



TEST REPORT

Test Report No. : UL-RPT-RP93037JD10A V2.0

Manufacturer : Cambium Networks Ltd
Model No. : PTP 50650
FCC ID : QWP-50650
Test Standard(s) : FCC Part 15.207 & Part 90 Subpart Y

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 20 SEPTEMBER 2013

Checked by:

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Issued by :

pp

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This laboratory is accredited by UKAS.
The tests reported herein have been
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Table of Contents

1. Customer Information.....	4
2. Summary of Testing.....	5
2.1. General Information	5
2.2. Summary of Test Results	5
2.3. Methods and Procedures	6
2.4. Deviations from the Test Specification	6
3. Equipment Under Test (EUT)	7
3.1. Identification of Equipment Under Test (EUT)	7
3.2. Description of EUT	7
3.3. Modifications Incorporated in the EUT	7
3.4. Additional Information Related to Testing	8
3.5. Support Equipment	8
3.6. Antenna	9
4. Operation and Monitoring of the EUT during Testing	10
4.1. Operating Modes	10
4.2. Configuration and Peripherals	10
5. Measurements, Examinations and Derived Results	13
5.1. General Comments	13
5.2. Test Results	14
5.2.1. Transmitter AC Conducted Spurious Emissions	14
5.2.2. Conducted Output Power	21
5.2.3. Peak Power Spectral Density	27
5.2.4. Peak Excursion	70
5.2.5. Occupied Bandwidth	75
5.2.6. Conducted Emission Mask	85
5.2.7. Conducted Emissions	110
5.2.8. Radiated Spurious Emissions	115
5.2.9. Frequency Stability (Temperature Variation)	119
5.2.10. Frequency Stability (Voltage Variation)	121
6. Measurement Uncertainty	122
7. Report Revision History	123

1. Customer Information












Company Name:	Cambium Networks Ltd
Address:	Unit B2/3, Linhay Business Park Eastern Road Ashburton Devon TQ13 7UP United Kingdom

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR90
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 90 Subpart Y - Regulations Governing Licensing and Use of Frequencies in the 4940-4990 MHz Band
Specification Reference:	47CFR15.207
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section15.207
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	21 May 2013 to 04 July 2013

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
15.207	Transmitter AC Conducted Spurious Emissions	
2.1046, 90.205(p) & 90.1215(a)(1)	Transmitter Conducted Output Power	
90.1215(a)(2)	Conducted Peak Power Spectral Density	
90.1215(e)	Transmitter Peak Excursion	
2.1049	Transmitter Occupied Bandwidth	
90.210(m) / 2.1051	Transmitter Conducted Emissions Mask	
90.210(m) / 2.1051	Transmitter Conducted Emissions	
90.210(m)	Radiated Spurious Emissions	
90.213 / 2.1055	Transmitter Frequency Stability	
Key to Results		
 = Complied  = Did not comply		

2.3. Methods and Procedures

Reference:	ANSI/TIA-603-C-2004
Title:	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards.
Reference:	ANSI C63.4 (2009)
Title:	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
Reference:	FCC KDB 971168 D01 Licensed DTS Guidance v02r01, June 7 2013
Title:	Measurement Guidance for Certification of Licensed Digital Transmitters
Reference:	FCC KDB 662911 D02 v01, October 25 2011
Title:	MIMO with Cross-Polarized Antenna

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Cambium Networks Ltd
Model Name or Number:	PTP 50650
Hardware Version:	Production Rev 4
Software Version:	B880
Serial Number:	00045650004E
FCC ID:	QWP-50650

Brand Name:	Cambium Networks Ltd
Model Name or Number:	PTP 50650
Hardware Version:	Production Rev 4
Software Version:	B880
Serial Number:	00045650008E
FCC ID:	QWP-50650

Description:	PoE Power supply
Brand Name:	LEADER ELECTRONICS INC.
Model Name or Number:	NU60-R550111-I3
Serial Number:	Not marked or stated

Description:	PoE Power supply
Brand Name:	Cambium Networks
Model Name or Number:	E100109B G
Part Number:	C000065L002A
Serial Number:	1321000023

3.2. Description of EUT

The Equipment Under Test was a fixed radio transceiver operating in the 4940 MHz to 4990 MHz band. The EUT is available in two configurations:

1. Connectorised with two external antenna ports. Model No. C050065B002A.
2. Integrated flat plate antenna. Model No. C050065B001A.

Power is provided by a PoE supply.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	Digital Transmission System			
Type of Unit:	Microwave fixed radio link transceiver			
Modes/Modulation:	ACQ, BPSK, QPSK, 16QAM, 64QAM, 256QAM			
Intended Operating Environment:	Residential, Commercial and Light Industry			
Data rates:	9.63, 26.79, 107.18, 168.58 & 200.1 Mbp/s			
Power Supply Requirement(s):	Nominal	PoE supply input 120 VAC 60 Hz. PoE output 48 VDC.		
Channel Bandwidth:	5, 10, 15 & 20 MHz			
Frequency Range:	4940 MHz to 4990 MHz			
Channels Tested:	Channel Bandwidth (MHz)	Bottom Channel Frequency (MHz)	Middle Channel Frequency (MHz)	Top Channel Frequency (MHz)
	5	4943	4963	4987
	10	4945	4965	4985
	15	4948	4965	4982
	20	4950	4965	4980

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude D610
Serial Number:	UL Asset No. PC471NT

Description:	Ethernet Hub
Brand Name:	Netgear
Model Name or Number:	GS605 v2
Serial Number:	1FE17C5D01178

3.6. Antenna

The table below lists the antennas that the Customer intends to use with this product when operating in the 4940-4990 MHz band:

Type	Stated Gain (dBi)	Manufacturer	Antenna Name	Used for Testing	Note
Dual polarised flat plate	19.0	MARS	MA-EM56-DP-19CM	-	1,3
Dual polarised flat plate	23.0	MARS	MA-WS54-50R	X	3
4 ft Parabolic Dual Polarised	32.6	RadioWaves	SP4-4.7	X	2
6 ft Parabolic Dual Polarised	36.1	RadioWaves	SP6-4.7	X	2
65° Sectorised	17.0	Laird	ANT, AP Sector	X	2
90° Sectorised	17.0	Laird	ANT, AP Sector	-	1
Omnidirectional	13.0	KP	KPPA-5.7-DPOMA	X	2

X = This antenna was used for testing purposes

Note(s):

1. This antenna has the same gain or less gain and is of the same type as the antenna that was tested. Therefore it was not tested.
2. Used in conjunction with two, 1 metre length RF cables having an individual insertion loss of 1.5 dB across the EUT operating band.
3. Integral antenna. No external RF cables.

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- The unit operates in transceiver mode only as a TDD device in its' normal mode of operation. There is no dedicated receive only mode.
- For test purposes only, the EUT was continuously transmitting at maximum power with >99% duty cycle in test mode on the required channels using the supported modulation types and Acquisition mode.
- A test mode CW signal was used for frequency stability tests.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- A laptop PC with graphical user interface was used to configure the EUT via the PoE power supply and Ethernet cables.
- The EUT was powered throughout testing via the PoE power supply.
- The EUT was operating at maximum allowable output power unless stated.
- All configurations supported by the device were initially investigated on one channel in each channel bandwidth. The modes that produced the highest power were:
 - 5 MHz channel bandwidth – QPSK
 - 10 MHz channel bandwidth – 256QAM
 - 15 MHz channel bandwidth – 64QAM
 - 20 MHz channel bandwidth – 16QAM
- Occupied bandwidth tests; All configurations supported by the device were initially investigated on one channel and the data rate that produced the widest bandwidth (and was deemed the worst case) was BPSK.
- AC conducted emissions tests and radiated spurious emissions tests (case radiation) were performed with both RF ports terminated into 50 Ohm loads. The EUT was transmitting at maximum power on the highest frequency supported. Unused Ethernet ports were terminated into an Ethernet hub. The hub was not powered.

Power settings used during testing**Point-to-Point Parabolic Antennas**

The tables below show the EUT power settings that were used during testing for each channel bandwidth and modulation type, when the EUT was operated as a point-to-point device with parabolic antennas. Acquisition mode (ACQ) power setting was 24 dBm for all channel bandwidths apart from 5 MHz channel bandwidth where the setting was reduced to 22 dBm.

4' Parabolic Antenna

Ch. BW	BPSK			QPSK			16QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	20	20	20	20	20	20	20	20	20
10	23	23	23	23	23	23	23	23	23
15	24	24	24	24	24	24	24	24	24
20	24	24	24	24	24	24	24	24	24

Ch. BW	64QAM			256QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	20	20	20	20	20	20
10	23	23	23	23	23	23
15	24	24	24	24	24	24
20	24	24	24	24	24	24

6' Parabolic Antenna

Ch. BW	BPSK			QPSK			16QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	16	16	16	16	16	16	16	16	16
10	19	19	19	19	19	19	19	19	19
15	21	21	21	21	21	21	21	21	21
20	23	23	23	23	23	23	23	23	23

Ch. BW	64QAM			256QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	16	16	16	16	16	16
10	19	19	19	19	19	19
15	21	21	21	21	21	21
20	23	23	23	23	23	23

Power settings used during testing (continued)

The tables below show the EUT power settings that were used during testing when the EUT was operated with the sectorised antenna, flat plate antenna and omnidirectional antennas.

Acquisition mode (ACQ) power setting was 24 dBm for all channel bandwidths apart from 5 MHz channel bandwidth where the setting was reduced to 22 dBm.

Sectorised Antenna & Plate Antenna

Ch. BW	BPSK			QPSK			16QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	24	24	24	24	24	24	24	24	24
10	24	24	24	24	24	24	24	24	24
15	24	24	24	24	24	24	24	24	24
20	24	24	24	24	24	24	24	24	24

Ch. BW	64QAM			256QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	24	24	24	24	24	24
10	24	24	24	24	24	24
15	24	24	24	24	24	24
20	24	24	24	24	24	24

Omnidirectional Antenna

Ch. BW	BPSK			QPSK			16QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	23	23	23	23	23	23	23	23	23
10	24	24	24	24	24	24	24	24	24
15	24	24	24	24	24	24	24	24	24
20	24	24	24	24	24	24	24	24	24

Ch. BW	64QAM			256QAM		
	Bottom Channel	Middle Channel	Top Channel	Bottom Channel	Middle Channel	Top Channel
5	23	23	23	23	23	23
10	24	24	24	24	24	24
15	24	24	24	24	24	24
20	24	24	24	24	24	24

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6. Measurement Uncertainty* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Ian Watch	Test Date:	07 June 2013
Test Sample Serial Number:	00045650004E		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2 referencing ANSI C63.4

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	39

Note(s):

1. The Customer stated that two different power supplies can be used with this product. AC conducted spurious emissions tests were performed on each power supply.
2. The input to the power supply was connected to a 120 VAC 60 Hz single phase supply via a LISN during the testing.
3. The EUT was transmitting at maximum power during the test. RF ports were terminated using 50 Ohm loads.
4. The earth bonding point on the EUT was connected to the metal structure of the test chamber during testing.
5. All emissions >20 dB below the applicable limits were not recorded.

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / LEADER Power Supply**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.150000	Live	52.4	66.0	13.6	Complied
0.280500	Live	46.5	60.8	14.3	Complied
0.294000	Live	45.6	60.4	14.8	Complied
0.528000	Live	38.9	56.0	17.1	Complied
0.748500	Live	39.9	56.0	16.1	Complied
0.996000	Live	39.0	56.0	17.0	Complied
1.563000	Live	42.1	56.0	13.9	Complied

Results: Live / Average / LEADER Power Supply

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.150000	Live	38.6	56.0	17.4	Complied
0.280500	Live	40.1	50.8	10.7	Complied
0.339000	Live	34.8	49.2	14.4	Complied
0.519000	Live	32.6	46.0	13.4	Complied
0.730500	Live	33.7	46.0	12.3	Complied
0.960000	Live	33.8	46.0	12.2	Complied
1.563000	Live	33.5	46.0	12.5	Complied
4.222500	Live	27.2	46.0	18.8	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / LEADER Power Supply**

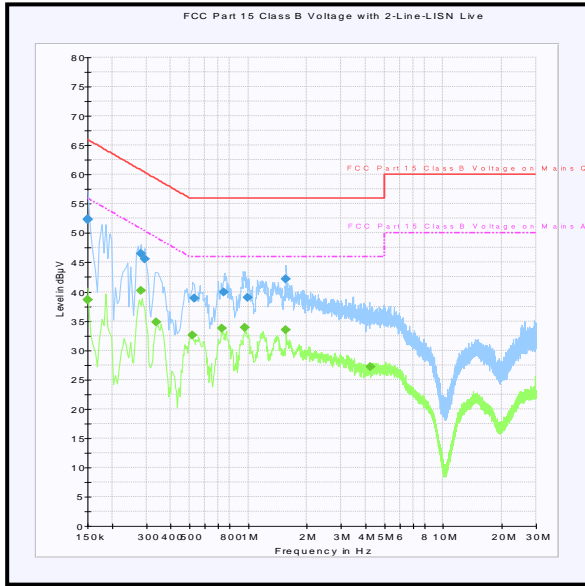
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.150000	Neutral	49.1	66.0	16.9	Complied
0.285000	Neutral	47.6	60.7	13.1	Complied
0.298500	Neutral	45.7	60.3	14.6	Complied
0.528000	Neutral	38.7	56.0	17.3	Complied
0.762000	Neutral	40.2	56.0	15.8	Complied
1.000500	Neutral	38.9	56.0	17.1	Complied
1.563000	Neutral	43.3	56.0	12.7	Complied

Results: Neutral / Average / LEADER Power Supply

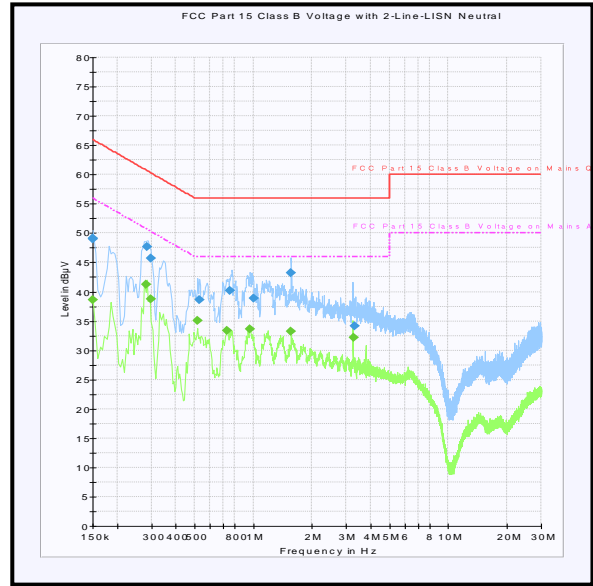
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.150000	Neutral	38.6	56.0	17.4	Complied
0.280500	Neutral	41.3	50.8	9.5	Complied
0.298500	Neutral	38.8	50.3	11.5	Complied
0.514500	Neutral	35.1	46.0	10.9	Complied
0.730500	Neutral	33.4	46.0	12.6	Complied
0.960000	Neutral	33.6	46.0	12.4	Complied
1.563000	Neutral	33.2	46.0	12.8	Complied
3.268500	Neutral	32.2	46.0	13.8	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: LEADER Power Supply



Live



Neutral

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / Cambium Networks Power Supply**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.226500	Live	46.9	62.6	15.7	Complied
0.582000	Live	43.0	56.0	13.0	Complied
0.627000	Live	45.5	56.0	10.5	Complied
0.672000	Live	36.8	56.0	19.2	Complied
1.563000	Live	39.0	56.0	17.0	Complied

Results: Live / Average / Cambium Networks Power Supply

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.226500	Live	43.8	52.6	8.8	Complied
0.627000	Live	45.1	46.0	0.9	Complied
0.627000	Live	44.9	46.0	1.1	Complied
0.766500	Live	34.0	46.0	12.0	Complied
1.167000	Live	33.2	46.0	12.8	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / Cambium Networks Power Supply**

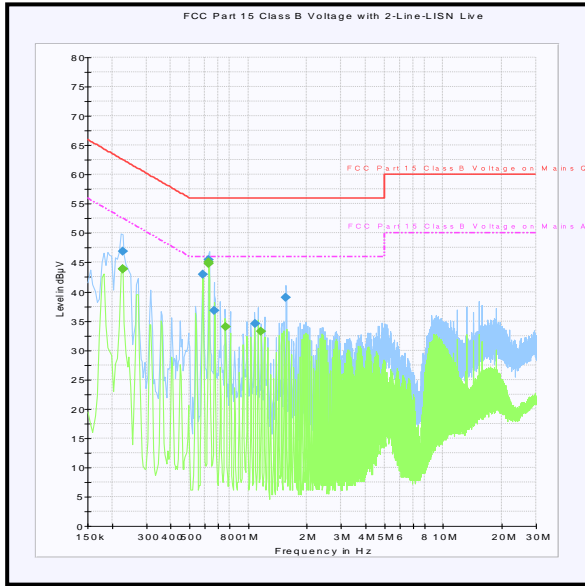
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.226500	Neutral	49.2	62.6	13.4	Complied
0.586500	Neutral	45.2	56.0	10.8	Complied
0.631500	Neutral	47.4	56.0	8.6	Complied
1.563000	Neutral	38.2	56.0	17.8	Complied

Results: Neutral / Average / Cambium Networks Power Supply

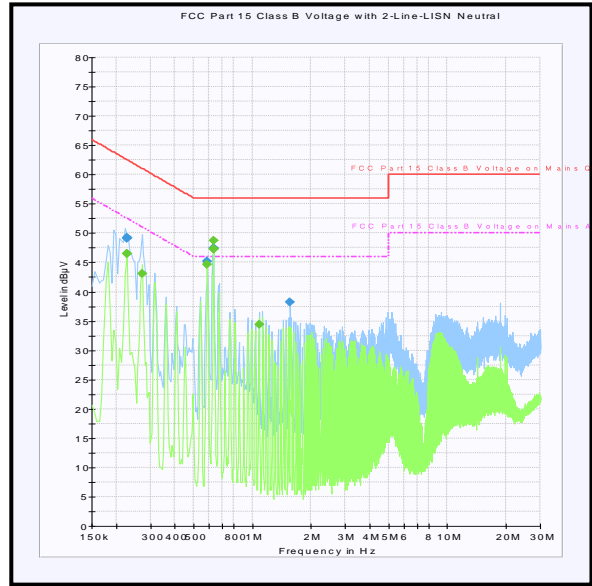
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.226500	Neutral	46.5	52.6	6.1	Complied
0.271500	Neutral	43.1	51.1	8.0	Complied
0.586500	Neutral	44.7	46.0	1.3	Complied
0.631500	Neutral	45.7	46.0	0.3	Complied
1.086000	Neutral	34.4	46.0	11.6	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: Cambium Networks Power Supply



Live



Neutral

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A004	LISN	Rohde & Schwarz	ESH3-Z5	890604/027	10 Oct 2013	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	19 Feb 2014	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	09 Aug 2013	12
M1625	Thermohygrometer	JM Handelpunkt	30.5015.06	N/A	09 Jan 2014	12

5.2.2. Conducted Output Power**Test Summary:**

Test Engineers:	David Doyle & Ian Watch	Test Dates:	21 May 2013 to 04 July 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Parts 2.1046, 90.205(p) and 90.1215(a)(1)
Test Method Used:	Part 90.1215(c) & KDB 971168 D01 Section 5.2.3

Environmental Conditions:

Temperature (°C):	21 to 25
Relative Humidity (%):	39 to 44

Note(s):

- The output port of the EUT was connected directly to an RF power meter via suitable attenuation. The attenuator was calibrated prior to use and the loss incorporated into the measurement as an RF level offset.
- Conducted power tests were performed in accordance with FCC KDB 971168 D01 Section 5.2.3. Worst case modes are recorded.
- The EUT was transmitting at 100% duty cycle.
- An omnidirectional antenna with gain of 13 dBi is intended to be used. One metre RF cables with insertion loss of 1.5 dB were supplied to connect the antenna to the EUT RF ports. The combined antenna gain and cable loss is 11.5 dBi which is 2.5 dB greater than 9 dBi allowed in Part 90.1215(a)(2). Therefore the maximum conducted output power limits for all supported channel bandwidths was reduced by 2.5 dB.
- Sectorised antennas and plate antennas intended to be used for point-to-point and point-to-multipoint operation have directional gains less than 26 dBi quoted in Part 90.1215(a)(2). No reduction in the maximum conducted power limit was required.
- Parabolic antennas with maximum gains of 32.6 dBi and 36.1 dBi are intended to be used for point-to-point operation. A one metre RF cable with insertion loss of 1.5 dB is used to connect the antenna to each RF port. The 4 foot antenna gain is 32.6 dBi and cable loss of 1.5 dB giving a total gain of 31.1 dBi. This is 5.1 dB greater than 26 dBi allowed for point-point operation in Part 90.1215(a)(2). The 6 foot antenna gain is 36.1 dBi and cable loss of 1.5 dB giving a total gain of 34.6 dBi. This is 8.6 dB greater than 26 dBi allowed for point-point operation in Part 90.1215(a)(2). Therefore, the high power maximum conducted output power limits for all supported channel bandwidths were reduced accordingly.

The Part 90.1215(a)(1) point-to-point maximum conducted power limits for the 4 foot parabolic antenna were recalculated as:

5 MHz channel bandwidth: $27 - 5.1 = 21.9$ dBm
 10 MHz channel bandwidth: $30 - 5.1 = 24.9$ dBm
 15 MHz channel bandwidth: $31.8 - 5.1 = 26.7$ dBm
 20 MHz channel bandwidth: $33 - 5.1 = 27.9$ dBm

The Part 90.1215(a)(1) point-to-point maximum conducted power limits for the 6 foot parabolic antenna were recalculated as:

5 MHz channel bandwidth: $27 - 8.6 = 18.4$ dBm
 10 MHz channel bandwidth: $30 - 8.6 = 21.4$ dBm
 15 MHz channel bandwidth: $31.8 - 8.6 = 23.2$ dBm
 20 MHz channel bandwidth: $33 - 8.6 = 24.4$ dBm

Conducted Output Power (continued)**Results: 5 MHz Channel / ACQ / Omnidirectional Antenna**

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	17.9	17.6	20.8	24.5	3.7	Complied
Middle	17.8	17.5	20.7	24.5	3.8	Complied
Top	17.9	17.6	20.8	24.5	3.7	Complied

Results: 5 MHz Channel / QPSK / Omnidirectional Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	19.3	19.5	22.4	24.5	2.1	Complied
Middle	19.6	19.7	22.7	24.5	1.8	Complied
Top	19.7	19.7	22.7	24.5	1.8	Complied

Results: 5 MHz Channel / QPSK / Plate and Sectorised Antennas

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	20.3	20.8	23.6	27.0	3.4	Complied
Middle	21.5	20.4	24.0	27.0	3.0	Complied
Top	21.5	20.4	24.0	27.0	3.0	Complied

Results: 5 MHz Channel / QPSK / 4' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	16.4	16.6	19.5	21.9	2.4	Complied
Middle	16.6	16.7	19.7	21.9	2.2	Complied
Top	16.7	16.7	19.7	21.9	2.2	Complied

Results: 5 MHz Channel / QPSK / 6' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	12.8	12.8	15.8	18.4	2.6	Complied
Middle	12.7	12.8	15.8	18.4	2.6	Complied
Top	12.8	13.1	16.0	18.4	2.4	Complied

Conducted Output Power (continued)**Results: 10 MHz Channel / ACQ / Omnidirectional Antenna**

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	19.5	19.2	22.4	27.5	5.1	Complied
Middle	19.5	19.5	22.5	27.5	5.0	Complied
Top	19.6	19.3	22.5	27.5	5.0	Complied

Results: 10 MHz Channel / 256QAM / Omnidirectional Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	20.2	20.9	23.6	27.5	3.9	Complied
Middle	21.4	20.5	24.0	27.5	3.5	Complied
Top	20.4	21.0	23.7	27.5	3.8	Complied

Results: 10 MHz Channel / 256QAM / Plate and Sectorised Antennas

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	20.2	20.9	23.6	30.0	6.4	Complied
Middle	21.4	20.5	24.0	30.0	6.0	Complied
Top	20.4	21.0	23.7	30.0	6.3	Complied

Results: 10 MHz Channel / 256QAM / 4' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	19.0	19.3	22.2	24.9	2.7	Complied
Middle	19.1	19.3	22.2	24.9	2.7	Complied
Top	19.1	19.5	22.3	24.9	2.6	Complied

Results: 10 MHz Channel / 256QAM / 6' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	15.5	15.8	18.7	21.4	2.7	Complied
Middle	15.4	15.8	18.6	21.4	2.8	Complied
Top	15.4	15.6	18.6	21.4	2.8	Complied

Conducted Output Power (continued)**Results: 15 MHz Channel / ACQ / Omnidirectional Antenna**

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	19.4	19.1	22.3	29.3	7.0	Complied
Middle	19.5	19.3	22.4	29.3	6.9	Complied
Top	19.3	19.2	22.3	29.3	7.0	Complied

Results: 15 MHz Channel / 64QAM / Omnidirectional Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	21.4	21.2	24.3	29.3	5.0	Complied
Middle	21.3	21.2	24.3	29.3	5.0	Complied
Top	21.3	21.2	24.3	29.3	5.0	Complied

Results: 15 MHz Channel / 64QAM / Plate and Sectorised Antennas

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	21.4	21.2	24.3	31.8	7.5	Complied
Middle	21.3	21.2	24.3	31.8	7.5	Complied
Top	21.3	21.2	24.3	31.8	7.5	Complied

Results: 15 MHz Channel / 64QAM / 4' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	21.4	21.2	24.3	26.7	2.4	Complied
Middle	21.3	21.2	24.3	26.7	2.4	Complied
Top	21.3	21.2	24.3	26.7	2.4	Complied

Results: 15 MHz Channel / 64QAM / 6' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	17.8	18.0	20.9	23.2	2.3	Complied
Middle	17.4	17.6	20.5	23.2	2.7	Complied
Top	17.6	18.0	20.8	23.2	2.4	Complied

Conducted Output Power (continued)**Results: 20 MHz Channel / ACQ / Plate and Sectorised Antennas**

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	19.5	19.4	22.5	33.0	10.5	Complied
Middle	19.6	19.5	22.6	33.0	10.4	Complied
Top	19.5	19.4	22.5	33.0	10.5	Complied

Results: 20 MHz Channel / 16QAM / Omnidirectional Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	20.3	20.9	23.6	30.5	6.9	Complied
Middle	21.3	20.4	23.9	30.5	6.6	Complied
Top	20.2	21.0	23.6	30.5	6.9	Complied

Results: 20 MHz Channel / 16QAM / Plate and Sectorised Antennas

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	21.4	21.2	24.3	33.0	8.7	Complied
Middle	21.3	21.2	24.3	33.0	8.7	Complied
Top	21.3	21.2	24.3	33.0	8.7	Complied

Results: 20 MHz Channel / 16QAM / 4' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	21.4	21.2	24.3	27.9	3.6	Complied
Middle	21.3	21.2	24.3	27.9	3.6	Complied
Top	21.3	21.2	24.3	27.9	3.6	Complied

Results: 20 MHz Channel / 16QAM / 6' Parabolic Antenna

Channel	Conducted Power H Port (dBm)	Conducted Power V Port (dBm)	Combined Conducted Power (dBm)	Conducted Power Limit (dBm)	Margin (dB)	Result
Bottom	19.2	19.4	22.3	24.4	2.1	Complied
Middle	19.2	19.3	22.3	24.4	2.1	Complied
Top	19.4	19.6	22.5	24.4	1.9	Complied

Conducted Output Power (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2143	Attenuator	Atlan TecRF	AN18-20	081120-23#1	Calibrated Before Use	N/A
A2144	Attenuator	Atlan TecRF	AN18-20	081120-23#2	Calibrated Before Use	N/A
M283	Power Sensor	HP	8487A	3318A03241	30 Apr 2014	12
M1592	Power Sensor	HP	8487A	3318A02094	02 Aug 2013	13
M1009	Power Meter	HP	437B	3125U13706	25 Jan 2014	12
M1435	Power Meter	HP	437B	3125U14631	26 Apr 2014	12
M1252	Signal Generator	HP	83640A	3119A00489	16 Sep 2013	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	N/A	24 May 2014	12
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	N/A	24 May 2014	12

5.2.3. Peak Power Spectral Density**Test Summary:**

Test Engineers:	David Doyle & Ian Watch	Test Dates:	21 May 2013 to 03 July 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Part 90.1215(a)(2)
Test Method Used:	Part 90.1215(d) & KDB 971168 D01 Section 5.4.1

Environmental Conditions:

Temperature (°C):	21 to 25
Relative Humidity (%):	39 to 44

Note(s):

- All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest Peak Power Spectral Density were:
 - 5 MHz channel bandwidth – QPSK
 - 10 MHz channel bandwidth – 256QAM
 - 15 MHz channel bandwidth – 64QAM
 - 20 MHz channel bandwidth – 16QAM
- A 30 dB attenuator and RF cable were used to connect the measurement equipment to the EUT. The combined cable and attenuator loss was measured prior to performing the measurements and the loss compensation incorporated into the measurement results. The loss appears on the result plots as an RF level offset.
- The EUT was transmitting at maximum allowed power with 100% duty cycle on the bottom, middle and top channels during the tests.
- The test was performed as a conducted measurement on a spectrum analyser using the following settings: RBW of 1 MHz and 3 MHz VBW. The sweep time was coupled, with a span set to completely capture the entire envelope of the signal. An RMS detector and trace averaging (RMS) over 100 traces were used. A marker was placed on the peak of the plot and the marker level recorded. A software bug in the spectrum analyser often caused the trace averaging count to be inaccurately shown on some plots when the screen plot is saved.
- Power from both ports was measured and combined using the measure-and-sum method stated in FCC KDB 662911 D02.
- An omnidirectional antenna with gain of 13 dBi is intended to be used. One metre RF cables with insertion loss of 1.5 dB were supplied to connect the antenna to the EUT RF ports. The combined antenna gain and cable loss is 11.5 dBi which is 2.5 dB greater than 9 dBi quoted in Part 90.1215(a)(2). Therefore the peak power spectral density limits for all supported channel bandwidths were reduced by 2.5 dB.
- Sectorised antennas and plate antennas intended to be used for point-to-point and point-to-multipoint operation have directional gains less than 26 dBi quoted in Part 90.1215(a)(2). No reduction in the peak power spectral density limit was required.

Peak Power Spectral Density (continued)**Note(s):**

8. Parabolic antennas with maximum gains of 32.6 dBi and 36.1 dBi are intended to be used for point-to-point operation. A one metre RF cable with insertion loss of 1.5 dB is used to connect the antenna to each RF port. The 4 foot antenna gain is 32.6 dBi and cable loss of 1.5 dB giving a total gain of 31.1 dBi. This is 5.1 dB greater than 26 dBi allowed for point-point operation in Part 90.1215(a)(2). The 6 foot antenna gain is 36.1 dBi and cable loss of 1.5 dB giving a total gain of 34.6 dBi. This is 8.6 dB greater than 26 dBi allowed for point-point operation in Part 90.1215(a)(2). Therefore, the peak power spectral density limits for all supported channel bandwidths were reduced accordingly.

The Part 90.1215(a)(1) point-to-point peak power spectral density limits for the 4 foot parabolic antenna were recalculated as:

$$\text{All channel bandwidths: } 21 \text{ dBm/MHz} - 5.1 = 15.9 \text{ dBm/MHz}$$

The Part 90.1215(a)(1) point-to-point peak power spectral density limits for the 6 foot parabolic antenna were recalculated as:

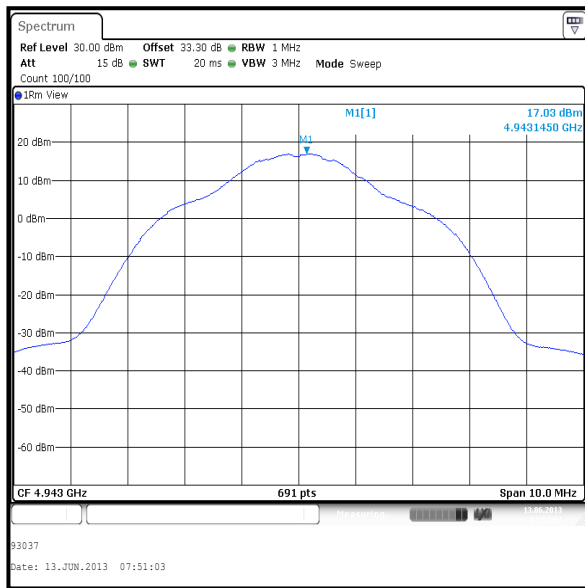
$$\text{All channel bandwidths: } 21 \text{ dBm/MHz} - 8.6 = 12.4 \text{ dBm/MHz}$$

Peak Power Spectral Density (continued)

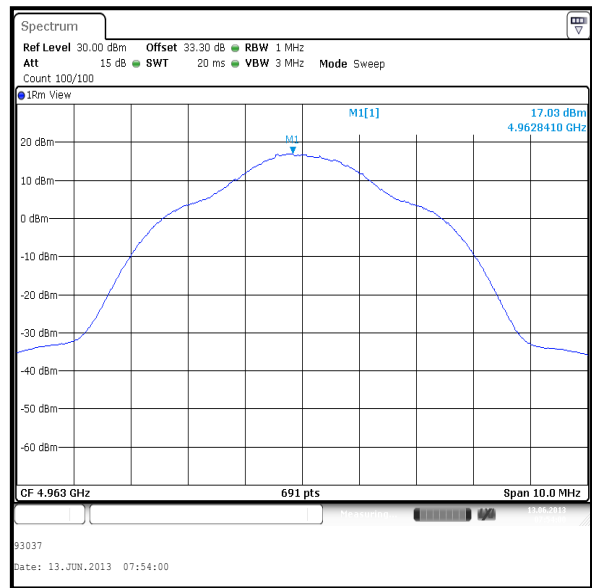
Results: 5 MHz Channel / ACQ / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	17.0	17.5	20.3	21.0	0.7	Complied
Middle	17.0	17.4	20.2	21.0	0.8	Complied
Top	17.8	17.2	20.5	21.0	0.5	Complied

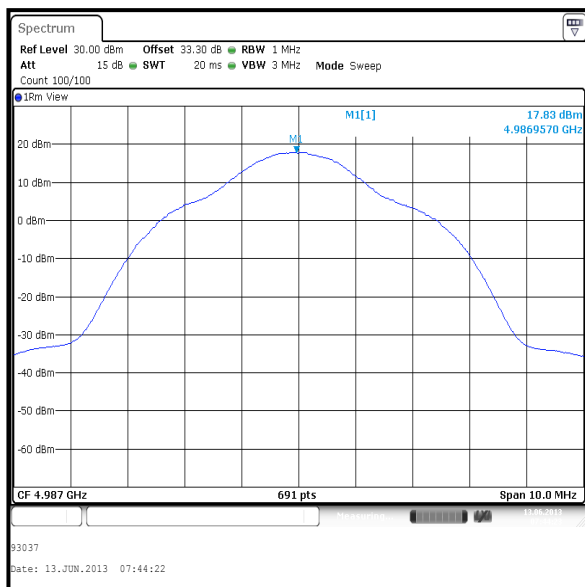
H Port



Bottom Channel



Middle Channel

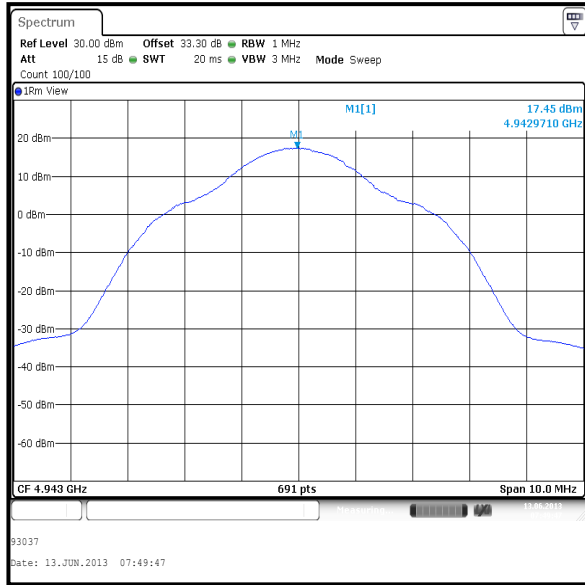


Top Channel

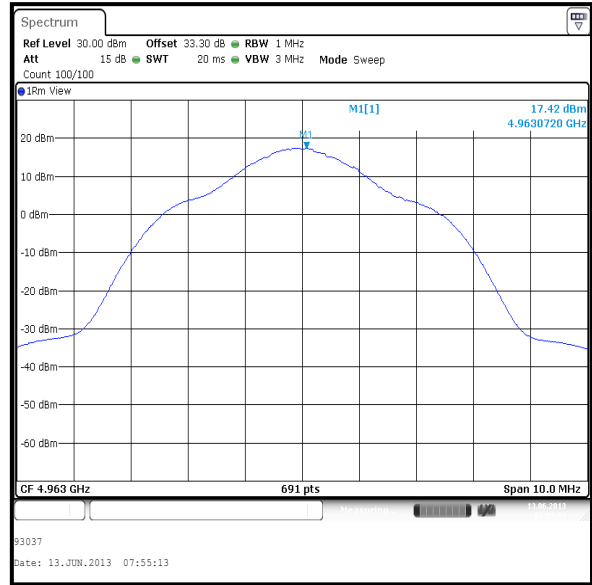
Peak Power Spectral Density (continued)

