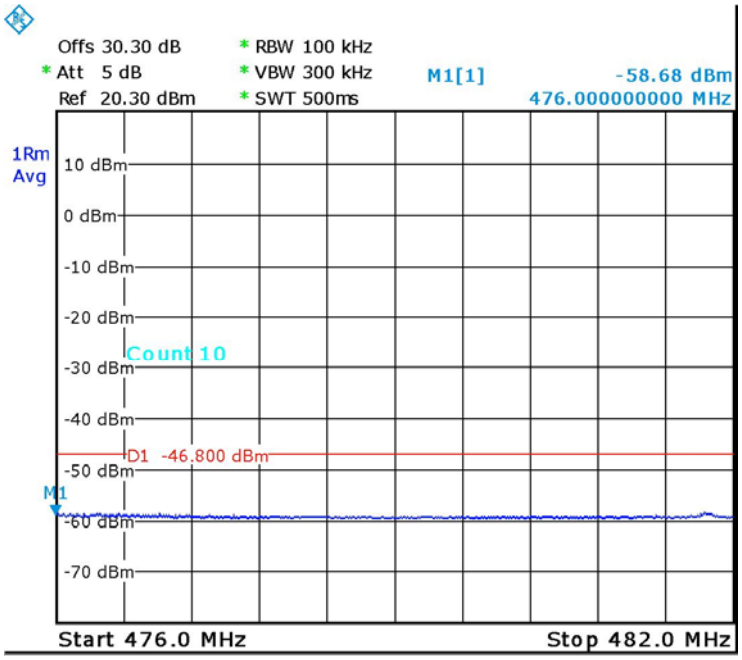


Figure 49. Chain 1 – Upper - 16QAM – 587MHz



Date: 16.JUN.2015 11:42:55

Figure 50. Chain 1 – Upper - 16QAM – 695MHz



Date: 16.JUN.2015 11:20:39

Figure 51. Chain 1- Upper - QPSK – 473MHz

