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Report On

FCC Testing of the Sharp SHV31 Dual-band UMTS (FDDI, FDDV) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Quad-band LTE (B1,B3, B17, B26) & AXGP (TDD41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 27

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FCC ID: APYHRO00214

Document 75928148 Report 15 Issue 1 **December 2014**

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COMMERCIAL-IN-CONFIDENCE

REPORT ON

FCC Testing of the
Sharp SHV31 Dual-band UMTS (FDDI, FDDV) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Quad-band LTE (B1,B3, B17, B26) & AXGP (TDD41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 27

Document 75928148 Report 15 Issue 1

December 2014

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DATED 23 December 2014

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47 Part 2 and FCC CFR 47 Part 27. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

G Lawler M Russell N Rousell

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SECTION 1

REPORT SUMMARY

FCC Testing of the
Sharp SHV31 Dual-band UMTS (FDDI, FDDV) & Quad-band GSM
(GSM850/GSM900/DCS1800/PCS1900) & Quad-band LTE (B1,B3, B17, B26) & AXGP
(TDD41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 27

1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC Testing of the Sharp SHV31 Dual-band UMTS (FDDI, FDDV) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Quad-band LTE (B1,B3, B17, B26) & AXGP (TDD41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS to the requirements of FCC CFR 47 Part 2 and FCC CFR 47 Part 27.

Objective	To perform FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Sharp Corporation
Model Number(s)	SHV31
Serial Number(s)	IMEI 004401115315943 IMEI 004401115315885
Number of Samples Tested	2
Test Specification/Issue/Date	FCC CFR 47 Part 2 (2013) FCC CFR 47 Part 27 (2013)
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	10329 20 October 2014
Start of Test	10 November 2014
Finish of Test	11 December 2014
Name of Engineer(s)	G Lawler M Russell N Rousell
Related Document(s)	ANSI C63.4: 2003 FCC KDB 971168 D01 v02r02 ANSI TIA-603-C-2004

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 27 is shown below.

Section	Spec Clause		Test Description	Result	Comments/Base Standard
	Pt 2	Pt 27			
LTE FDD 17					
2.1	2.1046	27.50	Power Limits and Duty Cycle	Pass	
2.2	2.1047(d)	-	Modulation Characteristics	Pass	
2.3	2.1049	27.53	Emission Limits	Pass	
2.4	2.1055	27.54	Frequency Stability	Pass	

1.3 PRODUCT TECHNICAL DESCRIPTION

Please refer to the SHV31 Model Description Form.

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Sharp SHV31 Dual-band UMTS (FDDI, FDDV) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Quad-band LTE (B1,B3, B17, B26) & AXGP (TDD41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS. A full technical description can be found in the manufacturer's documentation.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a 4.0 V DC supply.

FCC Measurement Facility Registration Number
90987 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.

Product Service

SECTION 2

TEST DETAILS

FCC Testing of the
Sharp SHV31 Dual-band UMTS (FDDI, FDDV) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Quad-band LTE (B1,B3, B17, B26) & AXGP (TDD41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 27

Product Service

2.1 POWER LIMITS AND DUTY CYCLE

2.1.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1046
FCC CFR 47 Part 27, Clause 27.50

2.1.2 Equipment Under Test and Modification State

SHV31 S/N: IMEI 004401115315943 - Modification State 0

2.1.3 Date of Test

10 November 2014 & 8 December 2014

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Procedure

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2.1046 and KDB 971168, clause 5.2.3.

Carrier Power

The path loss between the EUT and the Power Meter was measured using a Network Analyser. The EUT was connected to a wideband RF average Power Meter via a cable, attenuator and combiner. The recorded path loss was entered as an offset on the Power Meter. The other port of the combiner was connected to a wideband communications tester.

Measurements were performed with the EUT operating at maximum power on bottom, middle and top frequencies on QPSK and 16-QAM modulation schemes with all resource blocks and a single resource block positioned at the low, middle and high position for each channel bandwidth.

The average power was then recorded as shown in the following tables.

Peak to Average Ratio

The path loss between the EUT and the Spectrum Analyser was measured using a Network Analyser. The EUT was connected to a Spectrum Analyser via a cable, attenuator and combiner. The recorded path loss was entered as a reference level offset on the Spectrum Analyser. The other port of the combiner was connected to a wideband communications tester.

Using the CCDF of the spectrum analyser and the procedure defined in KDB 971168, section 5.7.1, the peak to average ratio was recorded, the measurement was repeated ten times and the highest result was recorded as shown in the tables below.

Measurements were performed with the EUT operating at maximum power on bottom, middle and top frequencies on QPSK and 16-QAM modulation schemes with all resource blocks and a single resource block positioned at the low, middle and high position for each channel bandwidth.

Effective Radiated Power

Measurements of the fundamental from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The fundamental frequency was maximised by adjusting the antenna height, antenna polarisation and turntable azimuth. A peak detector was used with the trace set to max hold. The maximum result was recorded.

The mast and controller were then returned to the positions which gave the maximum result. The Spectrum Analyser detector was set to rms and configured to integrate the power over the entire emission bandwidth to give the total output power.

The EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result (ERP) was determined by a calculation using the signal generator level, antenna gain and cable loss.

Measurements were performed in the configuration that yielded the highest conducted RF output power for every supported modulation scheme on each bandwidth, as determined in the tables below. The measurements were performed at a 3m distance unless otherwise stated.

2.1.6 Environmental Conditions

Ambient Temperature	19.2 - 20.6°C
Relative Humidity	27.0 - 46.8%

Product Service

2.1.7 Test Results

4.0 V DC Supply

Conducted Power

Carrier Power

5.0 MHz Bandwidth - QPSK

Carrier Power (dBm)											
706.5 MHz				710.0 MHz				713.5 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
23.7	23.7	23.7	22.6	23.7	23.6	23.6	22.7	23.7	23.5	23.6	22.7

5.0 MHz Bandwidth – 16-QAM

Carrier Power (dBm)											
706.5 MHz				710.0 MHz				713.5 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
22.7	22.7	22.6	21.7	22.8	22.7	22.6	21.7	22.7	22.7	22.7	21.7

10.0 MHz Bandwidth - QPSK

Carrier Power (dBm)											
709.0 MHz				710.0 MHz				711.0 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
23.6	23.6	23.6	22.7	23.5	23.4	23.4	22.6	23.8	23.7	23.7	22.8

10.0 MHz Bandwidth – 16-QAM

Carrier Power (dBm)											
709.0 MHz				710.0 MHz				711.0 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
22.9	22.8	22.7	21.7	22.7	22.7	22.7	21.7	22.6	22.5	22.5	21.7

Peak to Average Ratio

5.0 MHz Bandwidth - QPSK

Peak To Average Ratio (dB)											
706.5 MHz				710.0 MHz				713.5 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
4.4	4.8	4.8	6.1	4.7	4.8	4.7	6.1	4.8	4.6	4.4	6.0

5.0 MHz Bandwidth – 16-QAM

Peak To Average Ratio (dB)											
706.5 MHz				710.0 MHz				713.5 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
5.3	5.8	5.8	6.9	5.7	5.9	5.7	7.2	6.1	5.9	5.7	7.1

10.0 MHz Bandwidth - QPSK

Peak To Average Ratio (dB)											
709.0 MHz				710.0 MHz				711.0 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
4.6	4.8	4.9	6.9	4.8	4.9	4.7	6.7	4.7	4.8	4.8	6.6

10.0 MHz Bandwidth – 16-QAM

Peak To Average Ratio (dB)											
709.0 MHz				710.0 MHz				711.0 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
5.8	5.9	4.8	8.3	5.6	5.8	5.5	7.6	6.1	6.0	5.8	7.8

Product Service

Radiated Power

Effective Radiated Power

5.0 MHz Bandwidth - QPSK

Resource Block	706.5 MHz		710.0 MHz		713.5 MHz	
	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)
1 Resource Block - Low	12.96	19.77	13.27	21.23	13.30	21.38

5.0 MHz Bandwidth – 16-QAM

Resource Block	706.5 MHz		710.0 MHz		713.5 MHz	
	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)
1 Resource Block - Low	-	-	12.12	16.29	12.40	17.38
1 Resource Block - Mid	12.08	16.14	-	-	-	-

10.0 MHz Bandwidth - QPSK

Resource Block	709.0 MHz		710.0 MHz		711.0 MHz	
	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)
1 Resource Block - Low	13.03	20.09	12.97	19.82	12.99	19.91

10.0 MHz Bandwidth – 16-QAM

Resource Block	709.0 MHz		710.0 MHz		711.0 MHz	
	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)	Result (dBm)	Result (mW)
1 Resource Block - Low	12.31	17.02	-	-	11.92	15.56
1 Resource Block - Mid	-	-	11.88	15.42	-	-

Remarks

Some resource block configurations were identified as being a lower power and therefore were not tested.

Limit Clause 27.50 (c)(10)

Portable Stations: <3 W

2.2 MODULATION CHARACTERISTICS

2.2.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1047(d)

2.2.2 Equipment Under Test and Modification State

SHV31 S/N: IMEI 004401115315885 - Modification State 0

2.2.3 Date of Test

18 November 2014

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

The following plots show a representation of the Modulation Characteristics of an LTE signal as measured from the EUT using the transmitter measurement functionality of a wideband radio communications tester. Both supported modulation schemes of QPSK and 16-QAM with a 10 MHz bandwidth were recorded as shown in the plots below.

2.2.6 Environmental Conditions

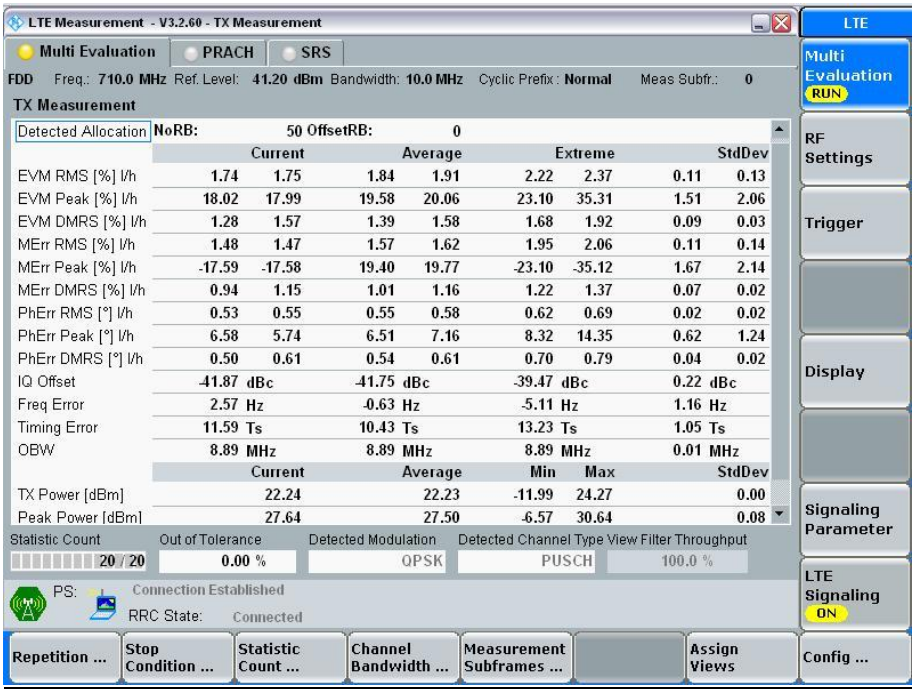
Ambient Temperature	23.3°C
Relative Humidity	43.3%