Results: 5 MHz Channel / ACQ / Plate and Sectorised Antennas

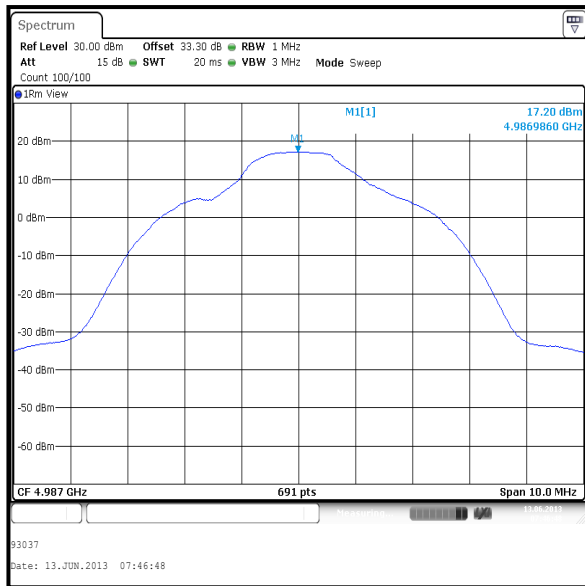
V Port



Bottom Channel



Middle Channel



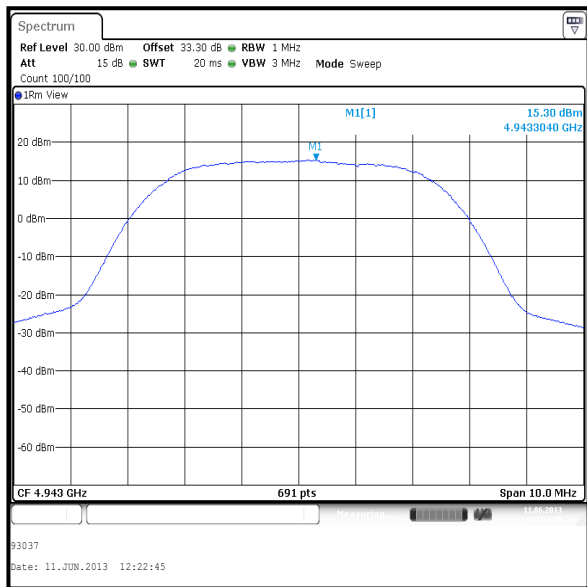
Top Channel

Peak Power Spectral Density (continued)

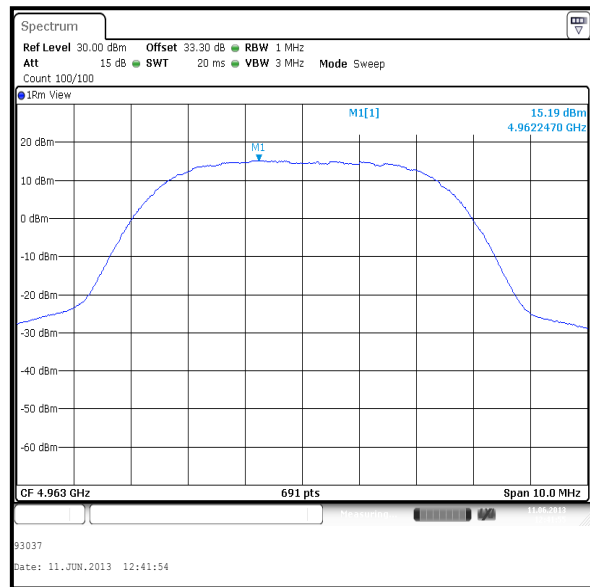
Results: 5 MHz Channel / QPSK / Omnidirectional Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	15.3	15.4	18.4	18.5	0.1	Complied
Middle	15.2	15.3	18.3	18.5	0.2	Complied
Top	15.2	15.5	18.4	18.5	0.1	Complied

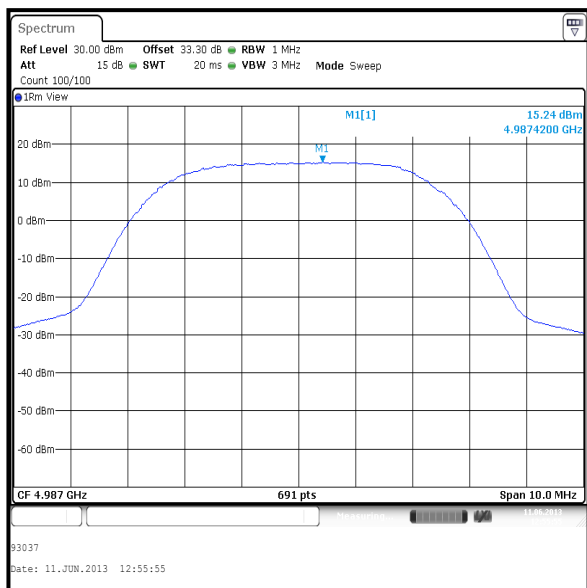
H Port



Bottom Channel



Middle Channel

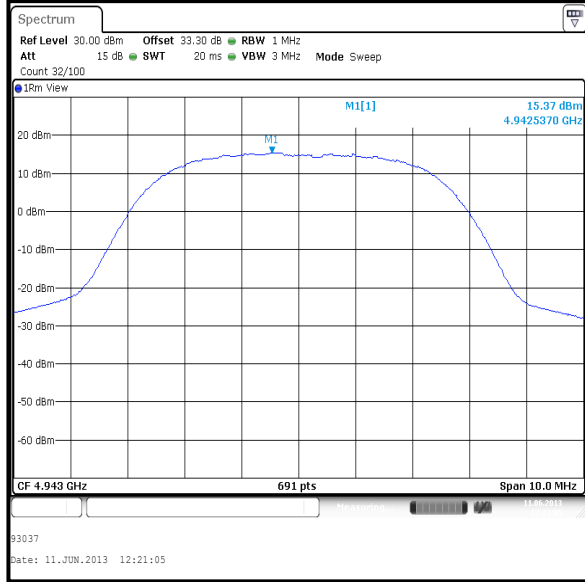


Top Channel

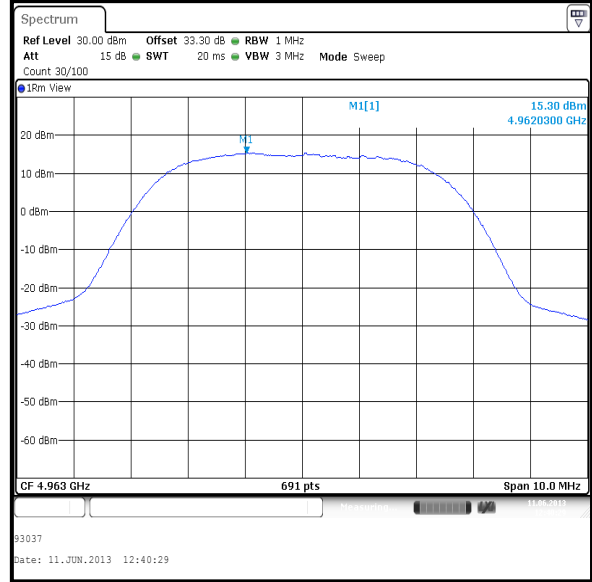
Peak Power Spectral Density (continued)

Results: 5 MHz Channel / QPSK / Omnidirectional Antenna

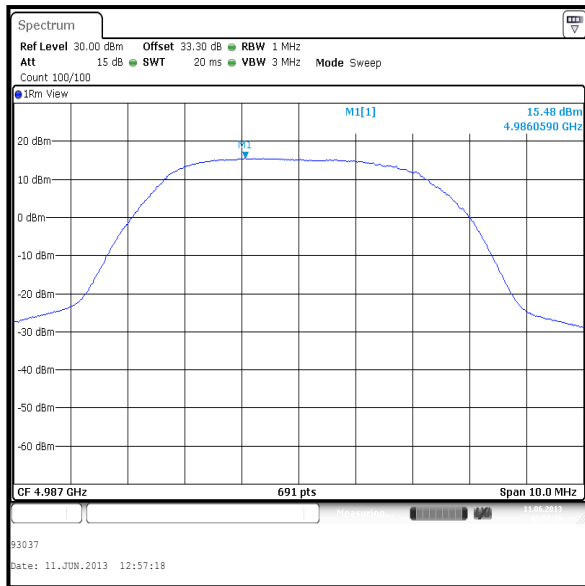
V Port



Bottom Channel



Middle Channel



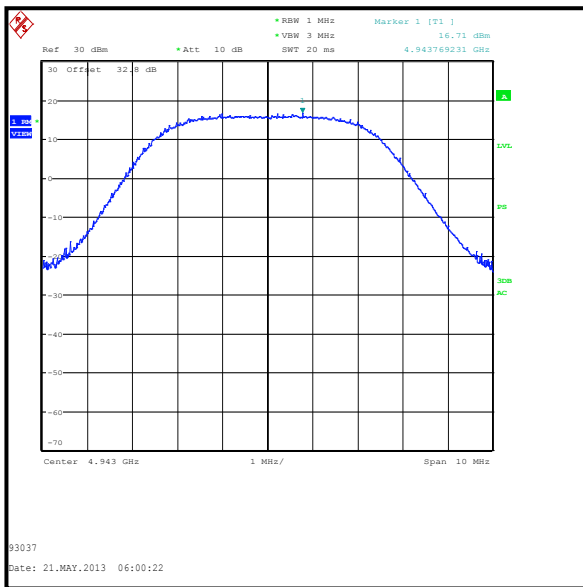
Top Channel

Peak Power Spectral Density (continued)

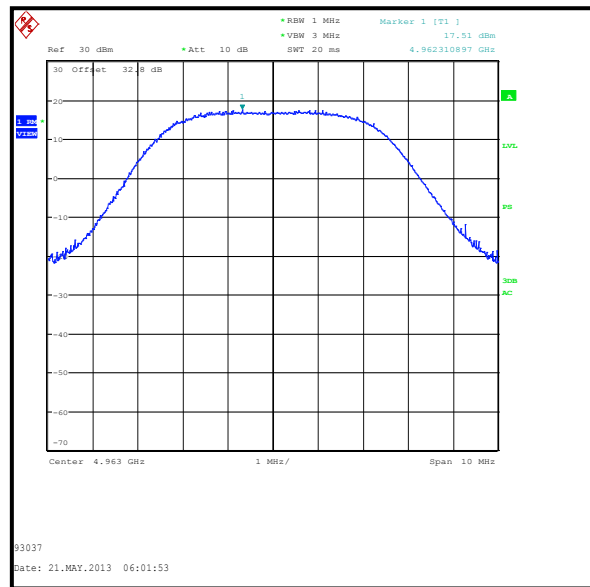
Results: 5 MHz Channel / QPSK / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	16.7	17.0	19.9	21.0	1.1	Complied
Middle	17.5	16.4	20.0	21.0	1.0	Complied
Top	16.1	17.0	19.6	21.0	1.4	Complied

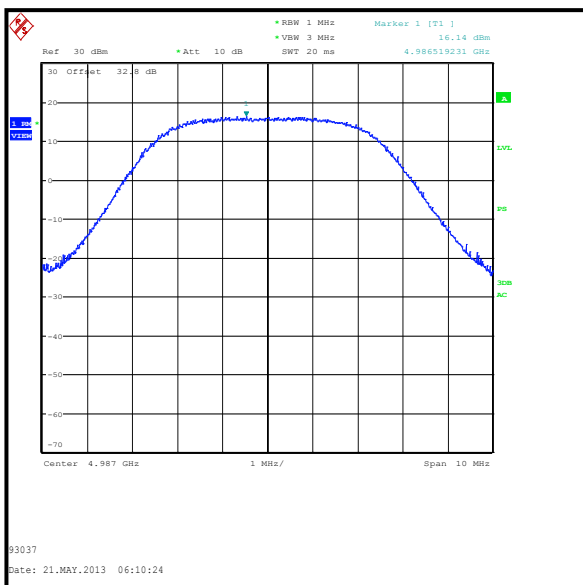
H Port



Bottom Channel



Middle Channel

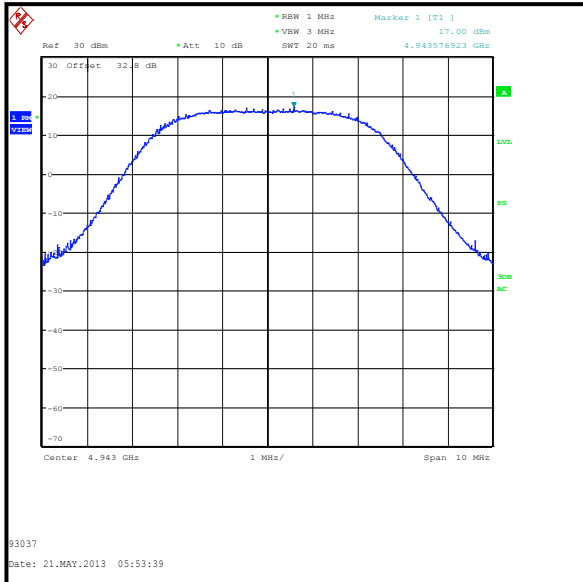


Top Channel

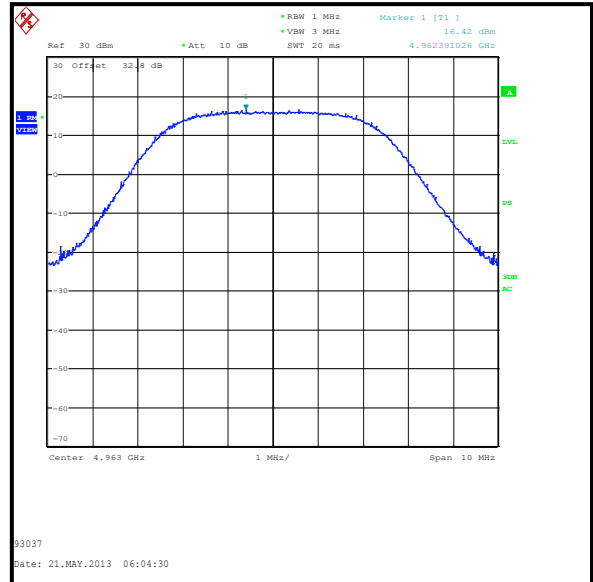
Peak Power Spectral Density (continued)

Results: 5 MHz Channel / QPSK / Plate and Sectorised Antennas

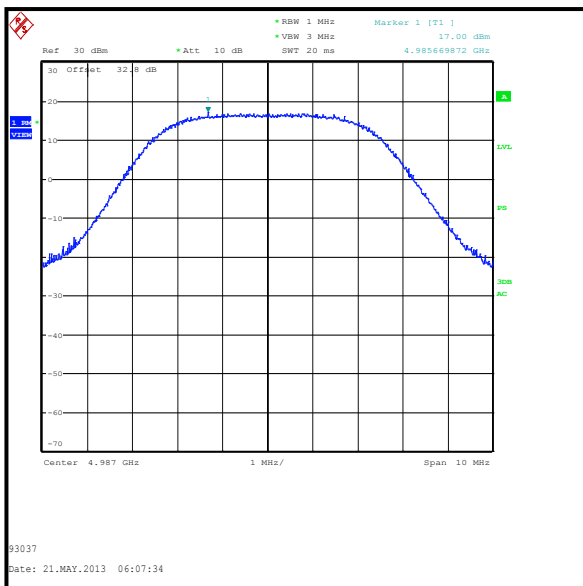
V Port



Bottom Channel



Middle Channel



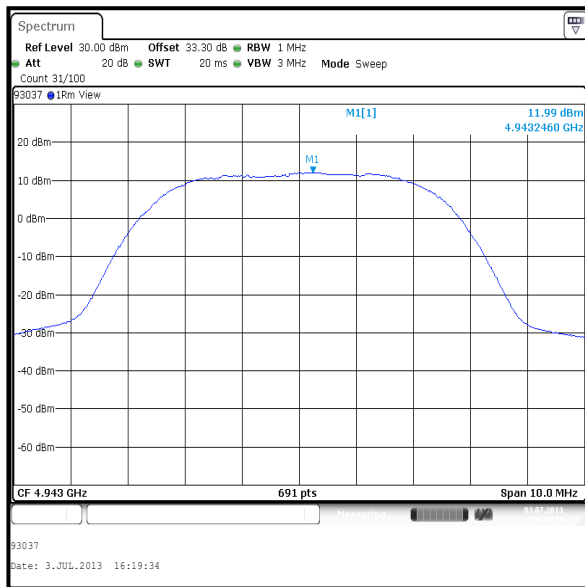
Top Channel

Peak Power Spectral Density (continued)

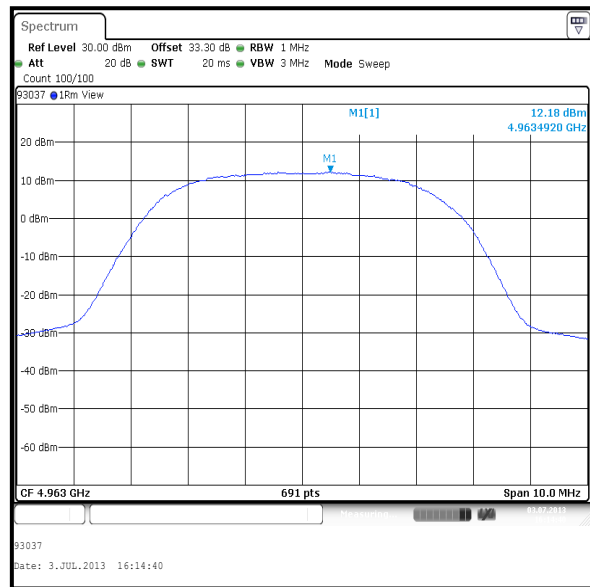
Results: 5 MHz Channel / QPSK / 4' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	12.0	11.5	14.8	15.9	1.1	Complied
Middle	12.2	12.1	15.2	15.9	0.7	Complied
Top	12.3	12.3	15.3	15.9	0.6	Complied

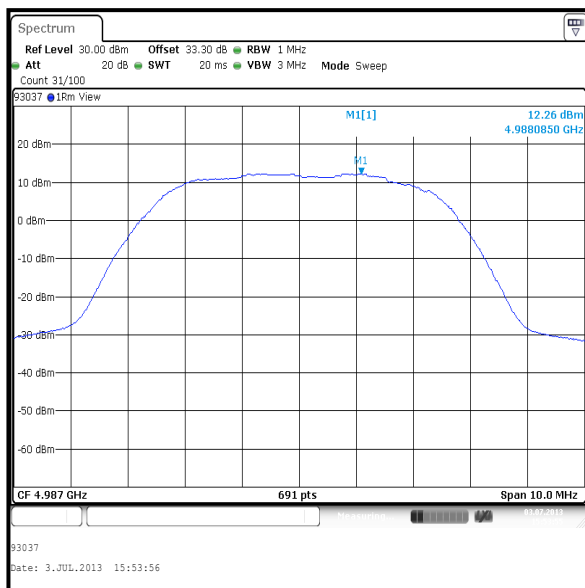
H Port



Bottom Channel



Middle Channel

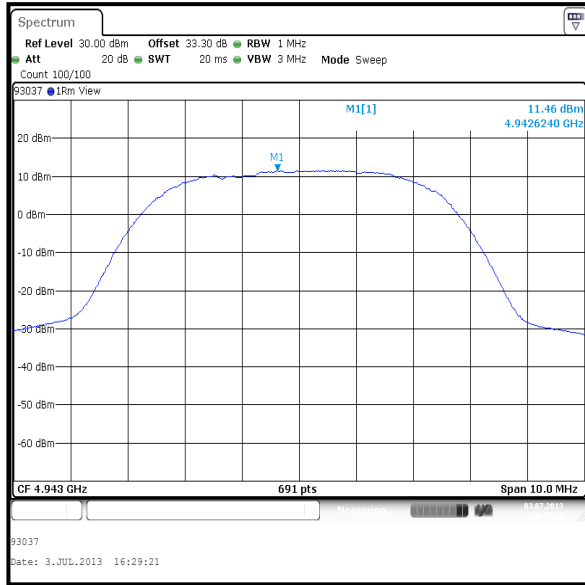


Top Channel

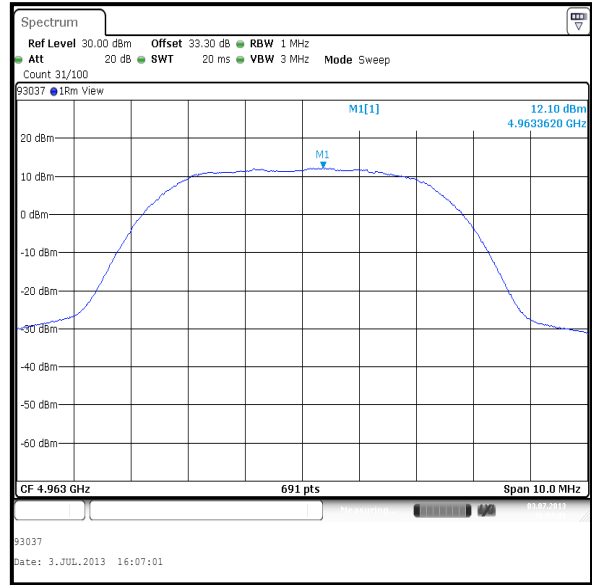
Peak Power Spectral Density (continued)

Results: 5 MHz Channel / QPSK / 4' Parabolic Antenna

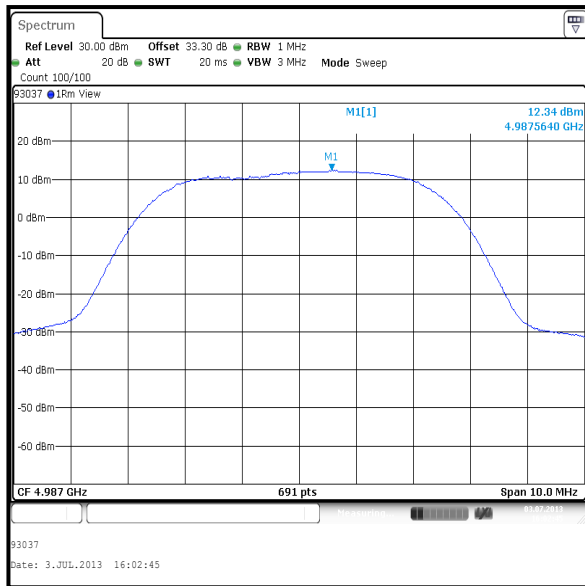
V Port



Bottom Channel



Middle Channel



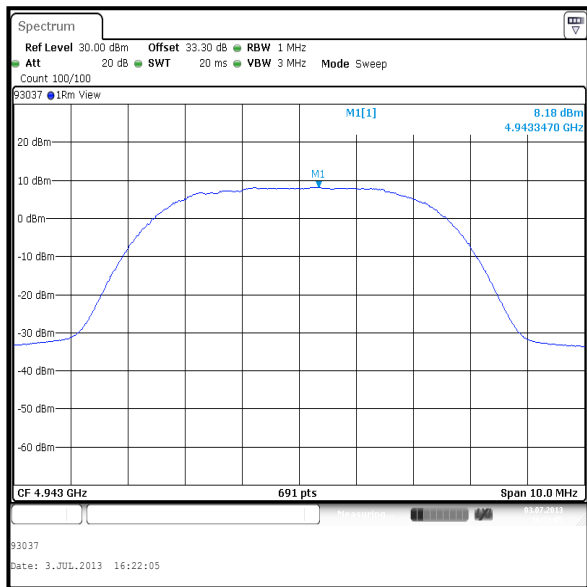
Top Channel

Peak Power Spectral Density (continued)

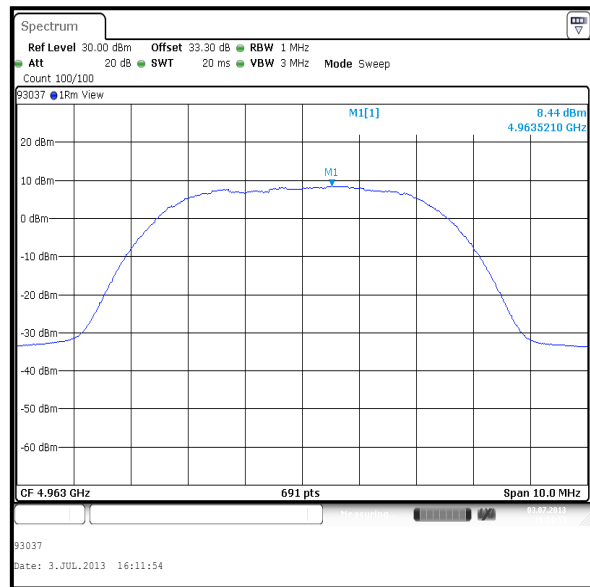
Results: 5 MHz Channel / QPSK / 6' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	8.2	8.3	11.3	12.4	1.1	Complied
Middle	8.4	8.3	11.4	12.4	1.0	Complied
Top	8.6	8.5	11.6	12.4	0.8	Complied

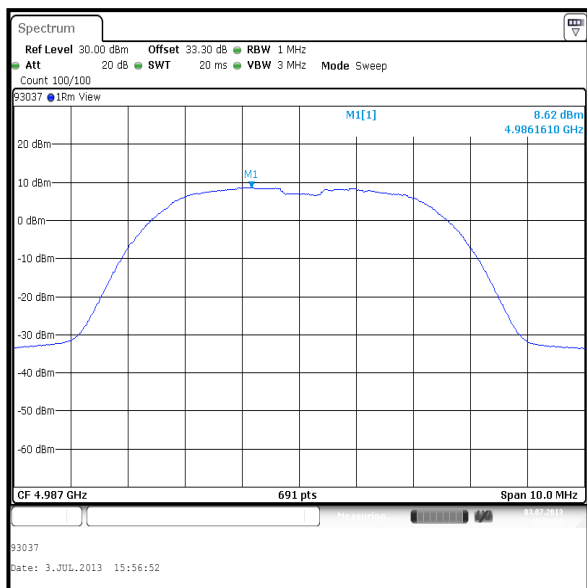
H Port



Bottom Channel



Middle Channel

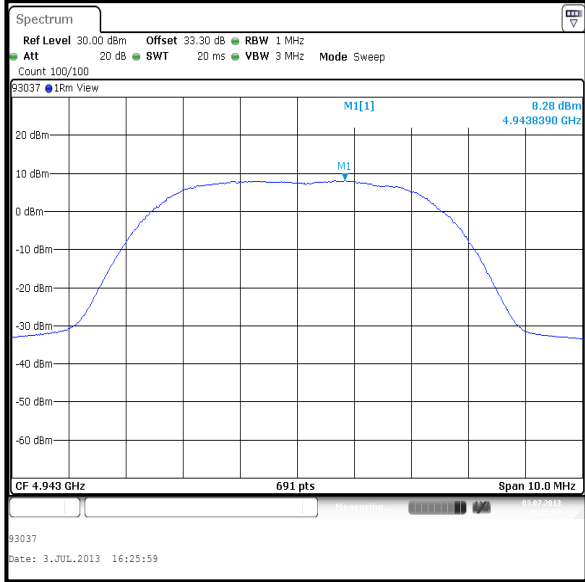


Top Channel

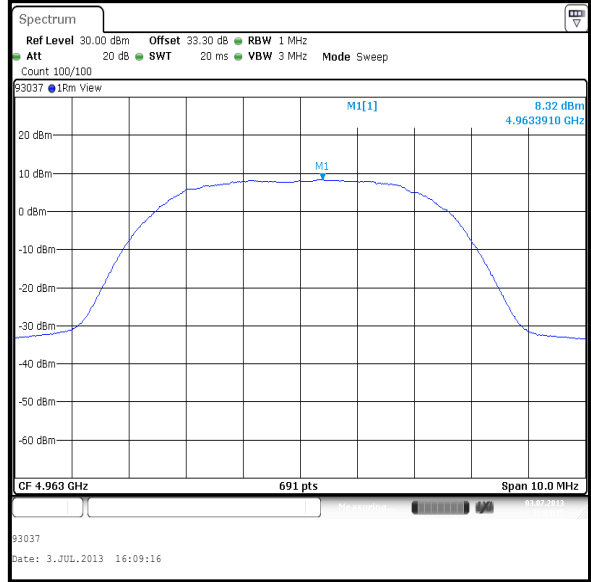
Peak Power Spectral Density (continued)

Results: 5 MHz Channel / QPSK / 6' Parabolic Antenna

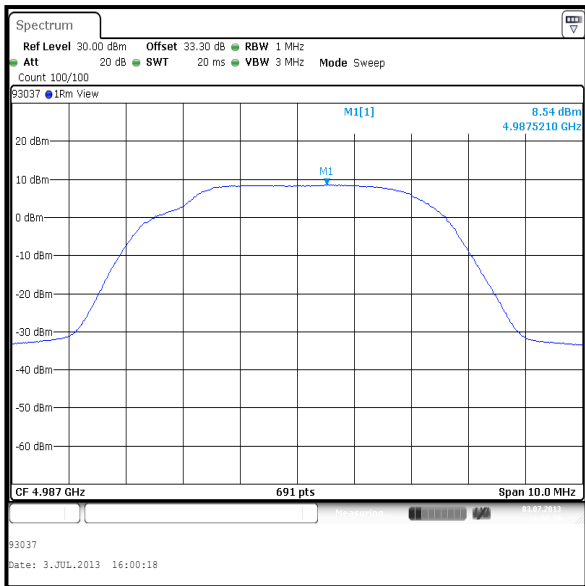
V Port



Bottom Channel



Middle Channel



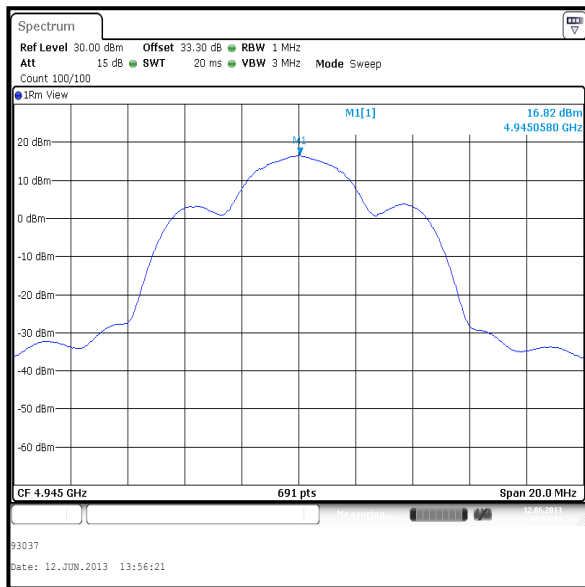
Top Channel

Peak Power Spectral Density (continued)

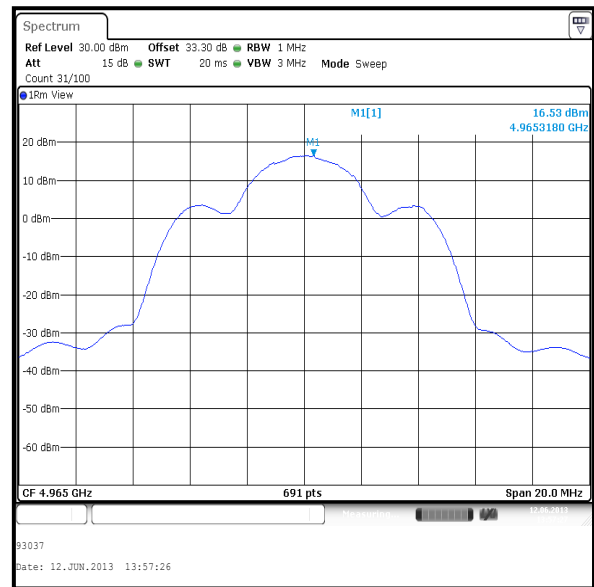
Results: 10 MHz Channel / ACQ / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	16.8	15.9	19.4	21.0	1.6	Complied
Middle	16.5	16.4	19.5	21.0	1.5	Complied
Top	16.8	16.5	19.7	21.0	1.3	Complied

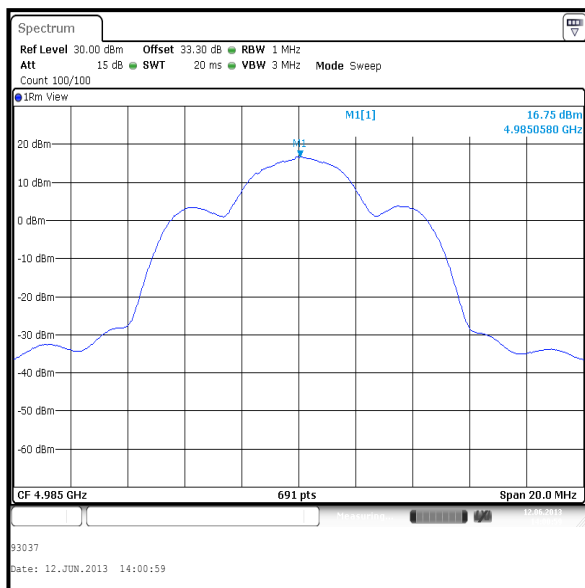
H Port



Bottom Channel



Middle Channel

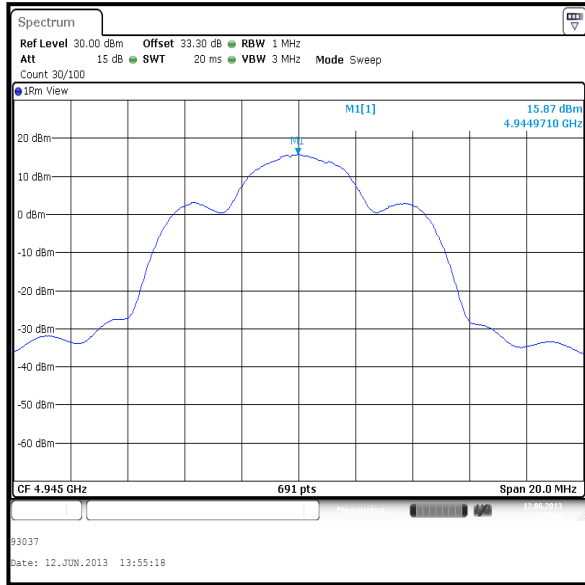


Top Channel

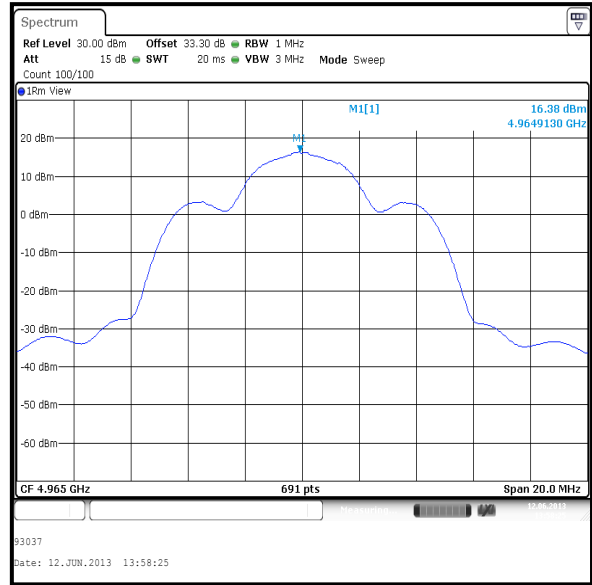
Peak Power Spectral Density (continued)

Results: 10 MHz Channel / ACQ / Plate and Sectorised Antennas

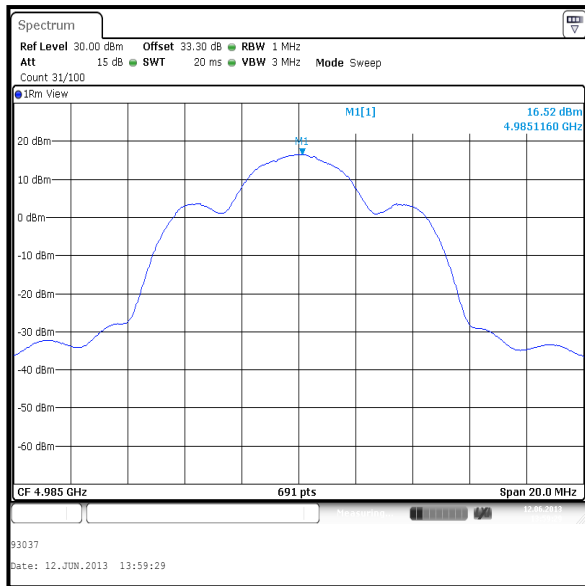
V Port



Bottom Channel



Middle Channel



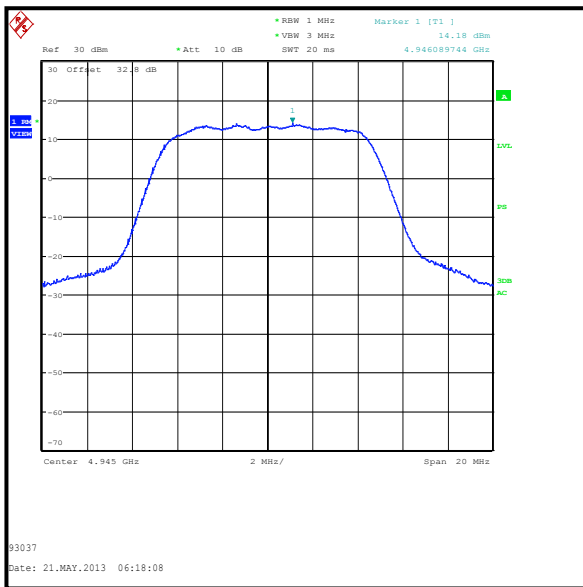
Top Channel

Peak Power Spectral Density (continued)

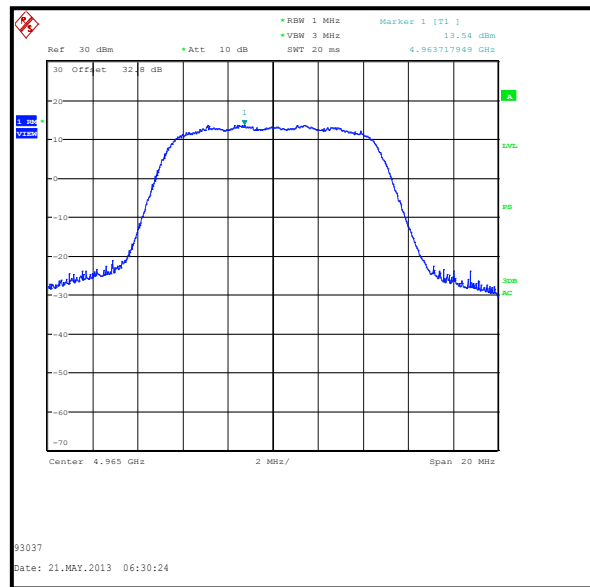
Results: 10 MHz Channel / 256QAM / Omnidirectional Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	14.2	13.5	16.9	18.5	1.6	Complied
Middle	13.5	14.0	16.8	18.5	1.7	Complied
Top	14.4	13.8	17.1	18.5	1.4	Complied