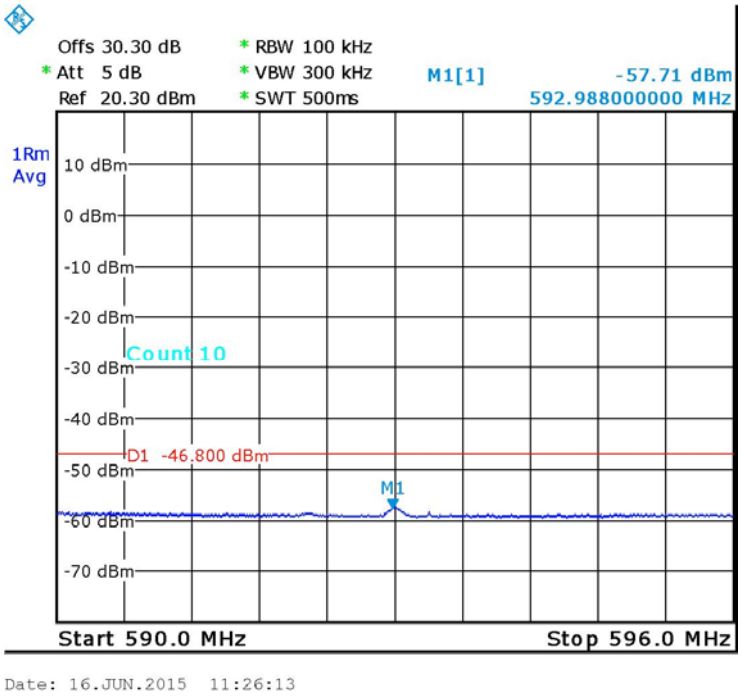


Figure 52. Chain 1- Upper - QPSK – 587MHz

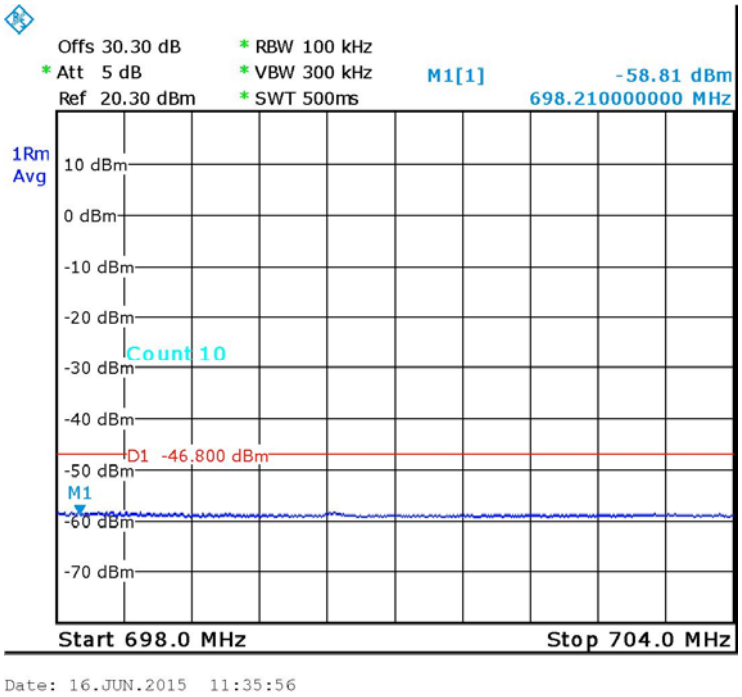


Figure 53. Chain 1 -Upper - QPSK – 695MHz

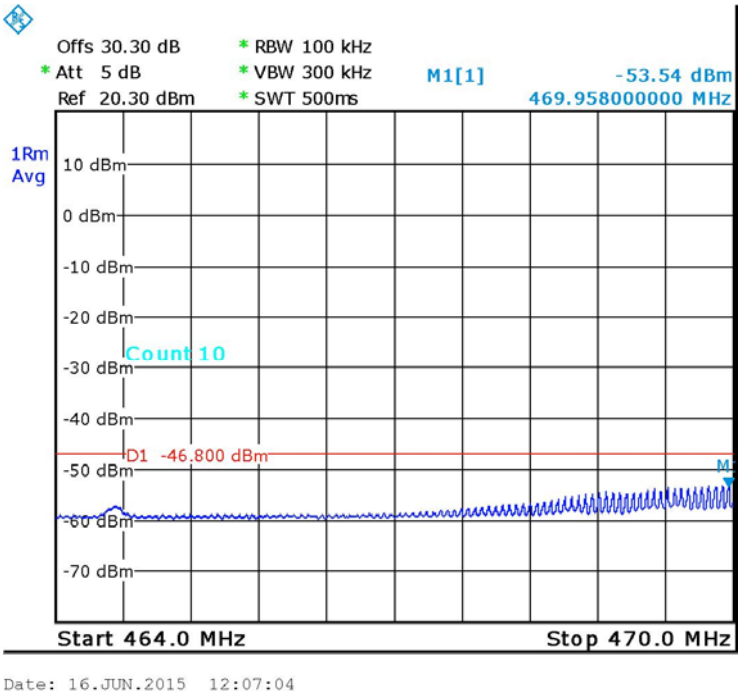


Figure 54. Chain 2 – Lower - 16QAM – 473MHz