Product Service

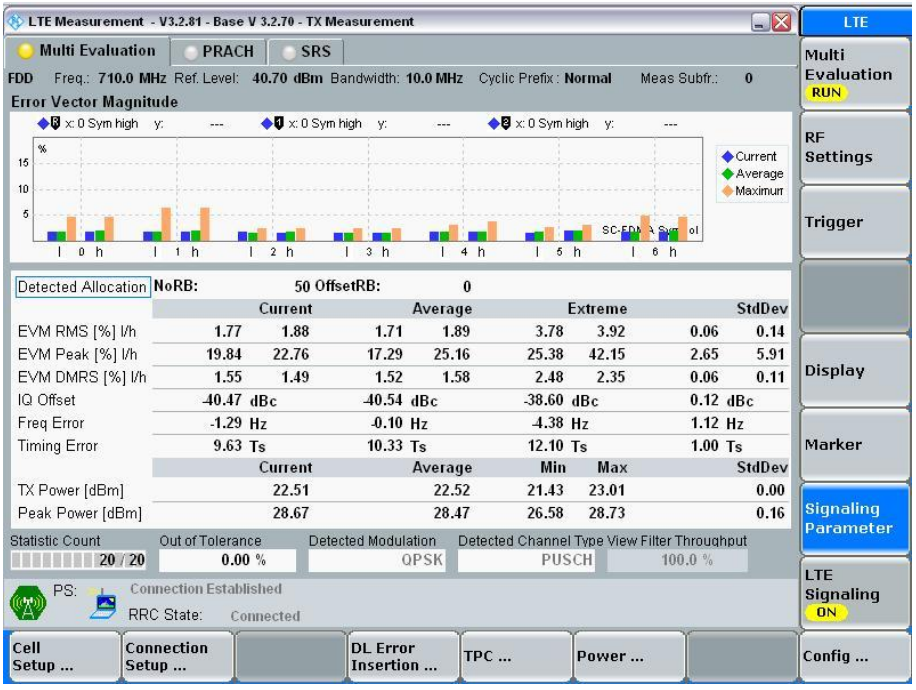
2.2.7 Test Results

10.0 MHz Bandwidth - QPSK

Transmitter Summary

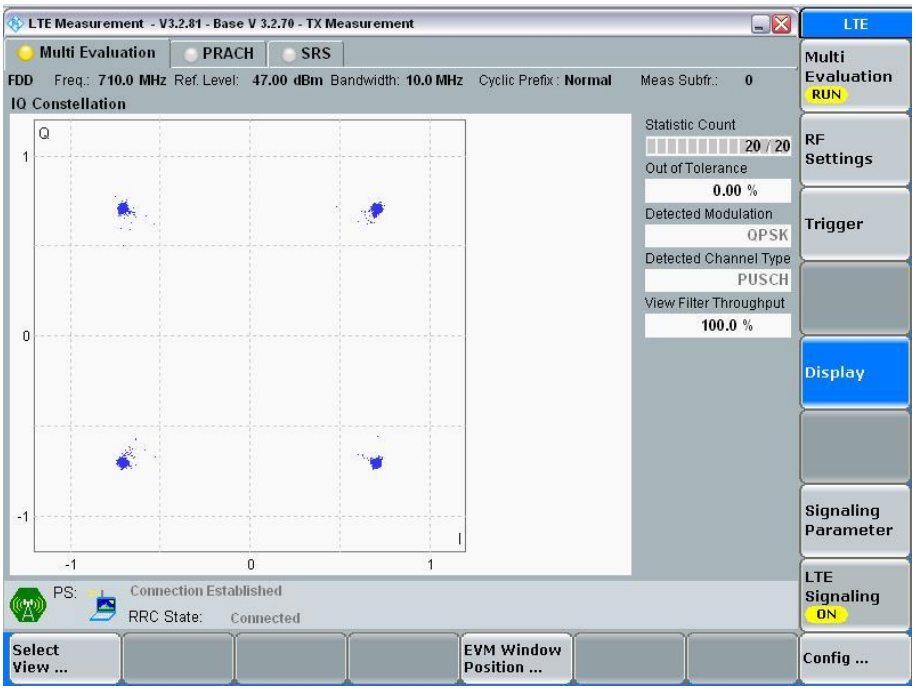


EVM

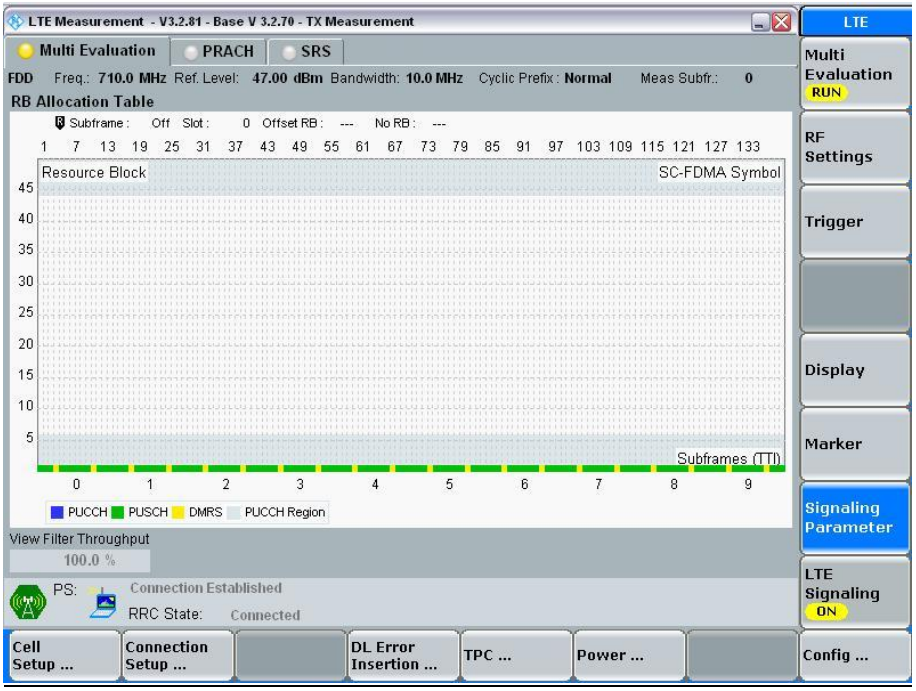


Product Service

IQ Constellation

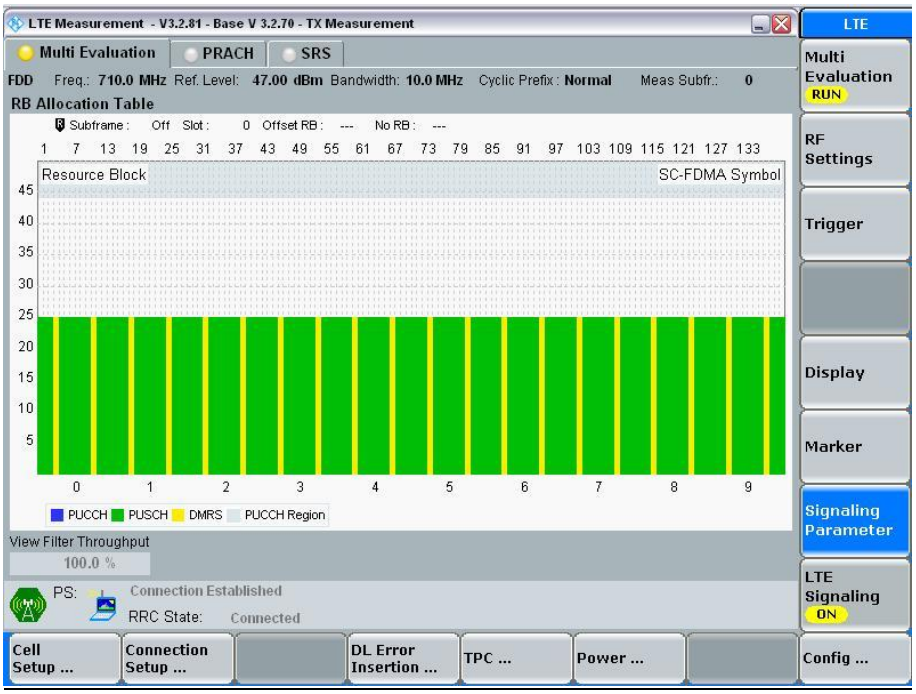


1 Resource Block Allocation

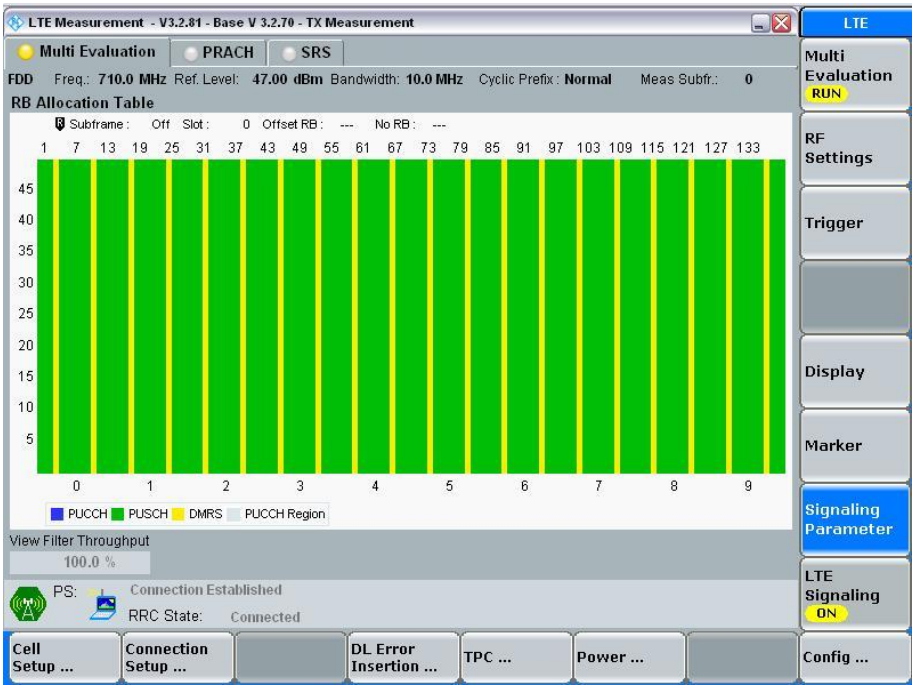


Product Service

25 Resource Block Allocation



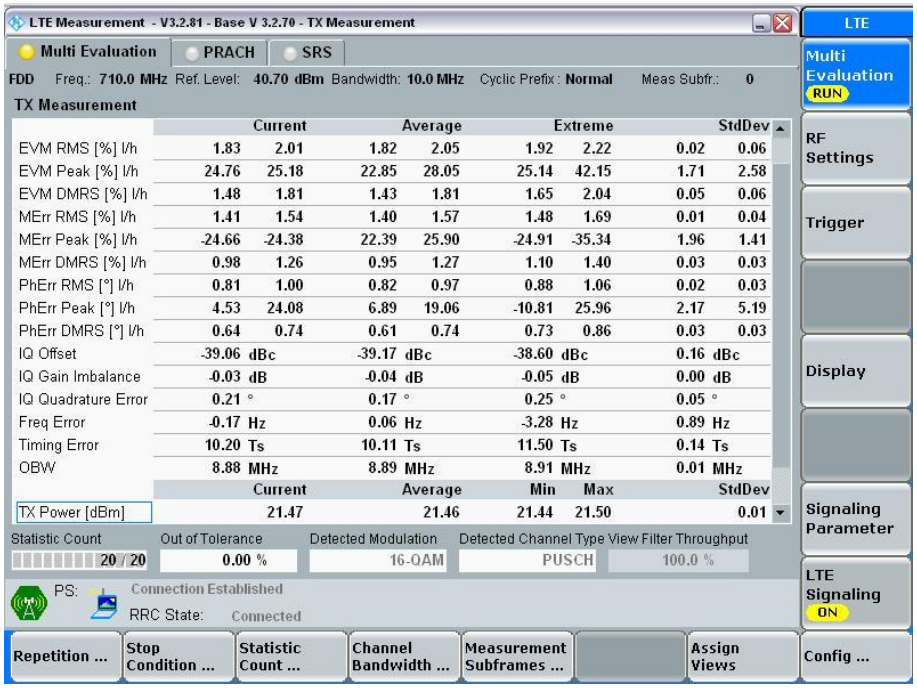
50 Resource Block Allocation



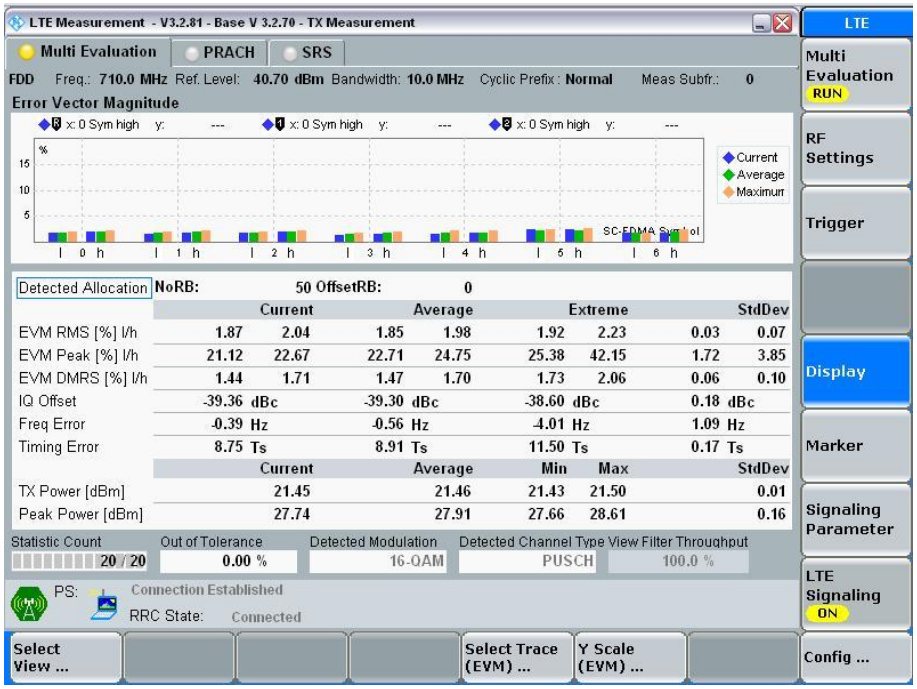
Product Service

10.0 MHz Bandwidth - 16-QAM

Transmitter Summary

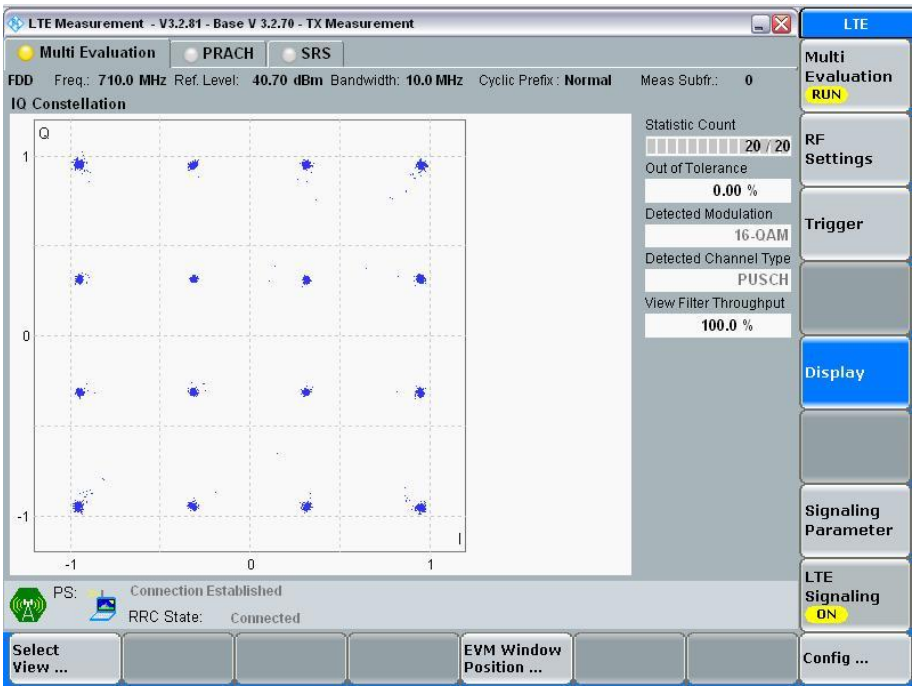


EVM

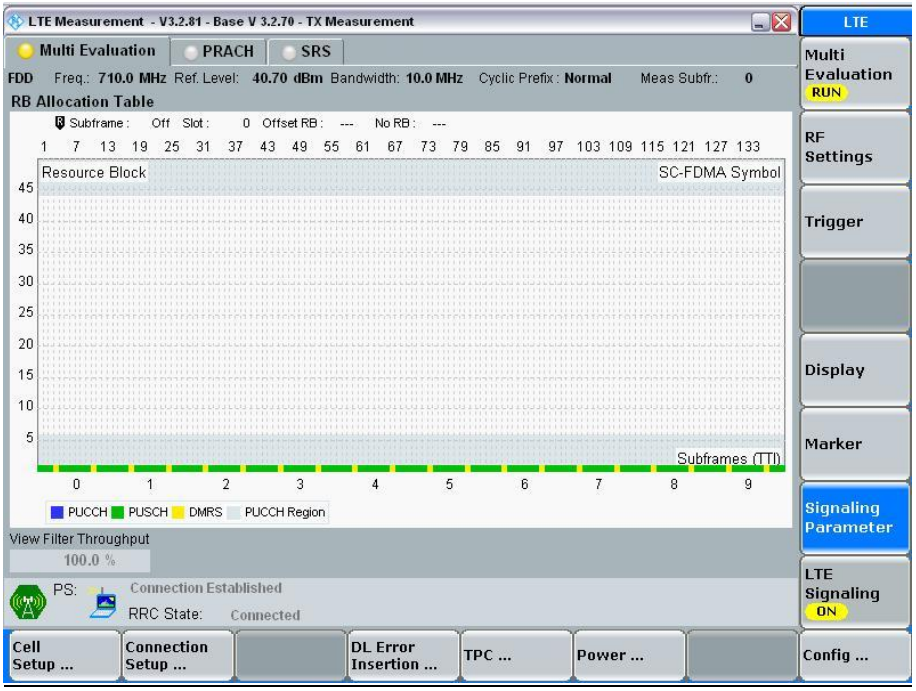


Product Service

IQ Constellation

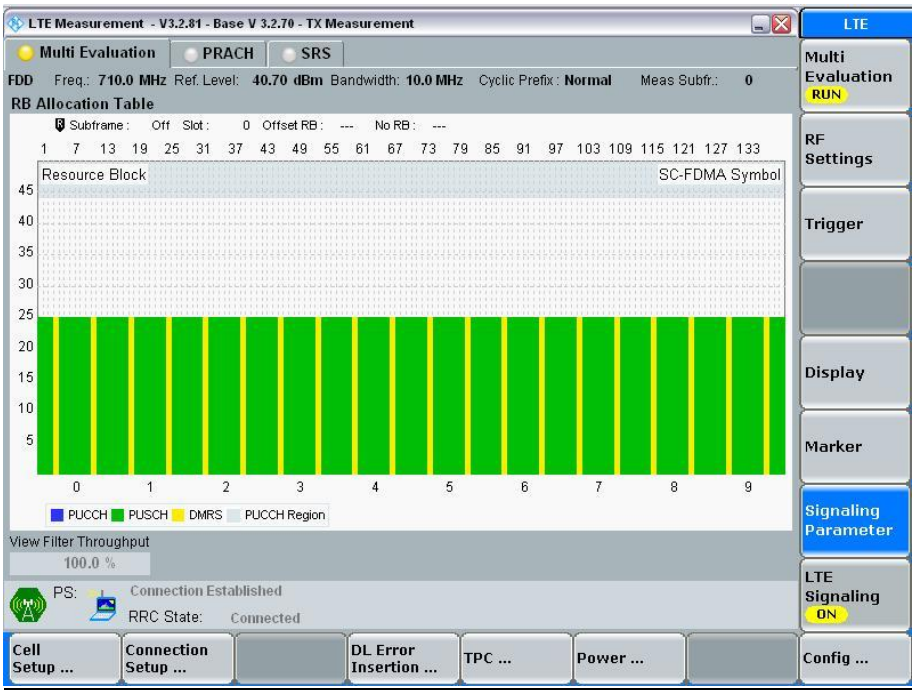


1 Resource Block Allocation

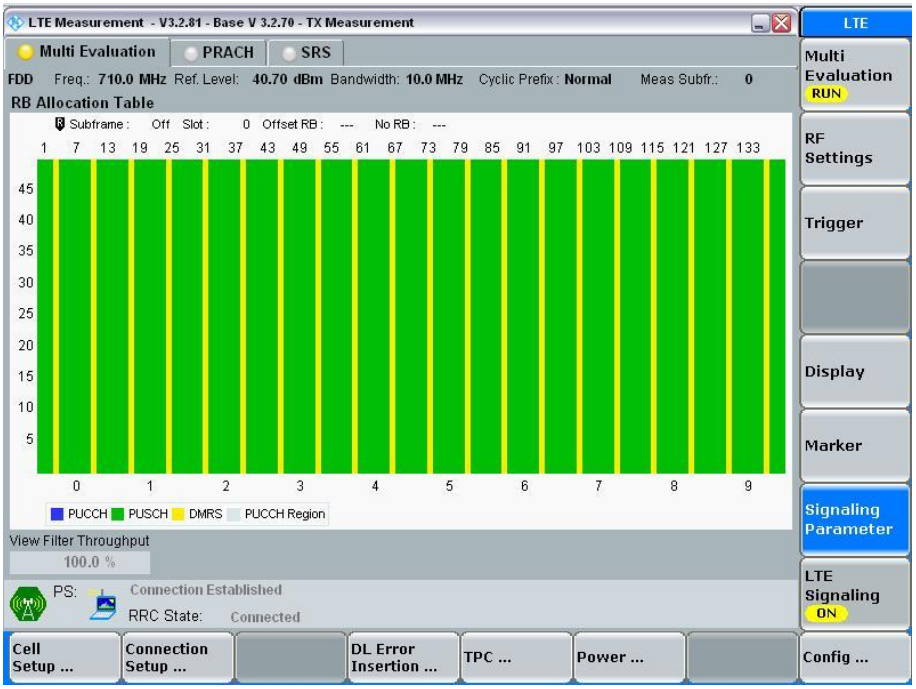


Product Service

25 Resource Block Allocation



50 Resource Block Allocation



Product Service

2.3 EMISSION LIMITS

2.3.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1049, 2.1051 and 2.1053
FCC CFR 47 Part 27, Clause 27.53

2.3.2 Equipment Under Test and Modification State

SHV31 S/N: IMEI 004401115315943 - Modification State 0

2.3.3 Date of Test

15 November 2014, 8 December 2014 & 11 December 2014

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Procedure

Emission Bandwidth

The Spectrum Analyser was configured to measure the Emission Bandwidth of the EUT. This was performed using the markers at the -26 dBc points in accordance with FCC KDB 971168 clause 4.1. The EUT was tested on Bottom, Middle and Top channels, on all channel bandwidths with QPSK/16-QAM modulation and with all resource blocks and a single resource block positioned at the low, mid and high offsets.