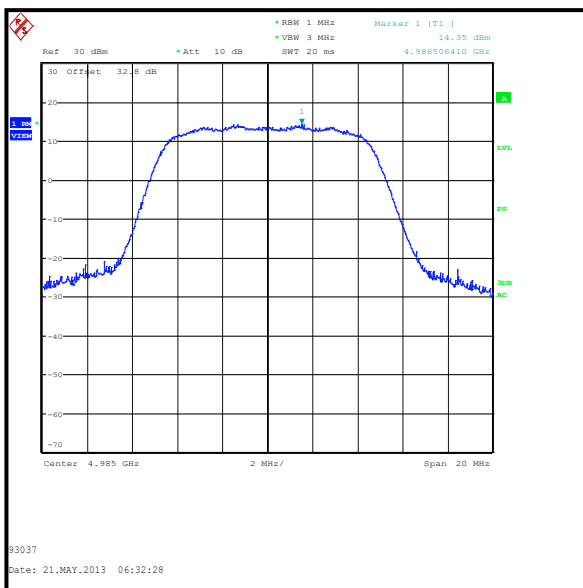
H Port



Bottom Channel



Middle Channel

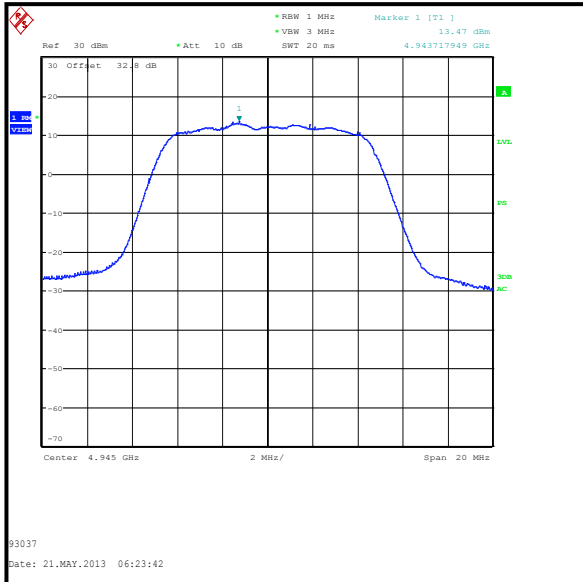


Top Channel

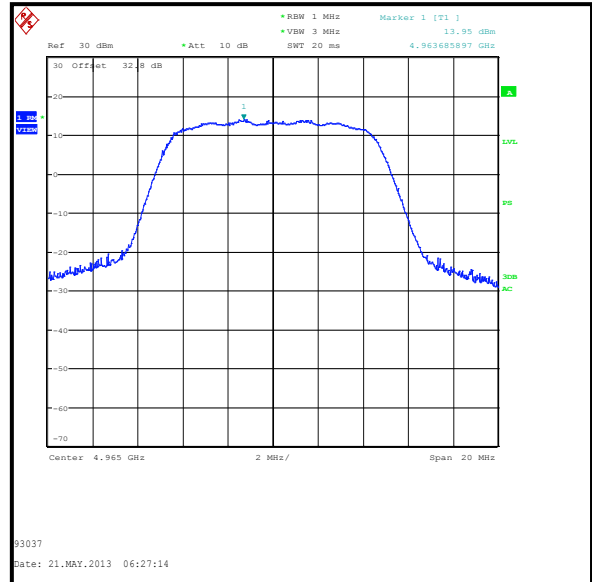
Peak Power Spectral Density (continued)

Results: 10 MHz Channel / 256QAM / Omnidirectional Antenna

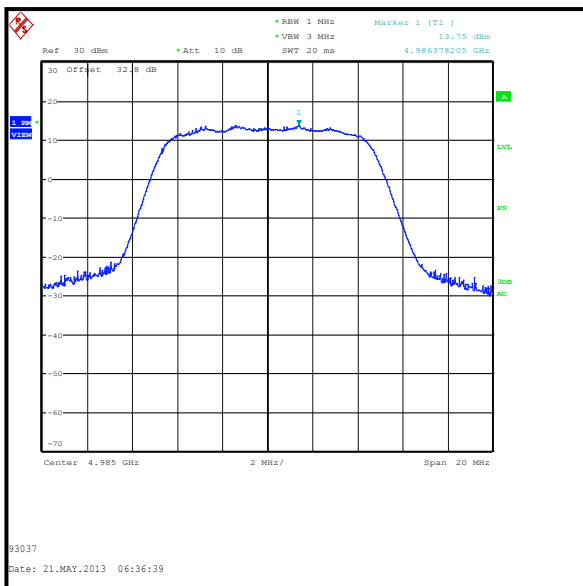
V Port



Bottom Channel



Middle Channel



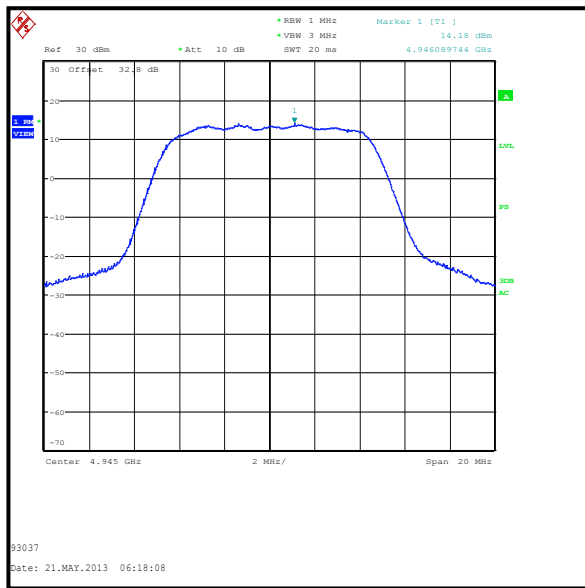
Top Channel

Peak Power Spectral Density (continued)

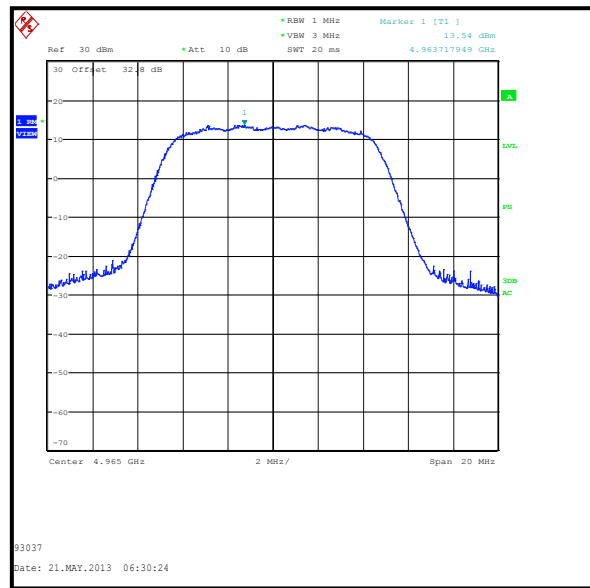
Results: 10 MHz Channel / 256QAM / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	14.2	13.5	16.9	21.0	4.1	Complied
Middle	13.5	14.0	16.8	21.0	4.2	Complied
Top	14.4	13.8	17.1	21.0	3.9	Complied

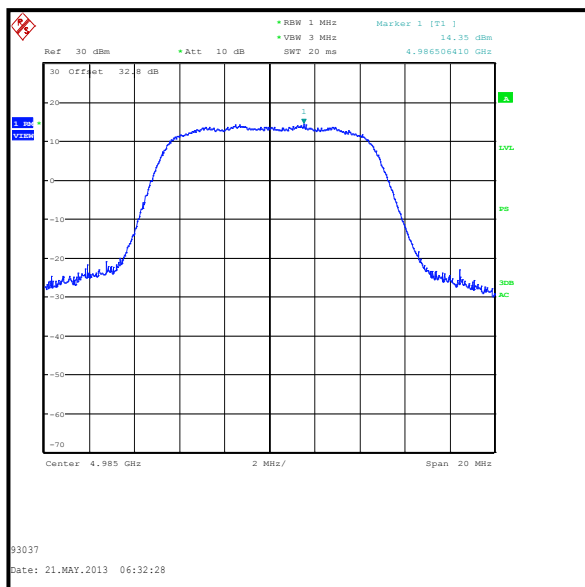
H Port



Bottom Channel



Middle Channel



Top Channel

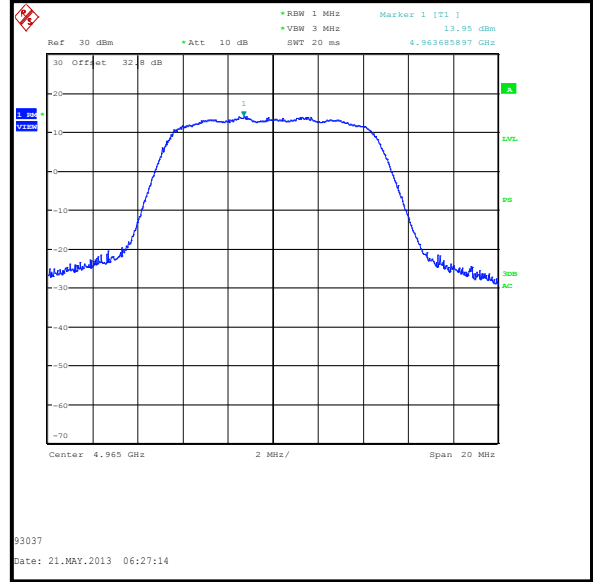
Peak Power Spectral Density (continued)

Results: 10 MHz Channel / 256QAM / Plate and Sectorised Antennas

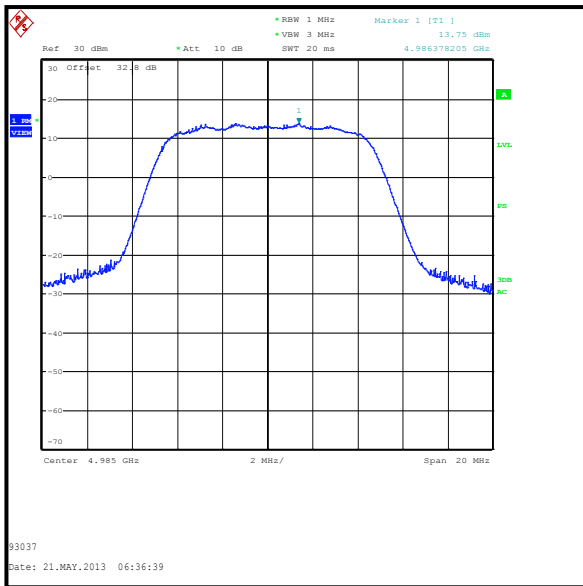
V Port



Bottom Channel



Middle Channel



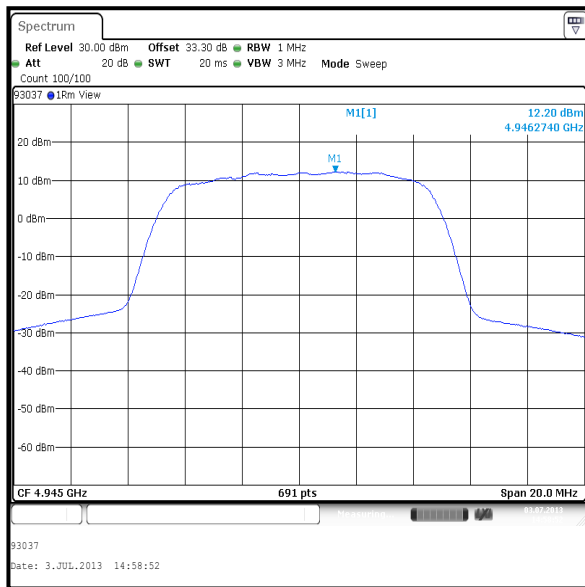
Top Channel

Peak Power Spectral Density (continued)

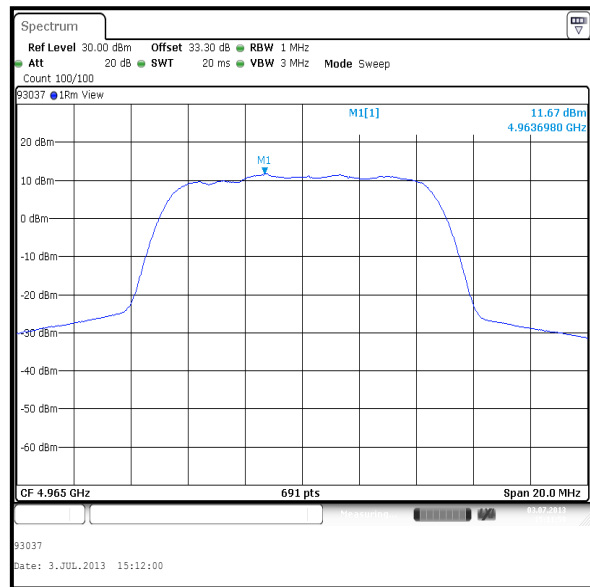
Results: 10 MHz Channel / 256QAM / 4' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	12.2	11.8	15.0	15.9	0.9	Complied
Middle	11.7	11.8	14.8	15.9	1.1	Complied
Top	12.2	12.1	15.2	15.9	0.7	Complied

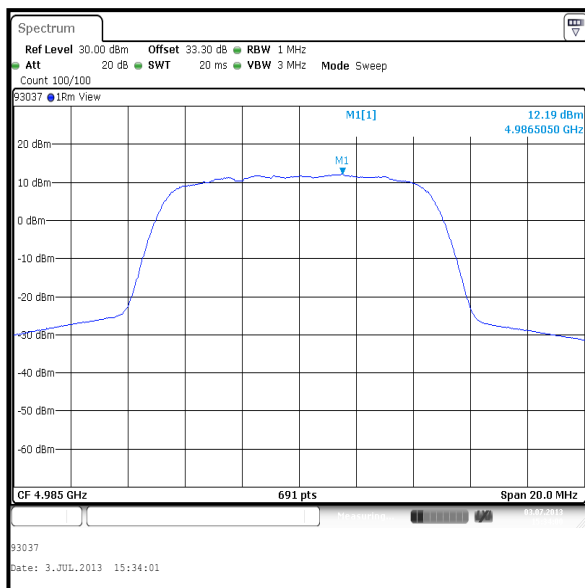
H Port



Bottom Channel



Middle Channel

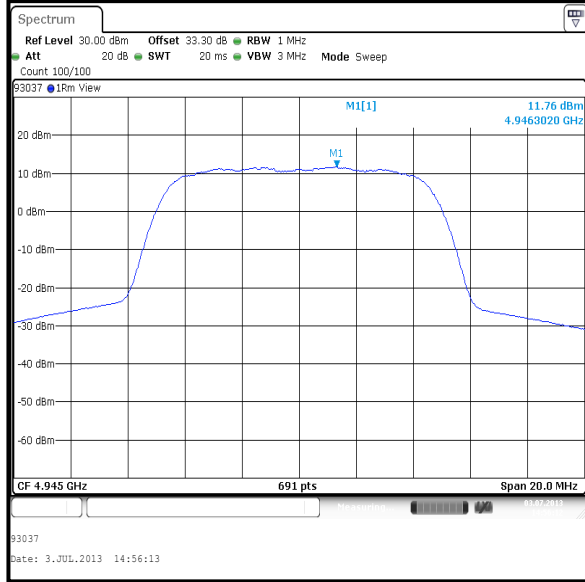


Top Channel

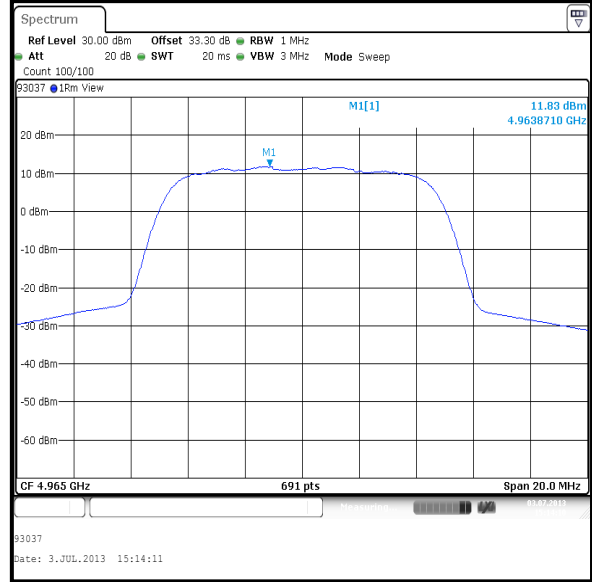
Peak Power Spectral Density (continued)

Results: 10 MHz Channel / 256QAM / 4' Parabolic Antenna

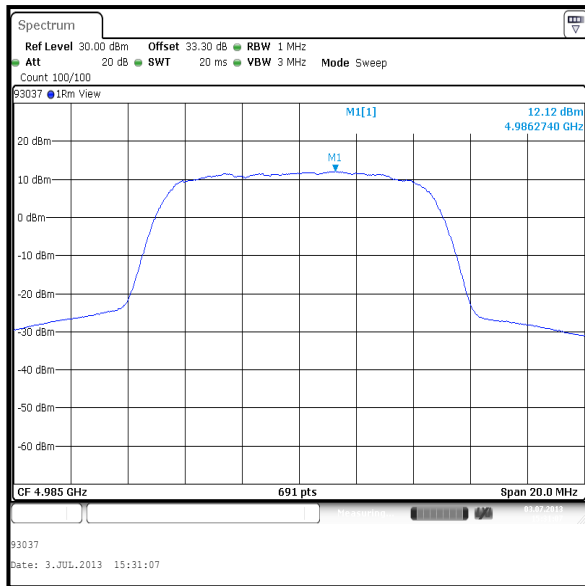
V Port



Bottom Channel



Middle Channel



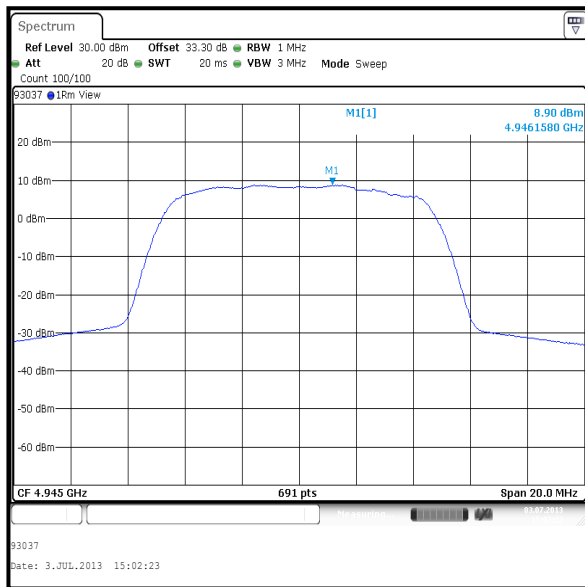
Top Channel

Peak Power Spectral Density (continued)

Results: 10 MHz Channel / 256QAM / 6' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	8.9	8.5	11.7	12.4	0.7	Complied
Middle	8.3	8.1	11.2	12.4	1.2	Complied
Top	8.4	8.4	11.4	12.4	1.0	Complied

H Port



Bottom Channel



Middle Channel

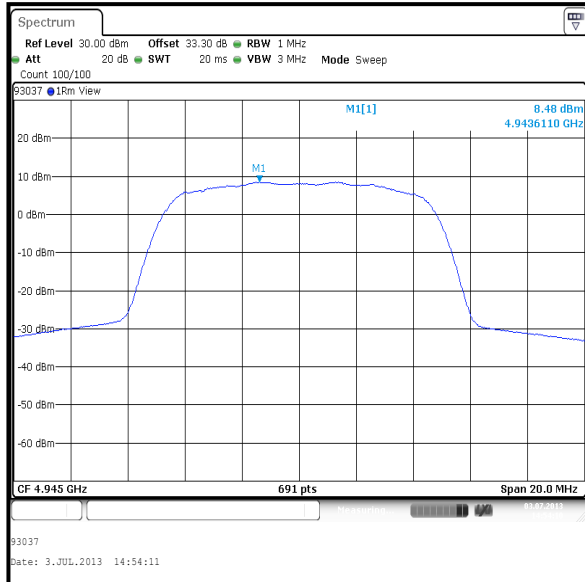


Top Channel

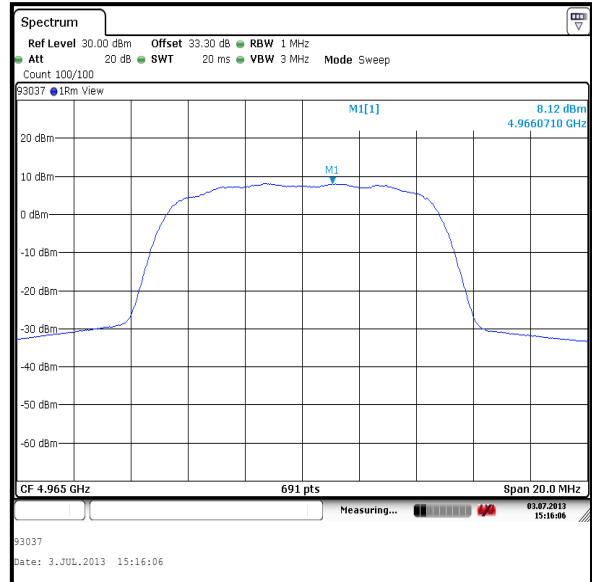
Peak Power Spectral Density (continued)

Results: 10 MHz Channel / 256QAM / 6' Parabolic Antenna

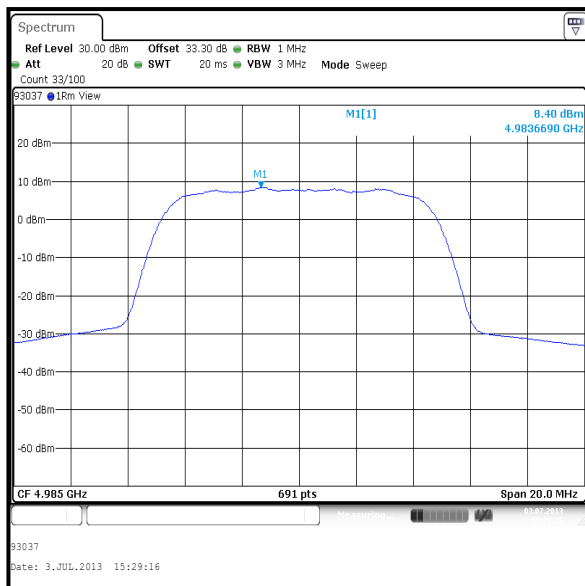
V Port



Bottom Channel



Middle Channel



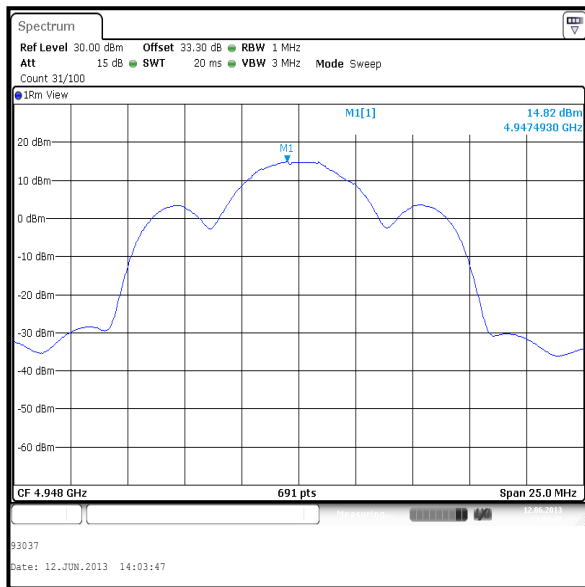
Top Channel

Peak Power Spectral Density (continued)

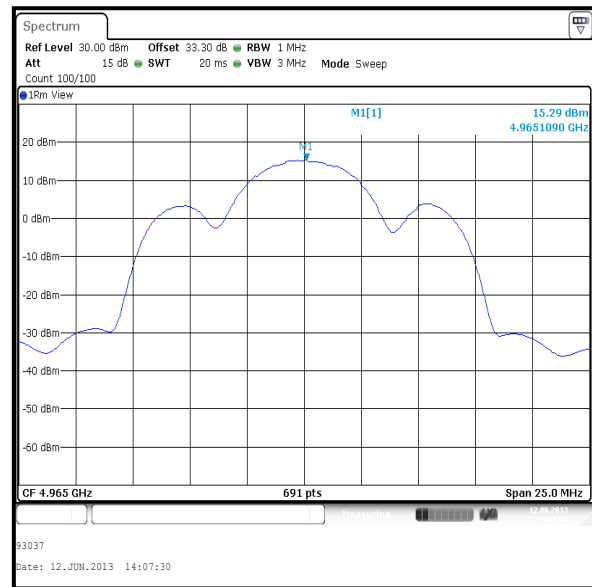
Results: 15 MHz Channel / ACQ / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	14.8	15.0	17.9	21.0	3.1	Complied
Middle	15.3	15.3	18.3	21.0	2.7	Complied
Top	15.4	15.3	18.4	21.0	2.6	Complied

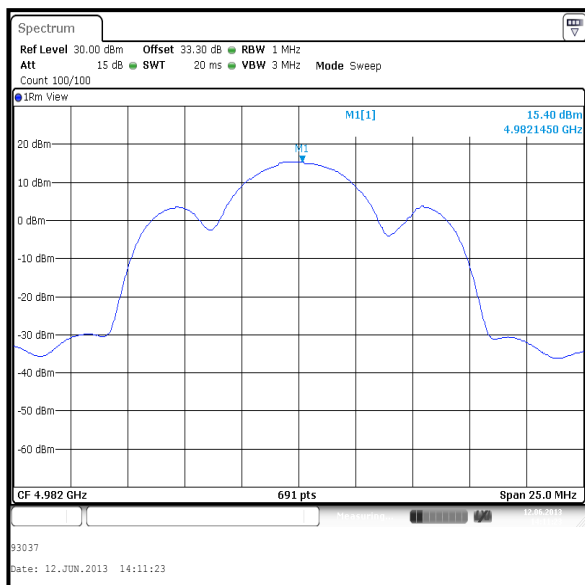
H Port



Bottom Channel



Middle Channel

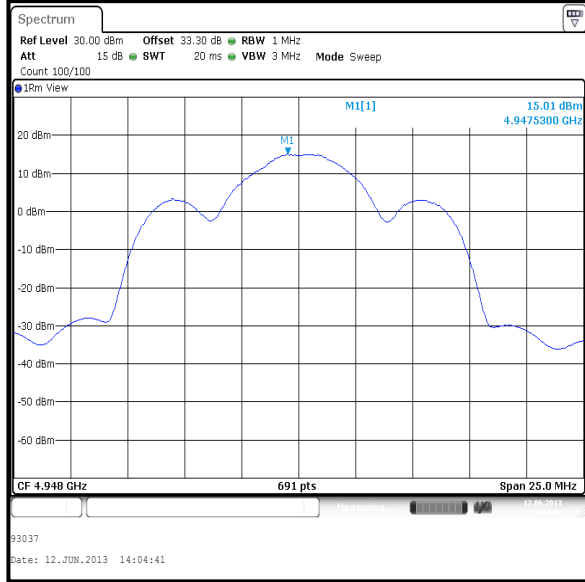


Top Channel

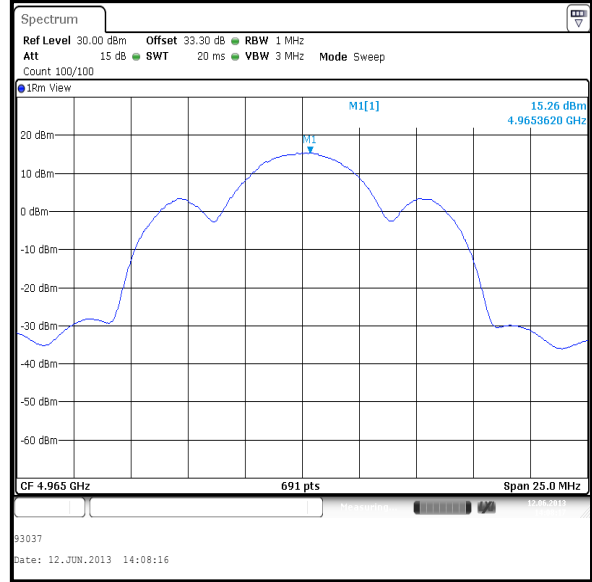
Peak Power Spectral Density (continued)

Results: 15 MHz Channel / ACQ / Plate and Sectorised Antennas

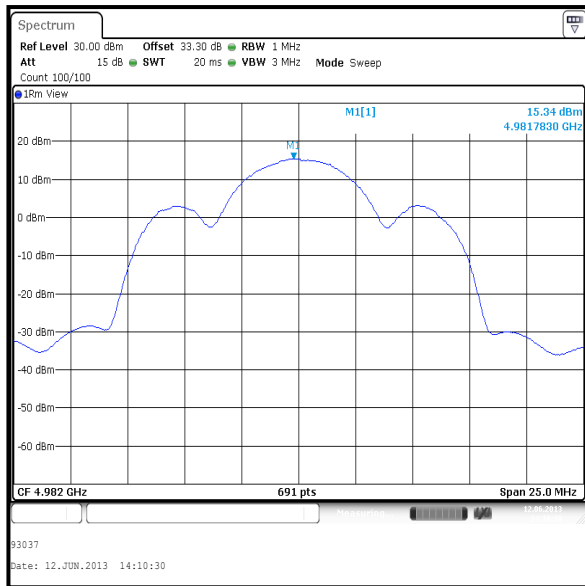
V Port



Bottom Channel



Middle Channel



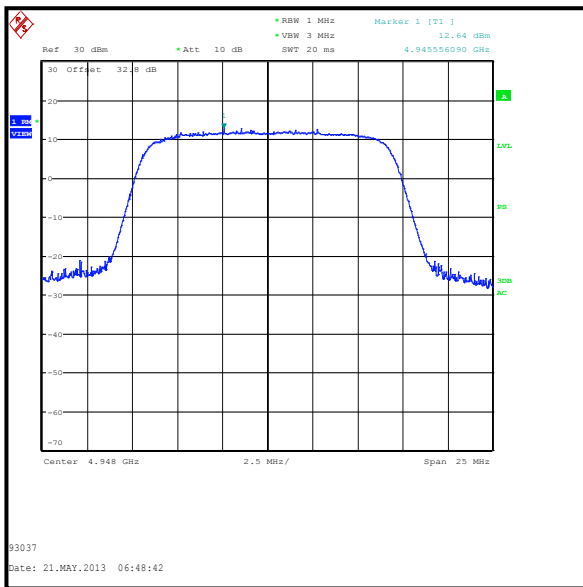
Top Channel

Peak Power Spectral Density (continued)

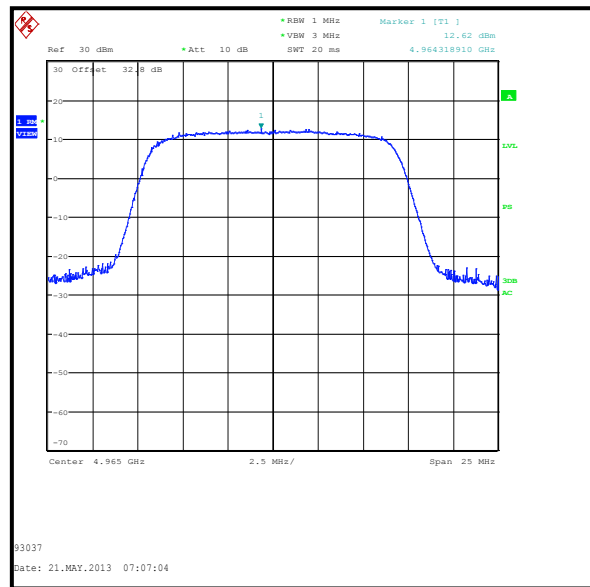
Results: 15 MHz Channel / 64QAM / Omnidirectional Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	12.6	12.7	15.7	18.5	2.8	Complied
Middle	12.6	12.4	15.5	18.5	3.0	Complied
Top	12.4	12.5	15.5	18.5	3.0	Complied

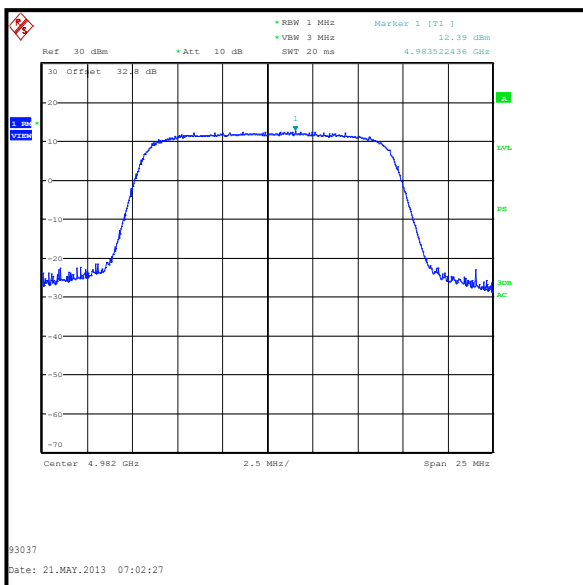
H Port



Bottom Channel



Middle Channel



Top Channel

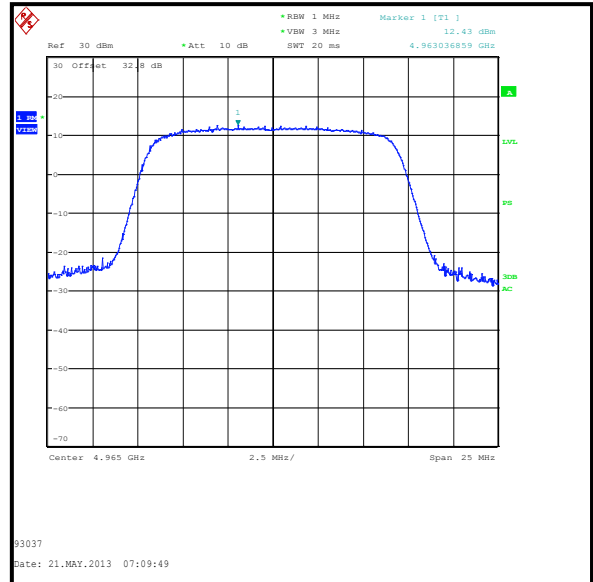
Peak Power Spectral Density (continued)

Results: 15 MHz Channel / 64QAM / Omnidirectional Antenna

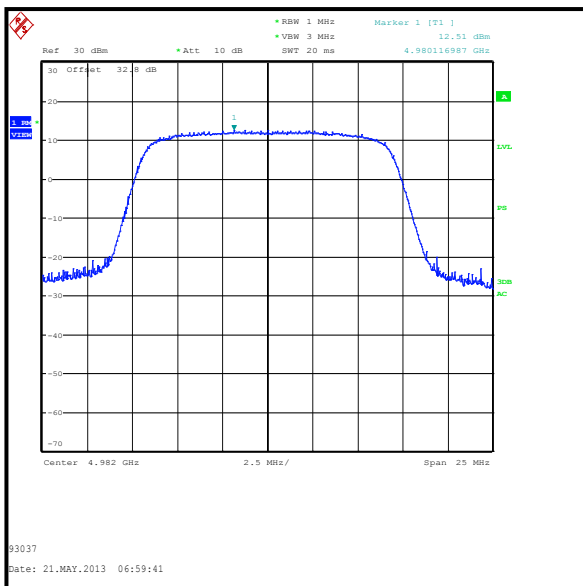
V Port



Bottom Channel



Middle Channel



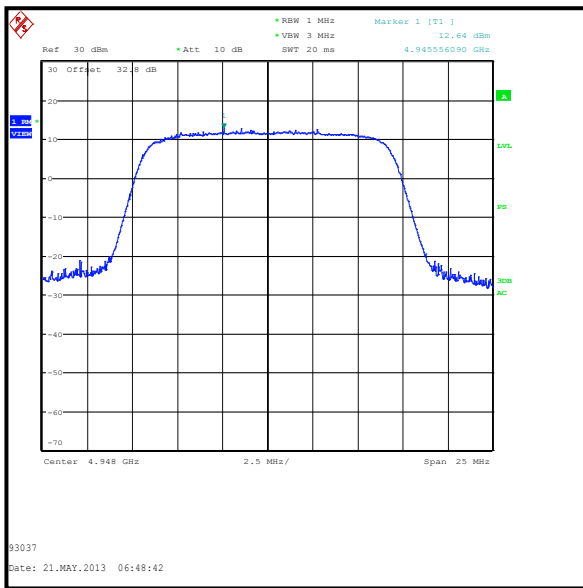
Top Channel

Peak Power Spectral Density (continued)

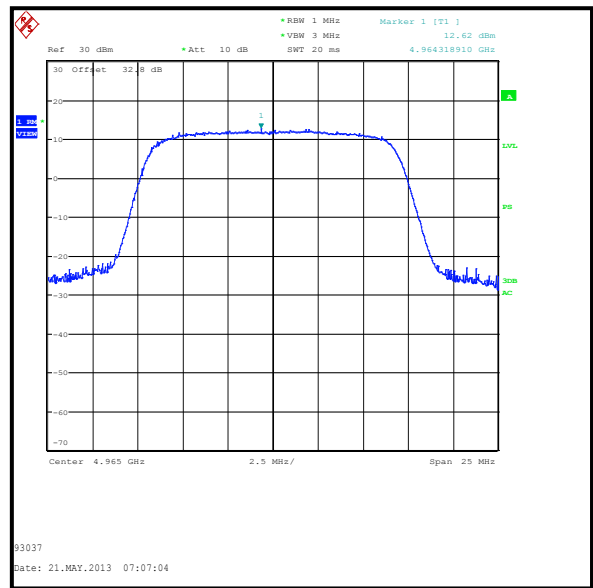
Results: 15 MHz Channel / 64QAM / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	12.6	12.7	15.7	21.0	5.3	Complied
Middle	12.6	12.4	15.5	21.0	5.5	Complied
Top	12.4	12.5	15.5	21.0	5.5	Complied