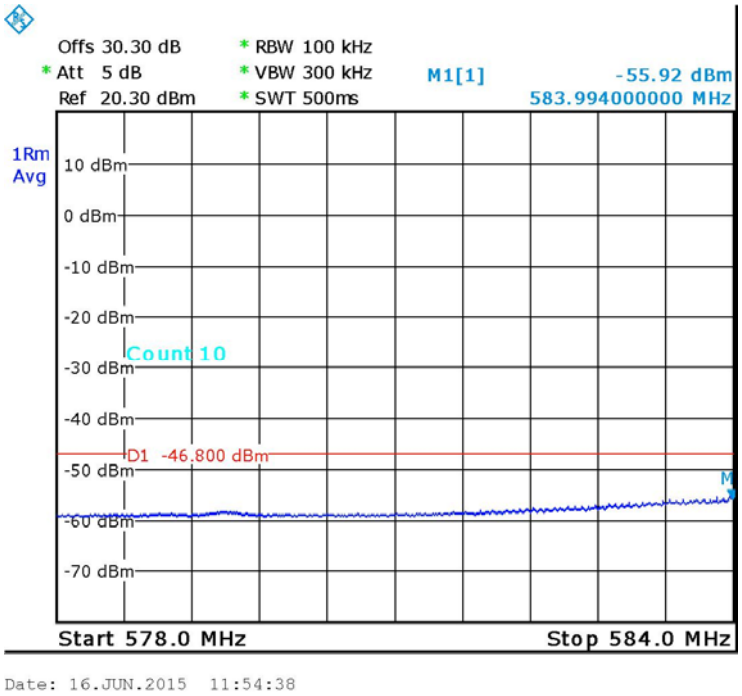


Figure 55. Chain 2– Lower - 16QAM – 587MHz

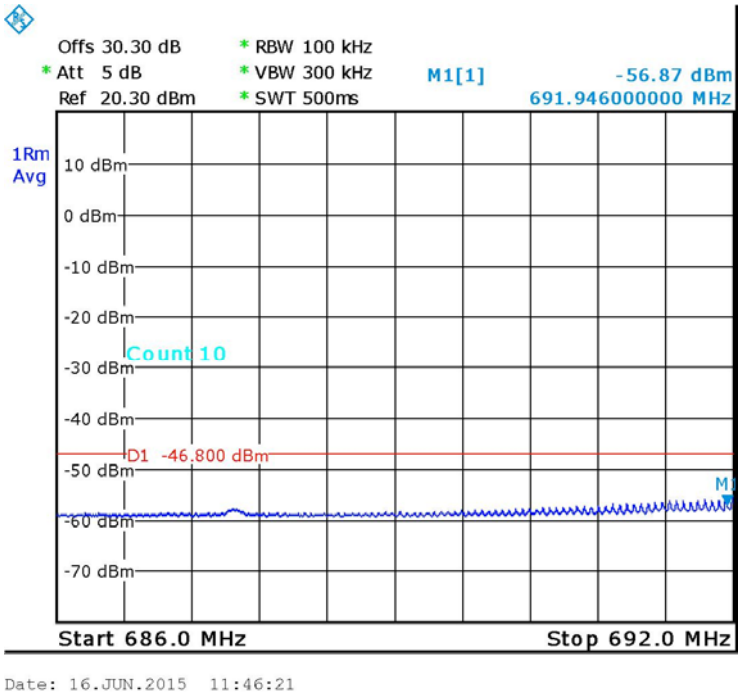


Figure 56. Chain 2 – Lower - 16QAM – 695MHz

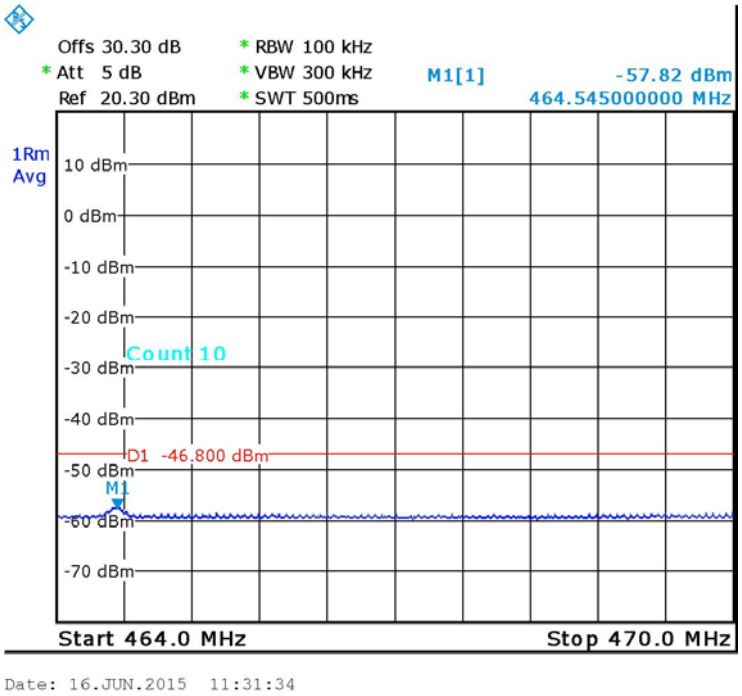