Band Edge

The path loss between the EUT and the Spectrum Analyser was measured using a Network Analyser and entered as a Reference Level Offset. The EUT was set to transmit on Maximum Power using a Communications Analyser. Using this instrument, the test channels were configured to the Top and Bottom of the band. The EUT was tested with All Resource Blocks active and with one Resource Block active at the position closest to the Band Edge. The RBW was set to a value of at least 30 kHz as defined in 27.53(g). The detector of the Spectrum Analyser was set to RMS and the result checked against the -13 dBm limit defined in the specification. The results are shown in the following summary tables and plots.

The EUT shall only be used on the channels defined in the summary tables shown in the reports. Any channels above or below the frequencies listed have not been tested and should not be used.

Product Service

Conducted Spurious Emissions

In accordance with Part 2.1051 and 27.53, the spurious emissions from the antenna terminal were measured. The transmitter output power was attenuated using a combination of filters and attenuators and the frequency spectrum investigated from 9 kHz to 8 GHz. The EUT was set to transmit on full power with QPSK and 16-QAM modulation schemes. The EUT was tested on Bottom, Middle and Top channels on all channel bandwidths with All Resource Blocks active and for a single resource block with the offset that yielded the highest conducted output power. The resolution and video bandwidths were set to 100 kHz and 300 kHz with the spectrum analyser detector set to Peak and trace to Max Hold.

From 9 kHz to 1.5 GHz, an attenuator was used. For measuring the range 1.5 GHz to 8 GHz an attenuator and high pass filter were used. This was to reduce saturation effects in the spectrum analyser. The maximum path loss across the measurement bands were used as reference level offsets to ensure worst case.

Radiated Emissions

A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT, the list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

The EUT was set to transmit on maximum power on for QPSK and 16-QAM on each supported bandwidth. The EUT was only tested for the resource block allocation/offset determined to give the highest ERP.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss.

The measurements were performed at a 3m distance unless otherwise stated.

2.3.6 Environmental Conditions

Ambient Temperature	19.2 - 20.6°C
Relative Humidity	27.0 - 46.8%

Product Service

2.3.7 Test Results

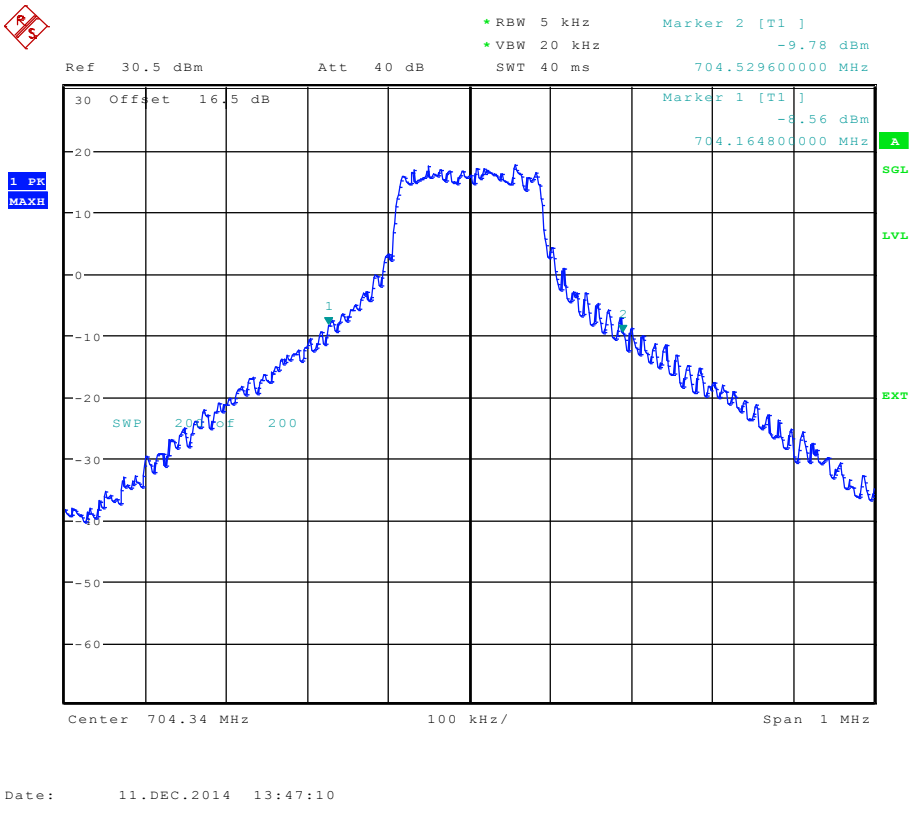
4.0 V DC Supply

26dB Bandwidth

5.0 MHz Bandwidth - QPSK

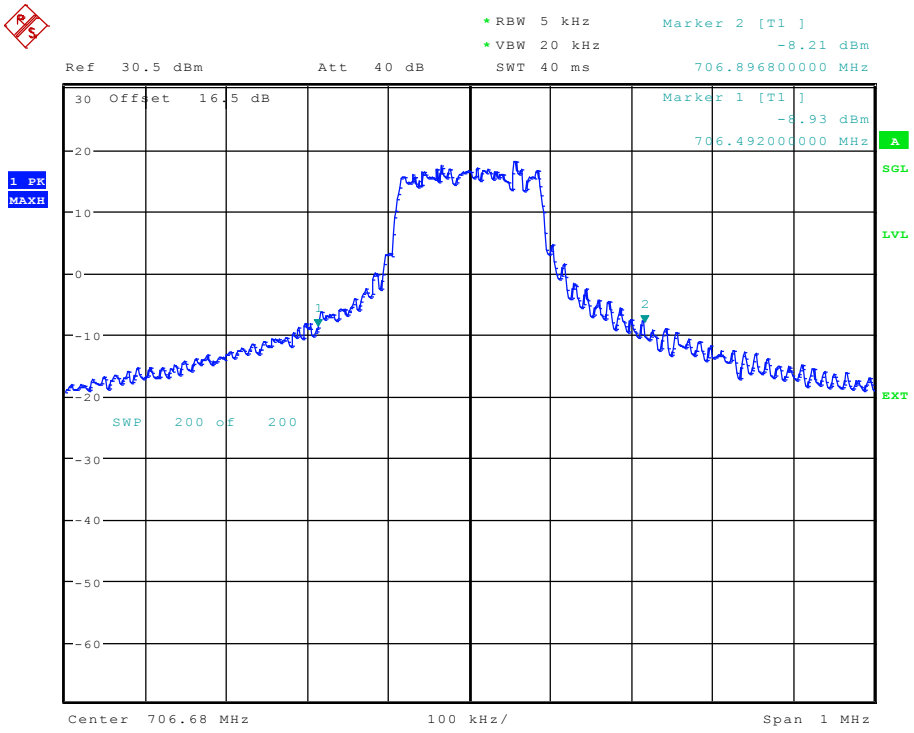
26dB Bandwidth (kHz)											
706.5 MHz				710.0 MHz				713.5 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
364.8	404.8	356.8	4940.8	368.0	432.0	363.2	4966.4	364.8	403.2	393.6	4915.2

706.5 MHz - 1 Resource Block - Low



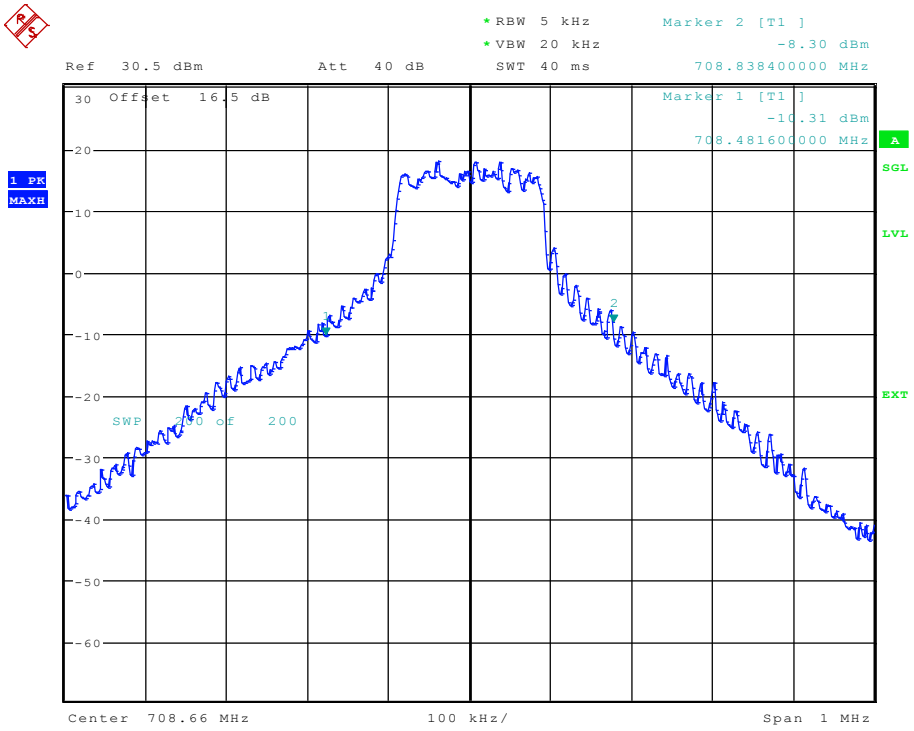
Product Service

706.5 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 13:48:02

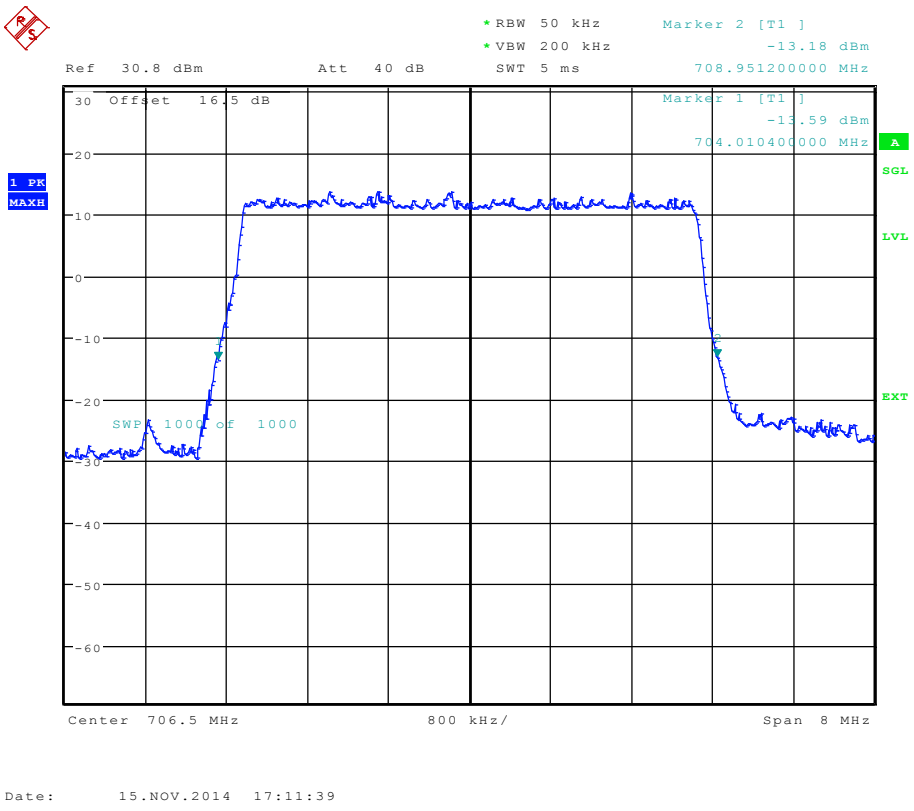
706.5 MHz - 1 Resource Block - High



Date: 11.DEC.2014 13:48:41

Product Service

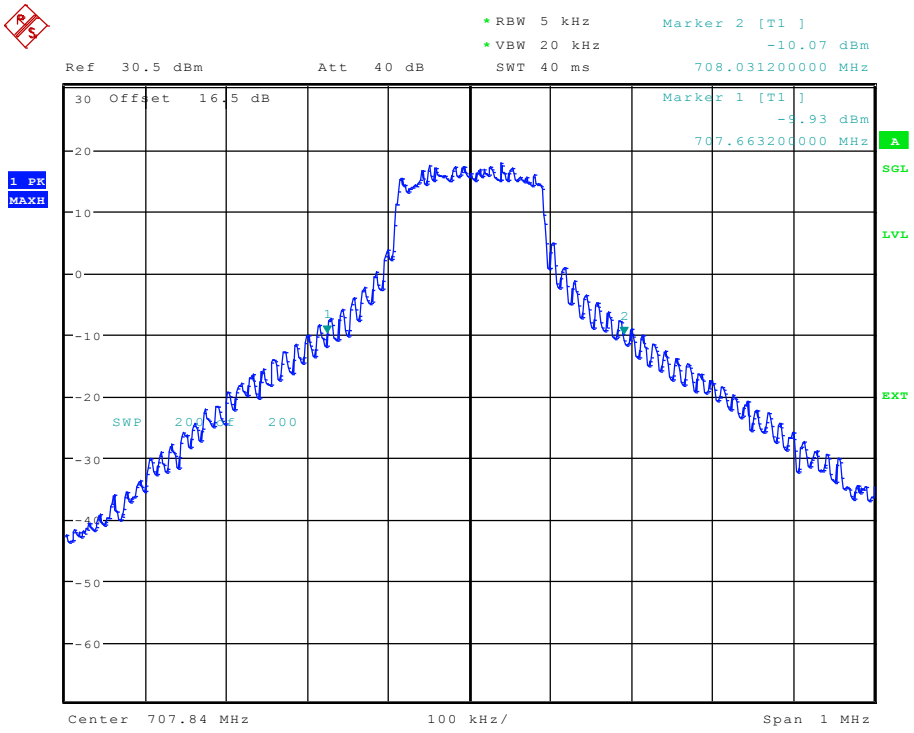
706.5 MHz - All Resource Blocks



Date: 15.NOV.2014 17:11:39

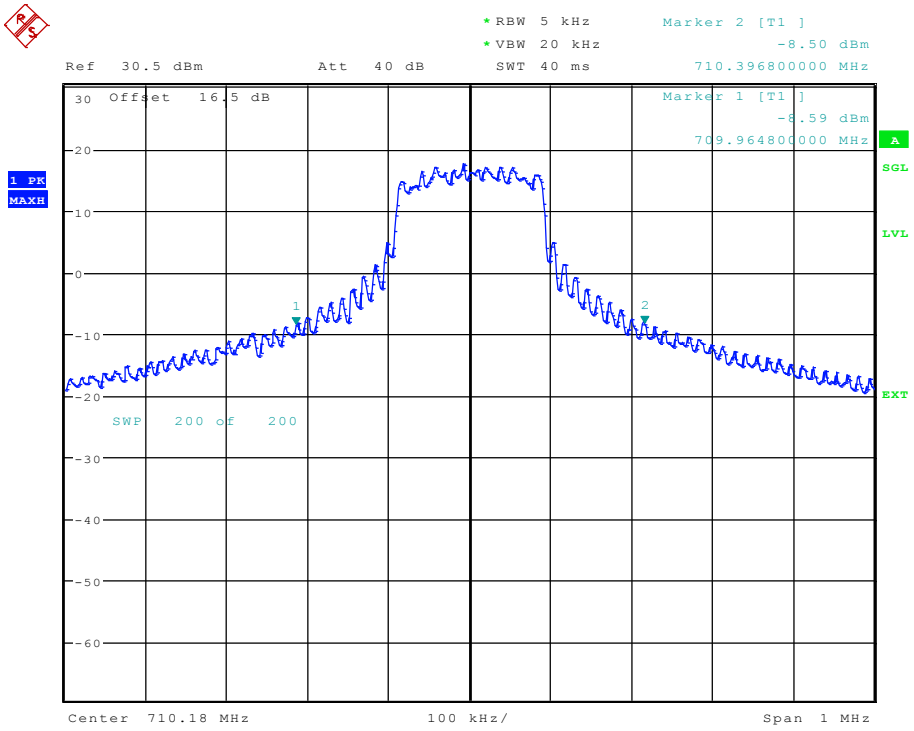
Product Service

710 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 13:49:33

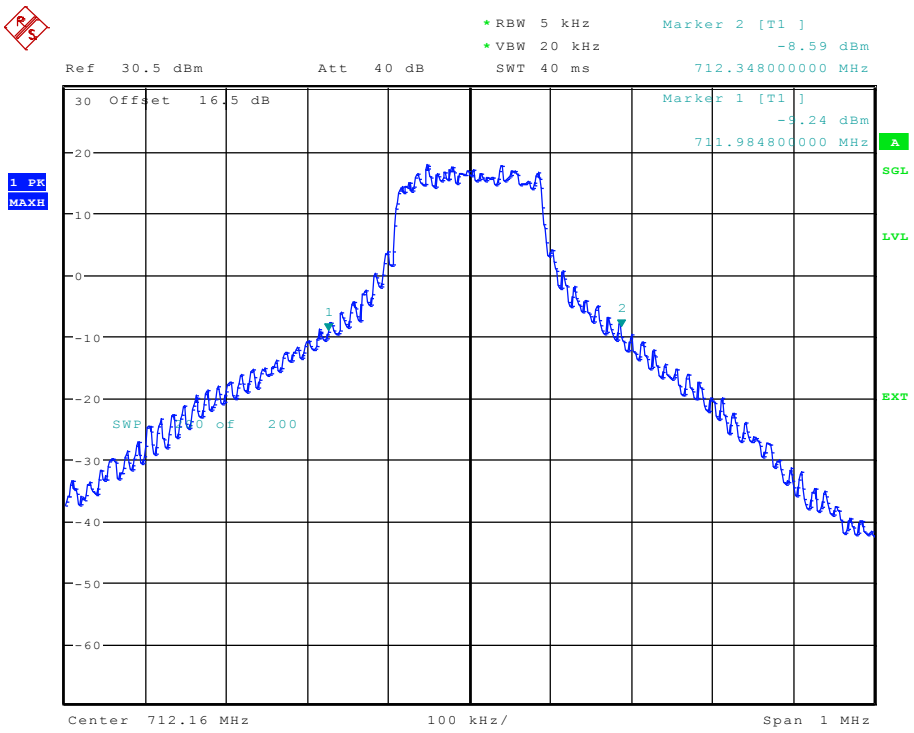
710 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 13:50:14