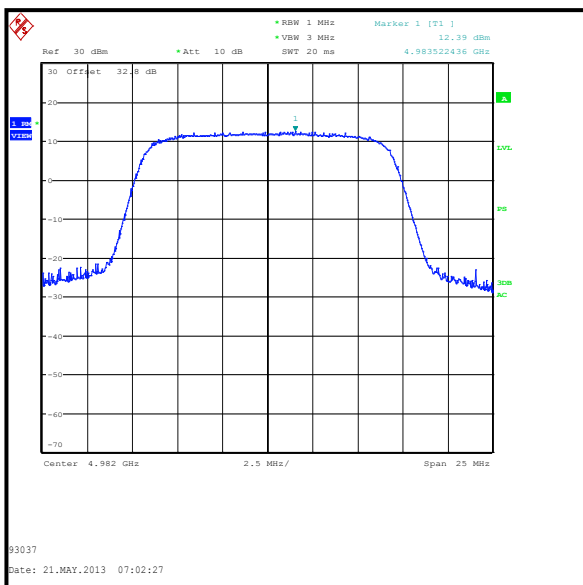
H Port



Bottom Channel



Middle Channel

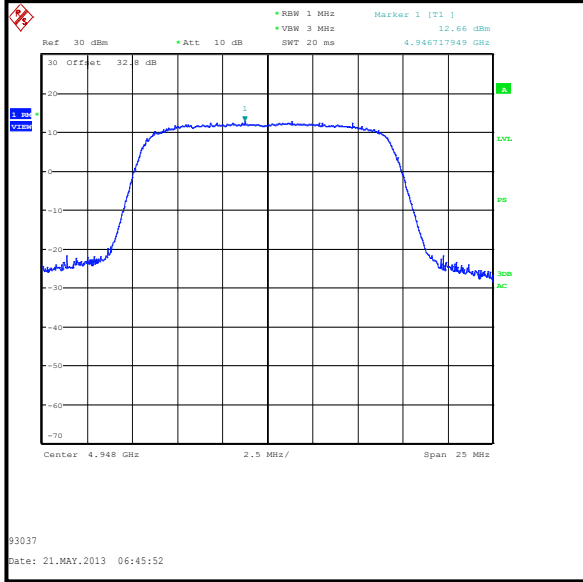


Top Channel

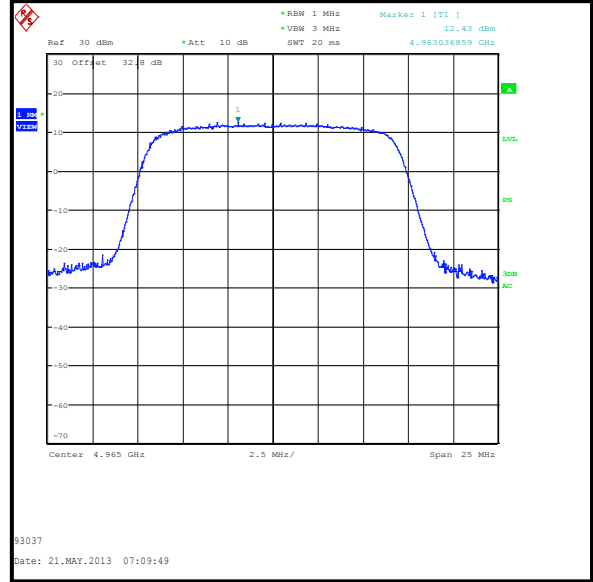
Peak Power Spectral Density (continued)

Results: 15 MHz Channel / 64QAM / Plate and Sectorised Antennas

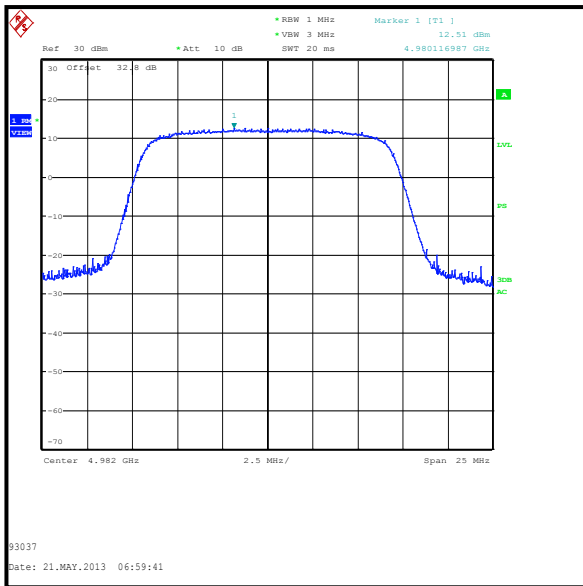
V Port



Bottom Channel



Middle Channel



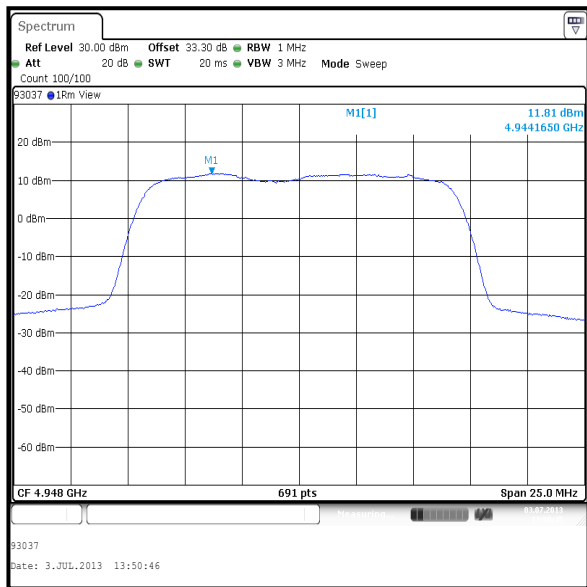
Top Channel

Peak Power Spectral Density (continued)

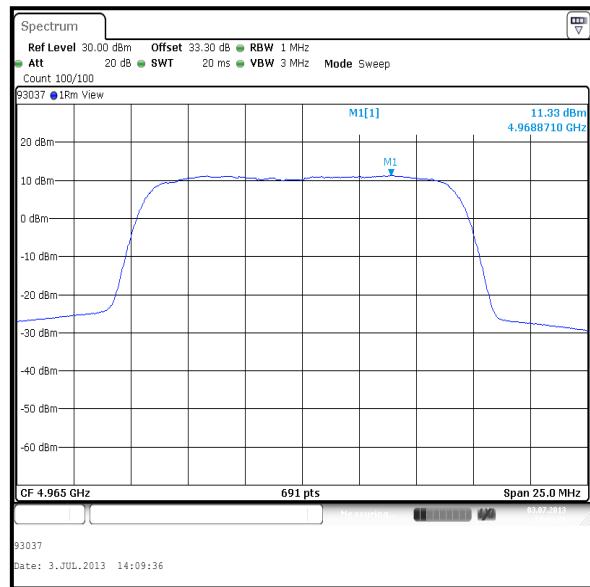
Results: 15 MHz Channel / 64QAM / 4' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	11.8	11.5	14.7	15.9	1.2	Complied
Middle	11.3	11.7	14.6	15.9	1.3	Complied
Top	11.3	11.3	14.3	15.9	1.6	Complied

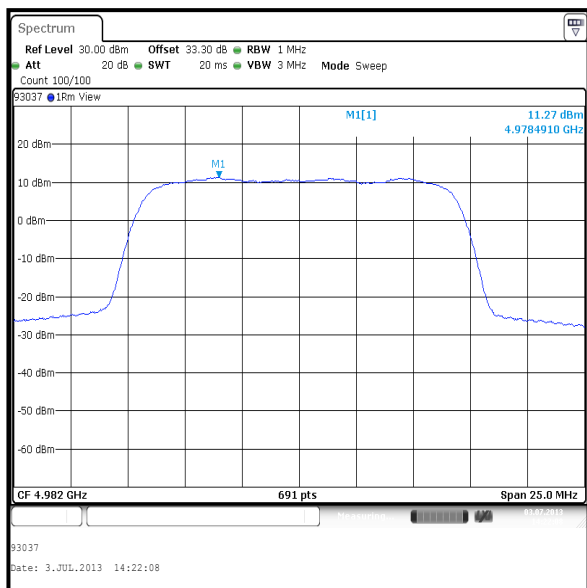
H Port



Bottom Channel



Middle Channel

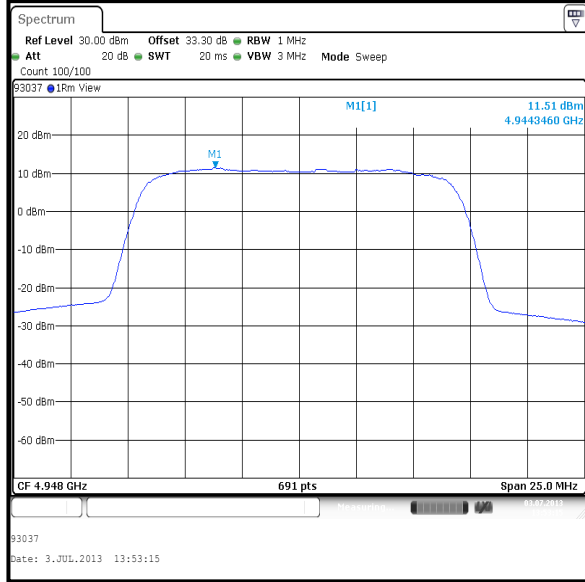


Top Channel

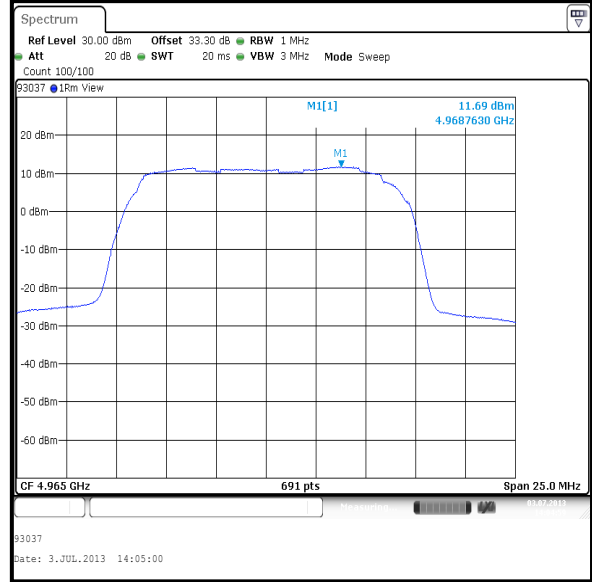
Peak Power Spectral Density (continued)

Results: 15 MHz Channel / 64QAM / 4' Parabolic Antenna

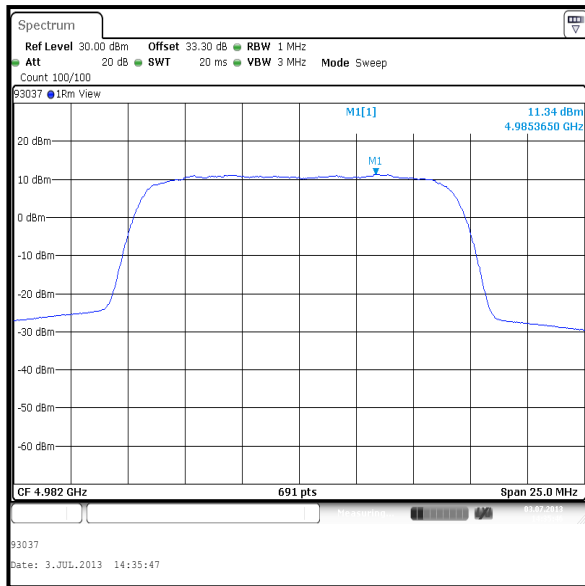
V Port



Bottom Channel



Middle Channel



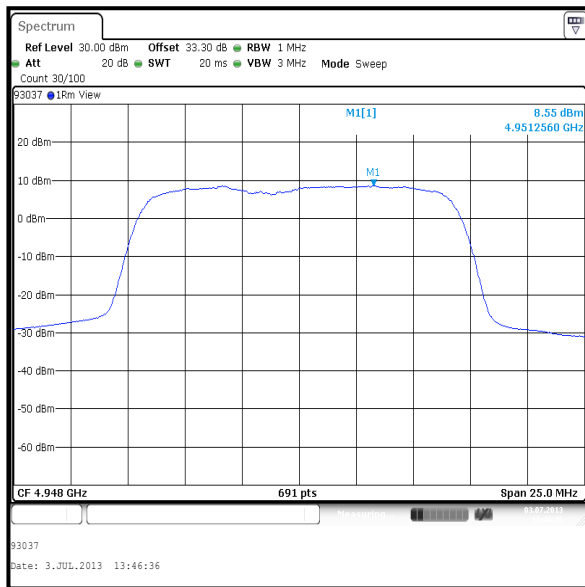
Top Channel

Peak Power Spectral Density (continued)

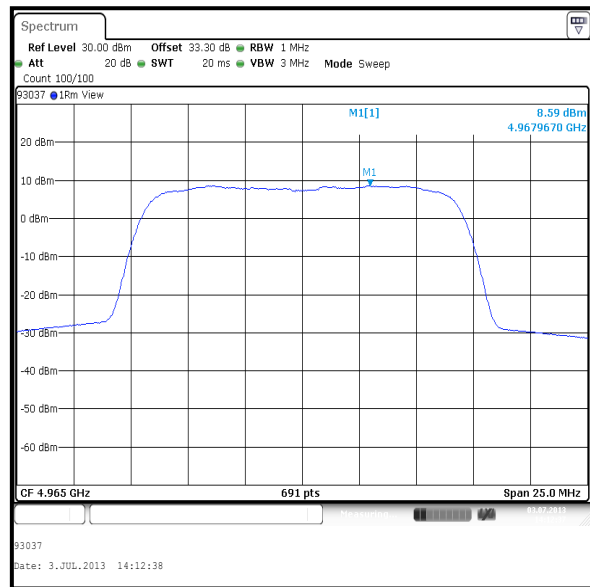
Results: 15 MHz Channel / 64QAM / 6' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	8.6	8.7	11.7	12.4	0.7	Complied
Middle	8.6	8.4	11.5	12.4	0.9	Complied
Top	8.9	8.4	11.7	12.4	0.7	Complied

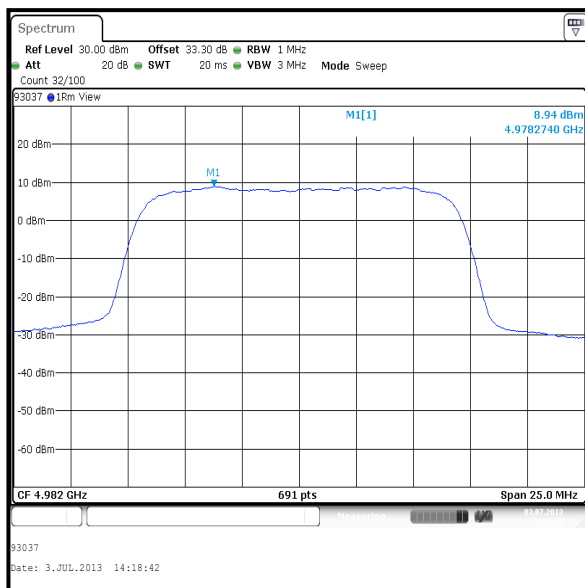
H Port



Bottom Channel



Middle Channel

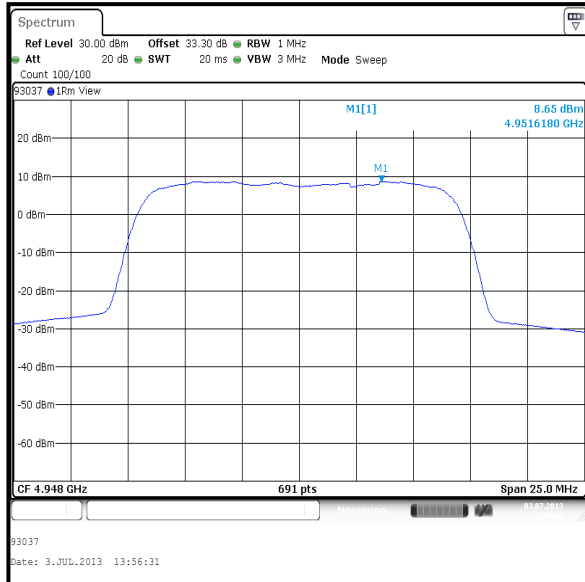


Top Channel

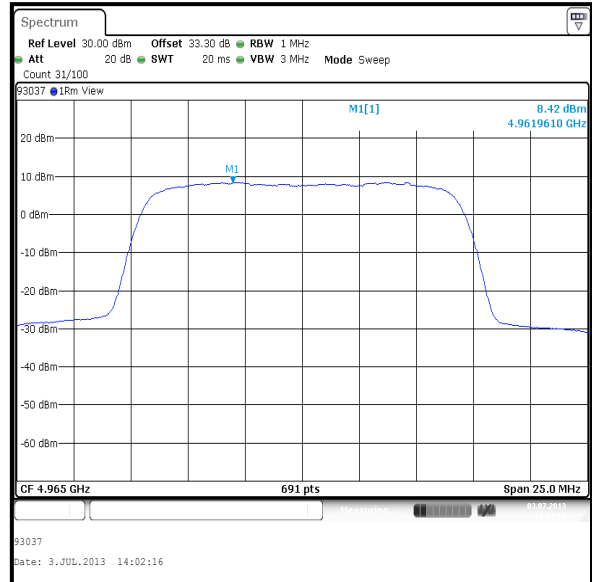
Peak Power Spectral Density (continued)

Results: 15 MHz Channel / 64QAM / 6' Parabolic Antenna

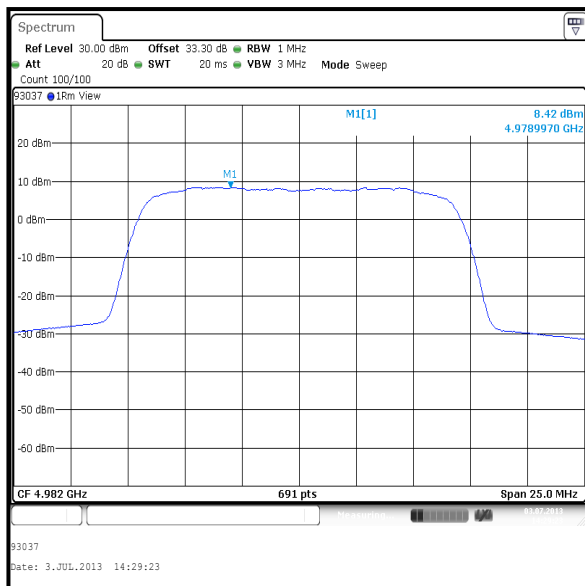
V Port



Bottom Channel



Middle Channel



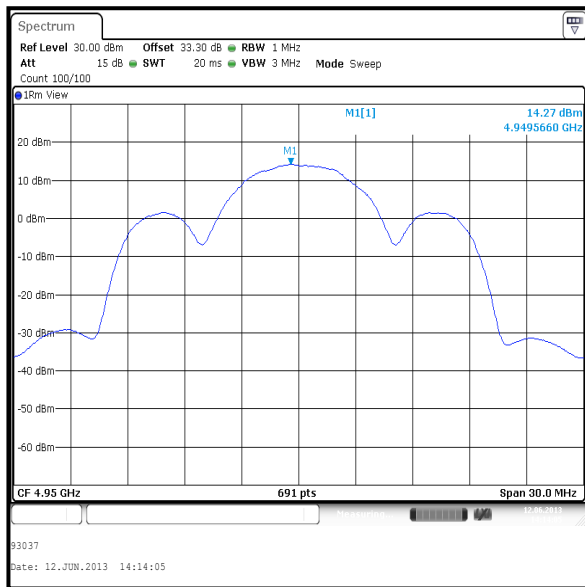
Top Channel

Peak Power Spectral Density (continued)

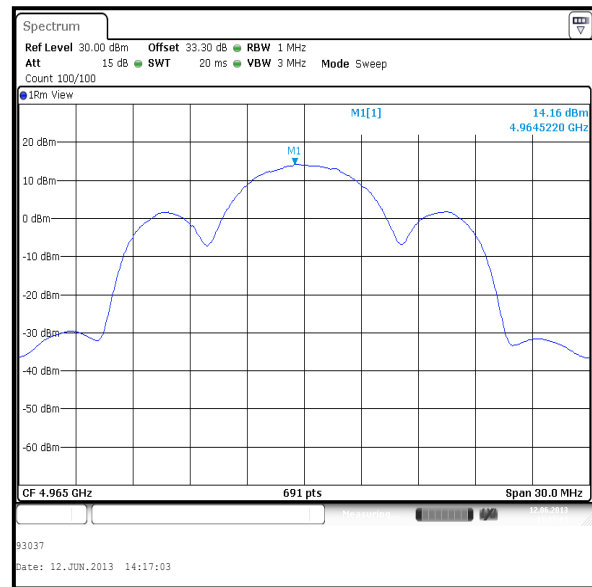
Results: 20 MHz Channel / ACQ / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	14.3	13.9	17.1	21.0	3.9	Complied
Middle	14.2	14.2	17.2	21.0	3.8	Complied
Top	14.1	14.1	17.1	21.0	3.9	Complied

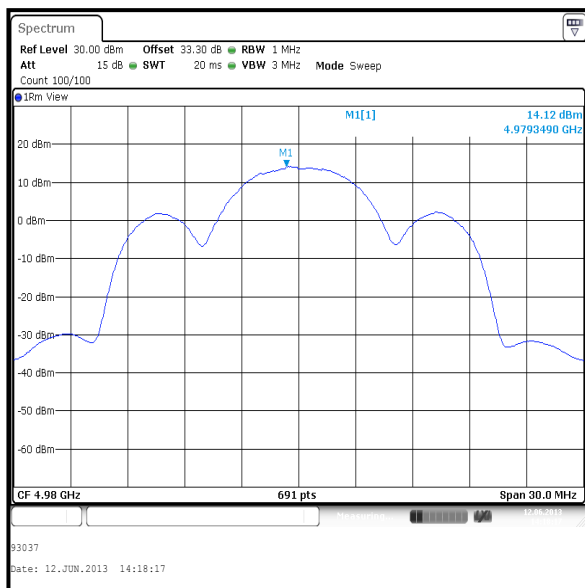
H Port



Bottom Channel



Middle Channel

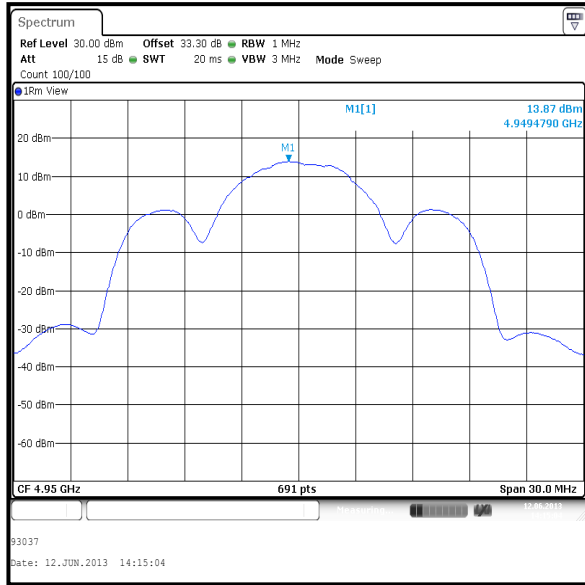


Top Channel

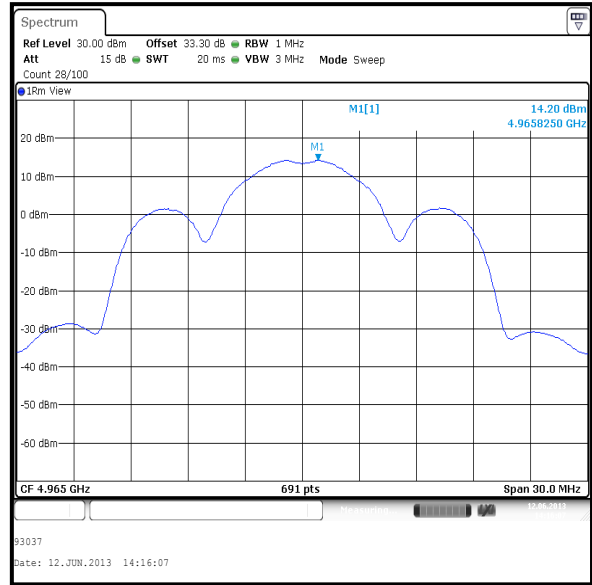
Peak Power Spectral Density (continued)

Results: 20 MHz Channel / ACQ / Plate and Sectorised Antennas

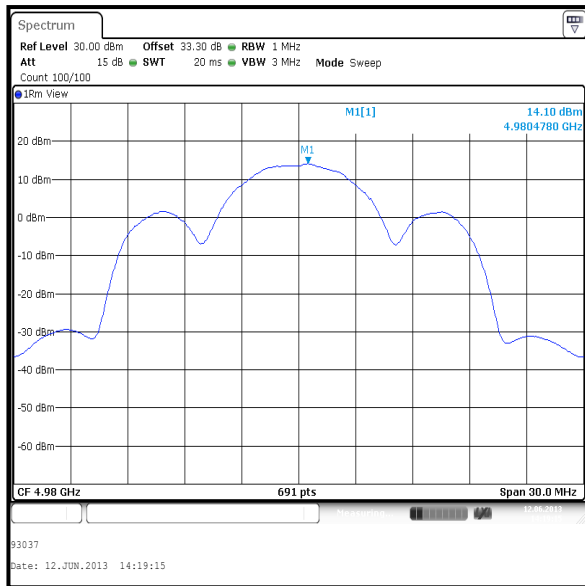
V Port



Bottom Channel



Middle Channel



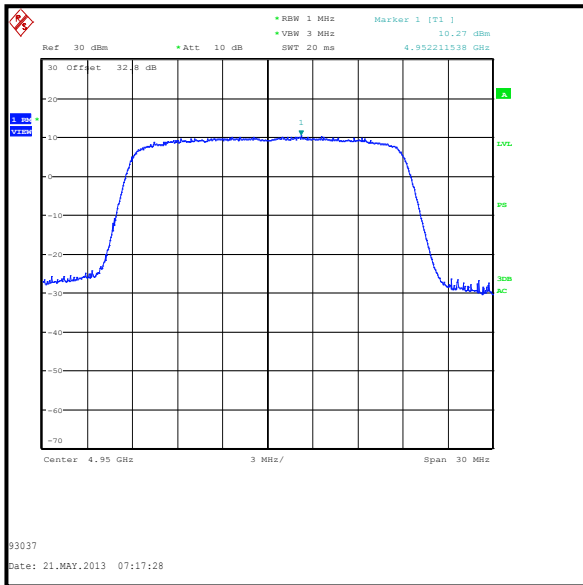
Top Channel

Peak Power Spectral Density (continued)

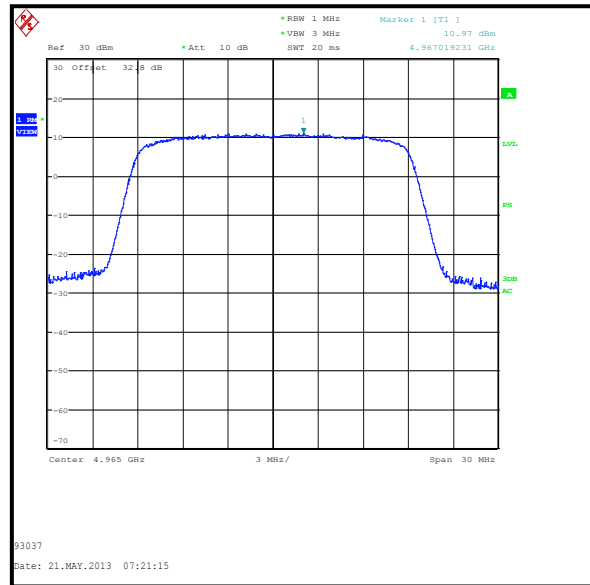
Results: 20 MHz Channel / 16QAM / Omnidirectional Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	10.3	10.5	13.4	18.5	5.1	Complied
Middle	11.0	10.2	13.6	18.5	4.9	Complied
Top	9.9	10.4	13.2	18.5	5.3	Complied

H Port



Bottom Channel



Middle Channel



Top Channel

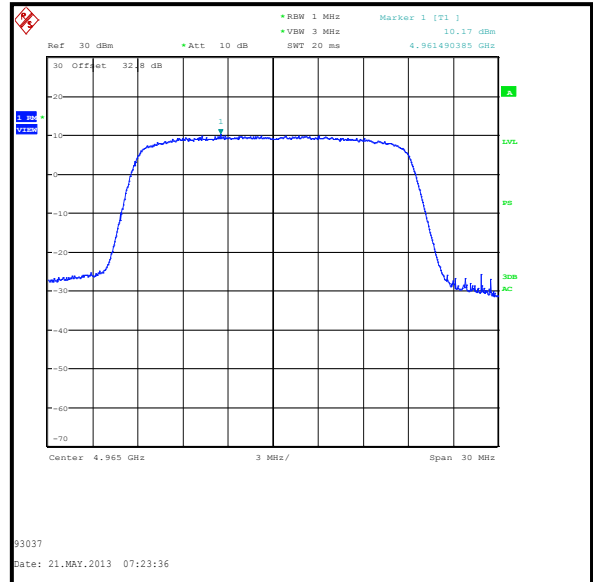
Peak Power Spectral Density (continued)

Results: 20 MHz Channel / 16QAM / Omnidirectional Antenna

H Port



Bottom Channel



Middle Channel



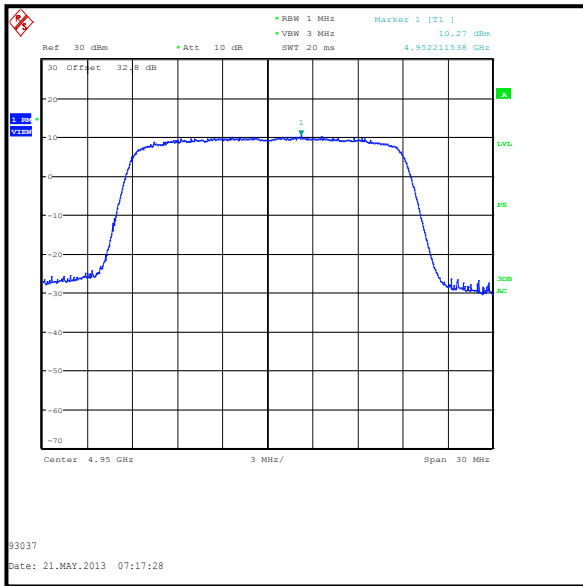
Top Channel

Peak Power Spectral Density (continued)

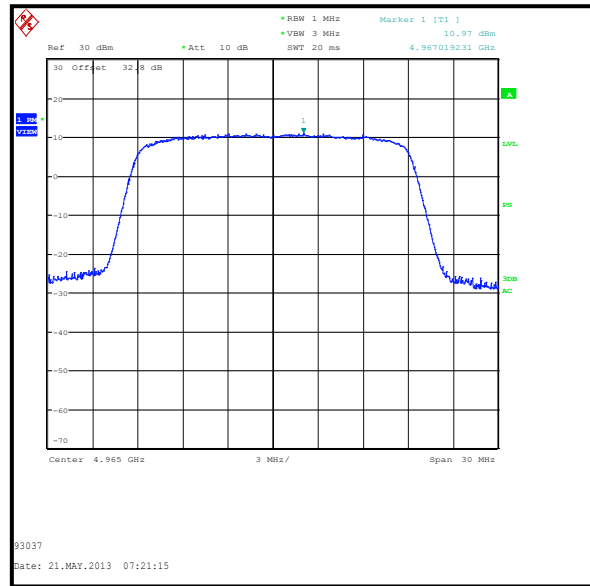
Results: 20 MHz Channel / 16QAM / Plate and Sectorised Antennas

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	10.3	10.5	13.4	21.0	7.6	Complied
Middle	11.0	10.2	13.6	21.0	7.4	Complied
Top	9.9	10.4	13.2	21.0	7.8	Complied

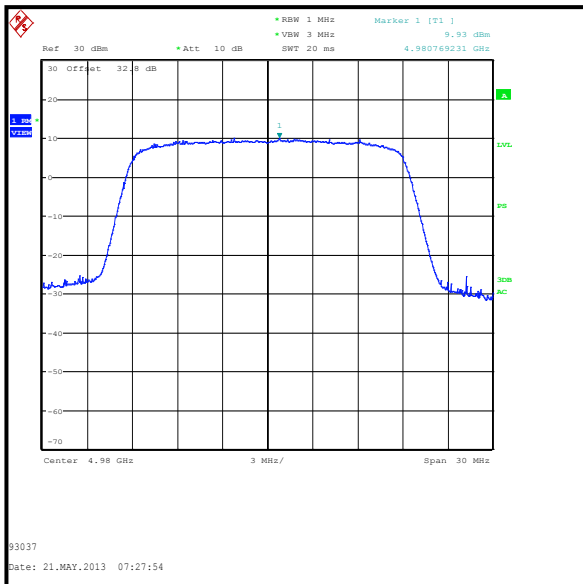
H Port



Bottom Channel



Middle Channel

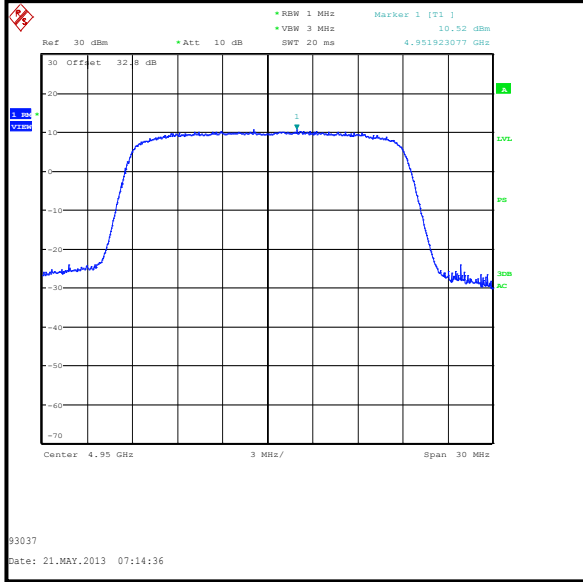


Top Channel

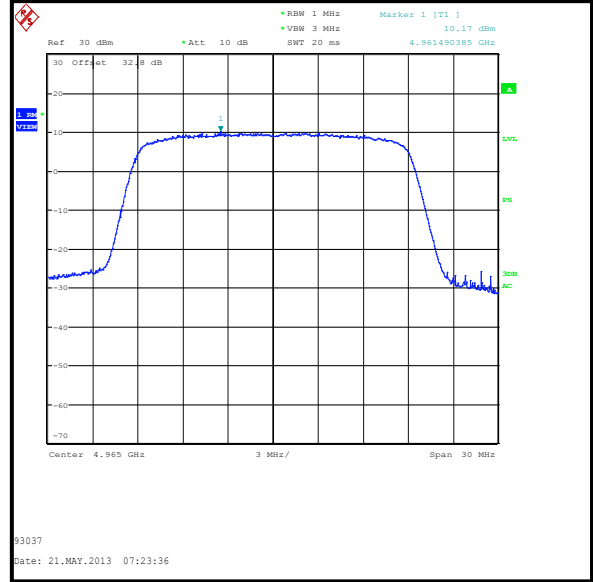
Peak Power Spectral Density (continued)

Results: 20 MHz Channel / 16QAM / Plate and Sectorised Antennas

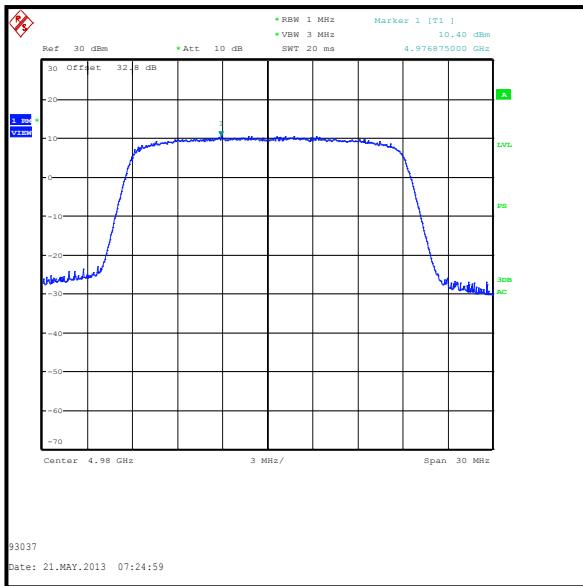
V Port



Bottom Channel



Middle Channel



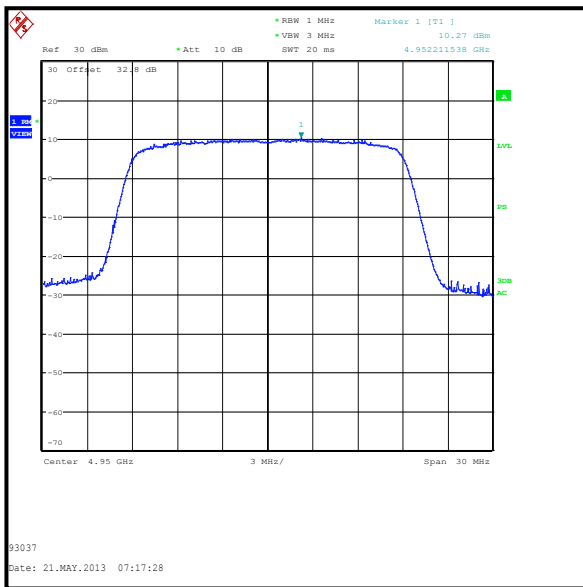
Top Channel

Peak Power Spectral Density (continued)

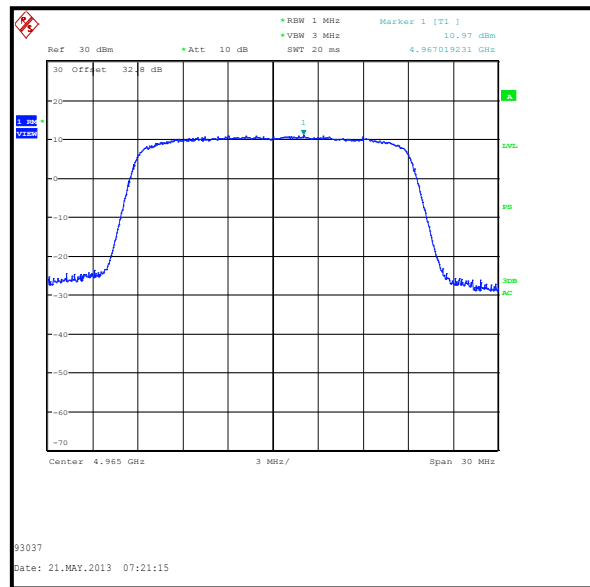
Results: 20 MHz Channel / 16QAM / 4' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	10.3	10.5	13.4	15.9	2.5	Complied
Middle	11.0	10.2	13.6	15.9	2.3	Complied
Top	9.9	10.4	13.2	15.9	2.7	Complied