Figure 57. Chain 2 – Lower - QPSK – 473MHz

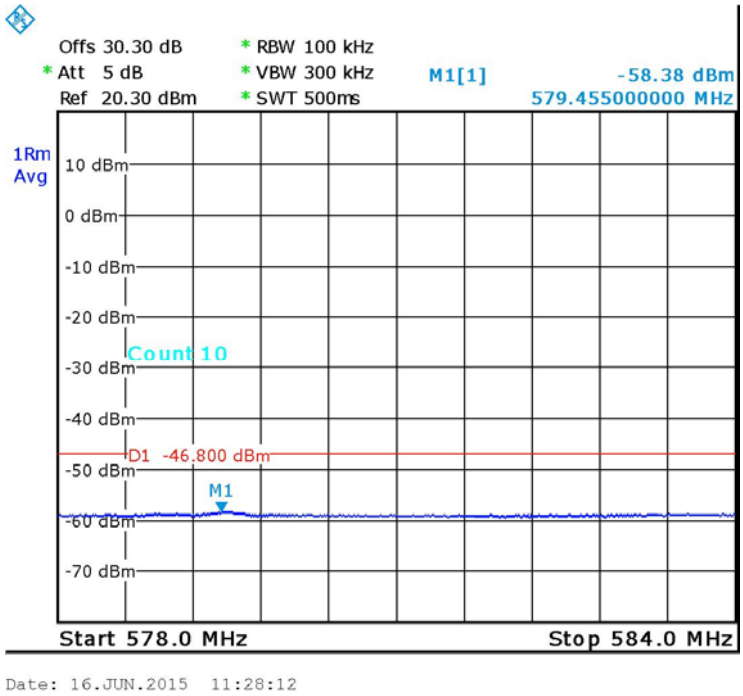


Figure 58. Chain 2– Lower - QPSK – 587MHz

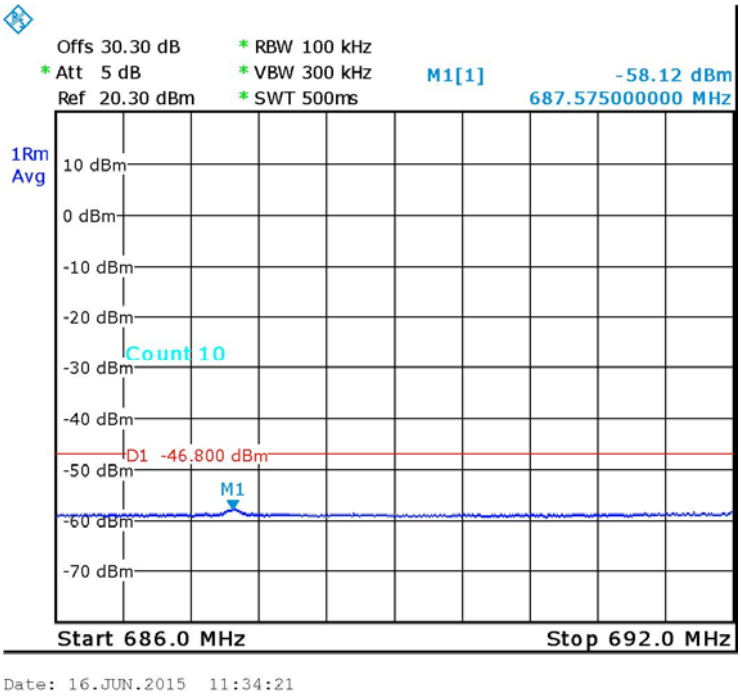


Figure 59. Chain 2 – Lower - QPSK – 695MHz

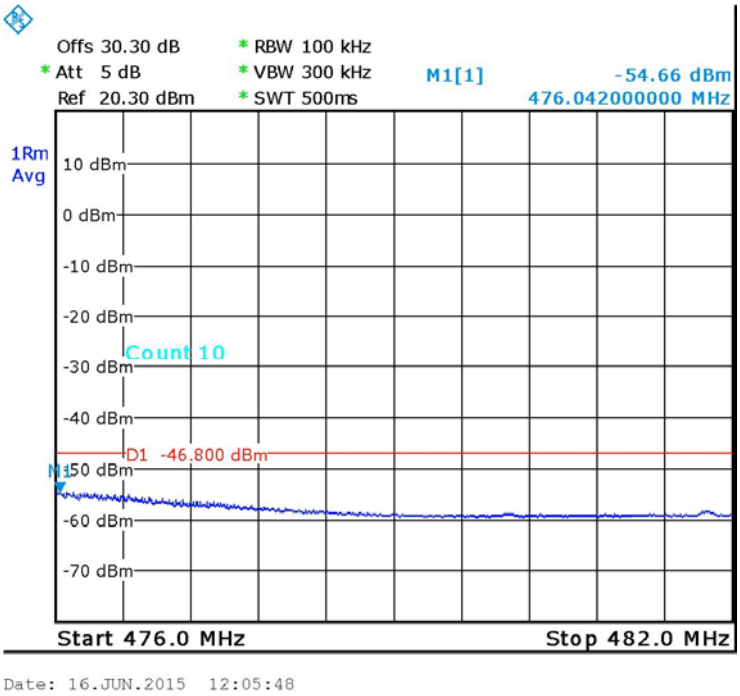