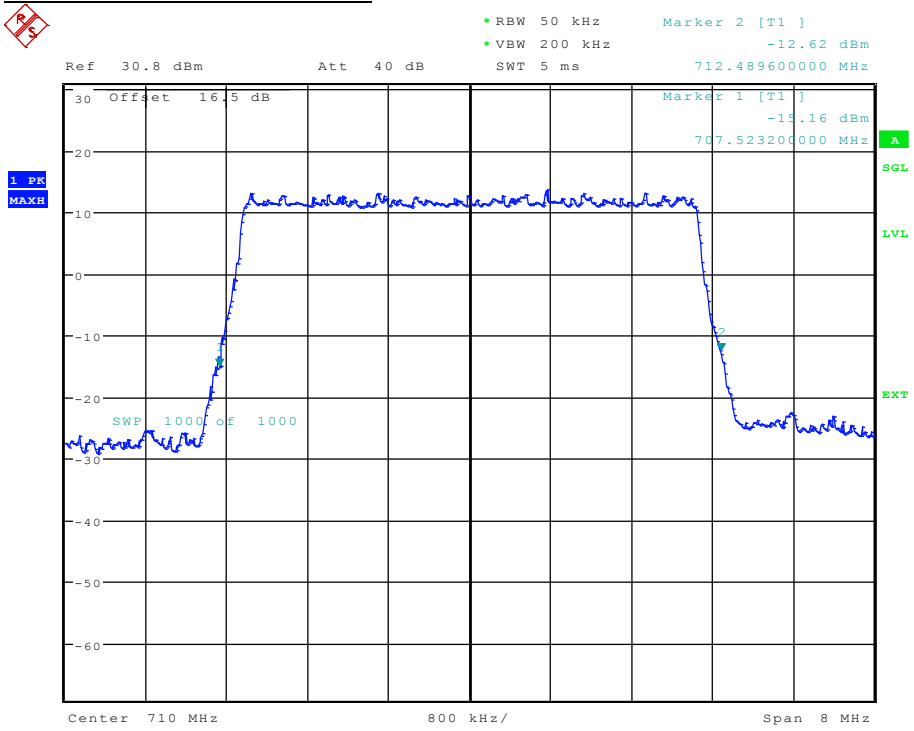
Product Service

710 MHz - 1 Resource Block - High



Date: 11.DEC.2014 13:50:49

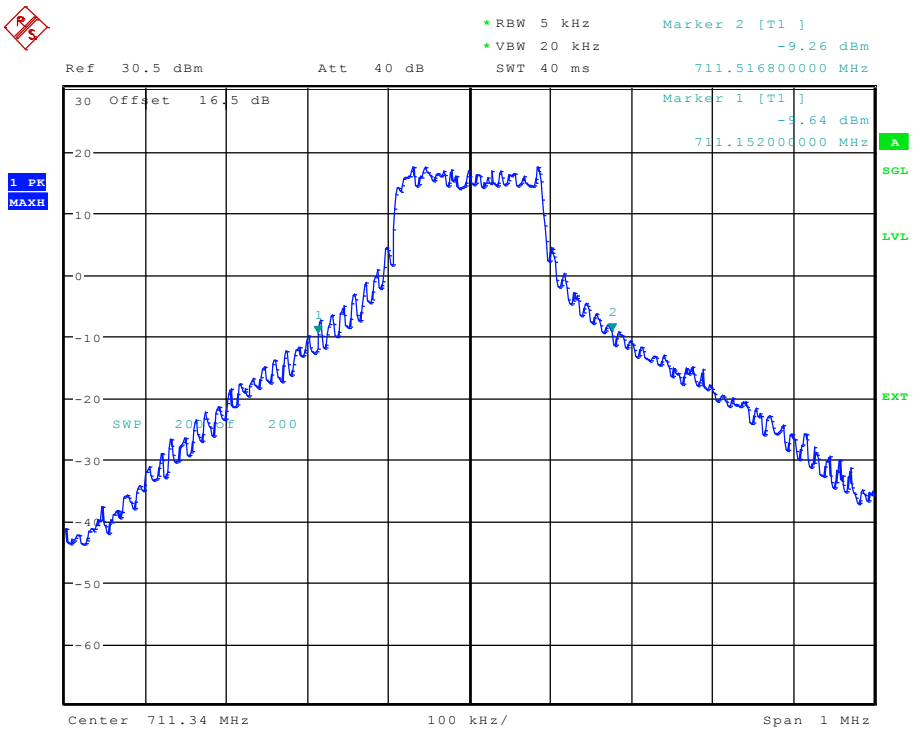
710 MHz - All Resource Blocks



Date: 15.NOV.2014 11:14:05

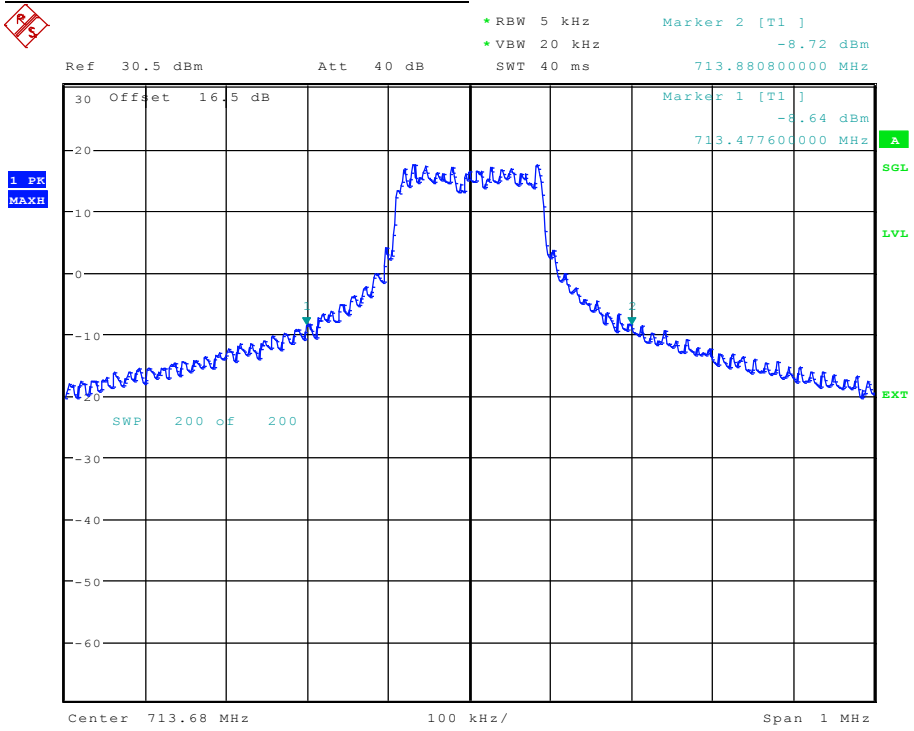
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 13:51:58

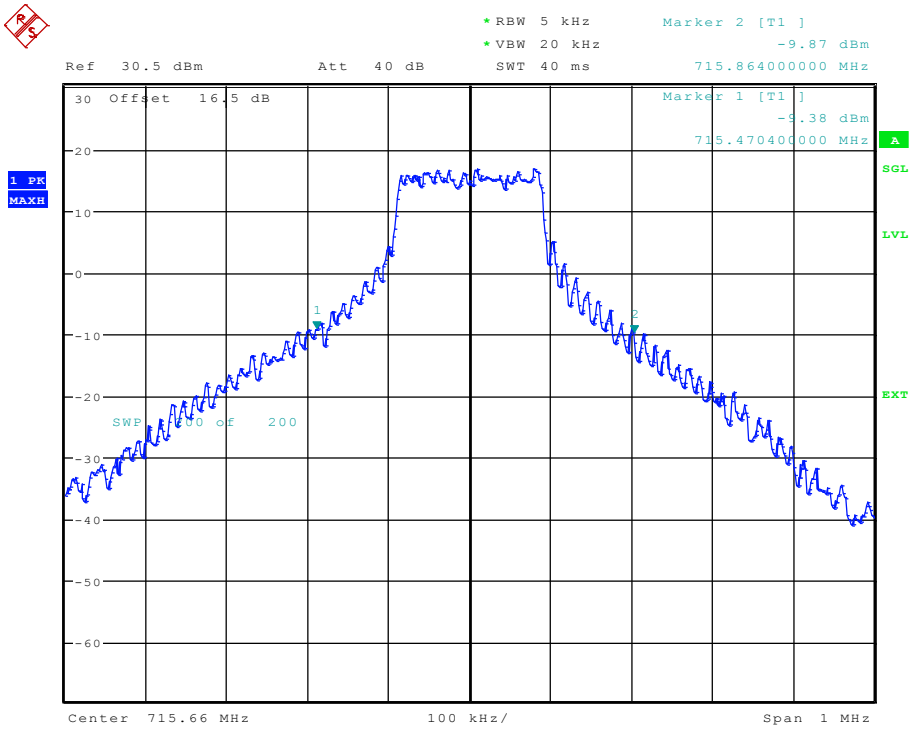
713.5 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 13:52:43

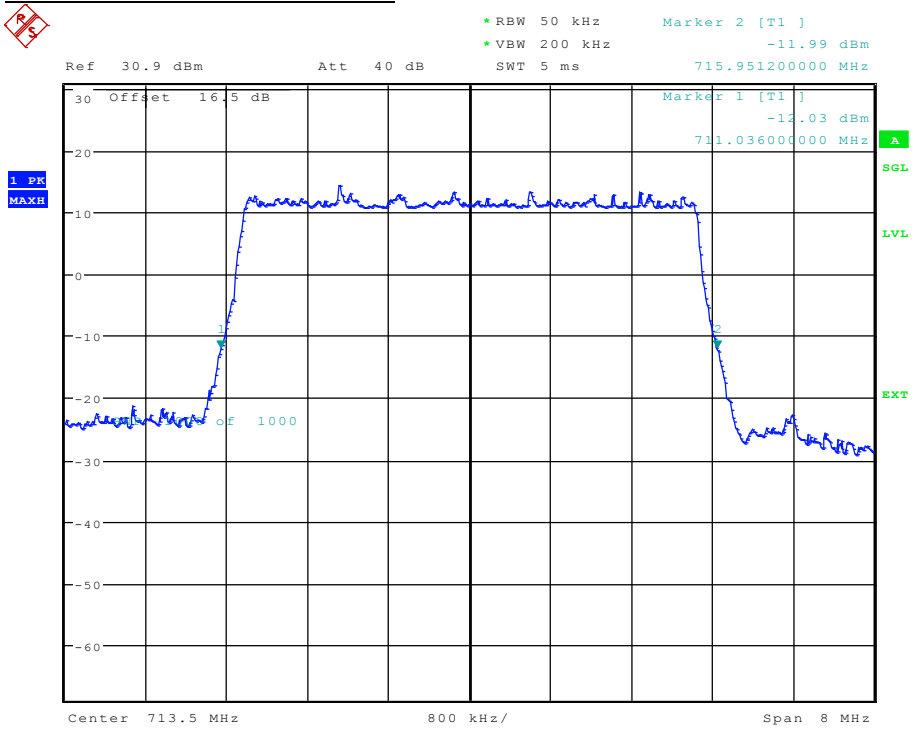
Product Service

713.5 MHz - 1 Resource Block - High



Date: 11.DEC.2014 13:53:23

713.5 MHz - All Resource Blocks



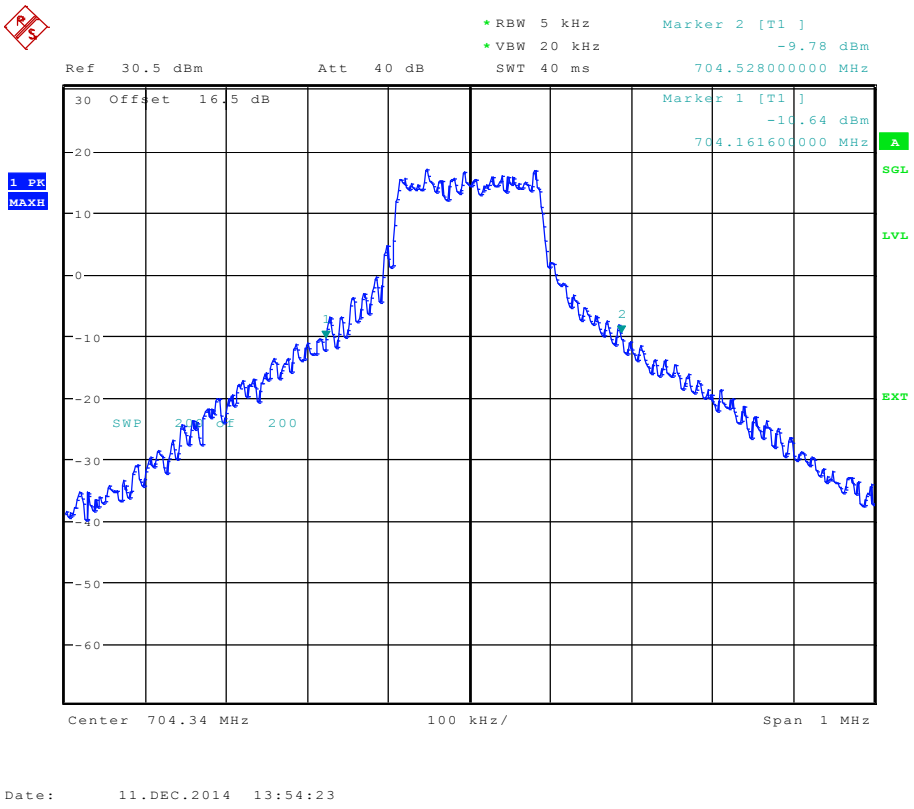
Date: 15.NOV.2014 11:45:21

Product Service

5.0 MHz Bandwidth - 16QAM

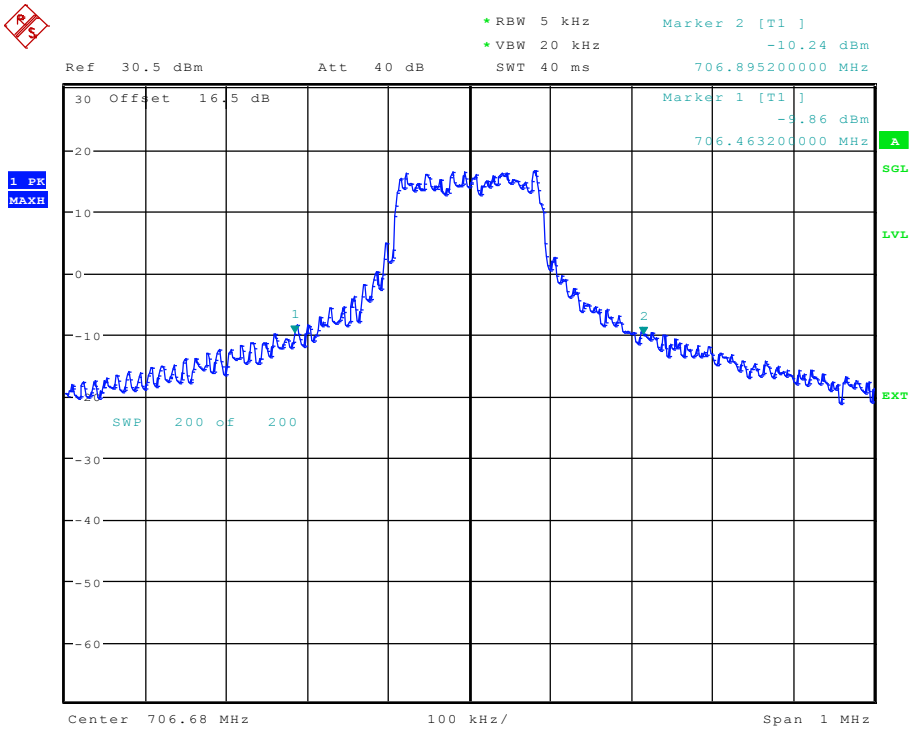
26dB Bandwidth (kHz)											
706.5 MHz				710.0 MHz				713.5 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
366.4	432.0	337.6	4928.0	364.8	432.0	368.0	4966.4	339.2	433.6	353.6	4915.2