H Port



Bottom Channel



Middle Channel

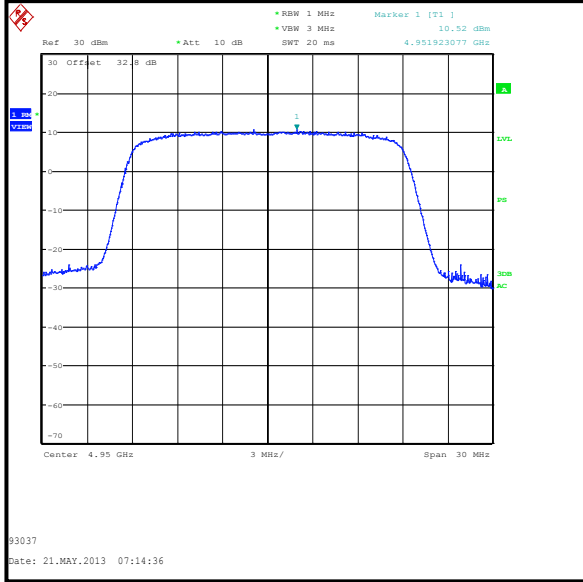


Top Channel

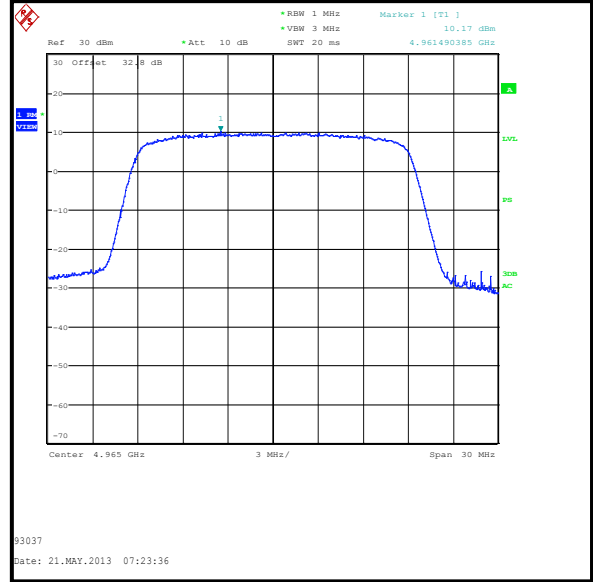
Peak Power Spectral Density (continued)

Results: 20 MHz Channel / 16QAM / 4' Parabolic Antenna

V Port



Bottom Channel



Middle Channel



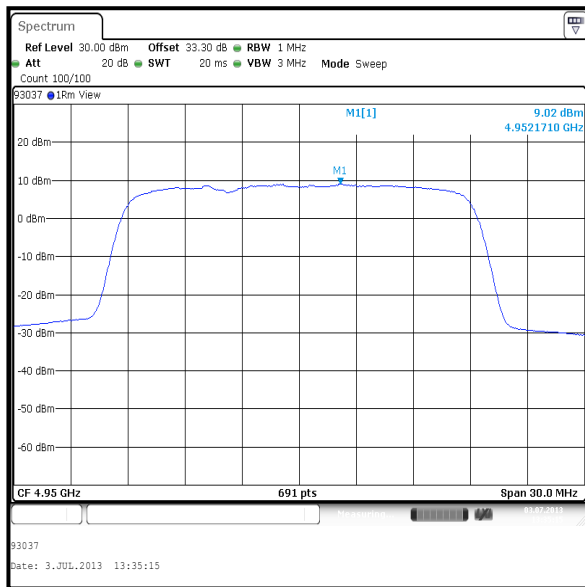
Top Channel

Peak Power Spectral Density (continued)

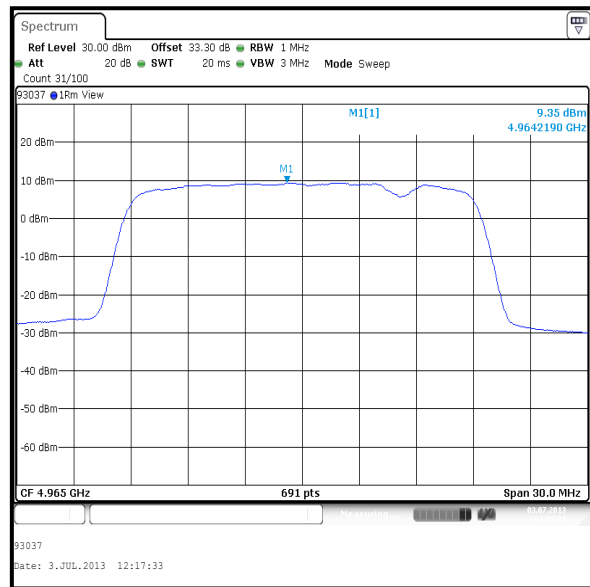
Results: 20 MHz Channel / 16QAM / 6' Parabolic Antenna

Channel	PPSD H Port (dBm/MHz)	PPSD V Port (dBm/MHz)	PPSD Power (dBm/MHz)	PPSD Power Limit (dBm/MHz)	Margin (dB)	Result
Bottom	9.0	9.4	12.2	12.4	0.2	Complied
Middle	9.4	8.6	12.0	12.4	0.4	Complied
Top	8.9	9.2	12.1	12.4	0.3	Complied

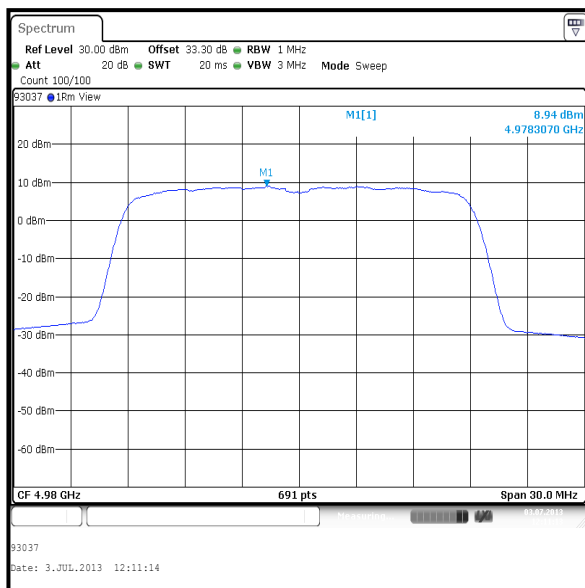
H Port



Bottom Channel



Middle Channel

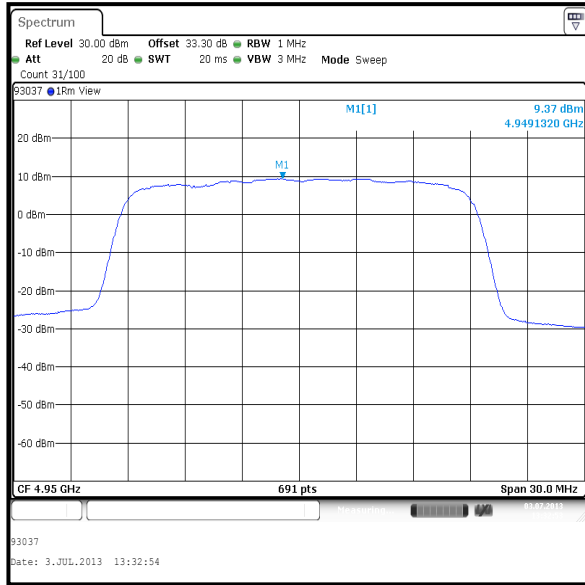


Top Channel

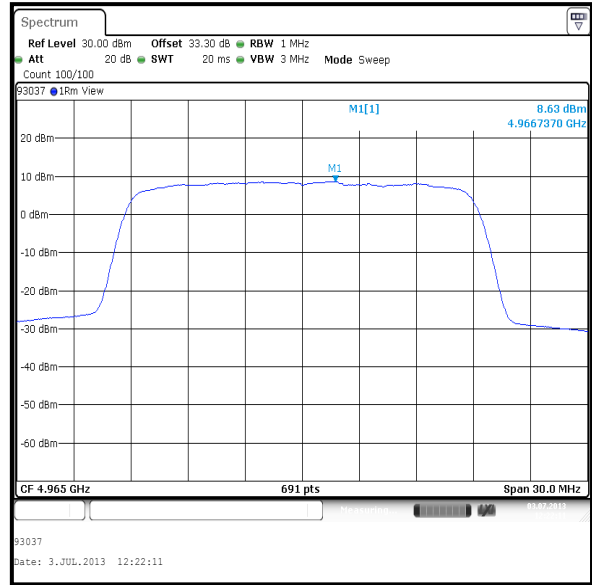
Peak Power Spectral Density (continued)

Results: 20 MHz Channel / 16QAM / 6' Parabolic Antenna

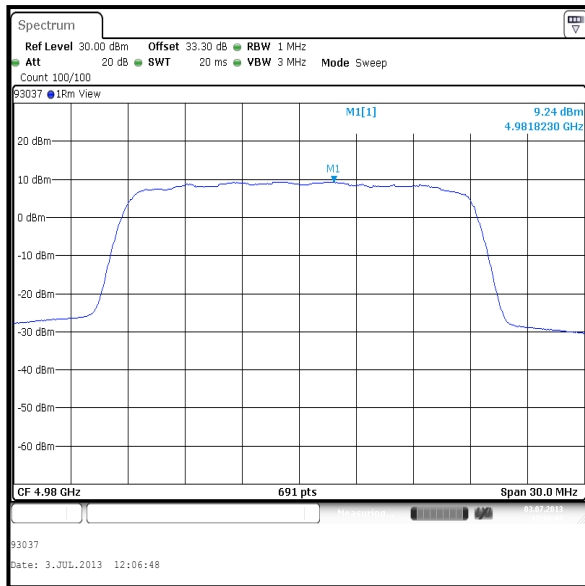
V Port



Bottom Channel



Middle Channel



Top Channel

Peak Power Spectral Density (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2007	Attenuator	Narda	769-20	001	Calibrated Before Use	N/A
L1028	Signal Analyser	Rohde & Schwarz	FSV 30	100854	23 May 2014	12
M1252	Signal Generator	HP	83640A	3119A00489	16 Sep 2013	12
M1590	Test Receiver	Rohde & Schwarz	ESU26	100239	15 Jun 2013	12
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	N/A	24 May 2014	12
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	N/A	24 May 2014	12

5.2.4. Peak Excursion**Test Summary:**

Test Engineer:	David Doyle	Test Date:	23 May 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Part 90.1215(e)
Test Method Used:	Part 90.1215(e) & KDB 971168 D01 Section 5.7.2

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	36

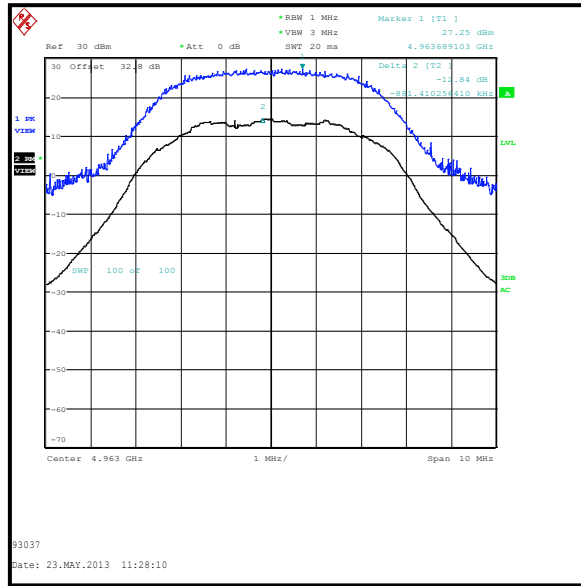
Note(s):

- The EUT was transmitting at >99% duty cycle during the test.
- All supported modes and channel widths were initially investigated on one channel in all configurations. The modes that produced the peak-to-average ratio closest to the limit were:
 - 5 MHz channel bandwidth – QPSK
 - 10 MHz channel bandwidth – 256QAM
 - 15 MHz channel bandwidth – 64QAM
 - 20 MHz channel bandwidth – 16QAM
- Final measurements were performed with the EUT transmitting on the middle channel of each supported channel bandwidth. Worst case modes are reported.
- The peak measurement (first trace) was performed using a peak detector. The second measurement (second trace) was performed using an RMS detector. A marker was placed at the peak of the first trace (P_{Pk}). A delta marker was placed of at the peak of the second trace (P_{Avg}). The peak excursion is the delta between the two markers. $PAPR (dB) = P_{Pk} - P_{Avg}$

Peak Excursion (continued)

Results: 5 MHz Channel / QPSK

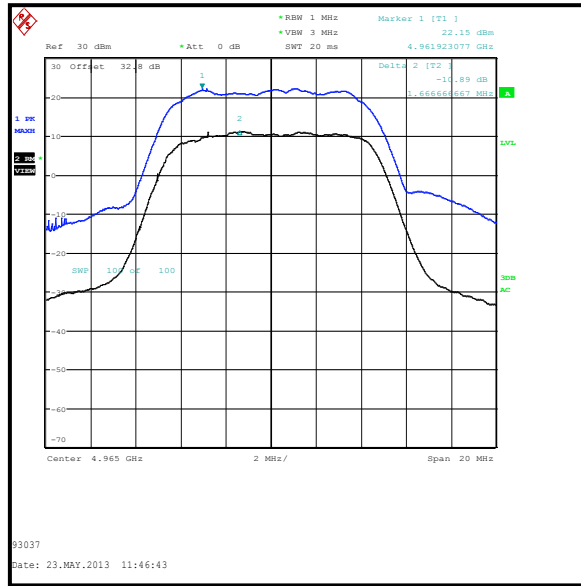
Channel Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)	Result
4963.000	12.8	13.0	0.2	Complied



Peak Excursion (continued)

Results: 10 MHz Channel / 256QAM

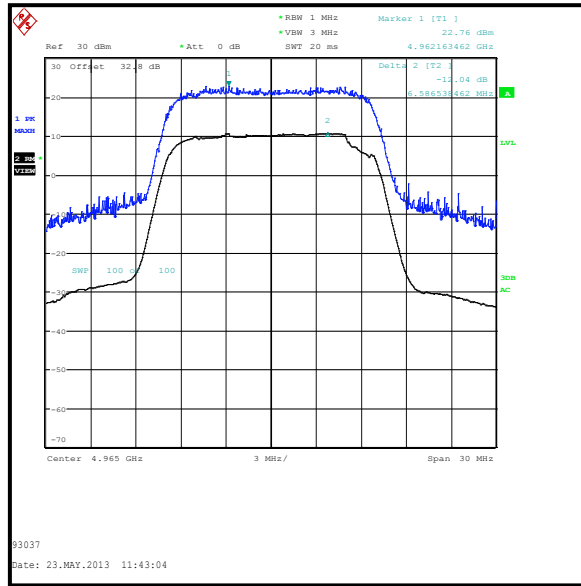
Channel Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)	Result
4965.000	10.9	13.0	2.1	Complied



Peak Excursion (continued)

Results: 15 MHz Channel / 64QAM

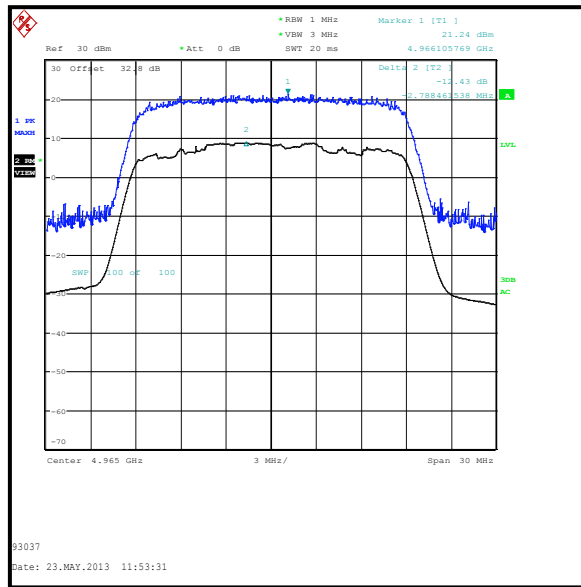
Channel Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)	Result
4965.000	12.0	13.0	1.0	Complied



Peak Excursion (continued)

Results: 20 MHz Channel / 16QAM

Channel Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)	Result
4965.000	12.4	13.0	0.6	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2007	Attenuator	Narda	769-20	001	Calibrated Before Use	N/A
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	07 Feb 2014	12
M1659	Thermohygrometer	JM Handelpunkt	30.5015.13	N/A	10 Jun 2013	12

5.2.5. Occupied Bandwidth**Test Summary:**

Test Engineer:	David Doyle	Test Dates:	16 May 2013 & 20 May 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Part 2.1053
Test Method Used:	KDB 971168 D01 Section 4.2

Environmental Conditions:

Temperature (°C):	21 to 22
Relative Humidity (%):	39 to 42

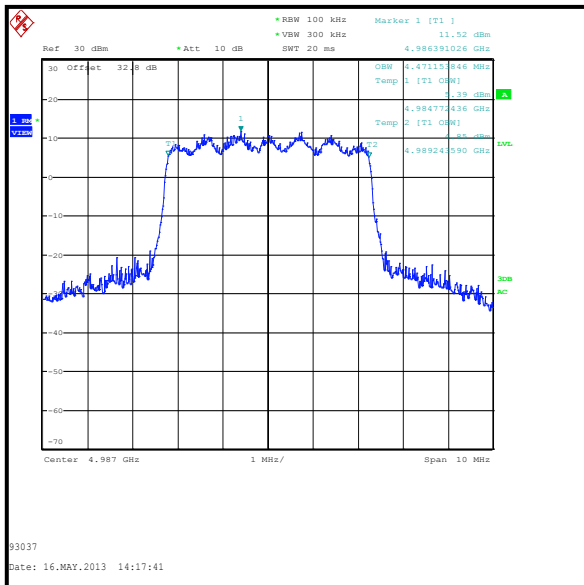
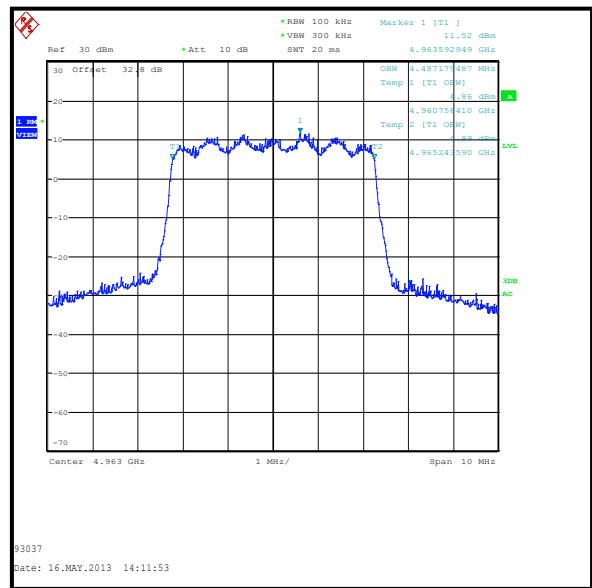
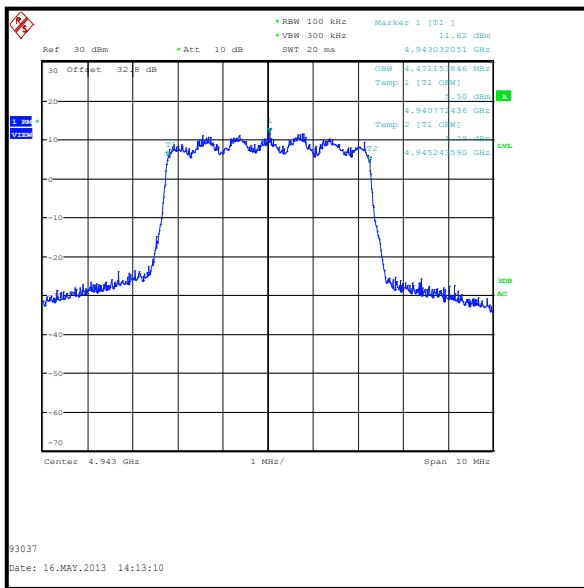
Note(s):

1. The 99% occupied bandwidth function of a spectrum analyser was used to perform the measurement.
2. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.
3. Measurement bandwidths using for testing were >1% of the occupied bandwidth. Video bandwidths used were as close to three times the measurement bandwidth as the spectrum analyser allowed.
4. All configurations supported by the device were investigated on one channel and the modulation type that was found to produce the widest bandwidth was BPSK.
5. Final measurements were performed using the above configurations on the bottom, middle and top channels. Both RF ports were tested.
6. 99% occupied bandwidth plots for QPSK and 256QAM measured in a 20 MHz channel bandwidth have been included as 'Reference measurements' at the end of this Section. The measured occupied bandwidth on the bottom, middle and top channels is identical. Only middle channel results are shown.

Occupied Bandwidth (continued)

Results: 5 MHz Channel / BPSK / H Port

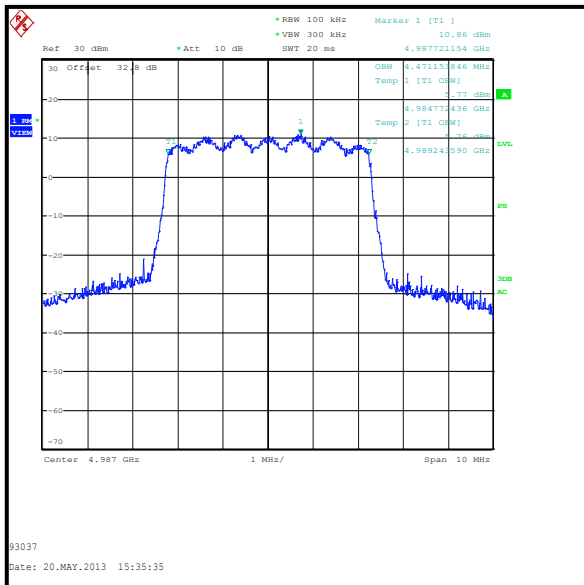
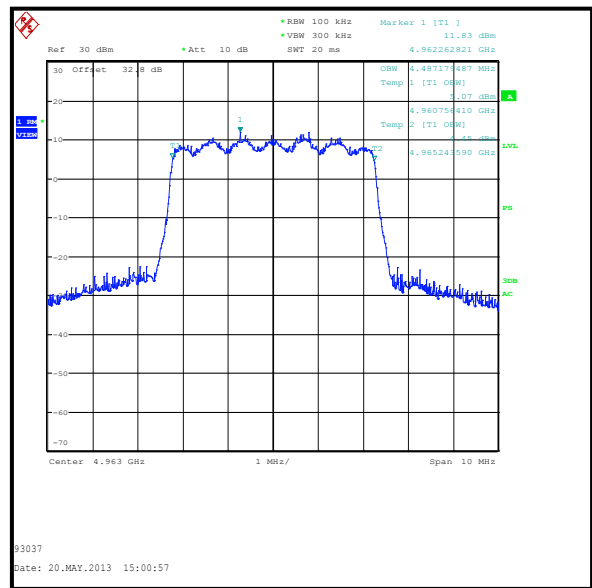
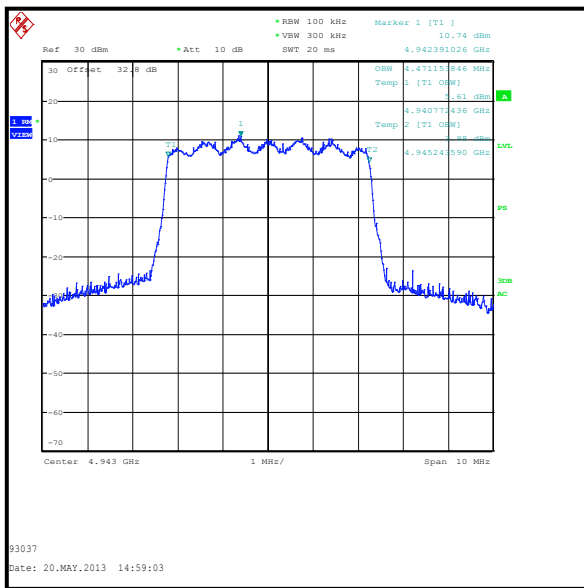
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4943	BPSK	100	300	4.471
Middle	4963	BPSK	100	300	4.487
Top	4987	BPSK	100	300	4.471



Occupied Bandwidth (continued)

Results: 5 MHz Channel / BPSK / V Port

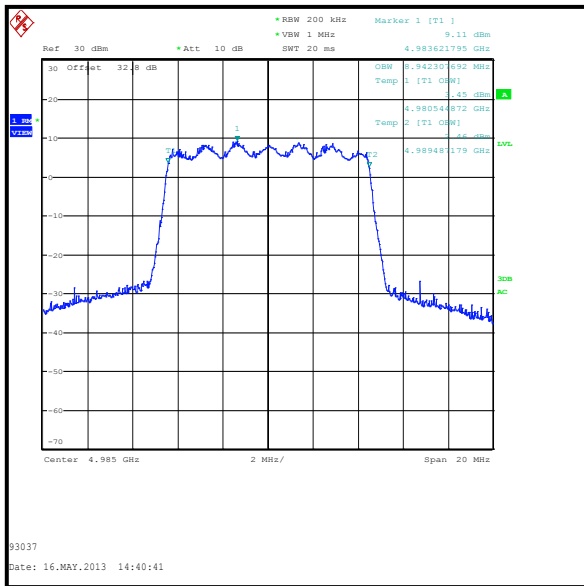
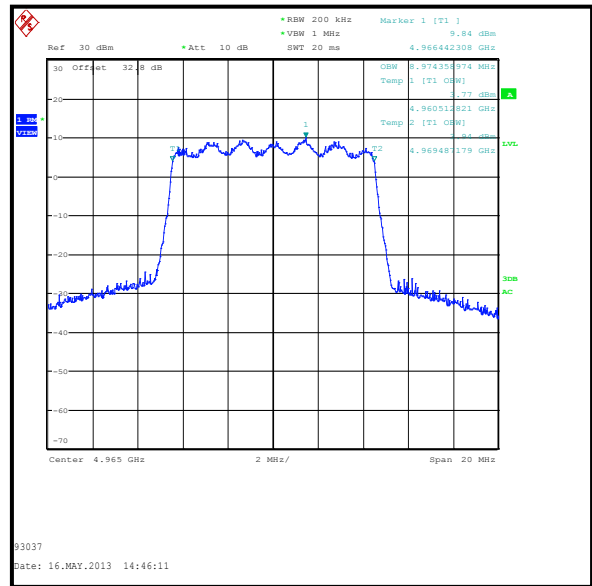
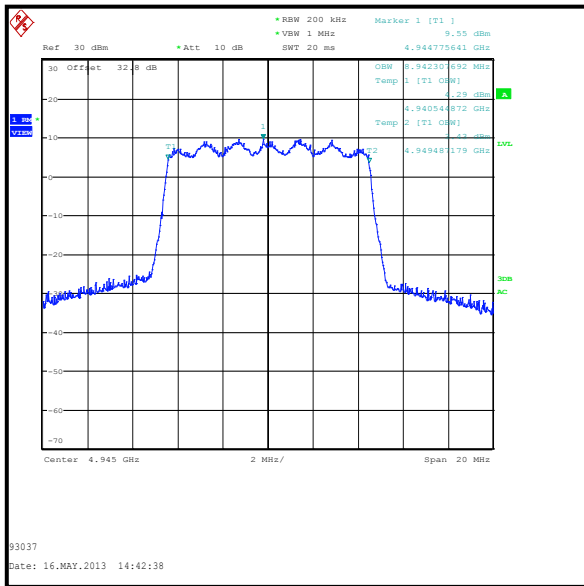
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4943	BPSK	100	300	4.471
Middle	4963	BPSK	100	300	4.487
Top	4987	BPSK	100	300	4.471



Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth /BPSK / H Port

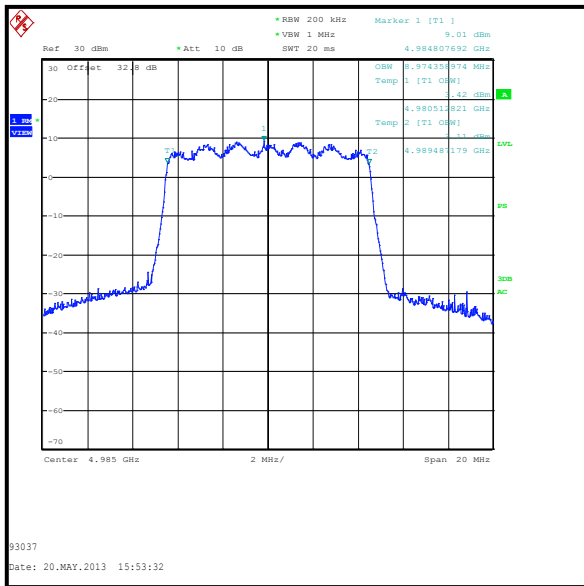
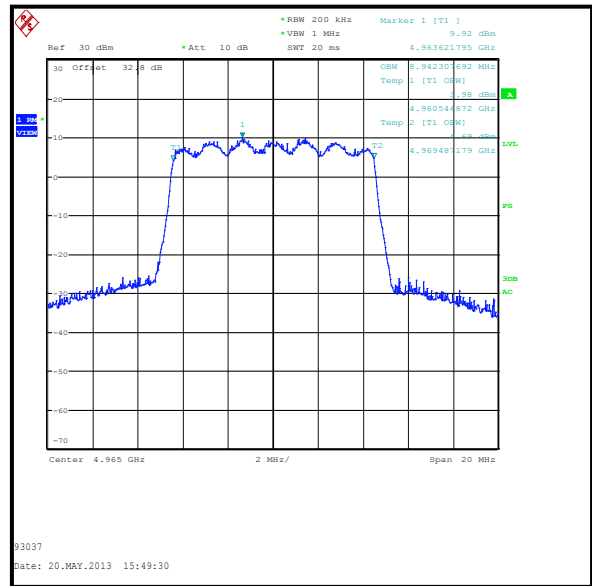
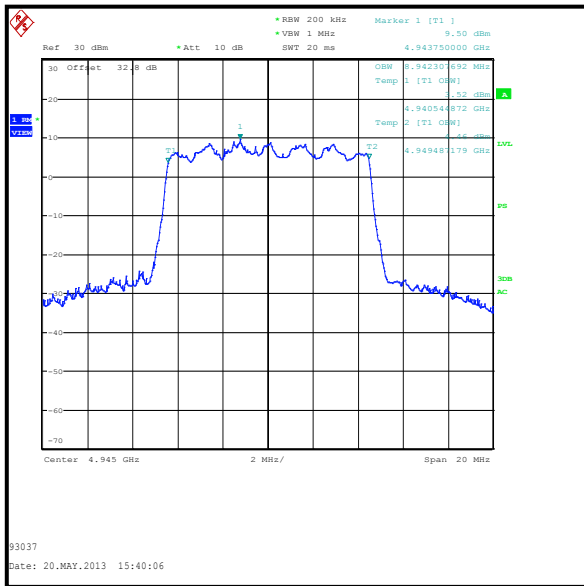
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4945	BPSK	200	1000	8.942
Middle	4965	BPSK	200	1000	8.974
Top	4985	BPSK	200	1000	8.942



Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth /BPSK / V Port

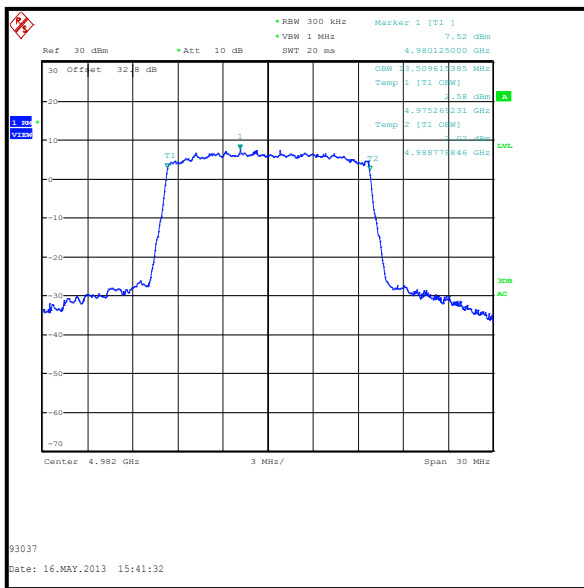
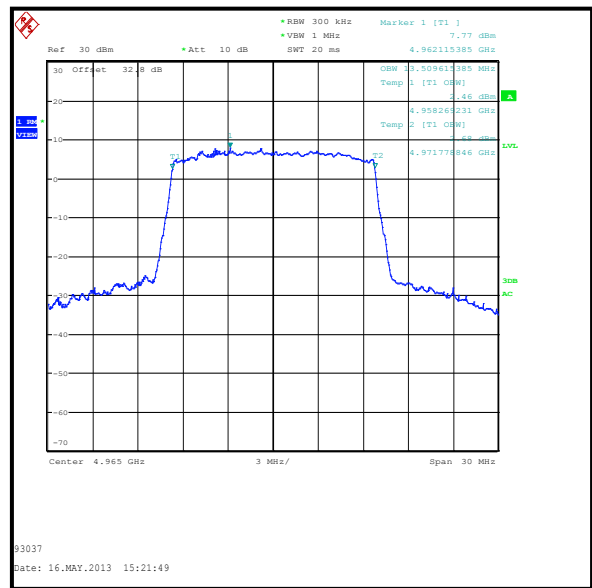
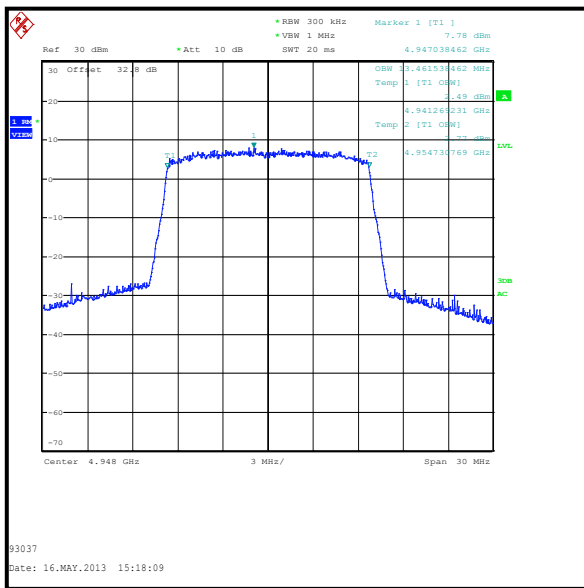
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4945	BPSK	200	1000	8.942
Middle	4965	BPSK	200	1000	8.942
Top	4985	BPSK	200	1000	8.974



Occupied Bandwidth (continued)

Results: 15 MHz Channel Bandwidth / BPSK / H Port

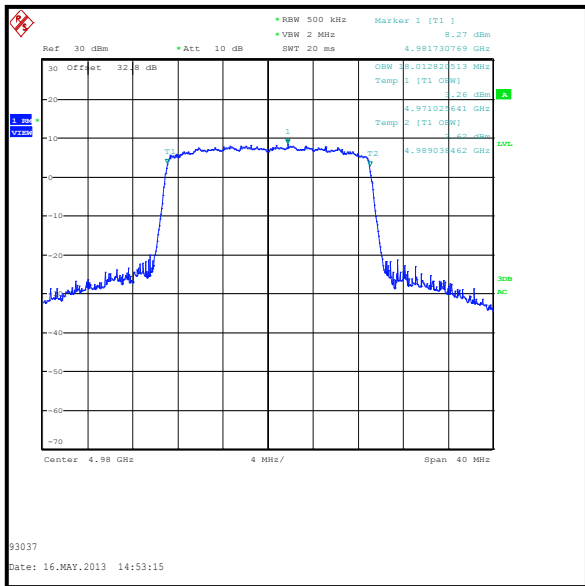
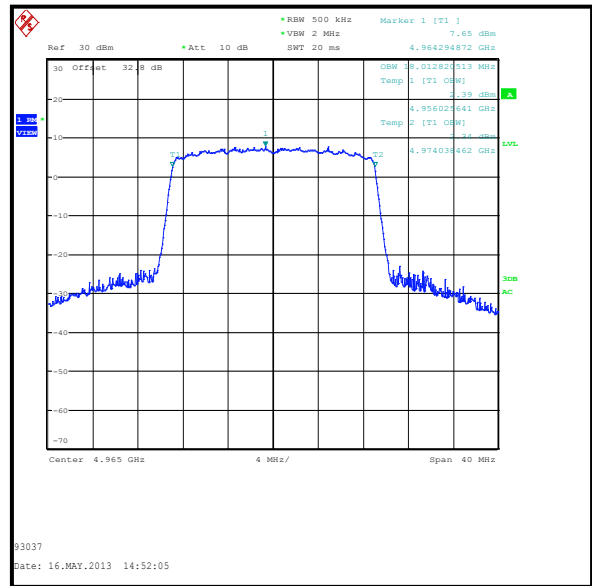
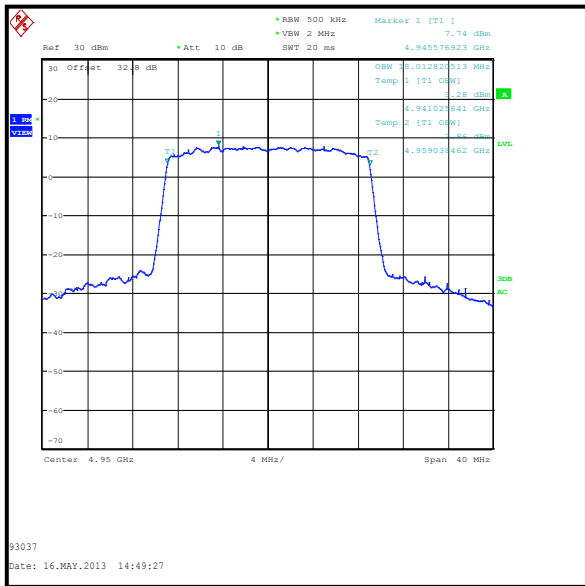
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4948	BPSK	300	1000	13.462
Middle	4965	BPSK	300	1000	13.510
Top	4982	BPSK	300	1000	13.510