Figure 60. Chain 2 – Upper - 16QAM – 473MHz

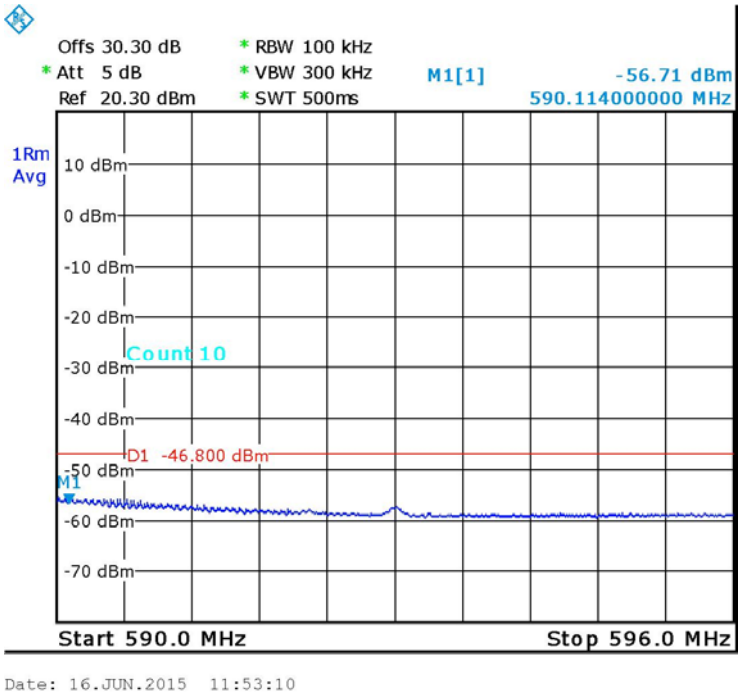


Figure 61. Chain 2 – Upper - 16QAM – 587MHz

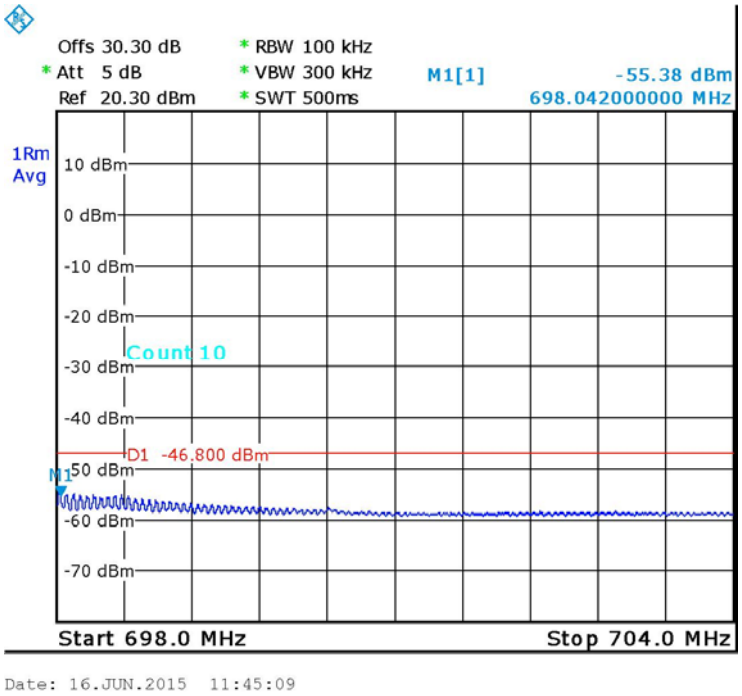


Figure 62. Chain 2 – Upper - 16QAM – 695MHz