706.5 MHz - 1 Resource Block - Low



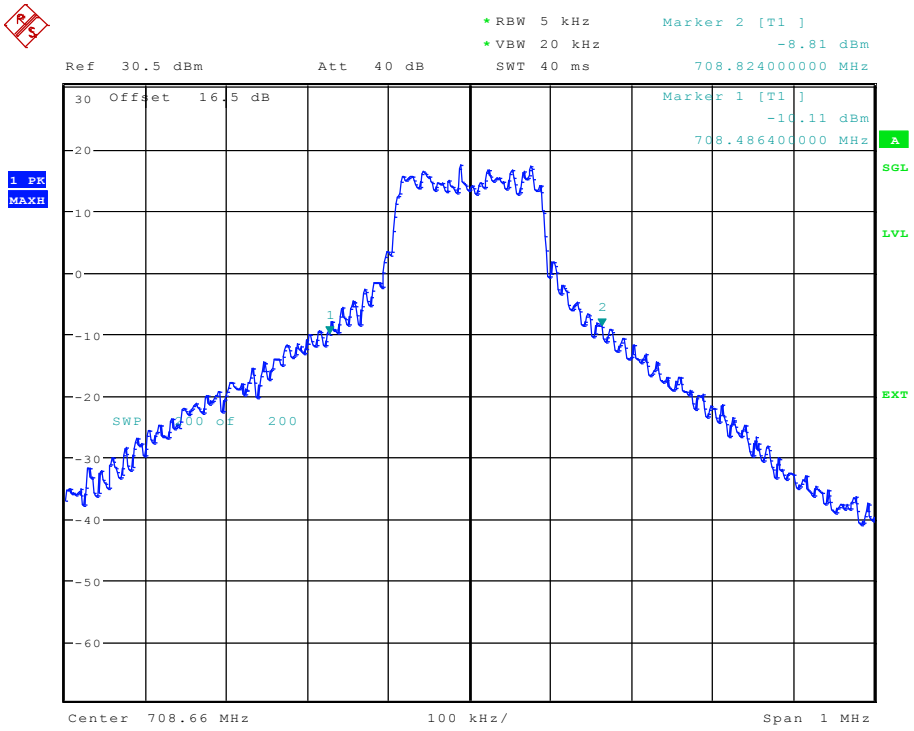
Product Service

706.5 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 13:55:17

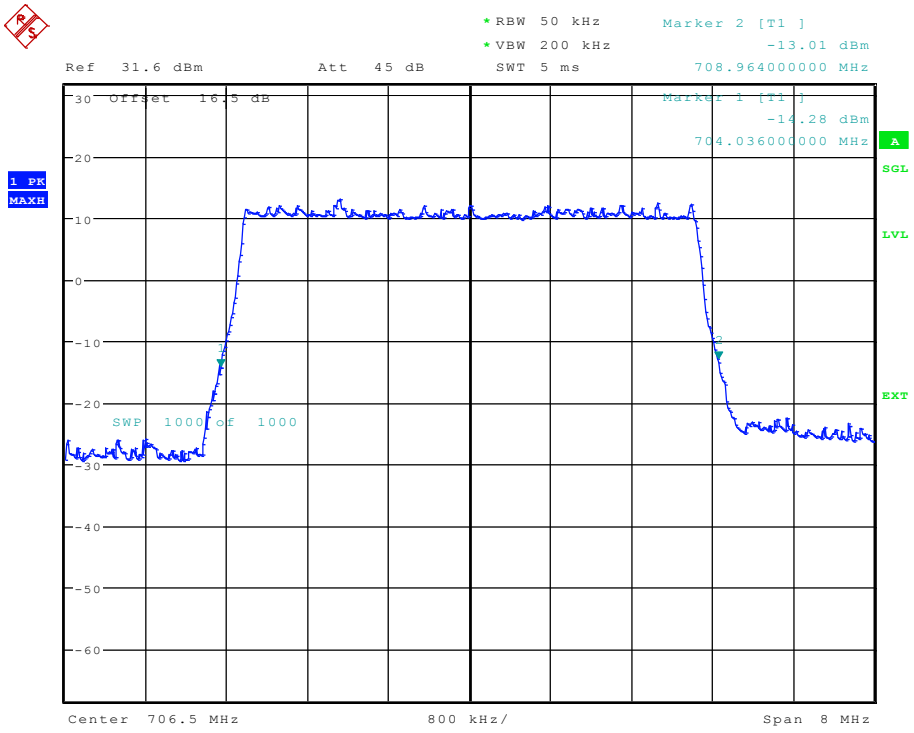
706.5 MHz - 1 Resource Block - High



Date: 11.DEC.2014 13:55:57

Product Service

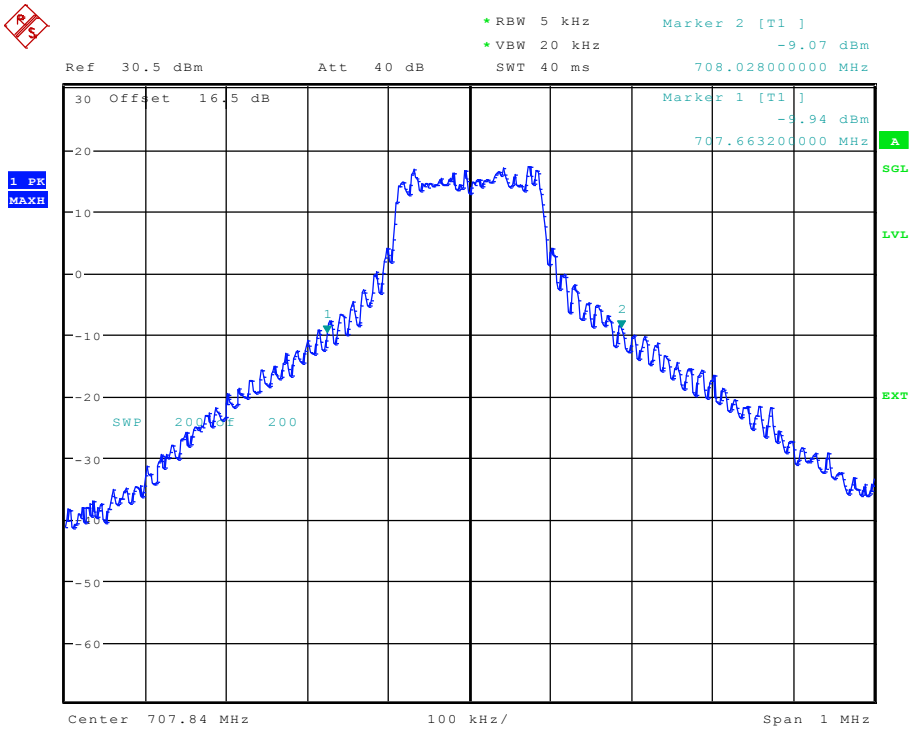
706.5 MHz - All Resource Blocks



Date: 15.NOV.2014 12:20:09

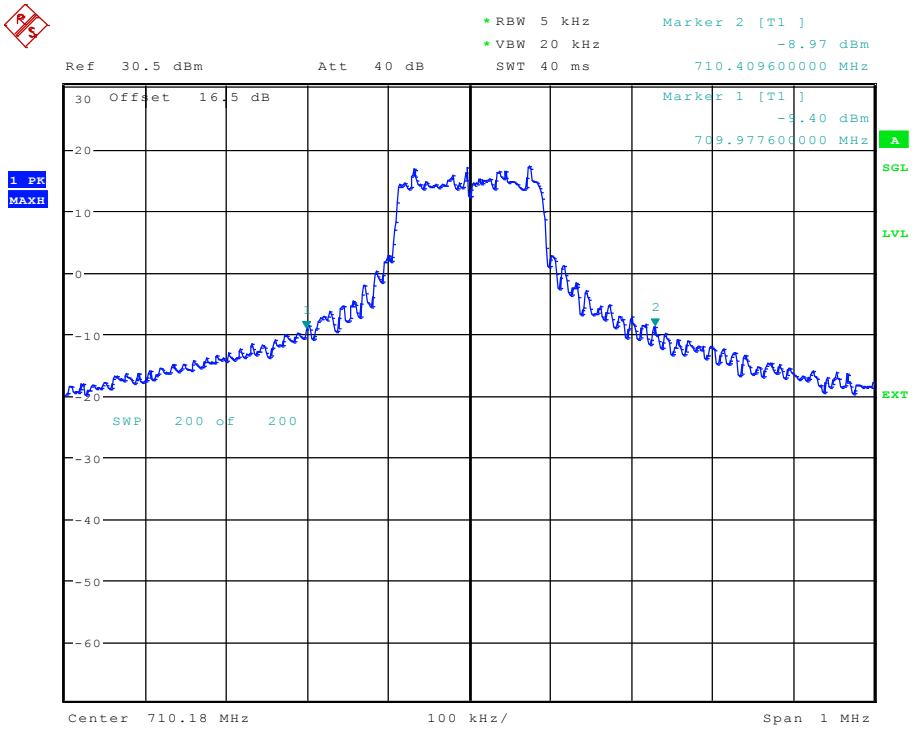
Product Service

710 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 13:56:59

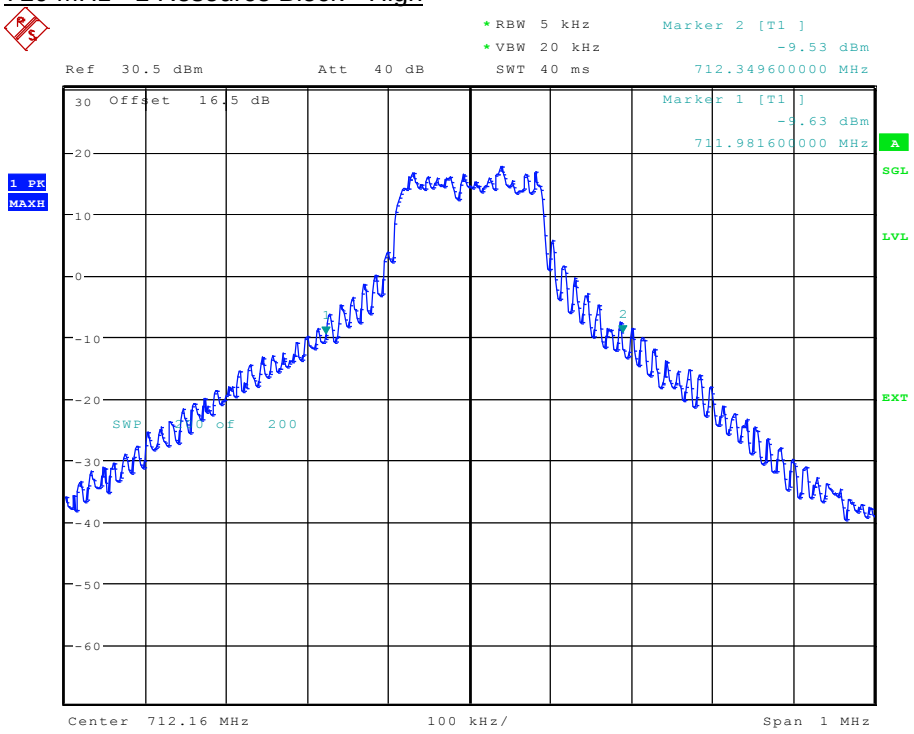
710 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 13:58:02

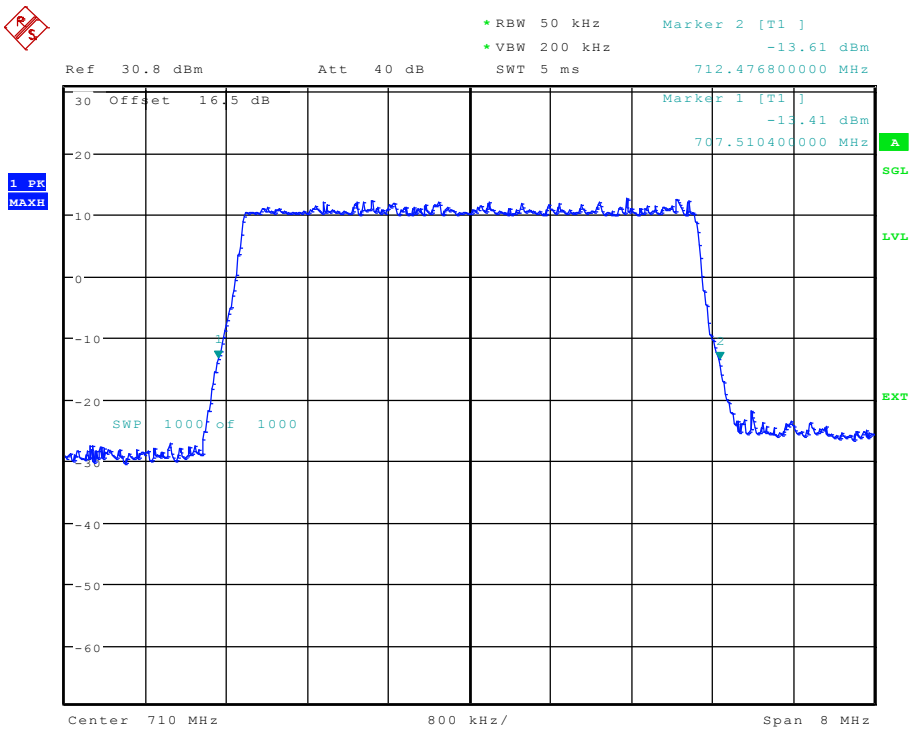
Product Service

710 MHz - 1 Resource Block - High



Date: 11.DEC.2014 13:59:38

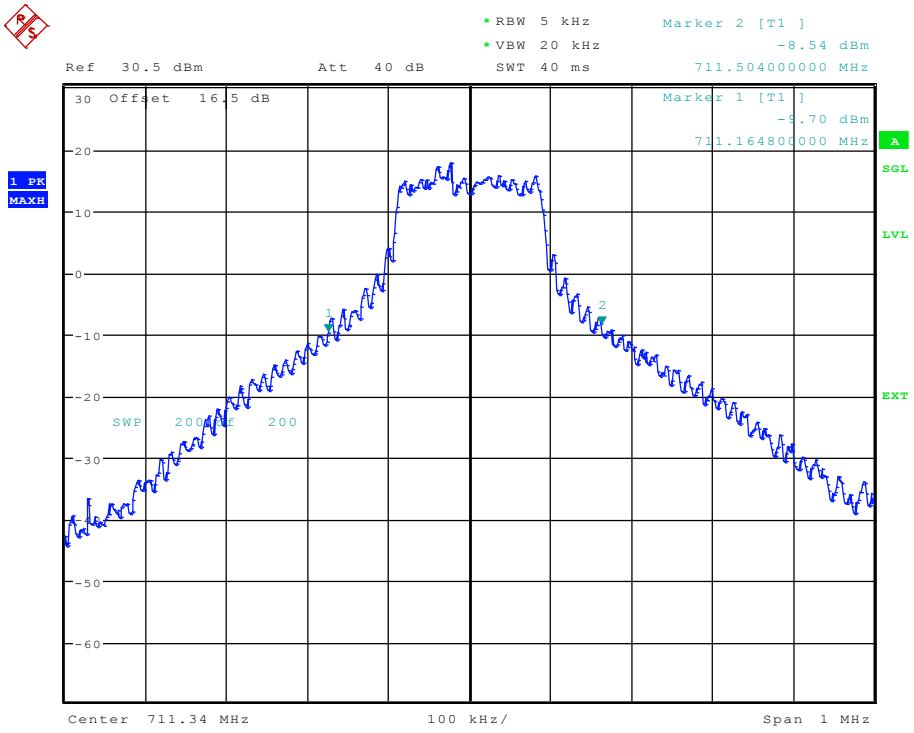
710 MHz - All Resource Blocks



Date: 15.NOV.2014 12:33:11

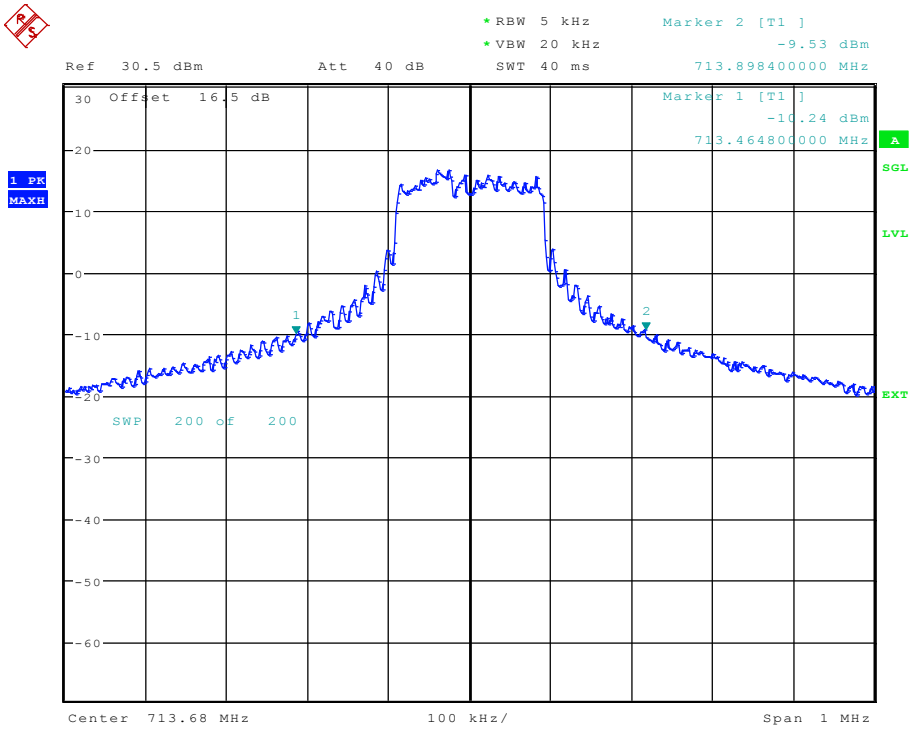
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 14:00:44