Occupied Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / BPSK / H Port

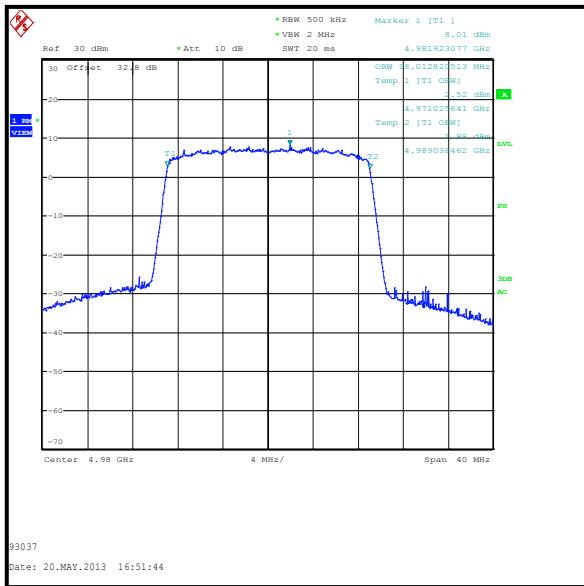
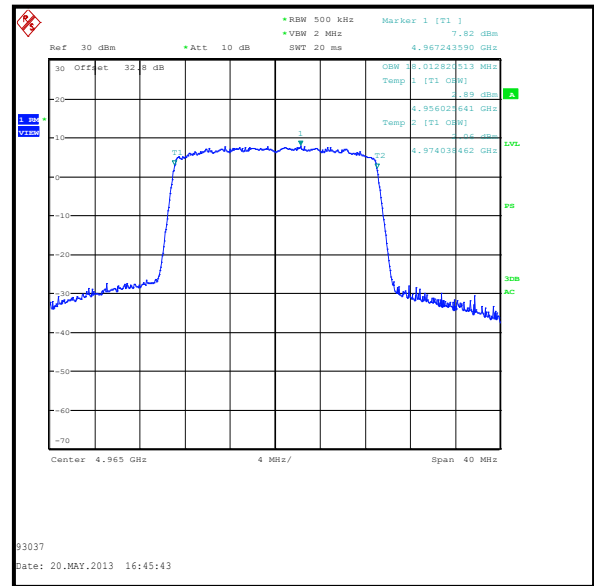
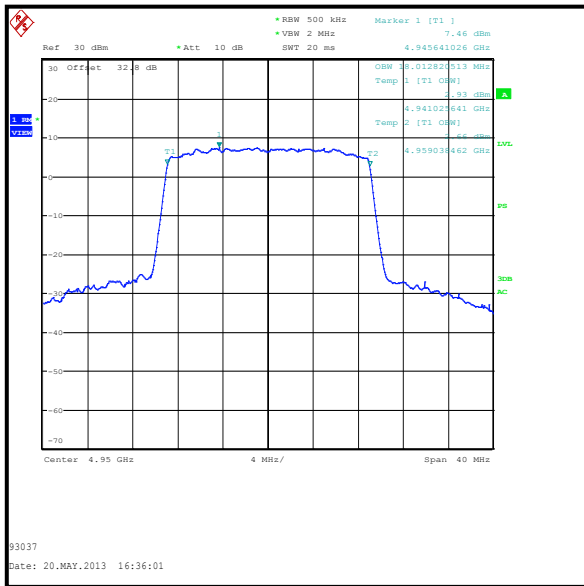
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4950	BPSK	500	2000	18.013
Middle	4965	BPSK	500	2000	18.013
Top	4980	BPSK	500	2000	18.013



Occupied Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / BPSK / V Port

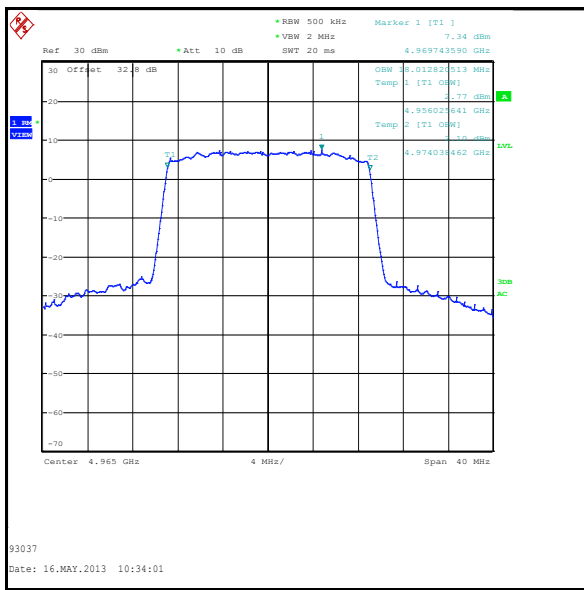
Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	4950	BPSK	500	2000	18.013
Middle	4965	BPSK	500	2000	18.013
Top	4980	BPSK	500	2000	18.013



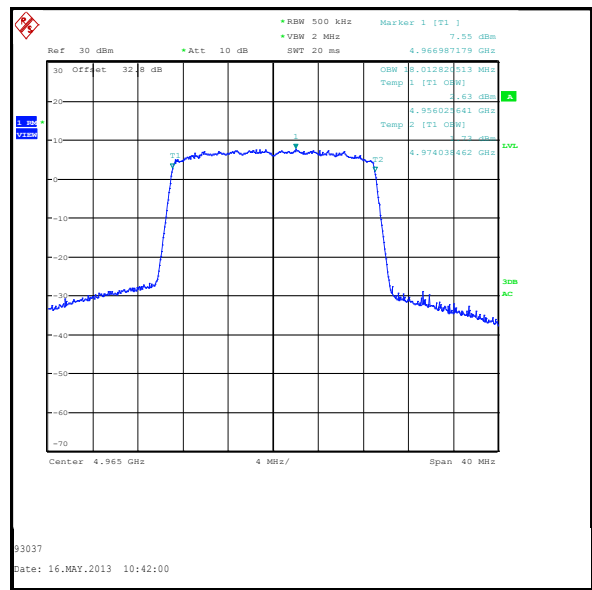
Occupied Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / V Port (reference measurements)

Channel	Frequency	Modulation	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Middle	4965	QPSK	500	2000	18.013
Middle	4965	256QAM	500	2000	18.013



Middle Channel / QPSK



Middle Channel / 256QAM

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2007	Attenuator	Narda	769-20	001	Calibrated Before Use	N/A
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	07 Feb 2014	12
M1659	Thermohygrometer	JM Handelpunkt	30.5015.13	N/A	10 Jun 2013	12

5.2.6. Conducted Emission Mask**Test Summary:**

Test Engineer:	David Doyle	Test Dates:	21 May 2013 to 23 May 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Part 90.210(m) / 2.1051
Test Method Used:	See Notes below

Environmental Conditions:

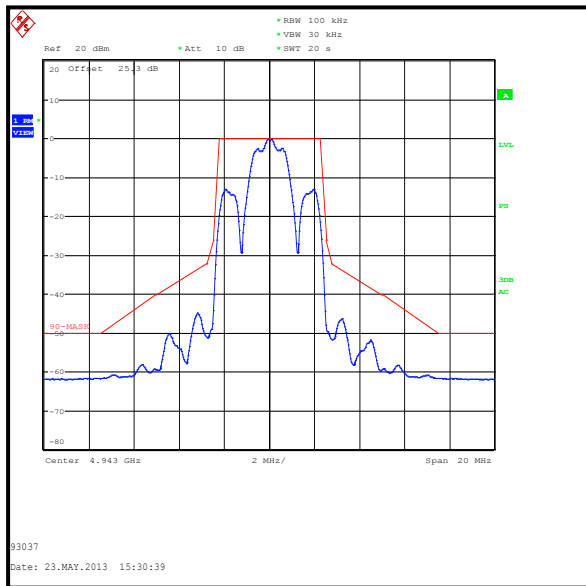
Temperature (°C):	21 to 23
Relative Humidity (%):	39 to 43

Note(s):

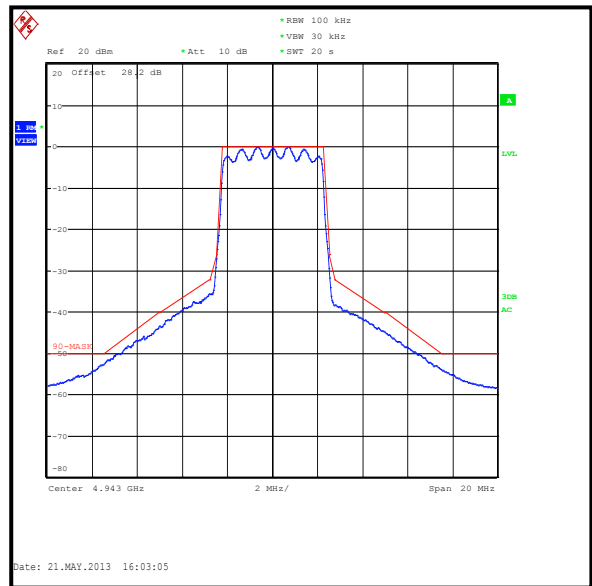
1. Part 90.210 emissions mask M was applied to all measurements.
2. The measurement was performed with the EUT antenna port connected to a spectrum analyser via suitable attenuation and RF cable. The power of the modulated signal was measured on a spectrum analyser using an RMS detector and 20 second sweep time in order to maximise the level. The mask was referenced to the peak of the carrier.
3. Full testing was performed on the V port and the results are shown in this section of the test report. Sample tests on the H port confirmed that the performance of both ports were identical. Results for the V port are not included but plots are archived on the test laboratory server and available for inspection if required.
4. No mask incursions were observed.

Conducted Emission Mask (continued)

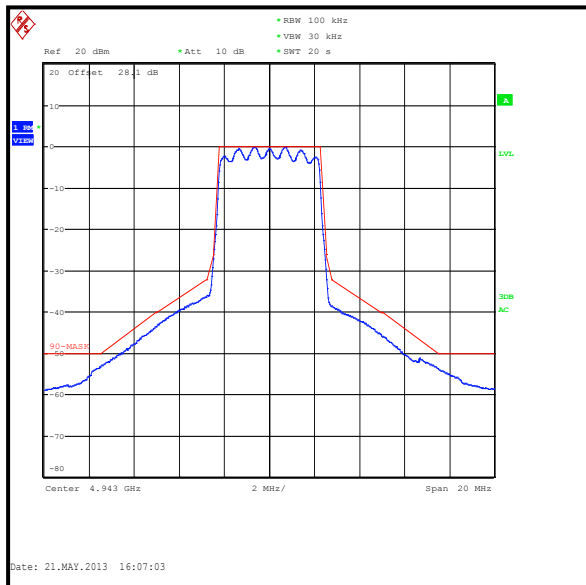
Results: 5 MHz Channel Bandwidth / Bottom Channel



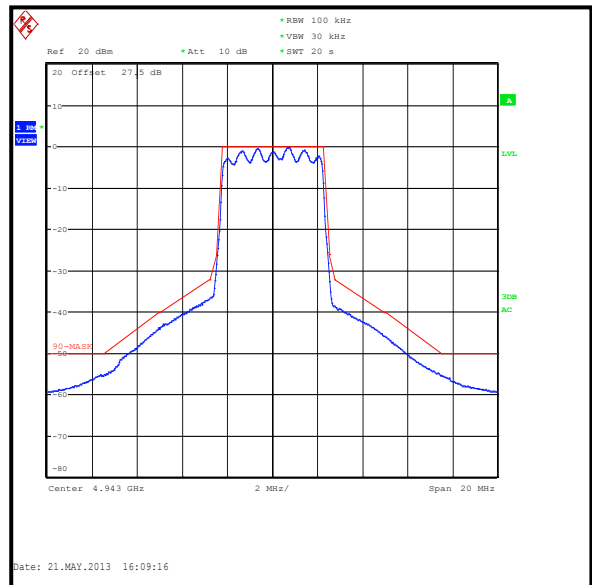
ACQ



BPSK



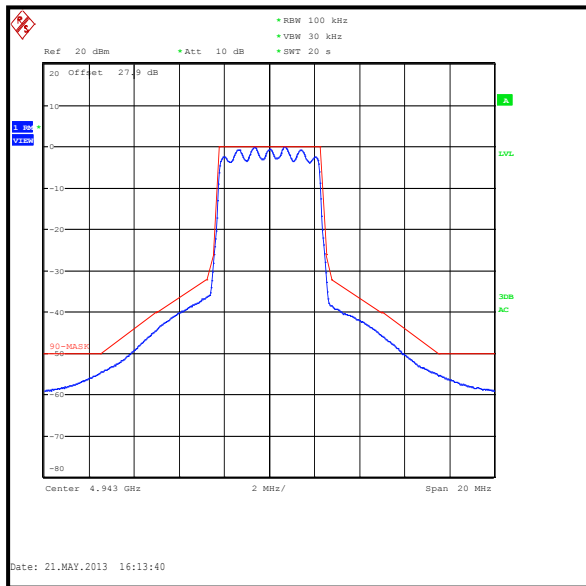
QPSK



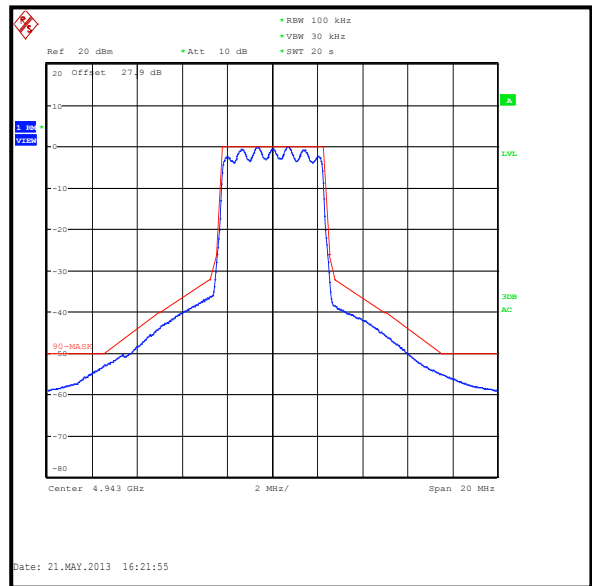
16QAM

Conducted Emission Mask (continued)

Results: 5 MHz Channel Bandwidth / Bottom Channel



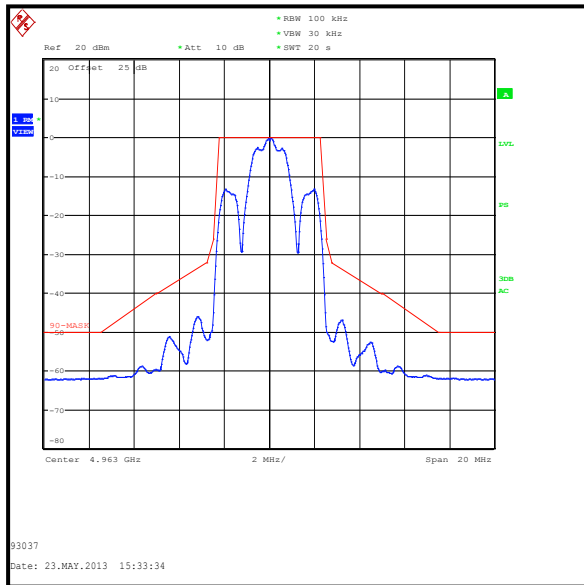
64QAM



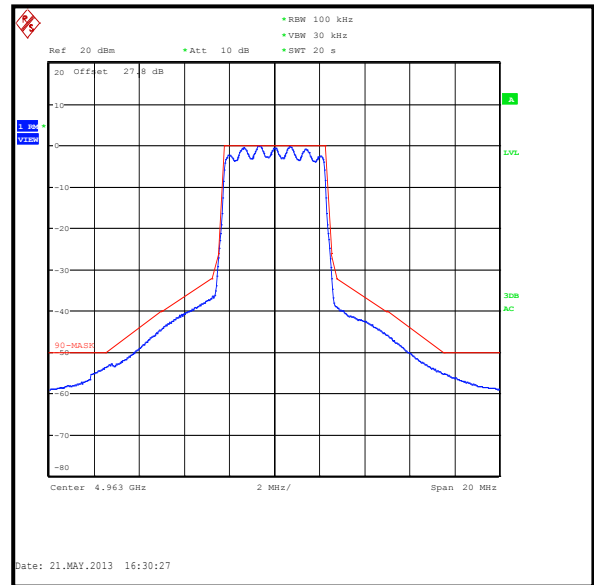
256QAM

Conducted Emission Mask (continued)

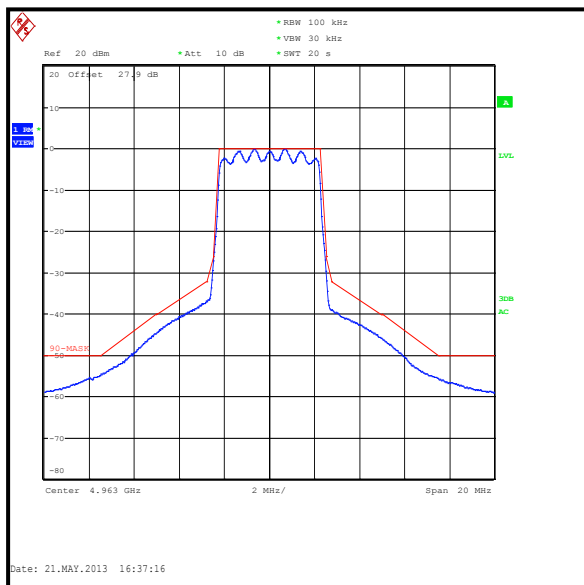
Results: 5 MHz Channel Bandwidth / Middle Channel



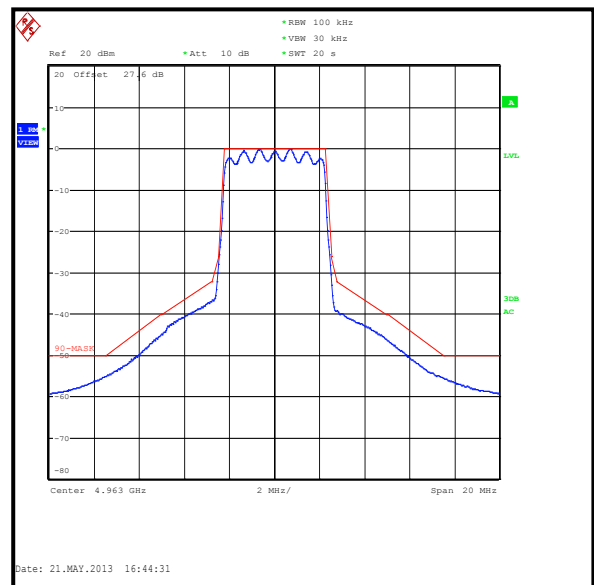
ACQ



BPSK



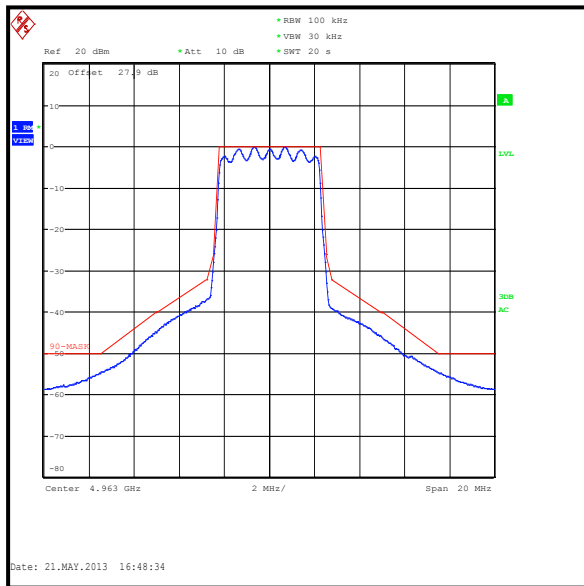
QPSK



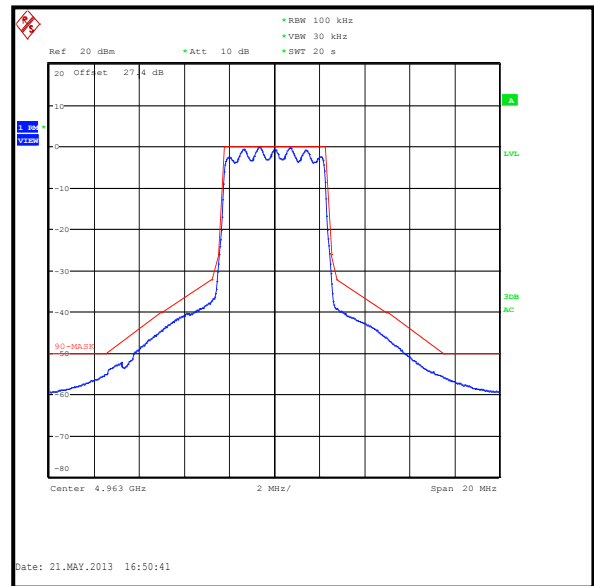
16QAM

Conducted Emission Mask (continued)

Results: 5 MHz Channel Bandwidth / Middle Channel



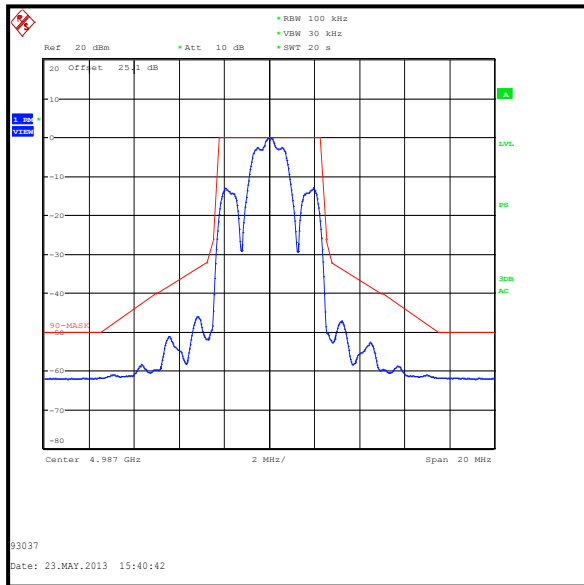
64QAM



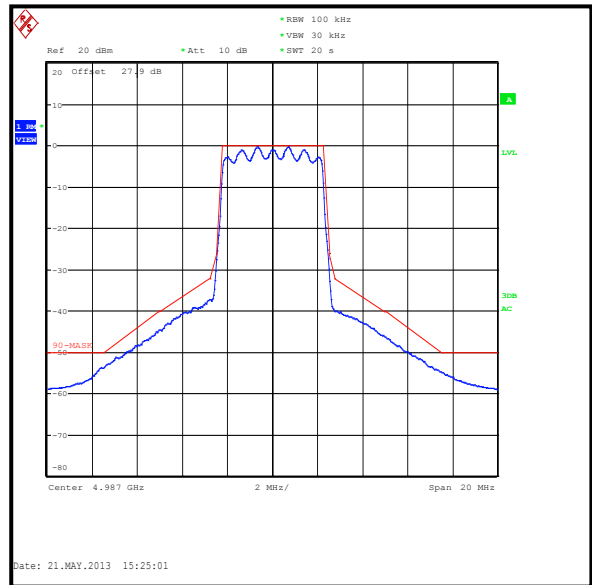
256QAM

Conducted Emission Mask (continued)

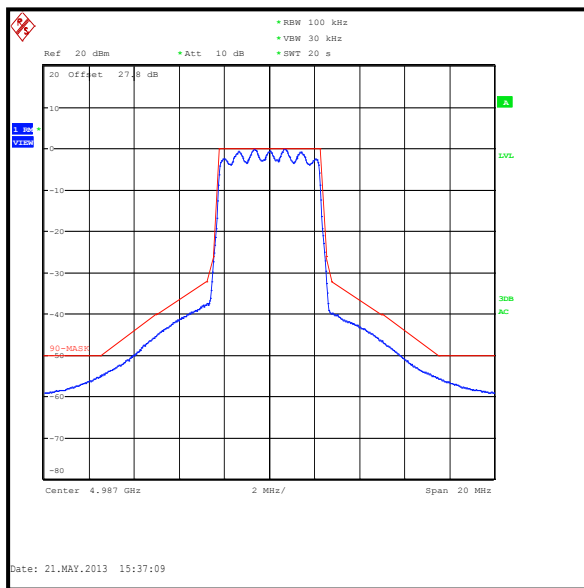
Results: 5 MHz Channel Bandwidth / Top Channel



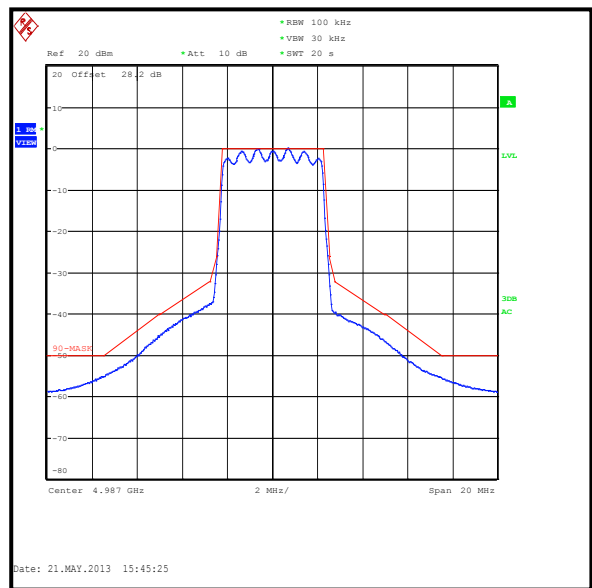
ACQ



BPSK



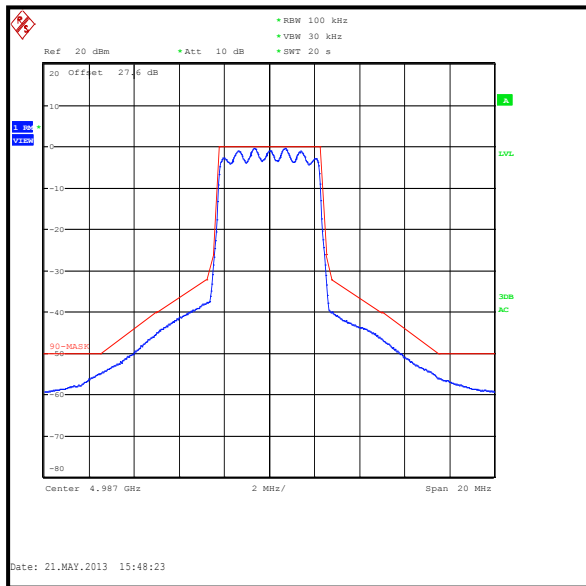
QPSK



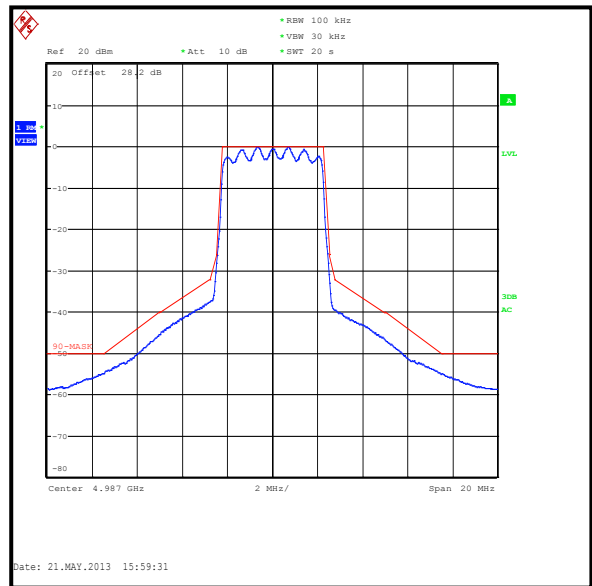
16QAM

Conducted Emission Mask (continued)

Results: 5 MHz Channel Bandwidth / Top Channel



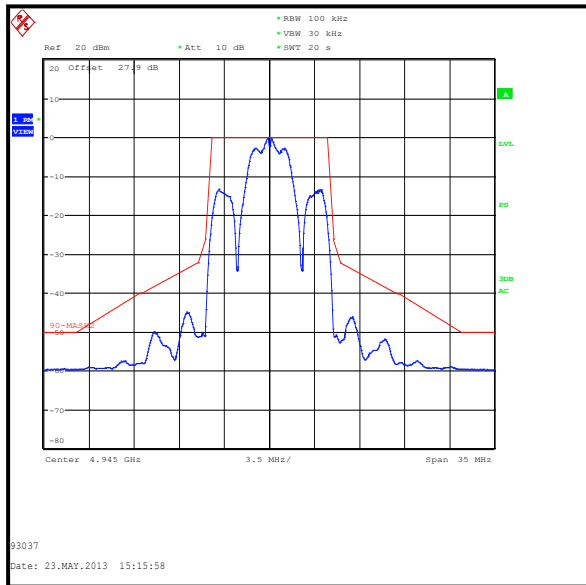
64QAM



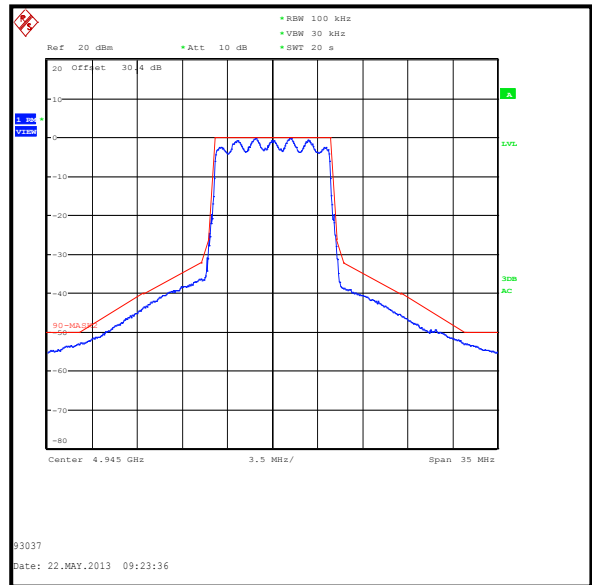
256QAM

Conducted Emission Mask (continued)

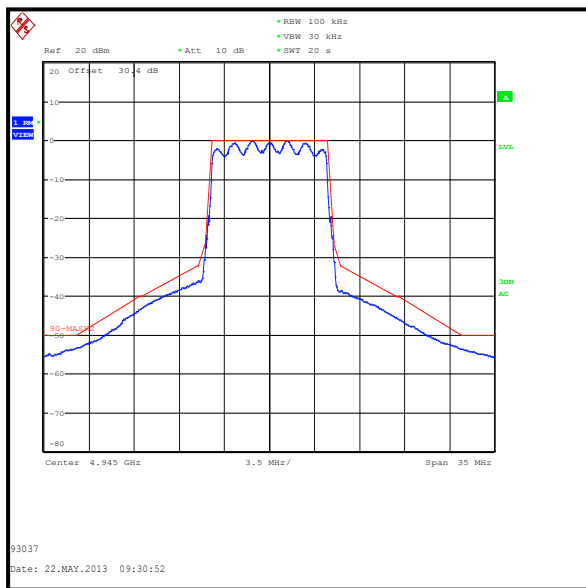
Results: 10 MHz Channel Bandwidth / Bottom Channel



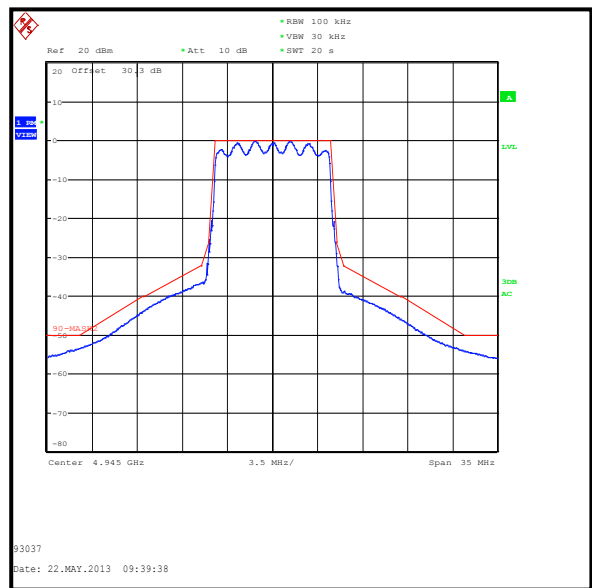
ACQ



BPSK



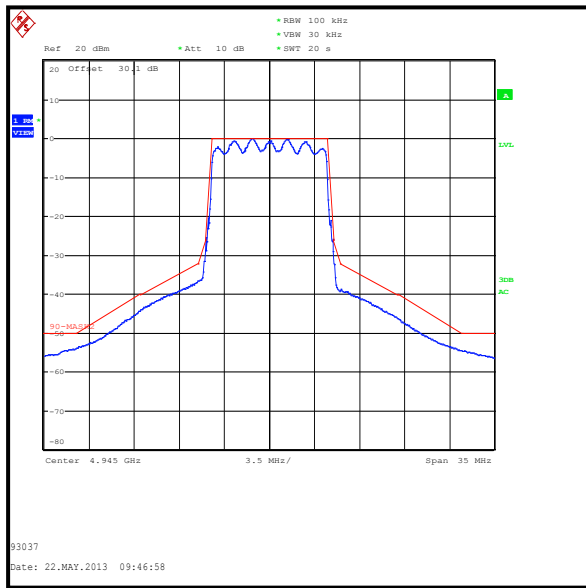
QPSK



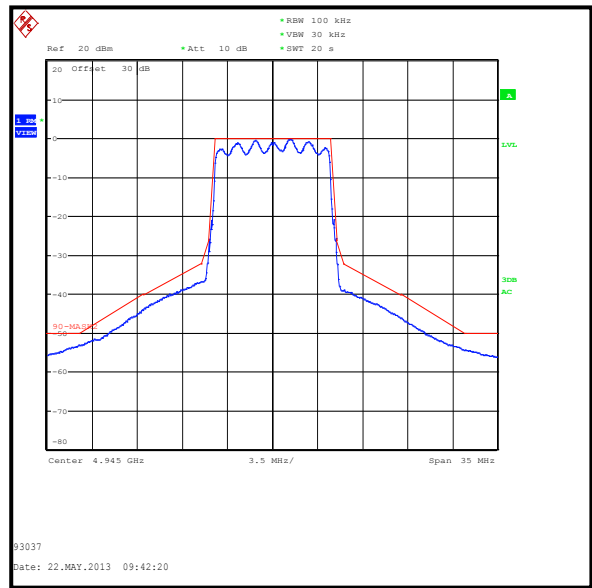
16QAM

Conducted Emission Mask (continued)

Results: 10 MHz Channel Bandwidth / Bottom Channel



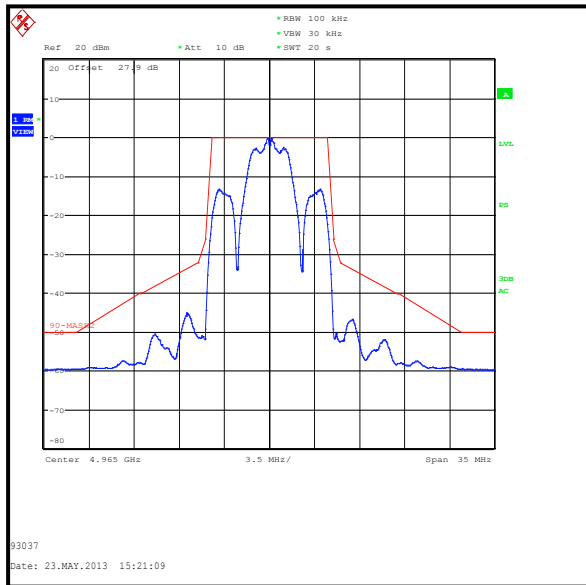
64QAM



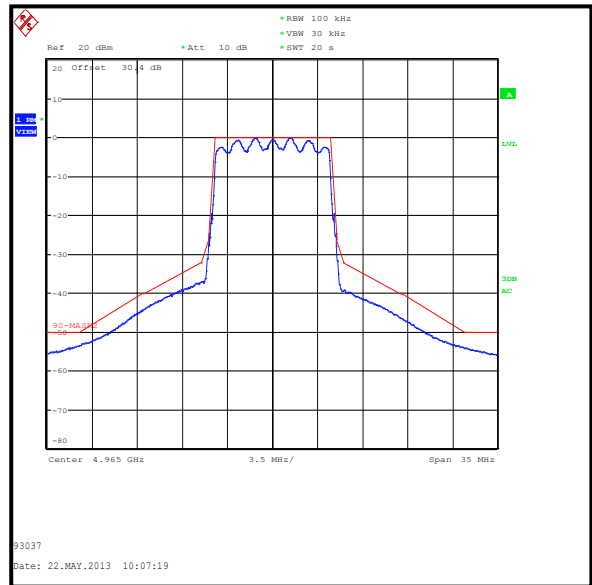
256QAM

Conducted Emission Mask (continued)

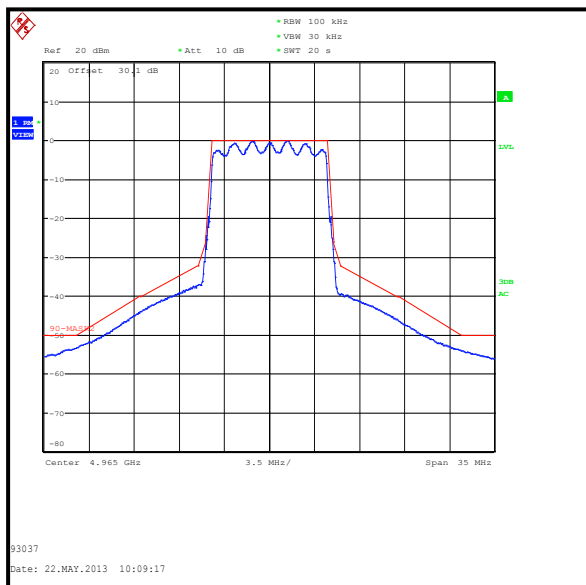
Results: 10 MHz Channel Bandwidth / Middle Channel