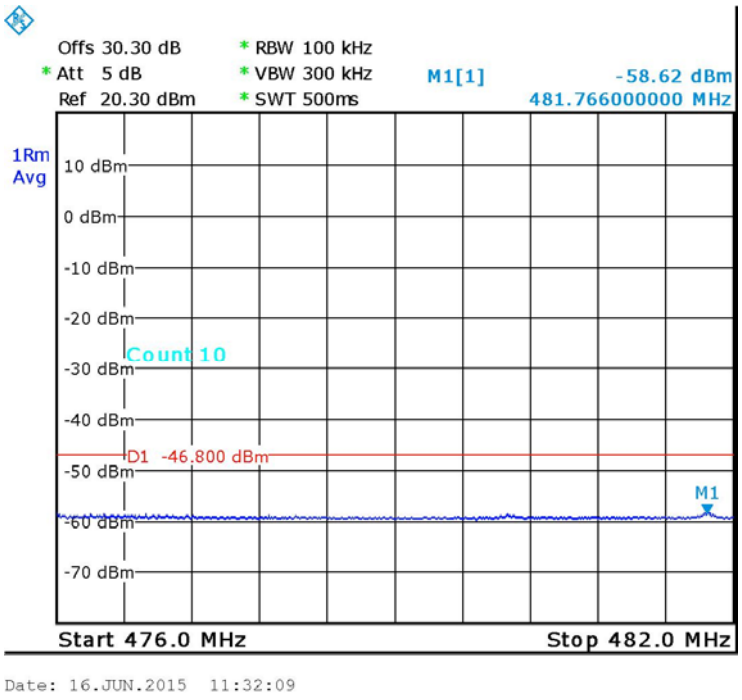


Figure 63. Chain 2- Upper - QPSK – 473MHz

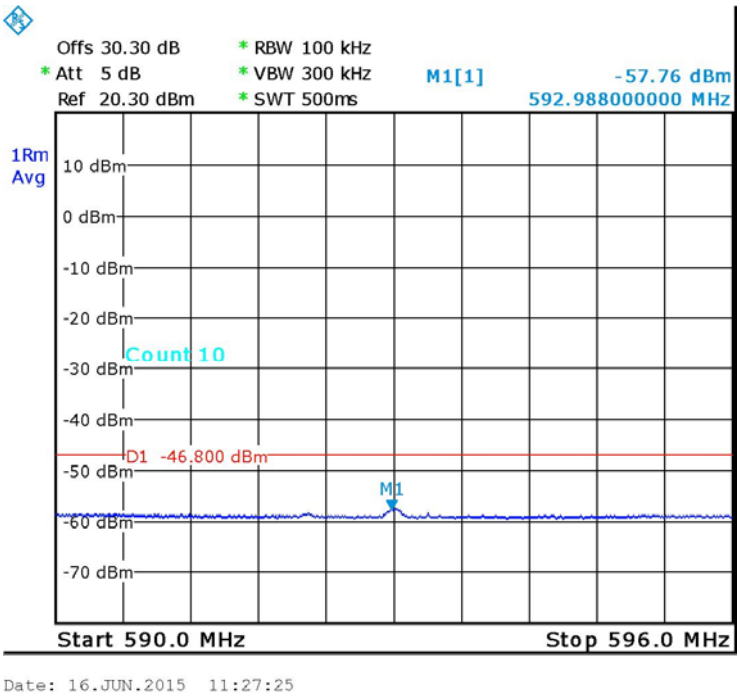


Figure 64. Chain 2- Upper - QPSK – 587MHz

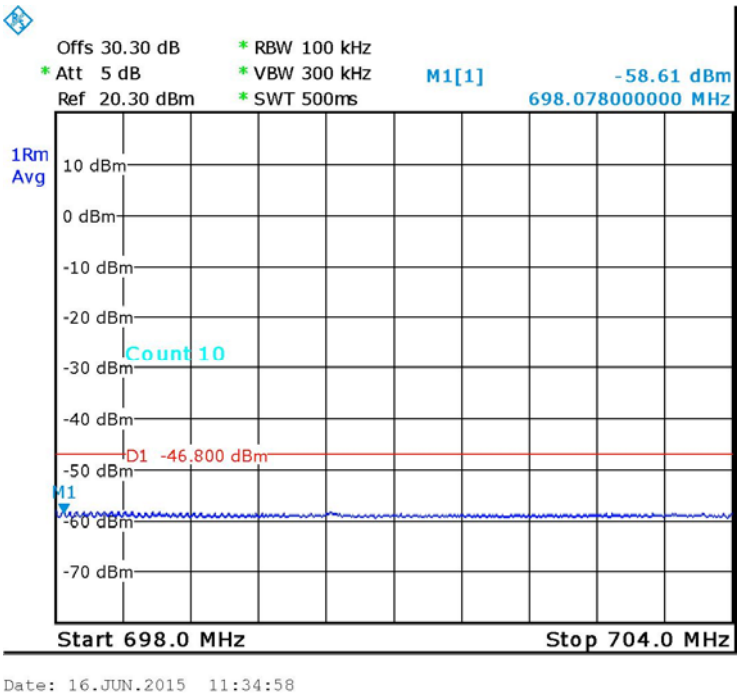


Figure 65. Chain 2 -Upper - QPSK – 695MHz

6.4 *Test Equipment Used; Adjacent Channel*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
30 dB attenuator	BIRD	8304-N30DB	-	June 2, 2015	1 year
Coupler	Macom	96341	2025-6006-10	-	-

Figure 66 Test Equipment Used