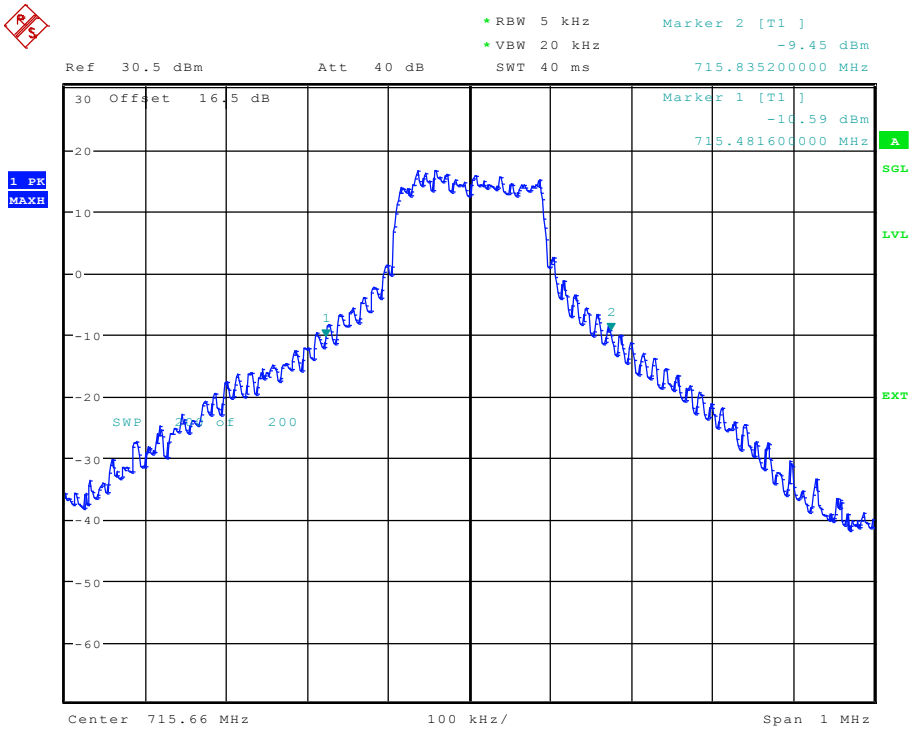
713.5 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:20:36

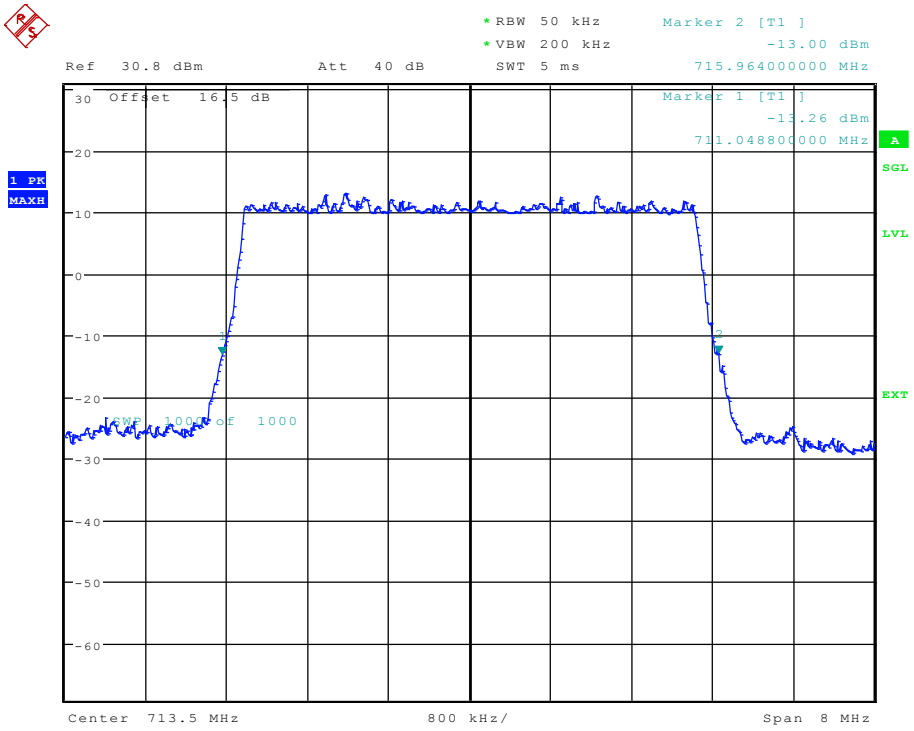
Product Service

713.5 MHz - 1 Resource Block - High



Date: 11.DEC.2014 14:21:12

713.5 MHz - All Resource Blocks

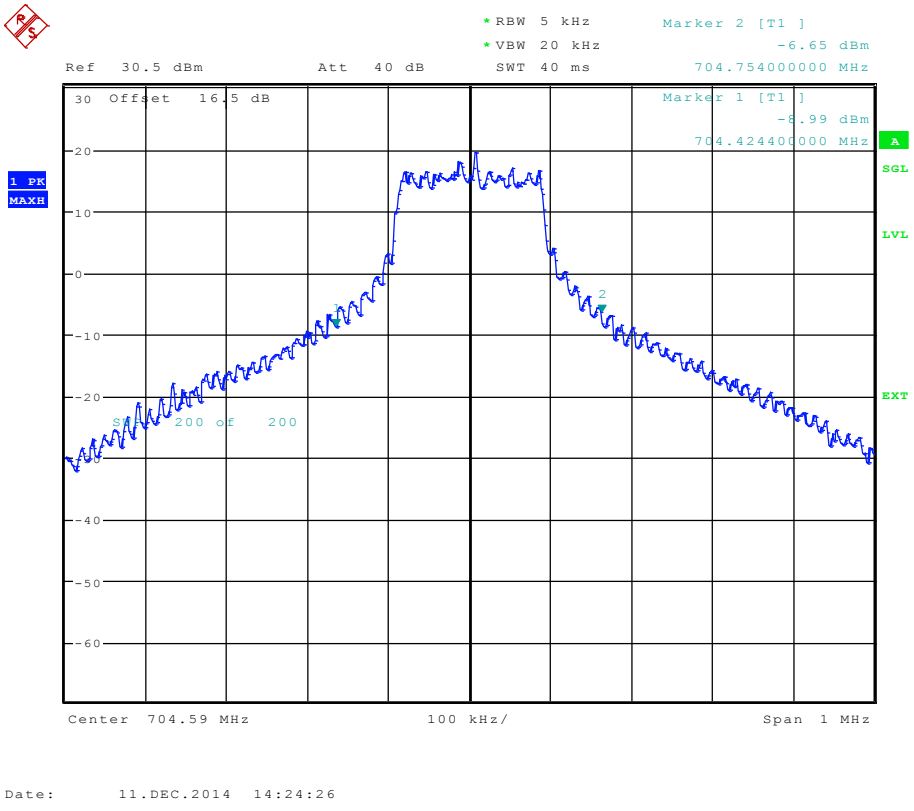


Date: 15.NOV.2014 12:45:20

10.0 MHz Bandwidth - QPSK

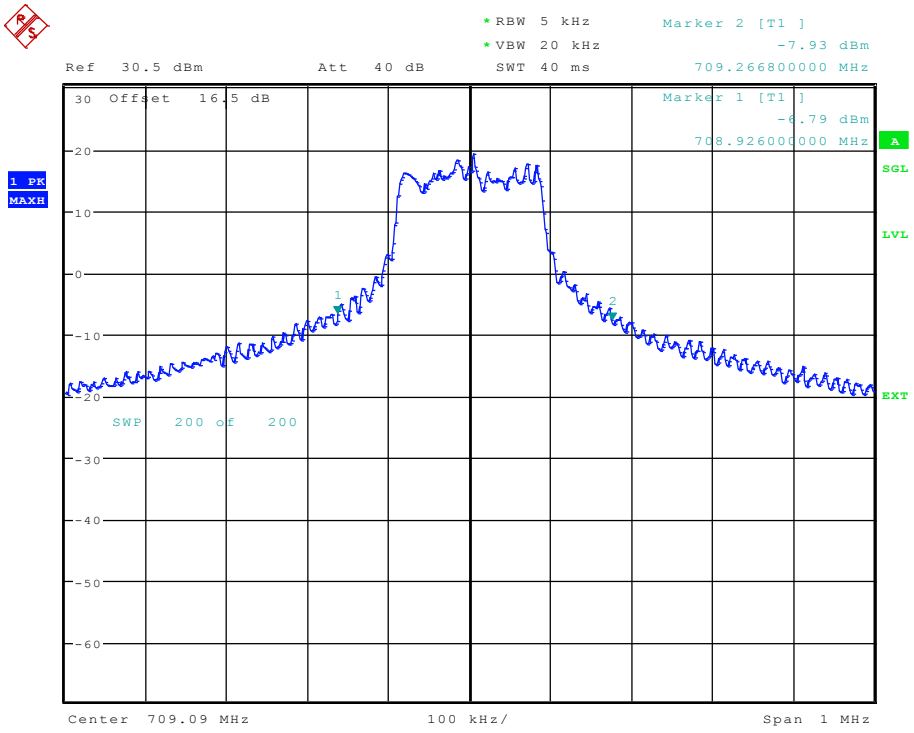
26dB Bandwidth (kHz)											
709.0 MHz				710.0 MHz				711.0 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
329.6	340.8	326.4	9864.0	350.4	364.8	339.2	9792.0	411.2	390.4	382.4	9864.0