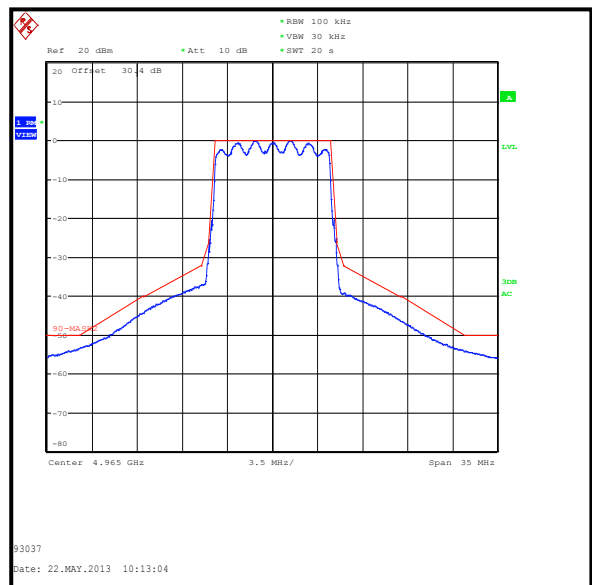
ACQ



BPSK



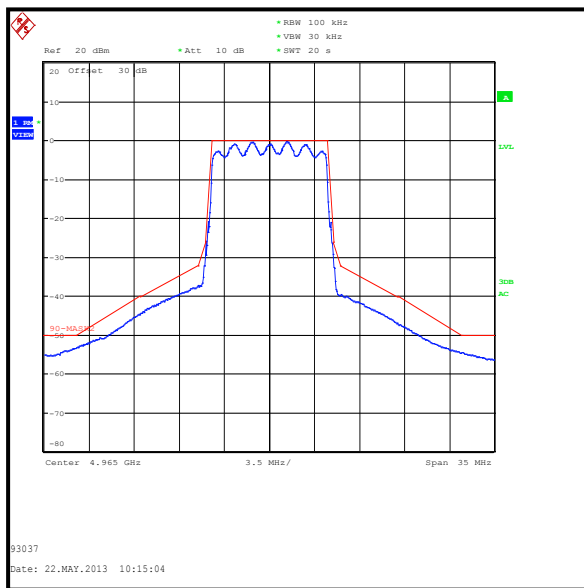
QPSK



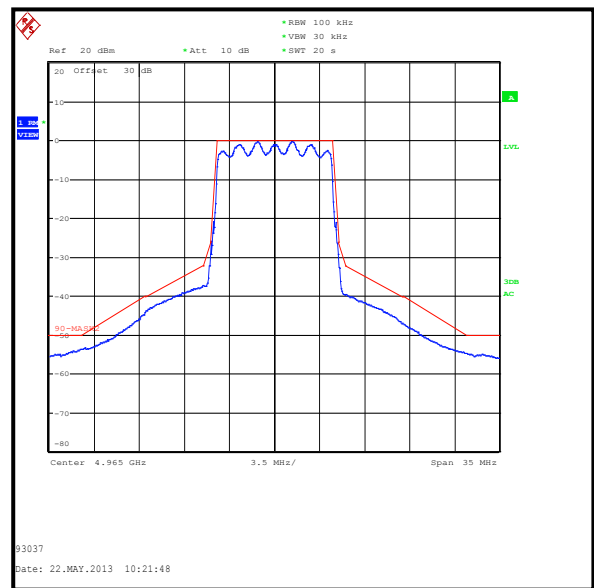
16QAM

Conducted Emission Mask (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel



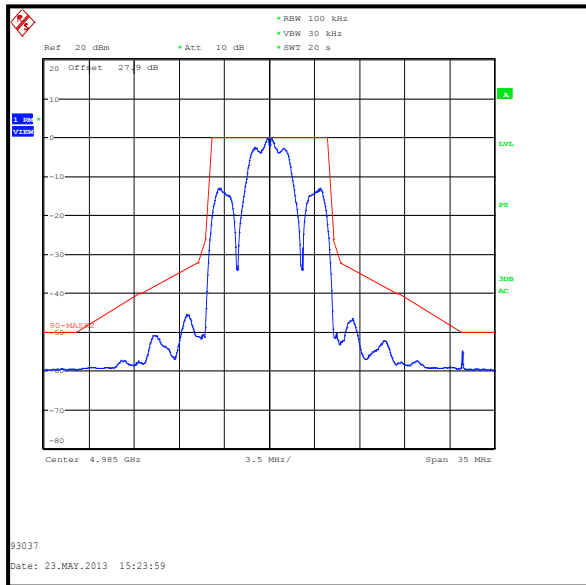
64QAM



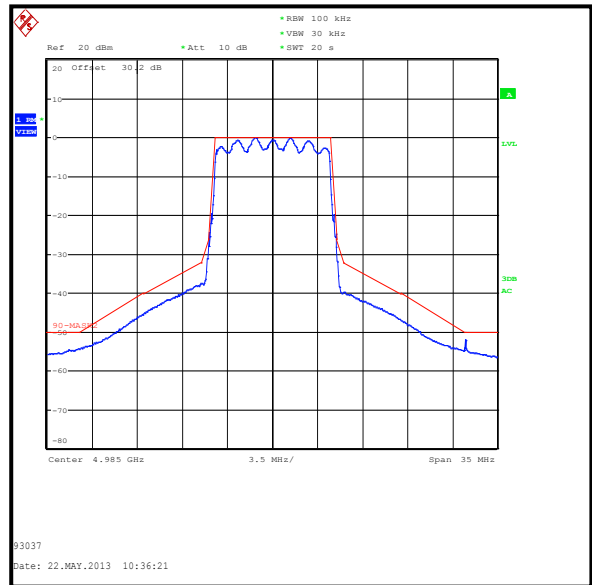
256QAM

Conducted Emission Mask (continued)

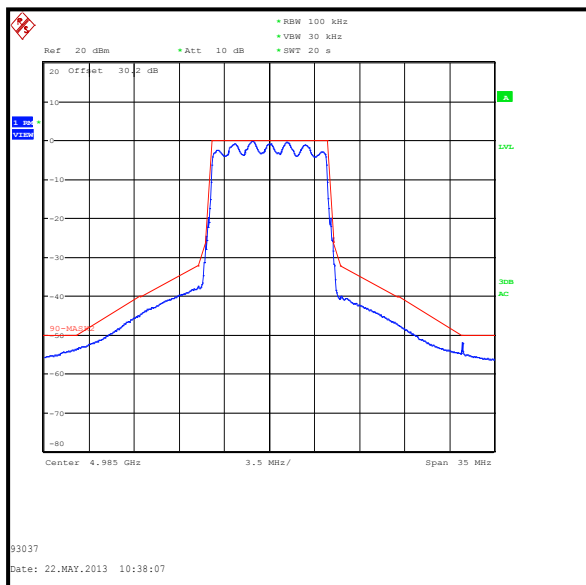
Results: 10 MHz Channel Bandwidth / Top Channel



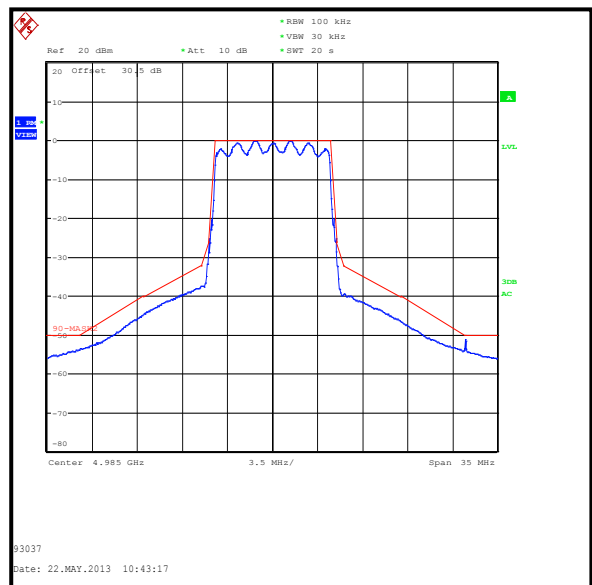
ACQ



BPSK



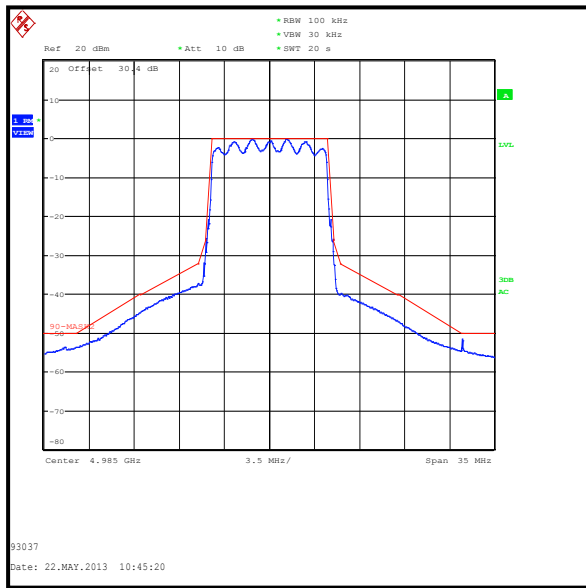
QPSK



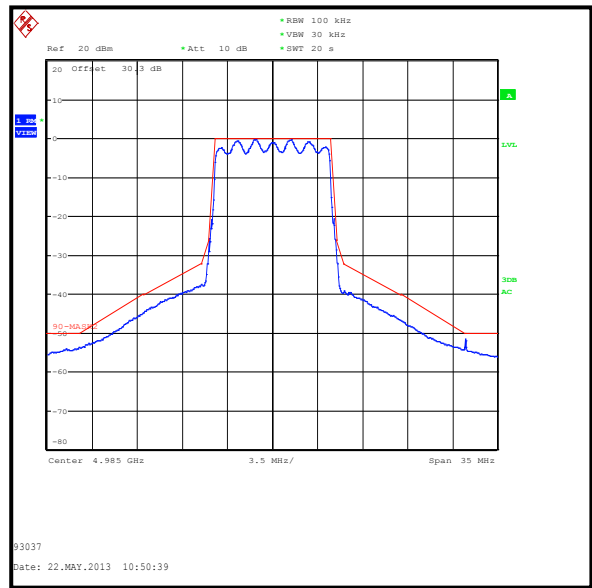
16QAM

Conducted Emission Mask (continued)

Results: 10 MHz Channel Bandwidth / Top Channel



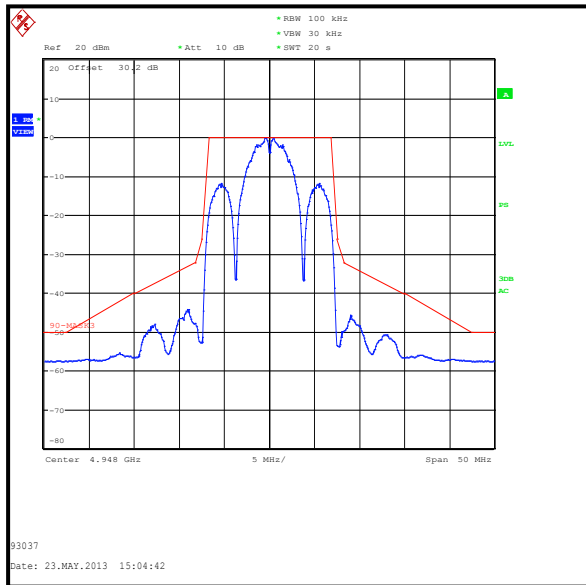
64QAM



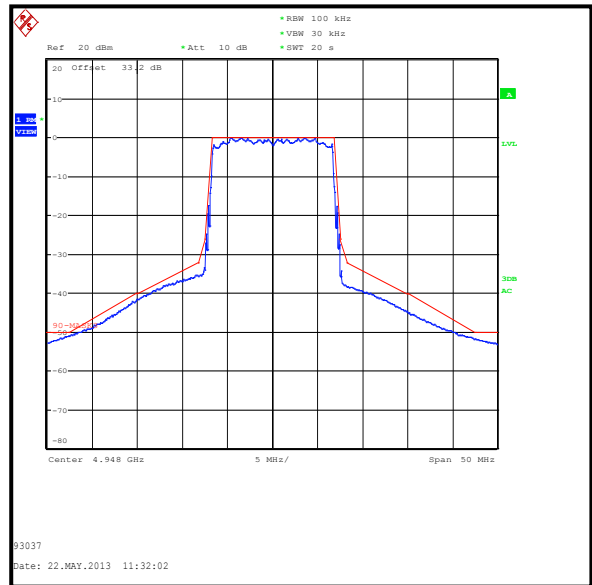
256QAM

Conducted Emission Mask (continued)

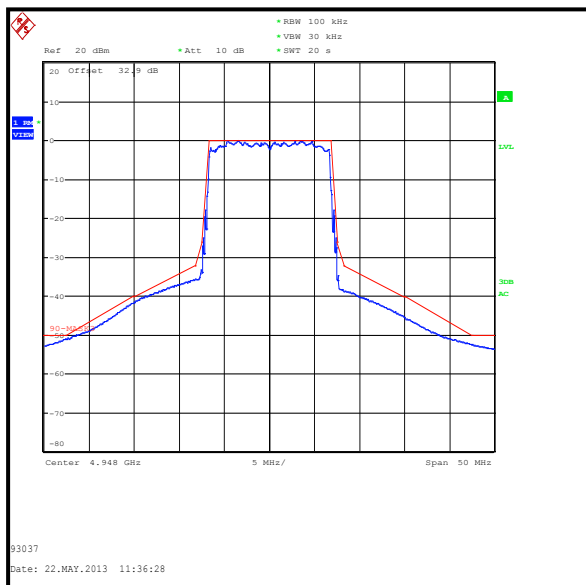
Results: 15 MHz Channel Bandwidth / Bottom Channel



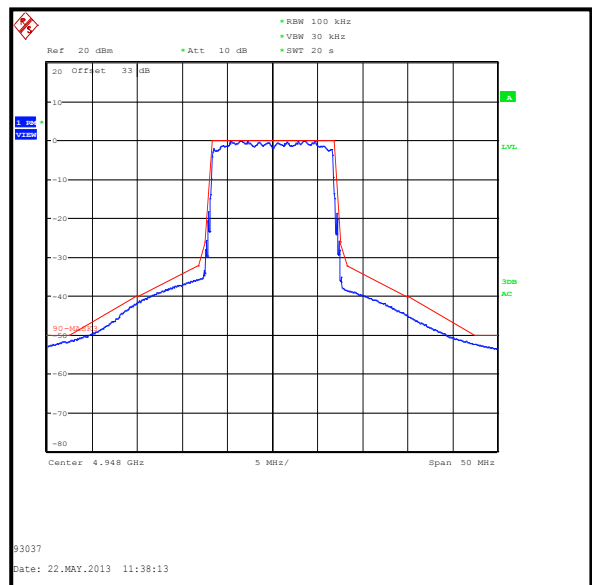
ACQ



BPSK



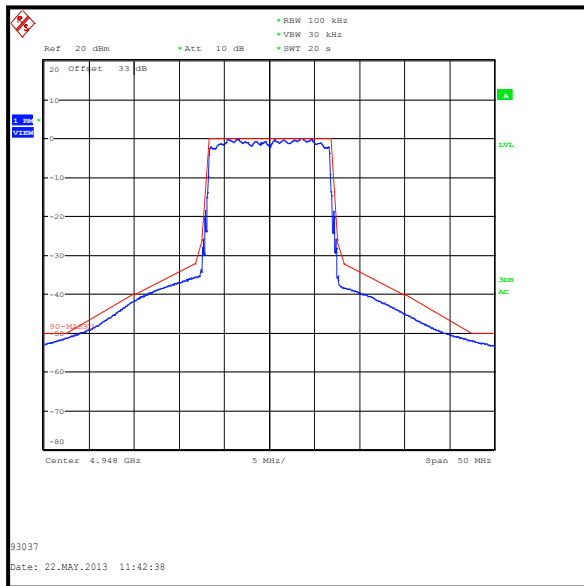
QPSK



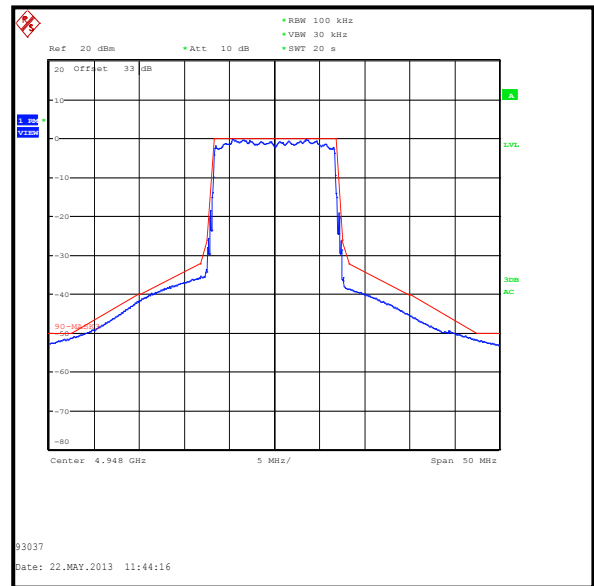
16QAM

Conducted Emission Mask (continued)

Results: 15 MHz Channel Bandwidth / Bottom Channel



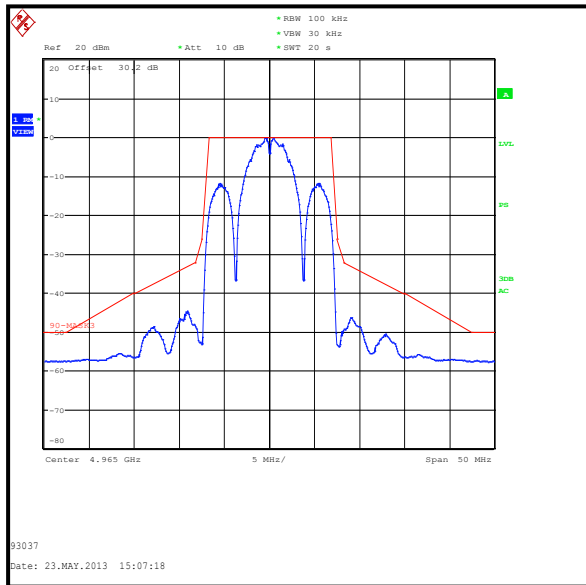
64QAM



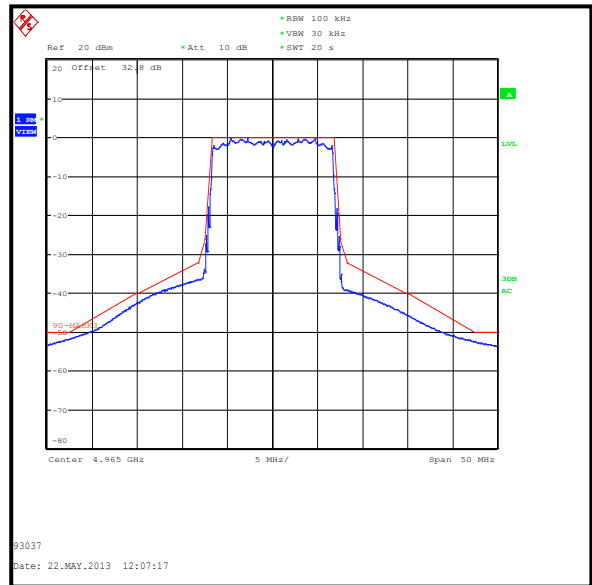
256QAM

Conducted Emission Mask (continued)

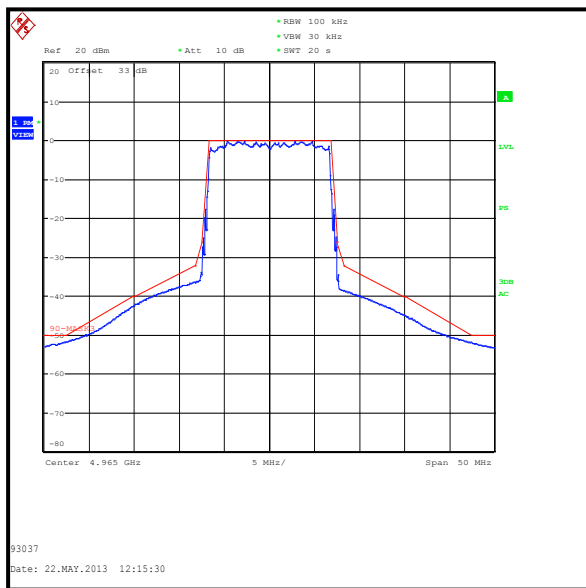
Results: 15 MHz Channel Bandwidth / Middle Channel



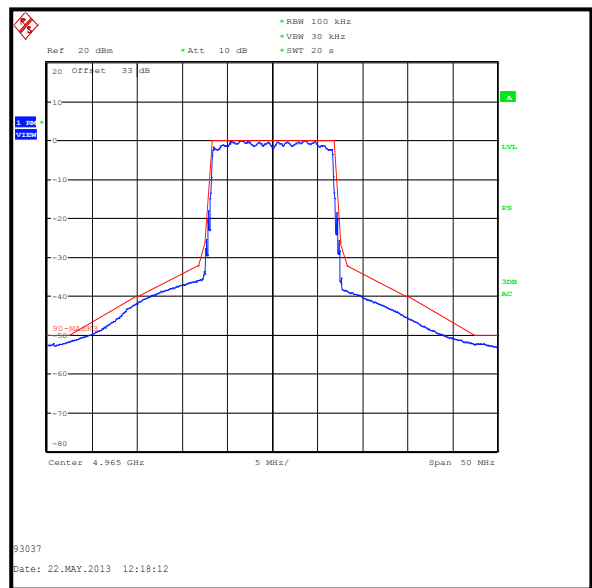
ACQ



BPSK



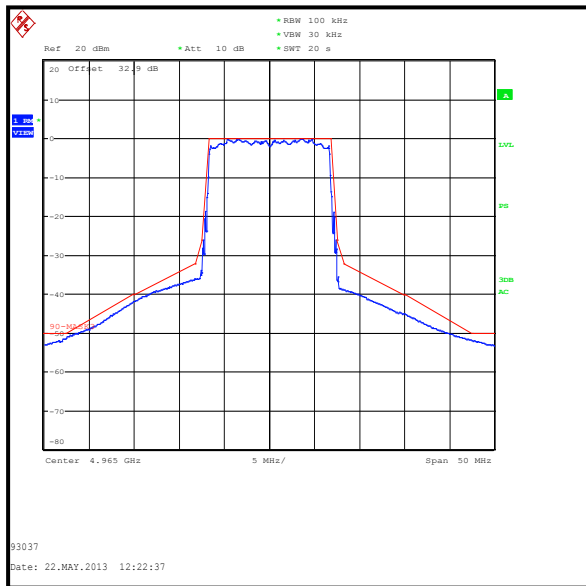
QPSK



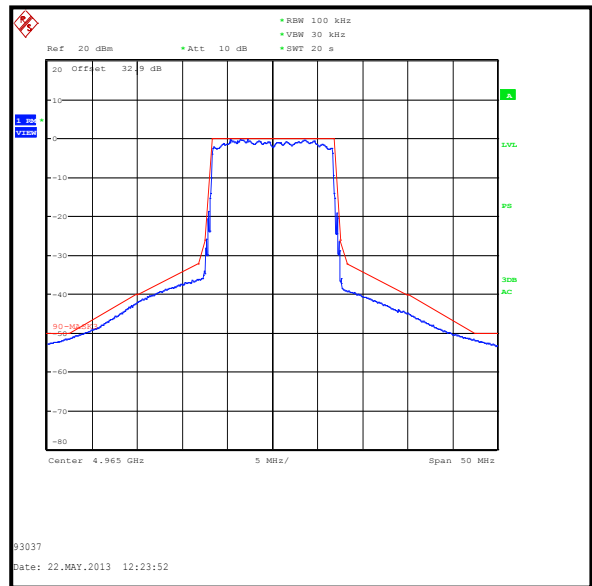
16QAM

Conducted Emission Mask (continued)

Results: 15 MHz Channel Bandwidth / Middle Channel



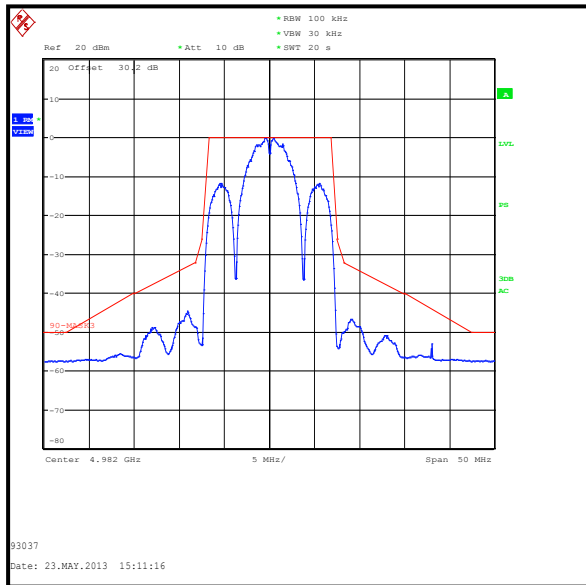
64QAM



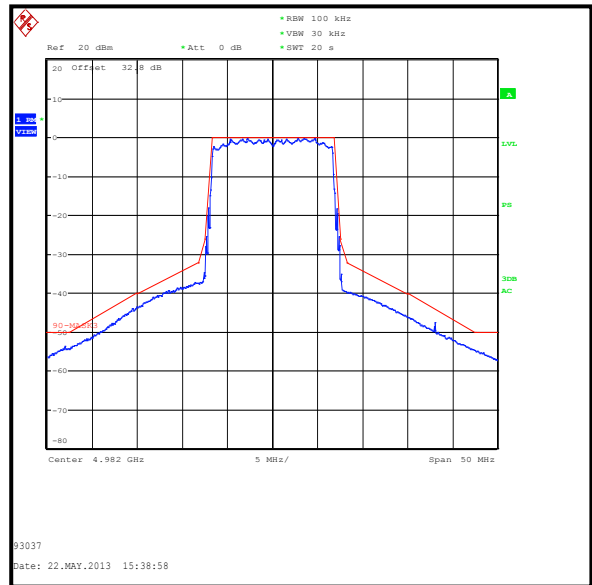
256QAM

Conducted Emission Mask (continued)

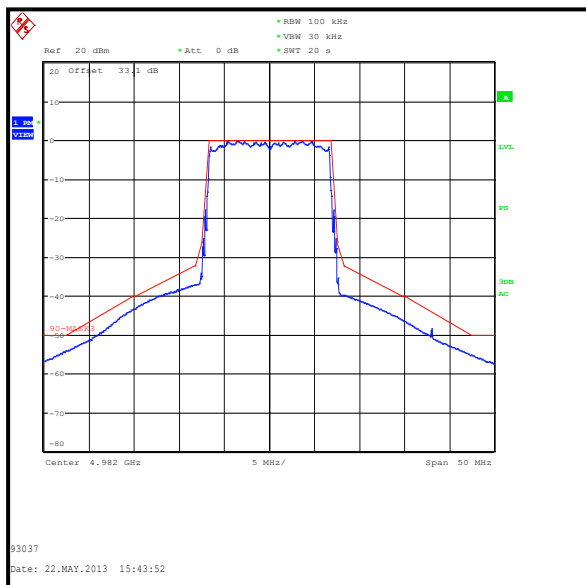
Results: 15 MHz Channel Bandwidth / Top Channel



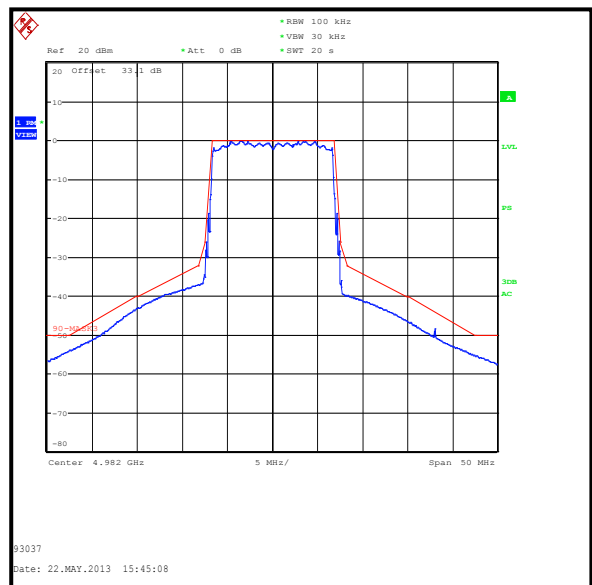
ACQ



BPSK



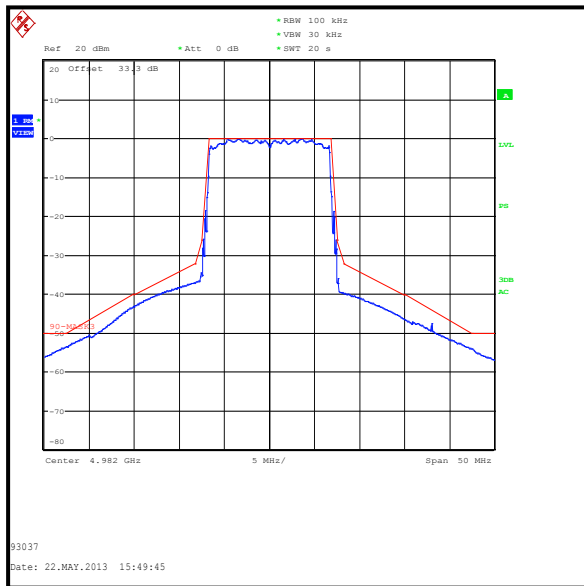
QPSK



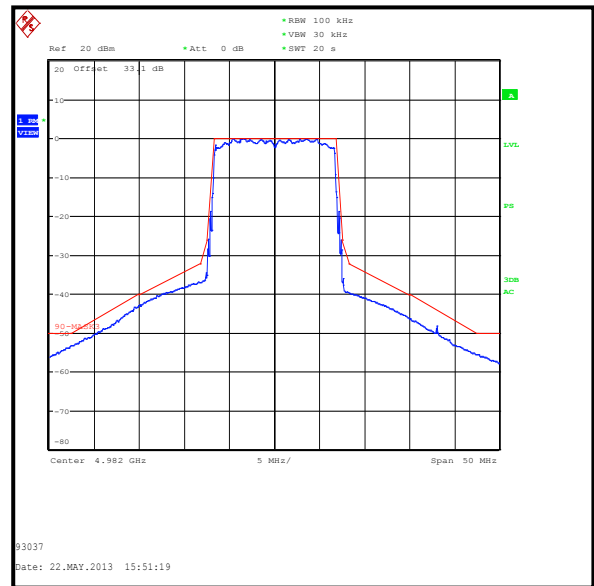
16QAM

Conducted Emission Mask (continued)

Results: 15 MHz Channel Bandwidth / Top Channel



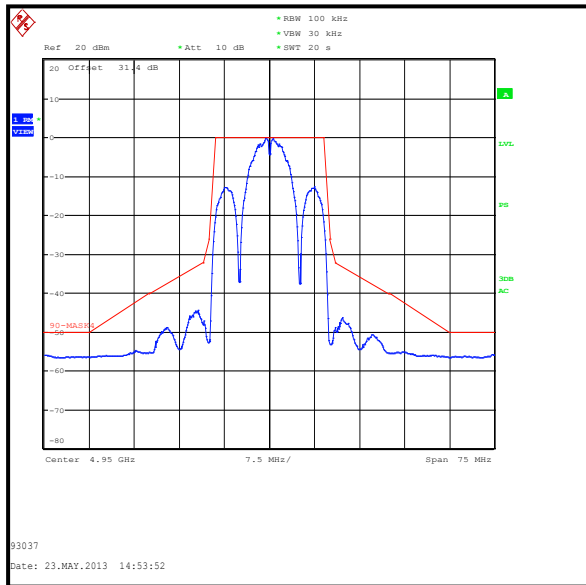
64QAM



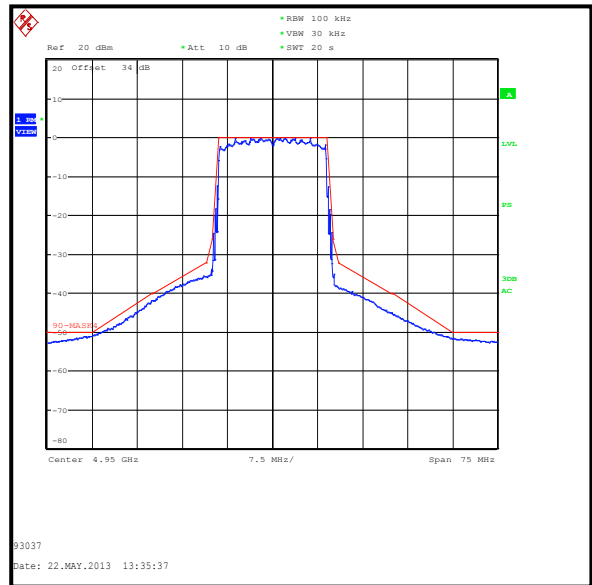
256QAM

Conducted Emission Mask (continued)

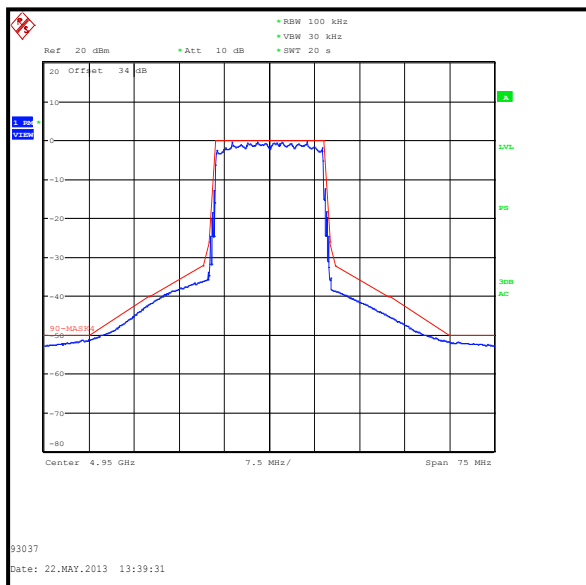
Results: 20 MHz Channel Bandwidth / Bottom Channel



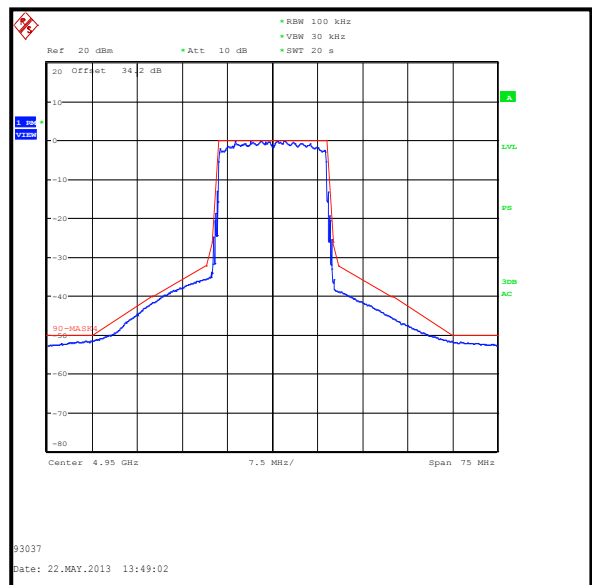
ACQ



BPSK



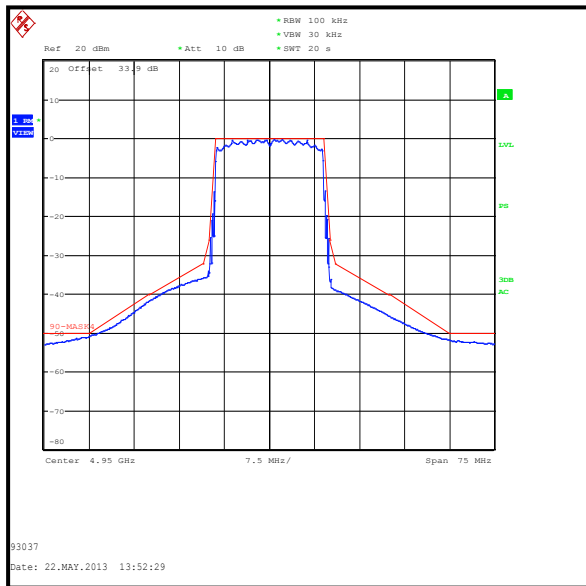
QPSK



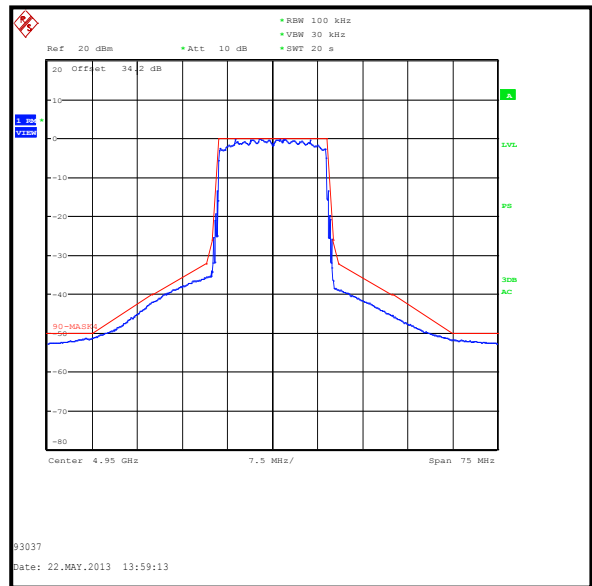
16QAM

Conducted Emission Mask (continued)

Results: 20 MHz Channel Bandwidth / Bottom Channel



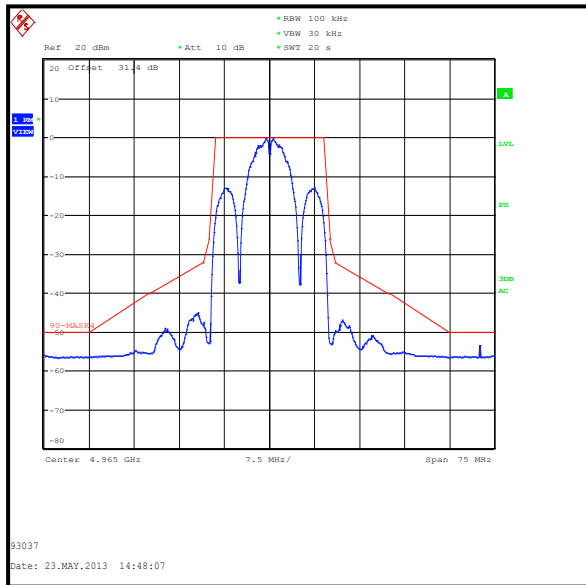
64QAM



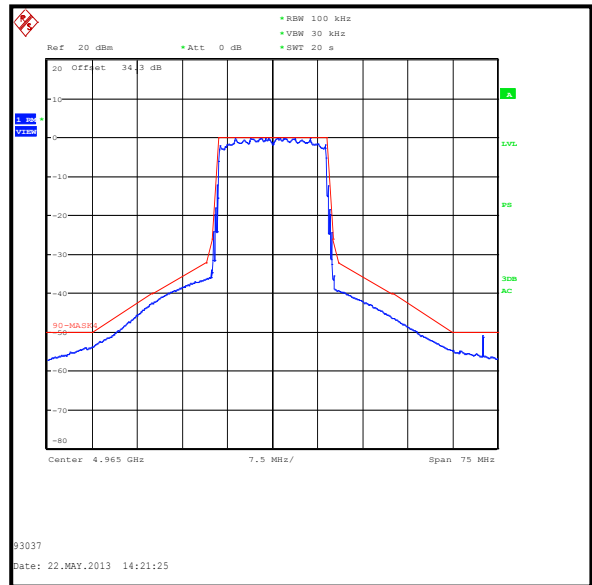
256QAM

Conducted Emission Mask (continued)