709 MHz - 1 Resource Block - Low



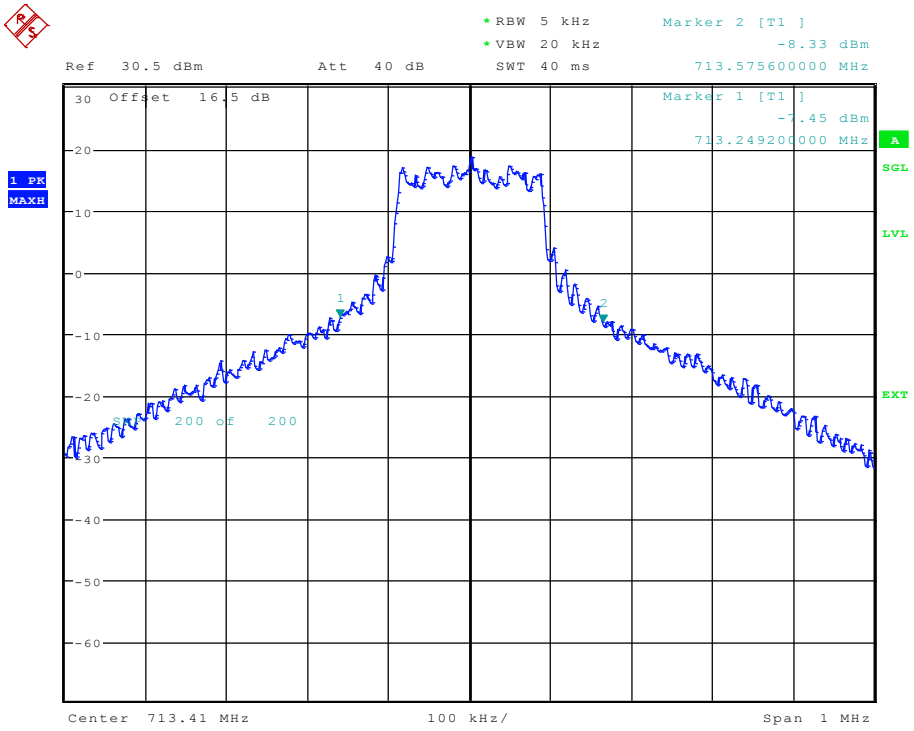
Product Service

709 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:25:11

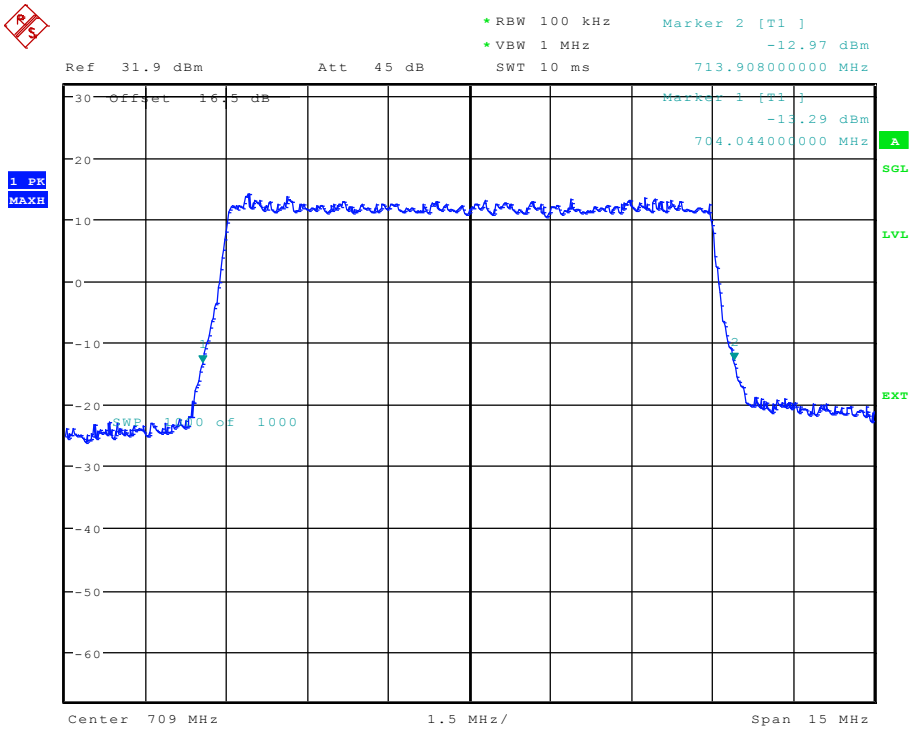
709 MHz - 1 Resource Block - High



Date: 11.DEC.2014 14:25:57

Product Service

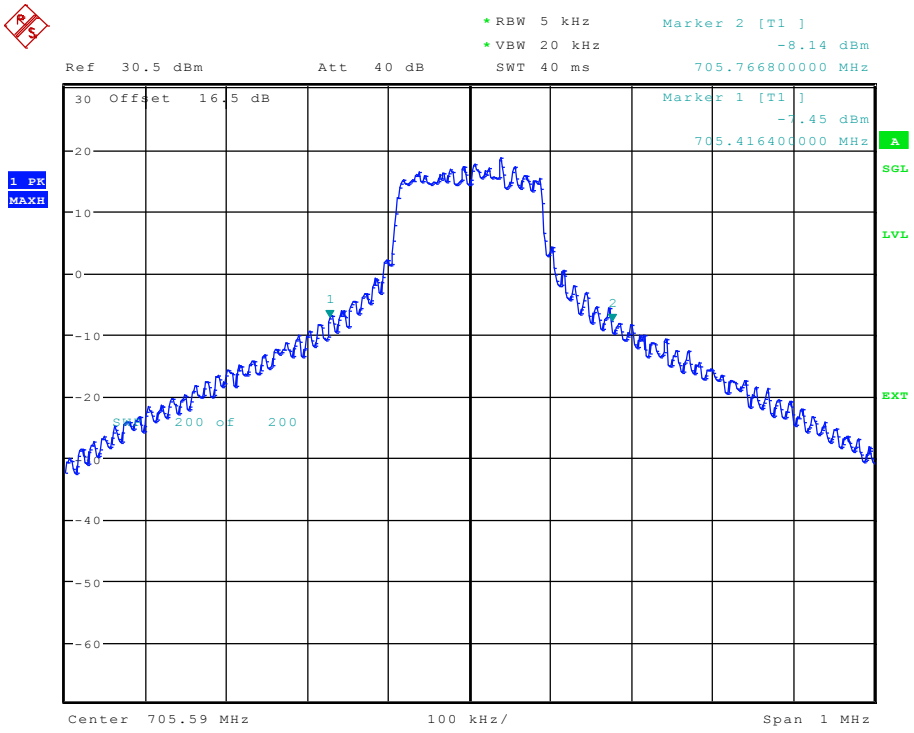
709 MHz - All Resource Blocks



Date: 15.NOV.2014 13:34:00

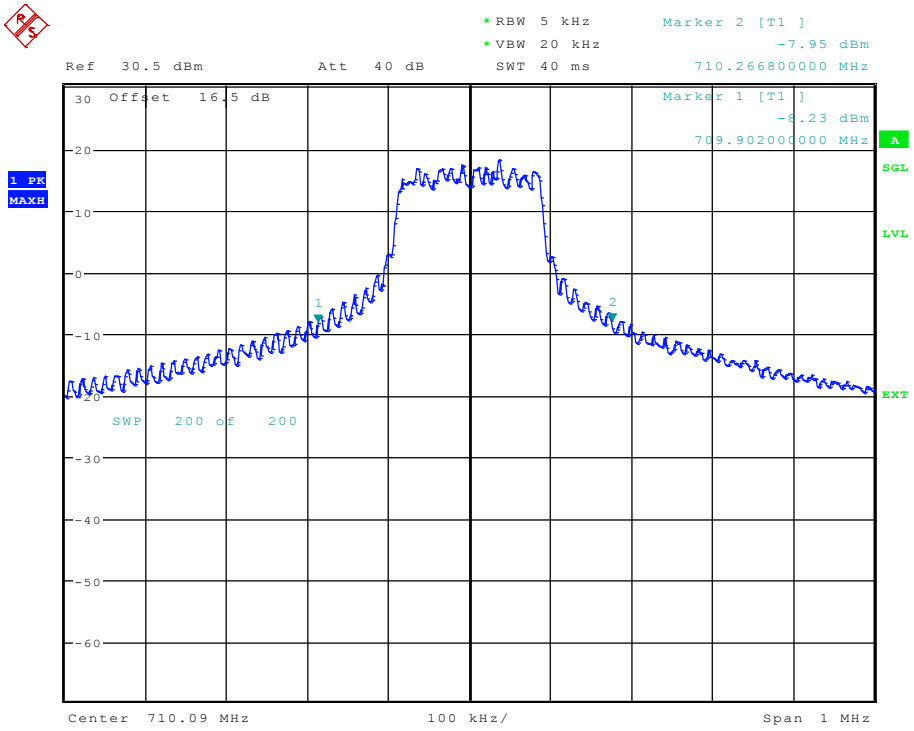
Product Service

710 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 14:26:48

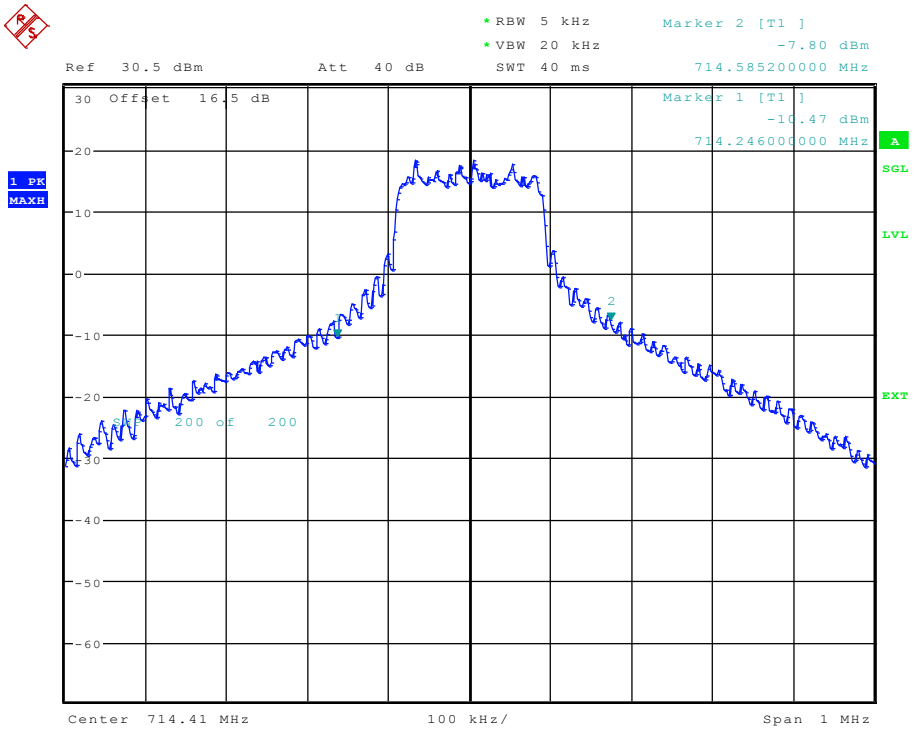
710 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:27:32

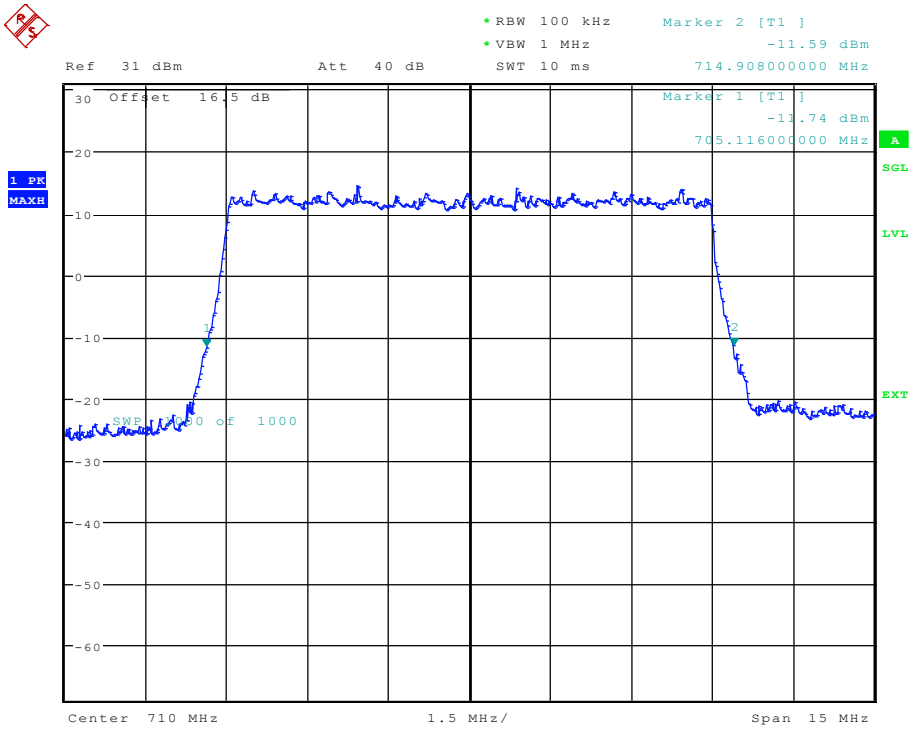
Product Service

710 MHz - 1 Resource Block - High



Date: 11.DEC.2014 14:28:10

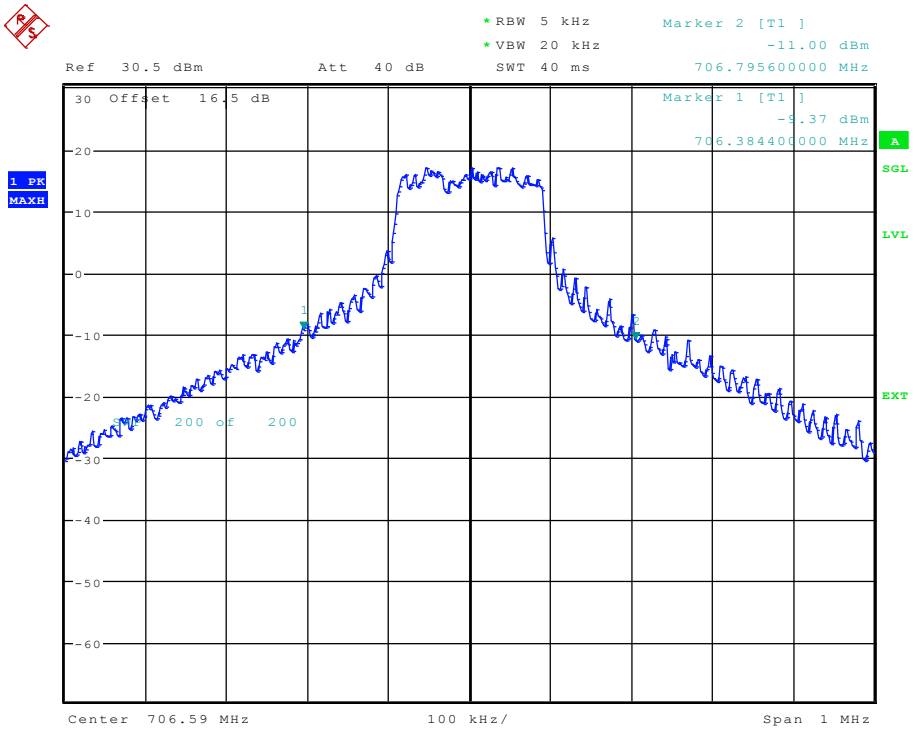
710 MHz - All Resource Blocks



Date: 15.NOV.2014 13:52:40

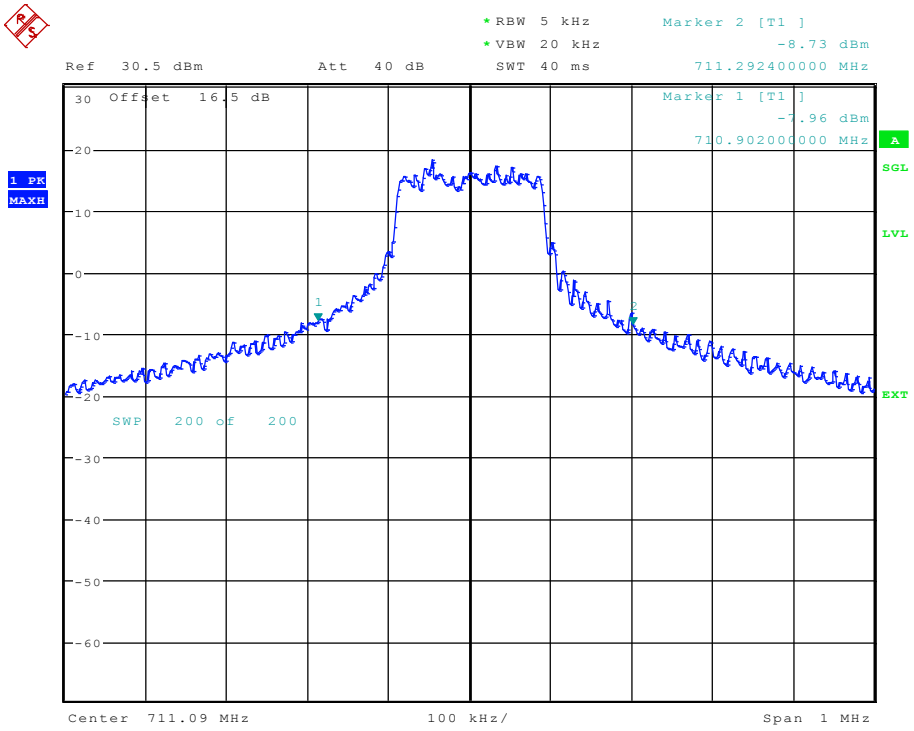
Product Service

711 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 14:29:01

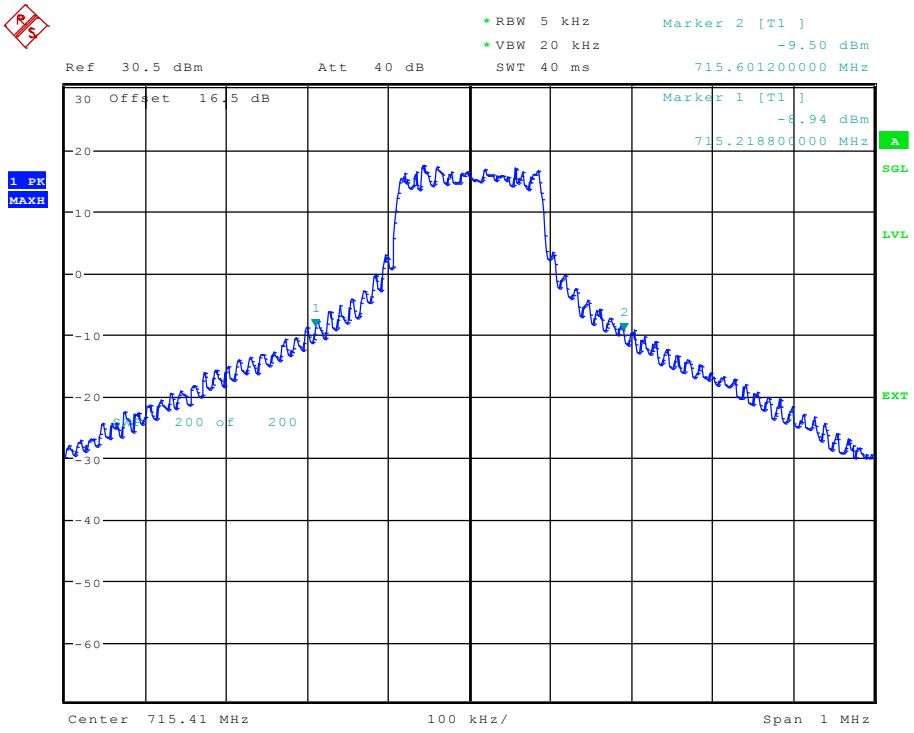
711 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:29:52

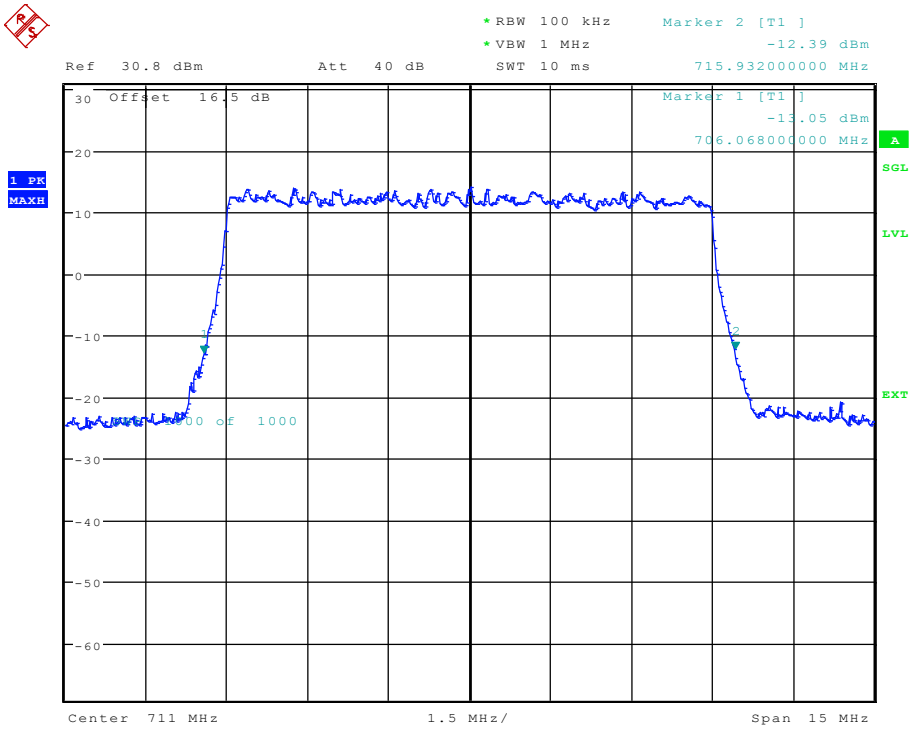
Product Service

711 MHz - 1 Resource Block - High



Date: 11.DEC.2014 14:30:31

711 MHz - All Resource Blocks

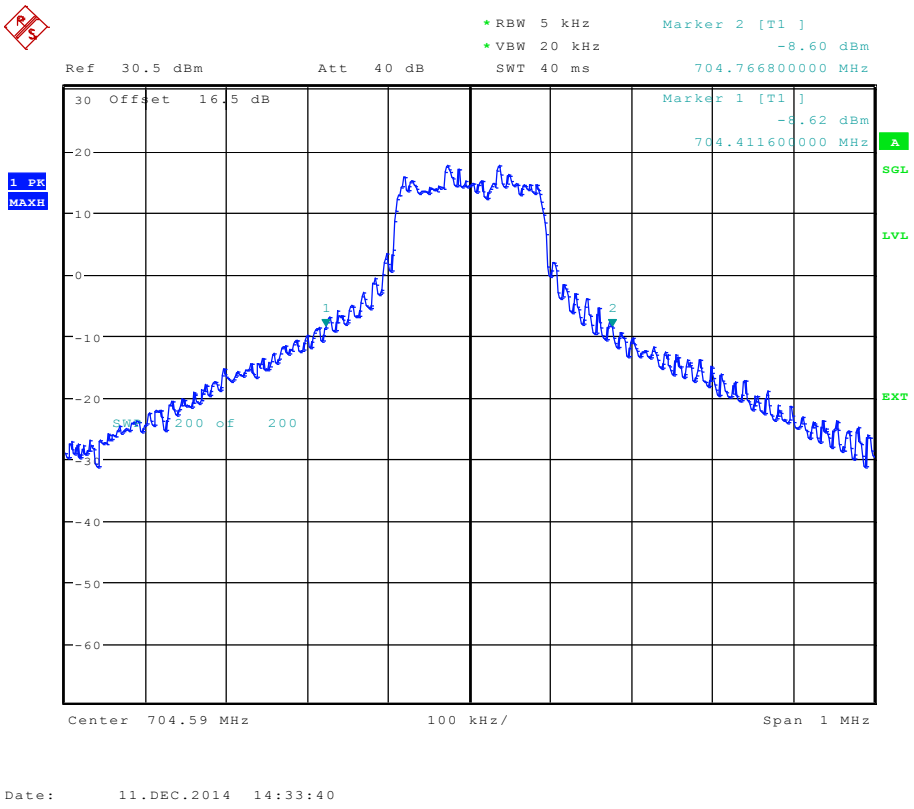


Date: 15.NOV.2014 14:07:28

10.0 MHz Bandwidth - 16QAM

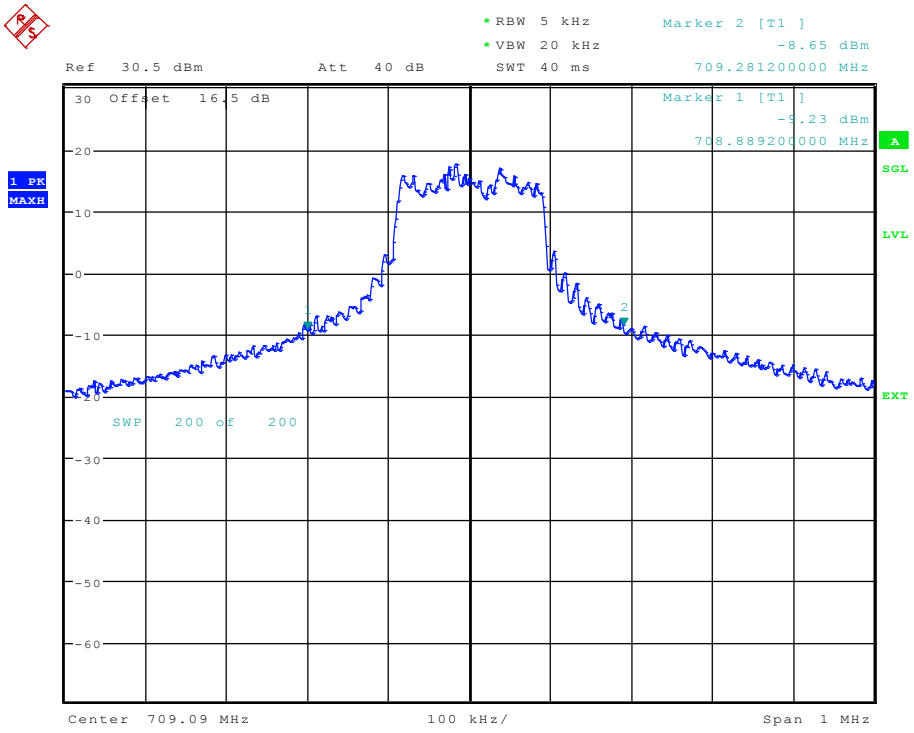
26dB Bandwidth (kHz)											
709.0 MHz				710.0 MHz				711.0 MHz			
1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks	1 Resource Block			All Resource Blocks
Low	Mid	High		Low	Mid	High		Low	Mid	High	
355.2	392.0	388.8	9792.0	404.8	457.6	382.4	9792.0	364.8	419.2	377.6	9840.0