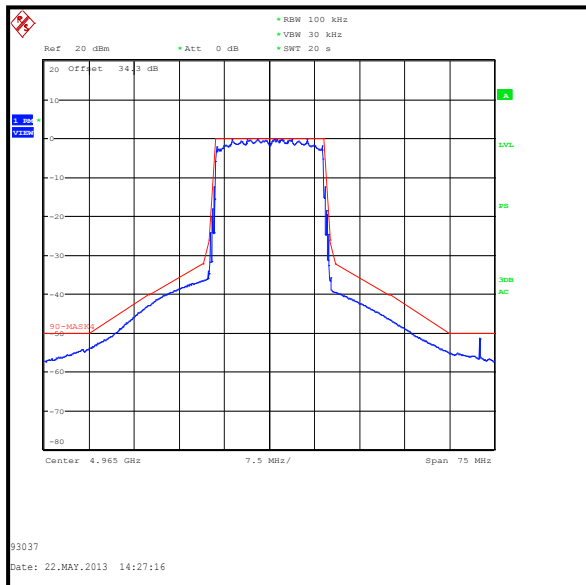
Results: 20 MHz Channel Bandwidth / Middle Channel



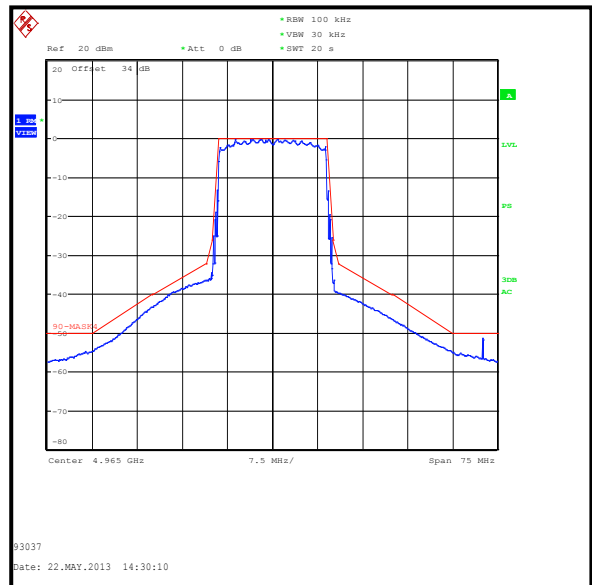
ACQ



BPSK



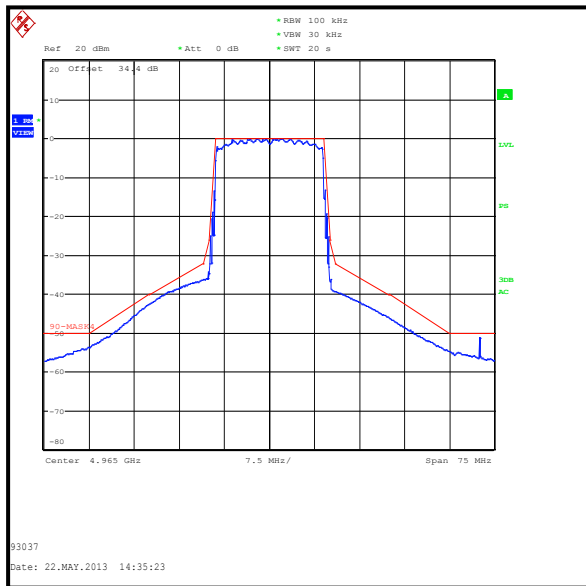
QPSK



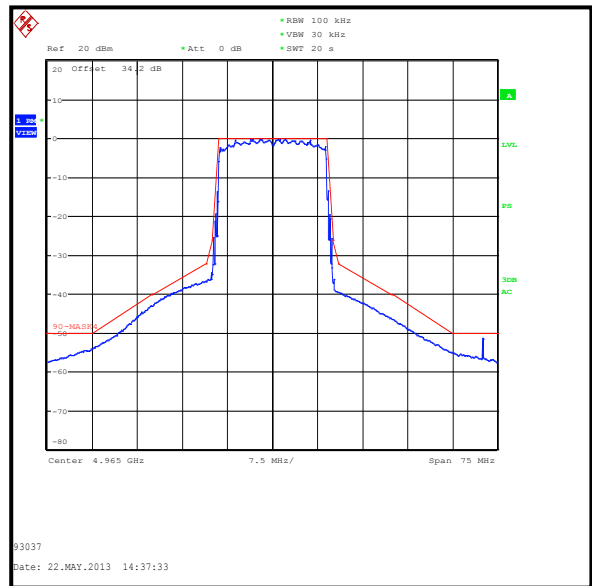
16QAM

Conducted Emission Mask (continued)

Results: 20 MHz Channel Bandwidth / Middle Channel



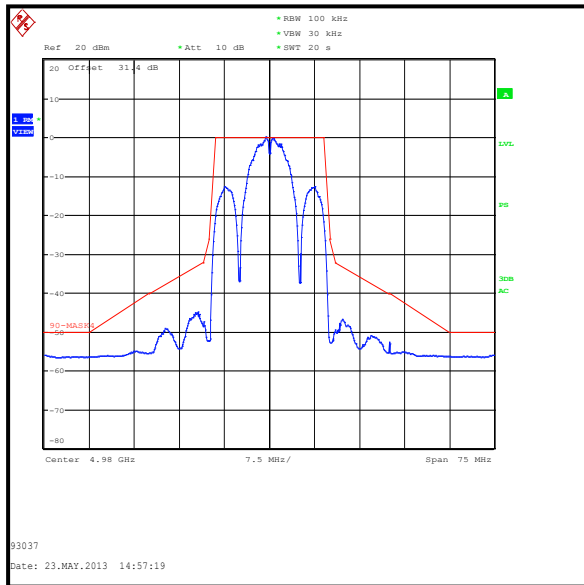
64QAM



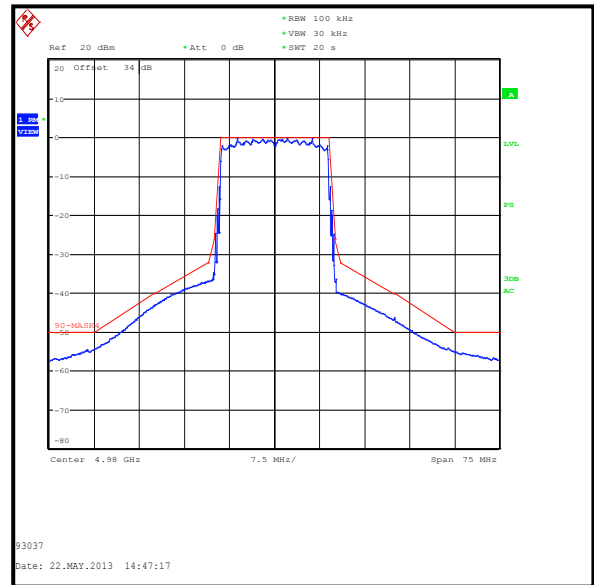
256QAM

Conducted Emission Mask (continued)

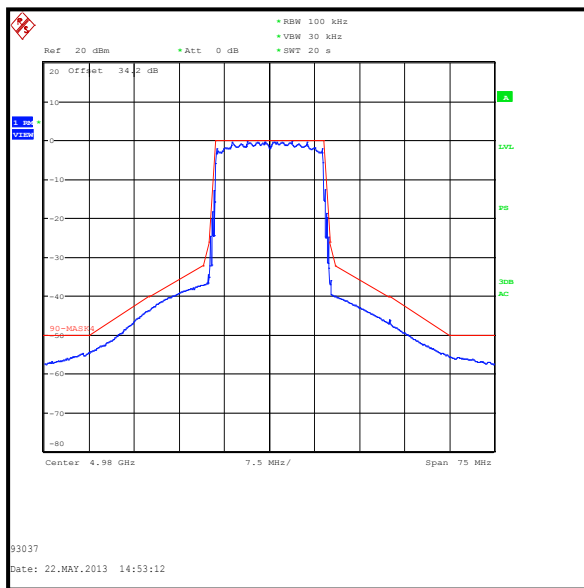
Results: 20 MHz Channel Bandwidth / Top Channel



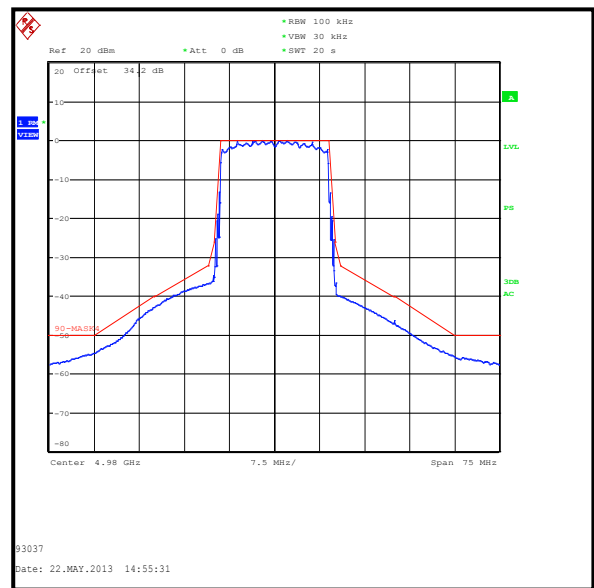
ACQ



BPSK



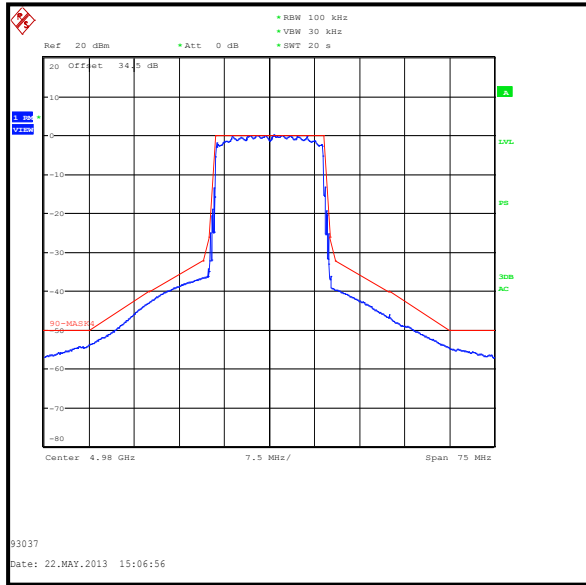
QPSK



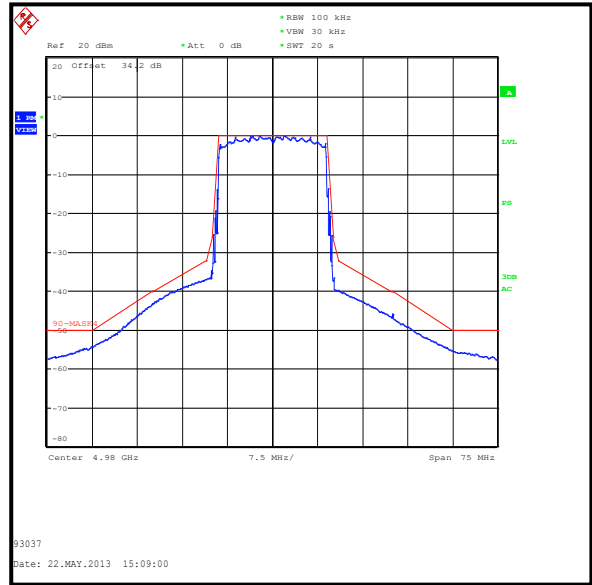
16QAM

Conducted Emission Mask (continued)

Results: 20 MHz Channel Bandwidth / Top Channel



64QAM



256QAM

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2007	Attenuator	Narda	769-20	001	Calibrated Before Use	N/A
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	07 Feb 2014	12
M1659	Thermohygrometer	JM Handelpunkt	30.5015.13	N/A	10 Jun 2013	12

5.2.7. Conducted Emissions**Test Summary:**

Test Engineer:	David Doyle	Test Dates:	23 May 2013 & 02 July 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Part 90.210(m)(6)
Test Method Used:	KDB 971168 D01 Section 6.0
Frequency Range:	9 kHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21 to 26
Relative Humidity (%):	36 to 38

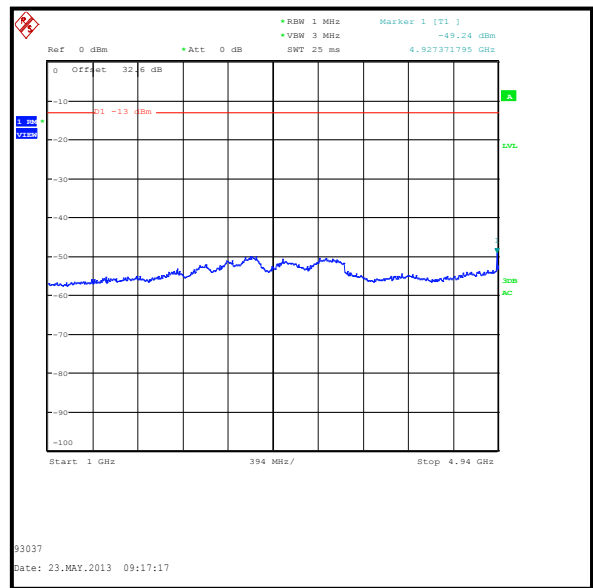
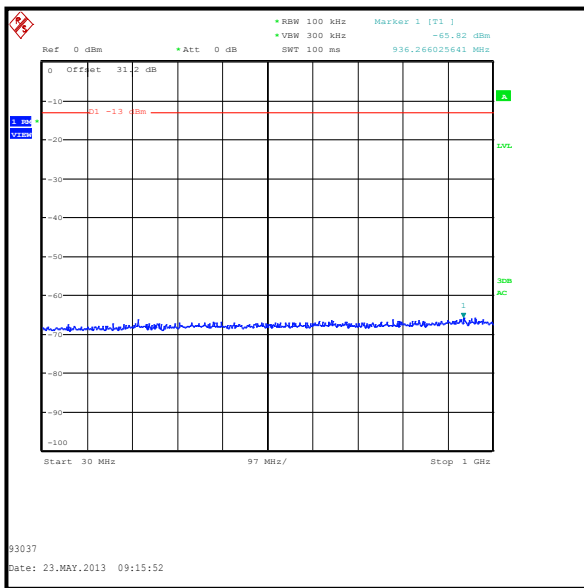
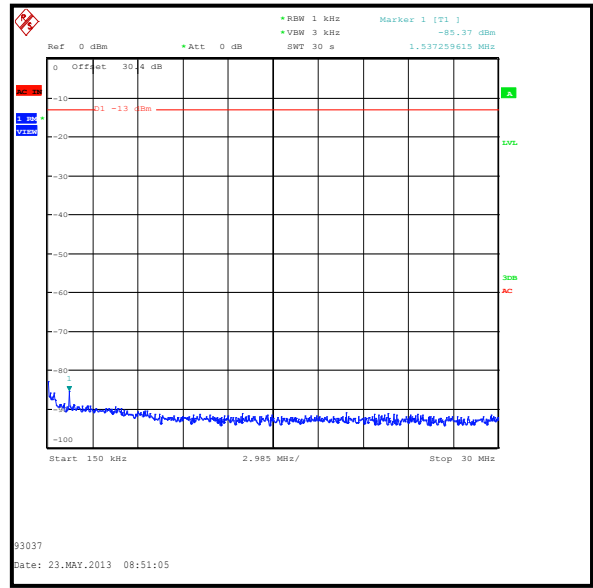
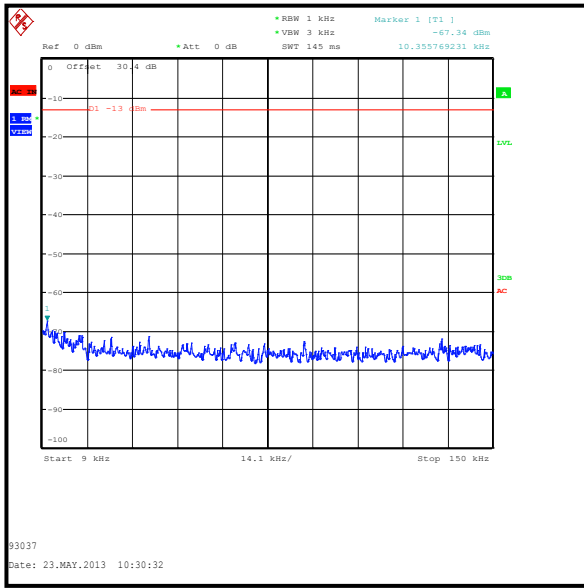
Note(s):

1. Pre-scans were performed with the EUT transmitting at maximum power on the middle channel.
2. The EUT was transmitting with a 5 MHz channel width and QPSK modulation as this produced the highest power level and therefore was deemed worst case.
3. The highest level emission across the measured frequency range was recorded in the table below.
4. The plots show a limit line at -13 dBm. The correct limit should be $55 + 10 \log (P)$ dB (-25 dBm) as shown in the table below.
5. All other emissions were >20 dB below the applicable limit or below the level of the noise floor of the spectrum analyser.

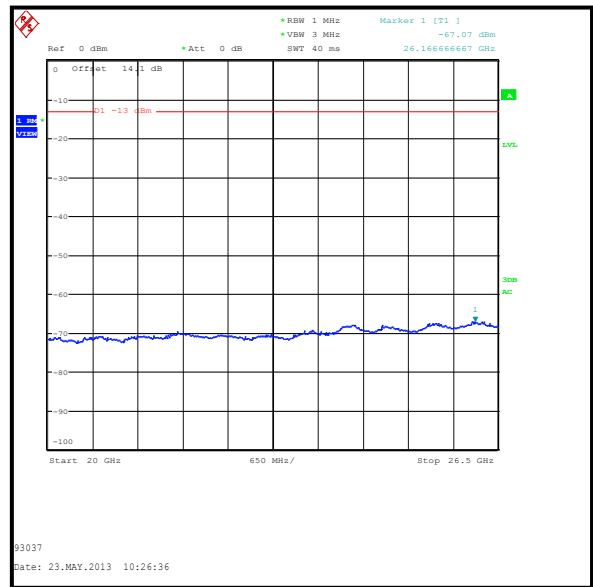
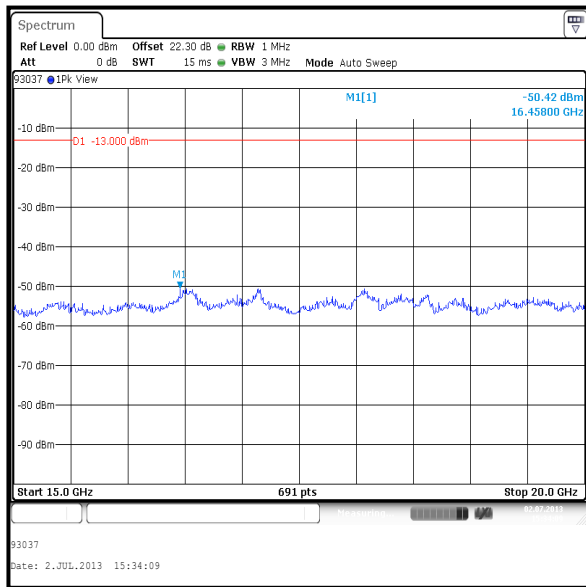
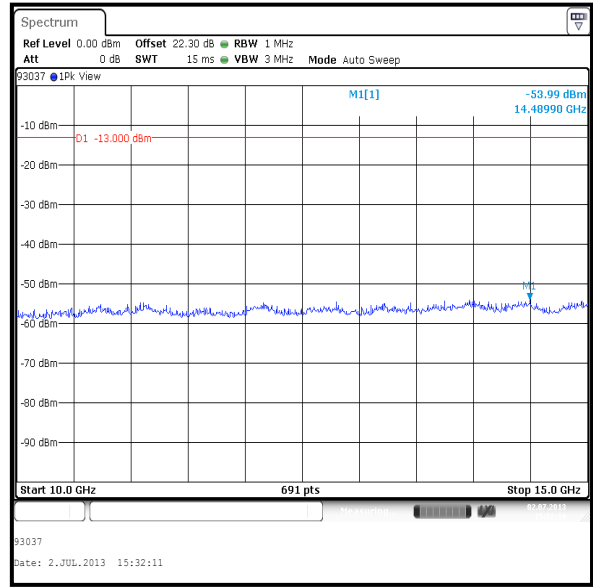
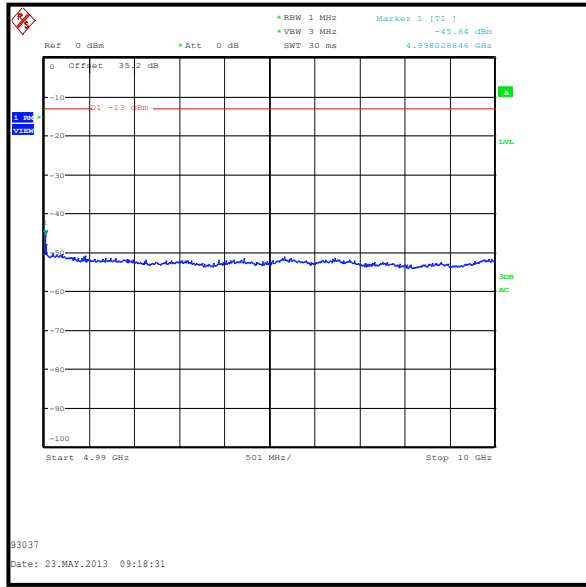
Results: 5 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
4998.029	-45.6	-25.0	20.6	Complied

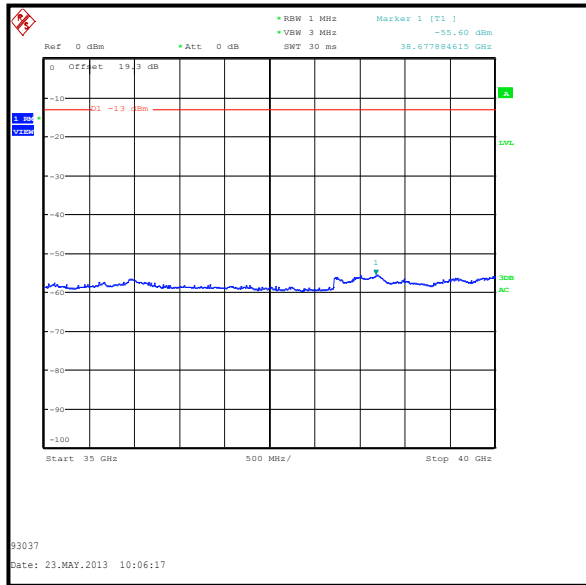
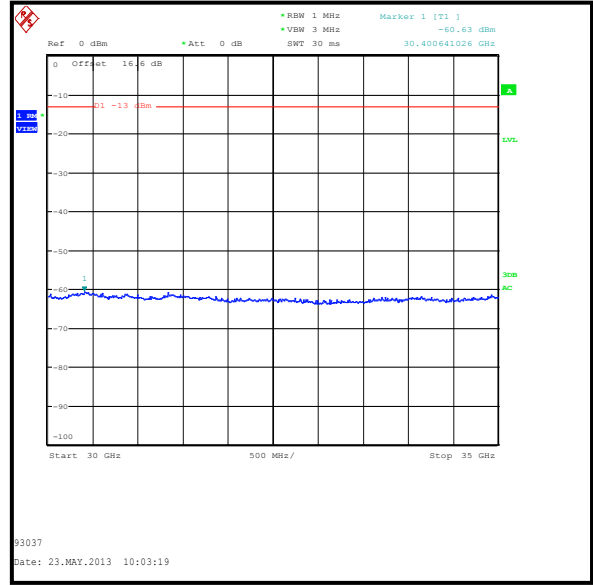
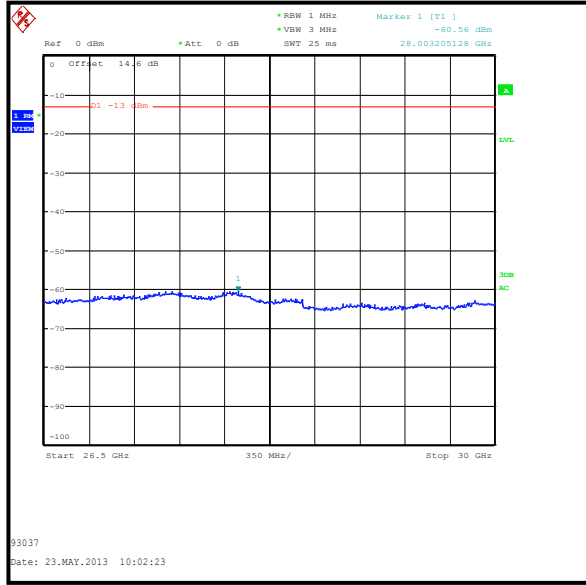
Conducted Emissions (continued)



Conducted Emissions (continued)



Conducted Emissions (continued)



Conducted Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A2007	Attenuator	Narda	769-20	001	Calibrated Before Use	N/A
L1028	Signal analyser	Rohde & Schwarz	FSV30	100854	23 May 2014	12
M1252	Signal Generator	HP	83640A	3119A00489	16 Sep 2013	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	07 Feb 2014	12
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	N/A	24 May 2014	12

5.2.8. Radiated Spurious Emissions**Test Summary:**

Test Engineer:	Ian Watch	Test Dates:	28 June 2013 & 02 July 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Part 90.213(m)
Test Method Used:	KDB 971168 D01 Section 7.0

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	43

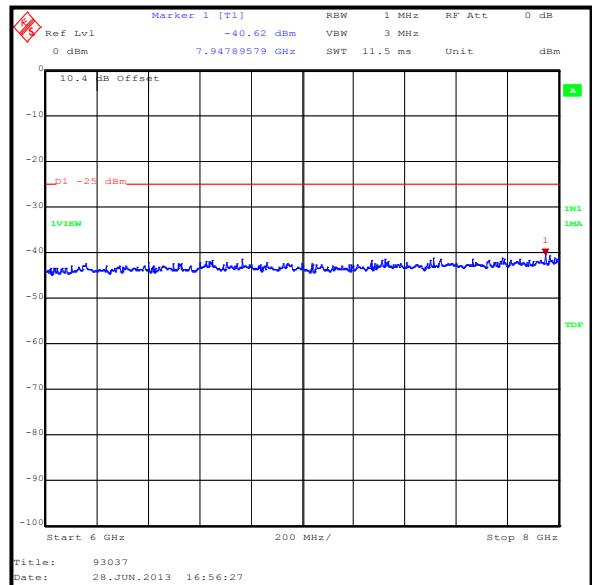
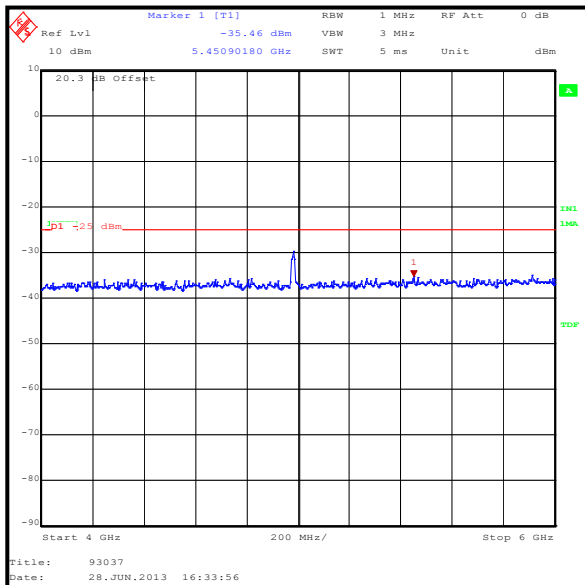
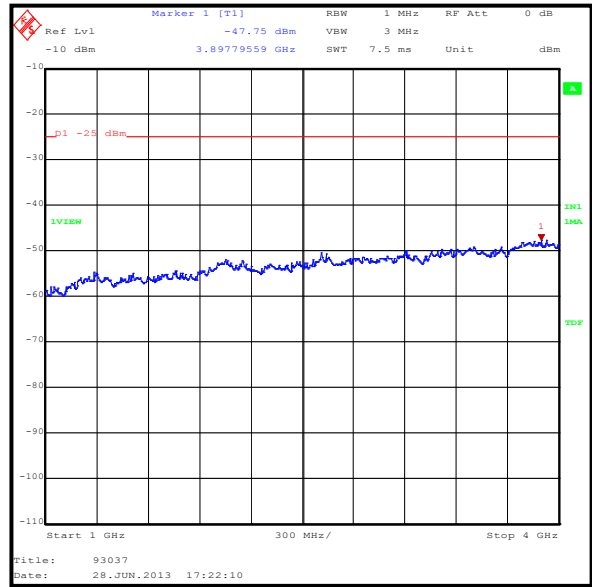
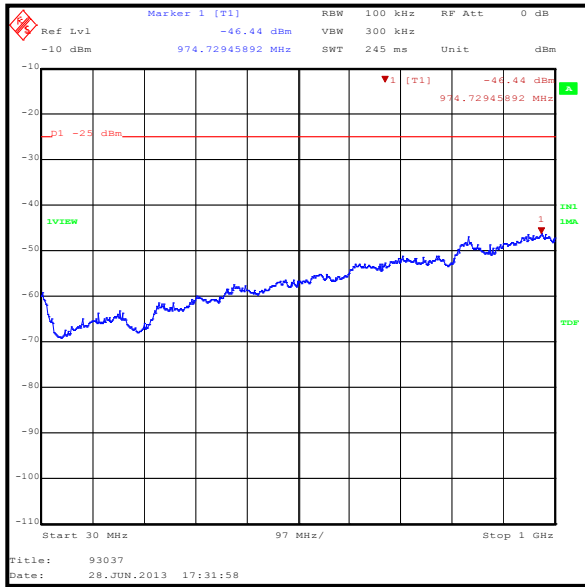
Note(s):

1. Antenna port conducted measurements were performed to demonstrate compliance. In addition, radiated spurious emission measurements (case radiation) were also performed in an anechoic chamber with both RF ports terminated.
2. The PoE supply and controlling laptop PC were located in the ante-chamber and connected by Ethernet cable. All unused ports were terminated into an Ethernet hub.
3. The EUT was transmitting using a 5 MHz channel and QPSK modulation as this produced the highest power level and therefore was deemed worst case.
4. The carrier is shown on the 4 GHz to 6 GHz plot.
5. No spurious emissions were detected above the noise floor of the measuring receiver. The highest peak noise floor reading of the measuring receiver was recorded.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (UL Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (UL Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (UL Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

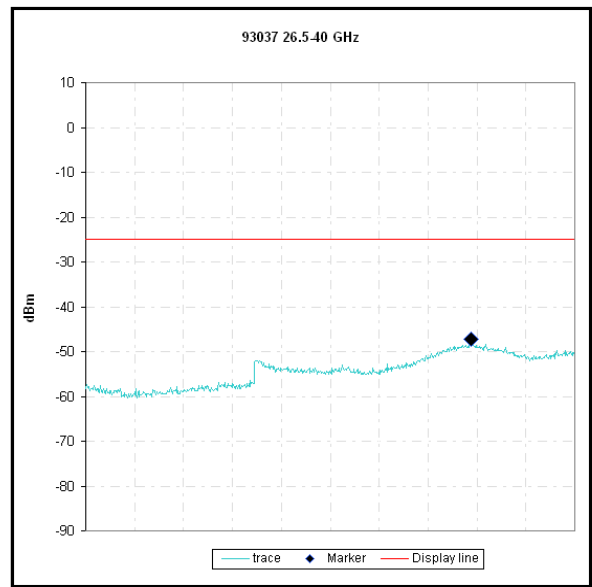
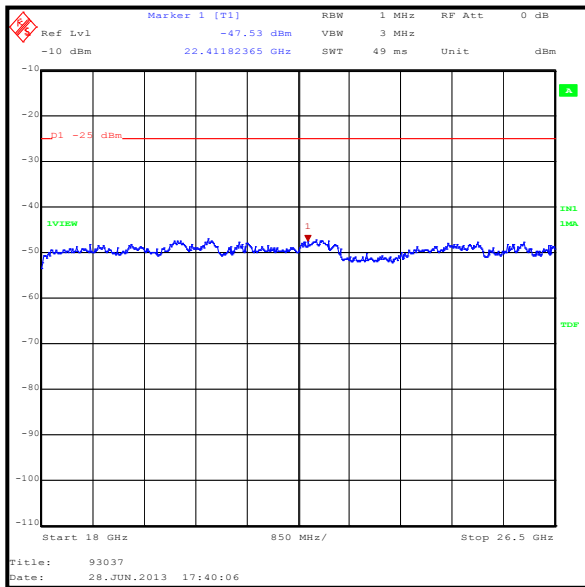
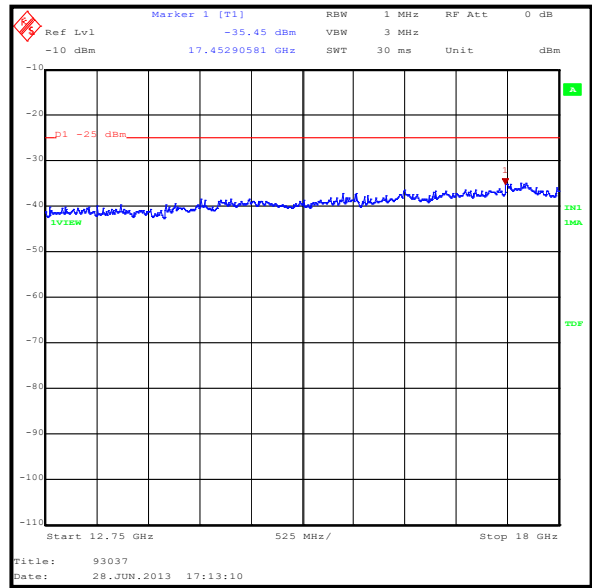
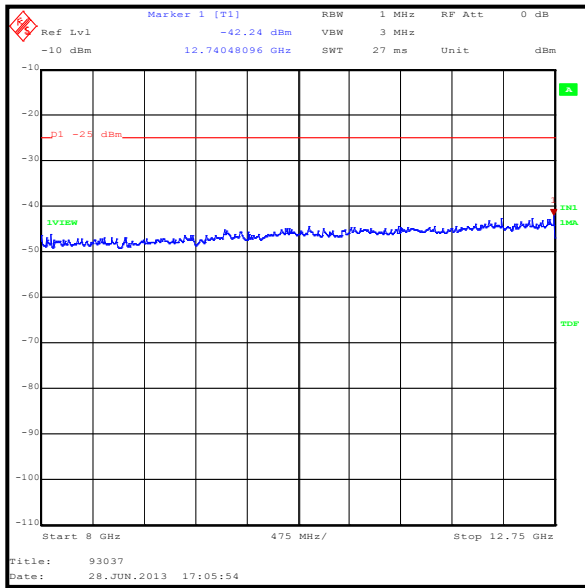
5 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
17452.906	-35.5	-25.0	10.5	Complied

Radiated Spurious Emissions (continued)



Radiated Spurious Emissions (continued)



RBW 1000 KHz; VBW 3000 KHz
Peak 37142.500 MHz; -48.2 dBm
Display line: -25 dBm
Start Freq: 26500 MHz
Stop Freq: 40000 MHz

Radiated Spurious Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A203	Antenna	Flann Microwave	22240-20	343	19 May 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	24 Oct 2013	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	04 Nov 2013	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	04 Nov 2013	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	14 Aug 2013	12
A1818	Antenna	EMCO	3115	00075692	04 Nov 2013	12
A253	Antenna	Flann Microwave	12240-20	128	04 Nov 2013	12
A254	Antenna	Flann Microwave	14240-20	139	04 Nov 2013	12
A255	Antenna	Flann Microwave	16240-20	519	04 Nov 2013	12
A256	Antenna	Flann Microwave	18240-20	400	04 Nov 2013	12
A436	Antenna	Flann Microwave	20249-20	330	04 Nov 2013	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	07 Feb 2014	12
A1817	Antenna	EMCO	3115	00075694	22 Feb 2014	12
M1584	Spectrum Analyser	HP	8564E	3943A01884	05 Mar 2014	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12

5.2.9. Frequency Stability (Temperature Variation)**Test Summary:**

Test Engineer:	David Doyle	Test Date:	24 May 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Parts 90.213 & 2.1055
Test Method Used:	ANSI TIA-603-C-2004 Section 2.2.2 referencing Part 2.1055 / KDB 971168 D01 Section 9.0.

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	39

Note(s):

1. Frequency stability was measured using the frequency count function of a spectrum analyser.
2. The EUT was configured continuously transmit a CW signal at maximum power during the test.
3. Temperature was monitored throughout the test with a calibrated digital thermometer.
4. The Customer declared the frequency stability as 10 ppm.

Results:

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	4987.004055	4055	0.8131	10	9.1869	Complied
-20	4987.002124	2124	0.4259	10	9.5741	Complied
-10	4987.000749	749	0.1502	10	9.8498	Complied
0	4986.999618	382	0.0766	10	9.9234	Complied
10	4986.999256	744	0.1492	10	9.8508	Complied
20	4986.999105	895	0.1795	10	9.8205	Complied
30	4986.998931	1069	0.2144	10	9.7856	Complied
40	4987.000647	647	0.1297	10	9.8703	Complied
50	4987.004260	4260	0.8542	10	9.1458	Complied

Frequency Stability (Temperature Variation)(Continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	07 Feb 2014	12
M1642	Thermometer	Fluke	52II	18890119	19 Mar 2014	12
E0513	Environmental Chamber	TAS	LT600 Series 3	23900506	Calibrated Before Use	N/A
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	N/A	10 Jun 2013	12

5.2.10. Frequency Stability (Voltage Variation)**Test Summary:**

Test Engineer:	David Doyle	Test Date:	24 May 2013
Test Sample Serial Number:	00045650008E		

FCC Reference:	Parts 90.213 & 2.1055
Test Method Used:	ANSI TIA-603-C-2004 Section 2.2.2 referencing Part 2.1055 / KDB 971168 D01 Section 9.0.

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	38

Note(s):

1. Frequency stability was measured using the frequency count function of a spectrum analyser.
2. The EUT was configured continuously transmit a CW signal at maximum power during the test.
3. Voltage was monitored throughout the test with a calibrated digital voltmeter.
4. The Customer declared the frequency stability limit as 10 ppm.

Results:

PoE Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
102	4986.999127	873	0.1751	10	9.8249	Complied
138	4986.999159	841	0.1686	10	9.8314	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	07 Feb 2014	12
M1642	Thermometer	Fluke	52II	18890119	19 Mar 2014	12
M1251	Digital Multimeter	Fluke	175	89170179	30 Jul 2013	12
E0513	Environmental Chamber	TAS	LT600 Series 3	23900506	Calibrated Before Use	N/A

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Conducted Output Power	4940 MHz to 4990 MHz	95%	±0.27 dB
Power Spectral Density	4940 MHz to 4990 MHz	95%	±2.94 dB
Occupied Bandwidth	4940 MHz to 4990 MHz	95%	±0.92 ppm
Conducted Spurious Emissions	9 kHz to 40 GHz	95%	±2.62 dB
Frequency Stability	4940 MHz to 4990 MHz	95%	±0.92 ppm
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	30 MHz to 40 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	75 & 84	-	Added reference measurements. Updated notes