709 MHz - 1 Resource Block - Low



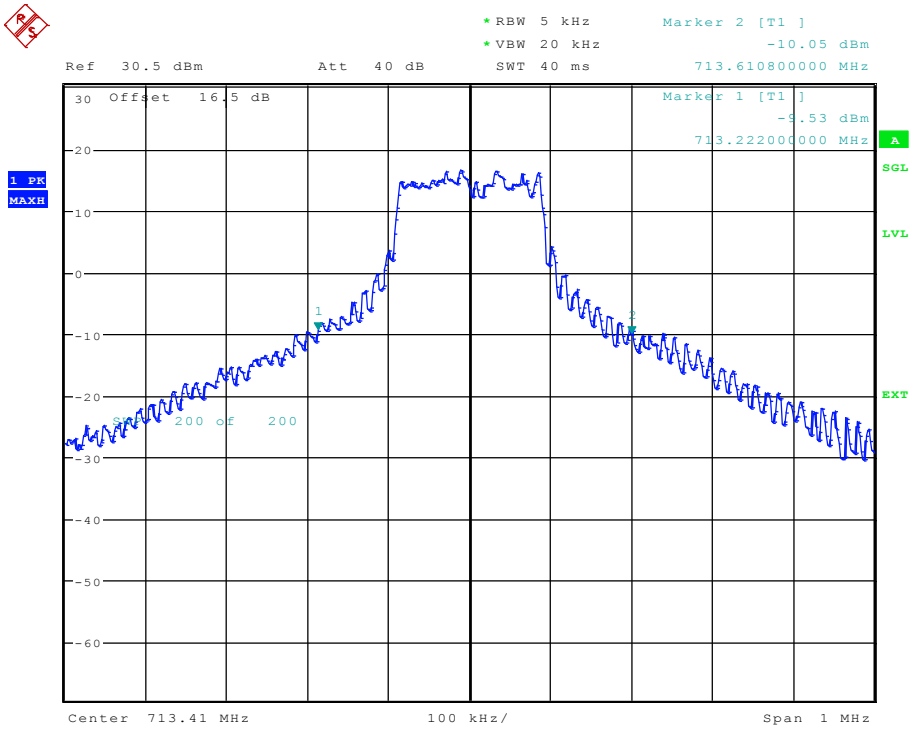
Product Service

709 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:34:24

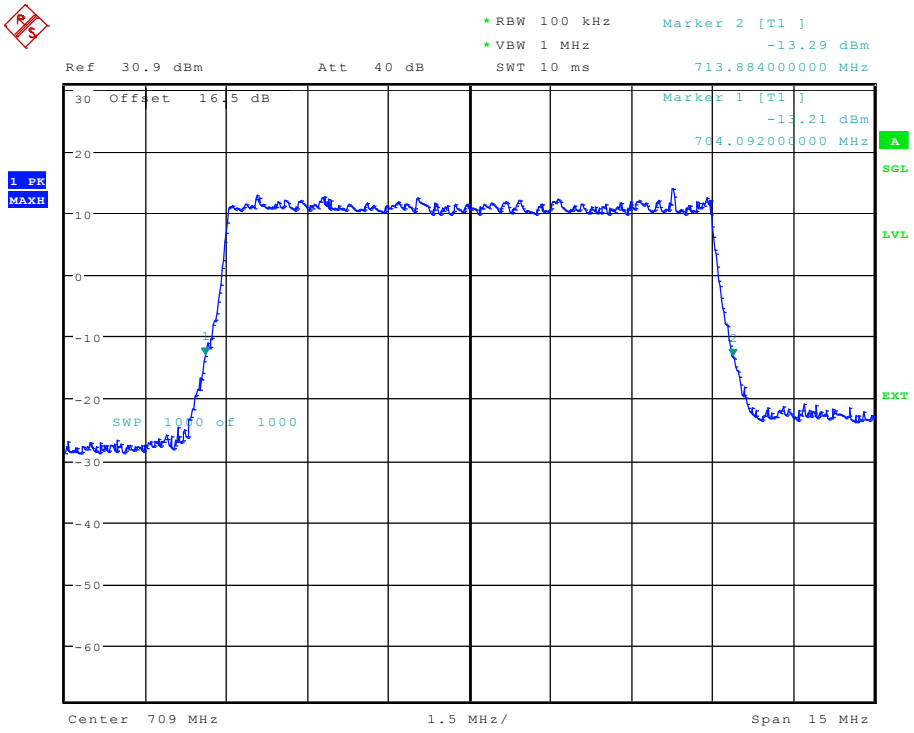
709 MHz - 1 Resource Block - High



Date: 11.DEC.2014 14:35:04

Product Service

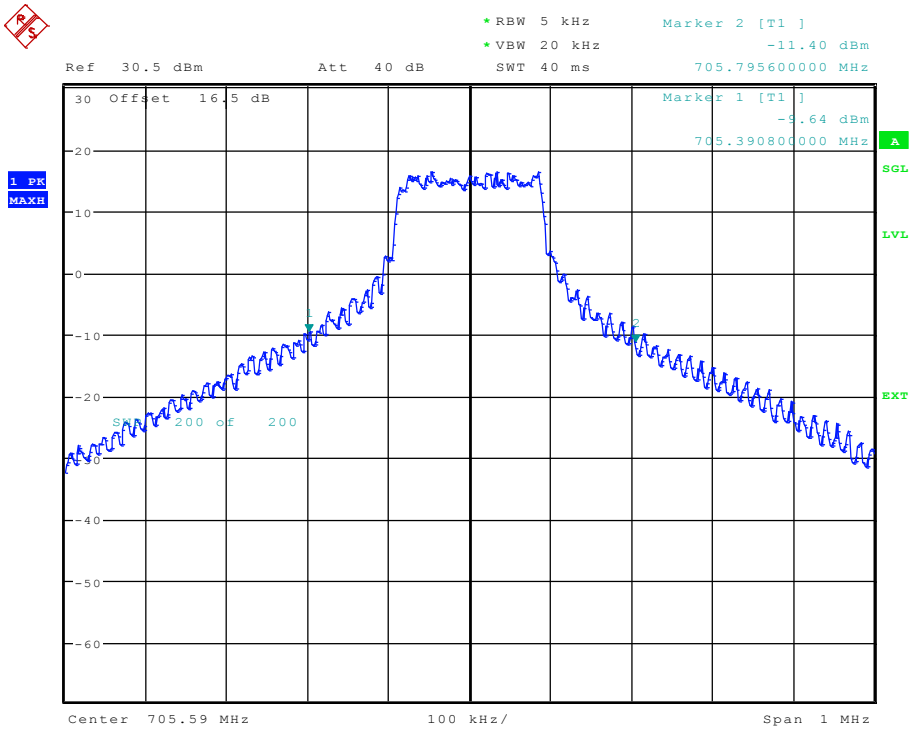
709 MHz - All Resource Blocks



Date: 15.NOV.2014 14:22:21

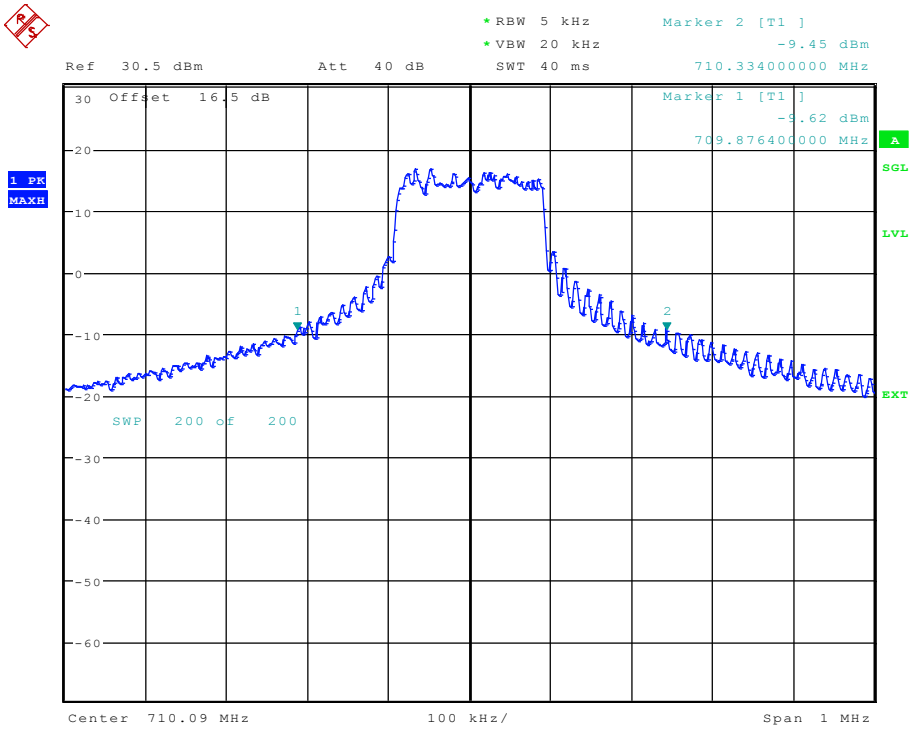
Product Service

710 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 14:36:20

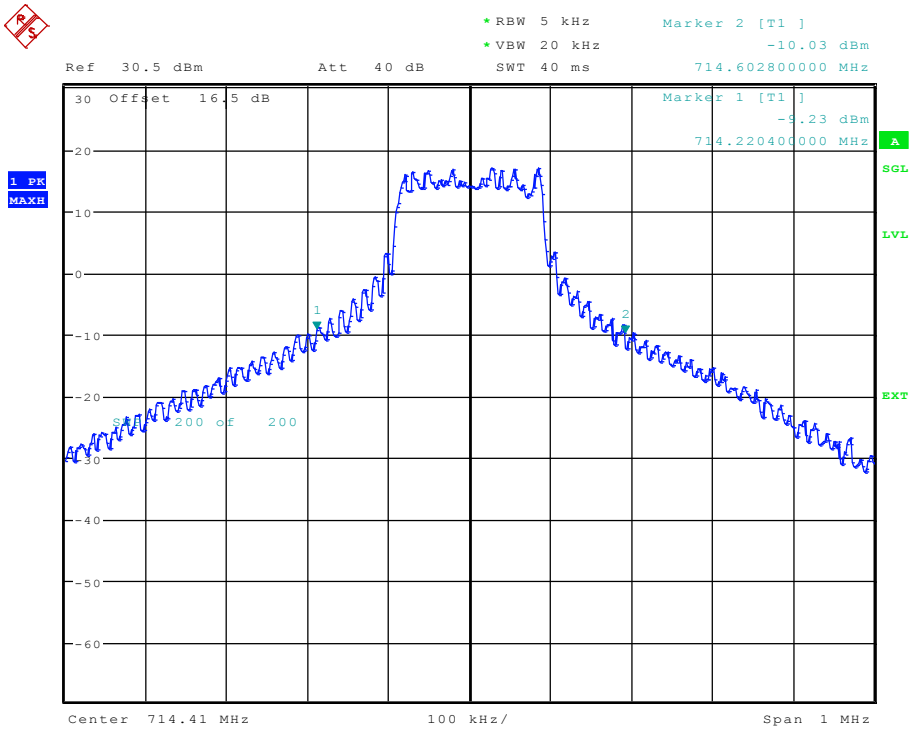
710 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:37:01

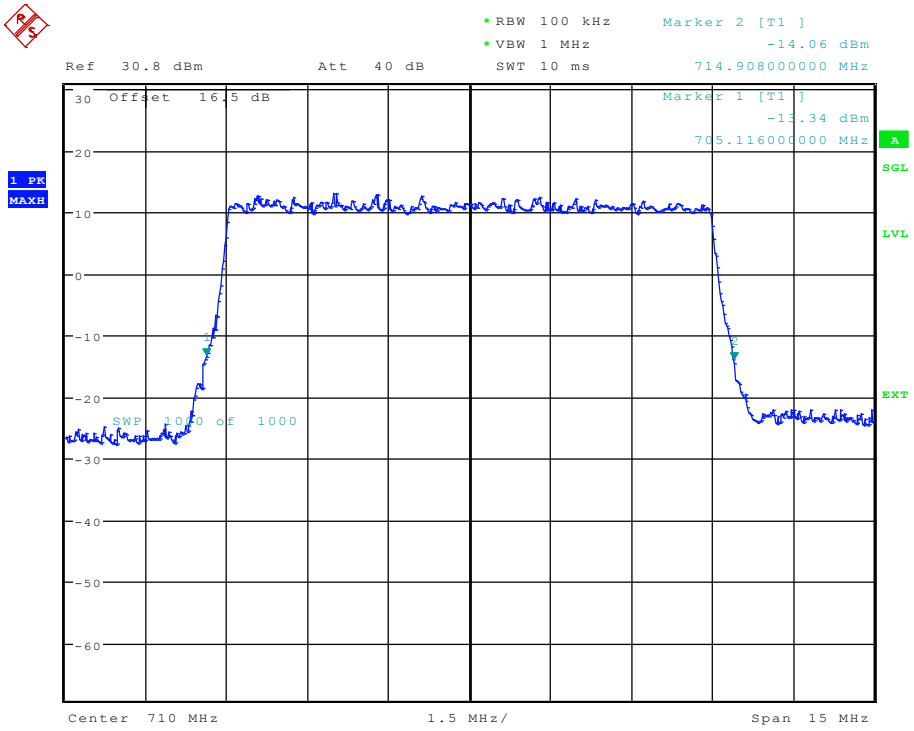
Product Service

710 MHz - 1 Resource Block - High



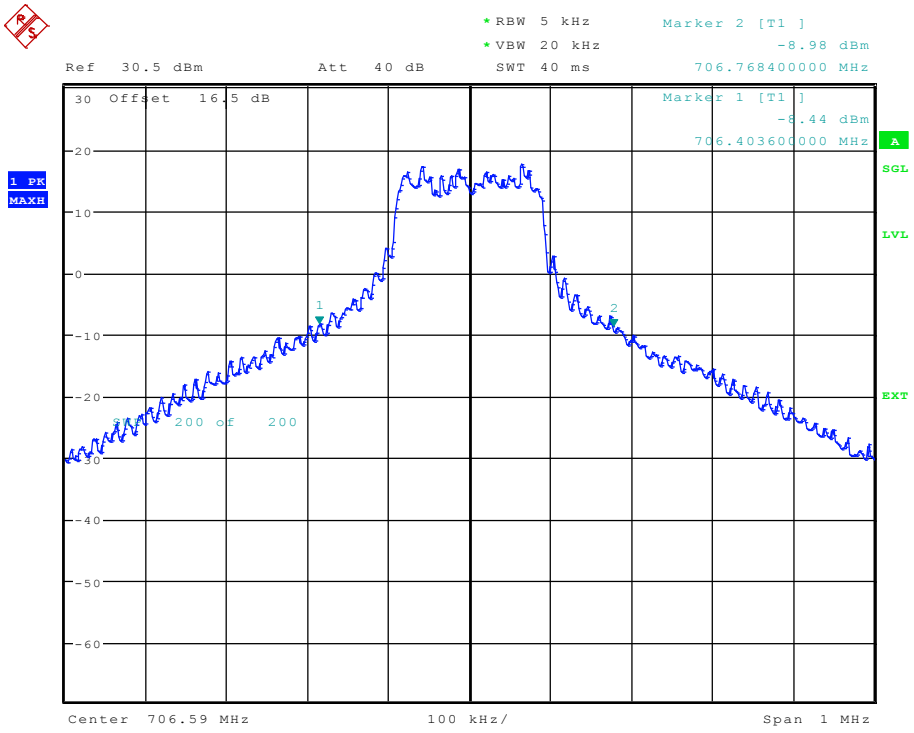
Date: 11.DEC.2014 14:37:38

710 MHz - All Resource Blocks



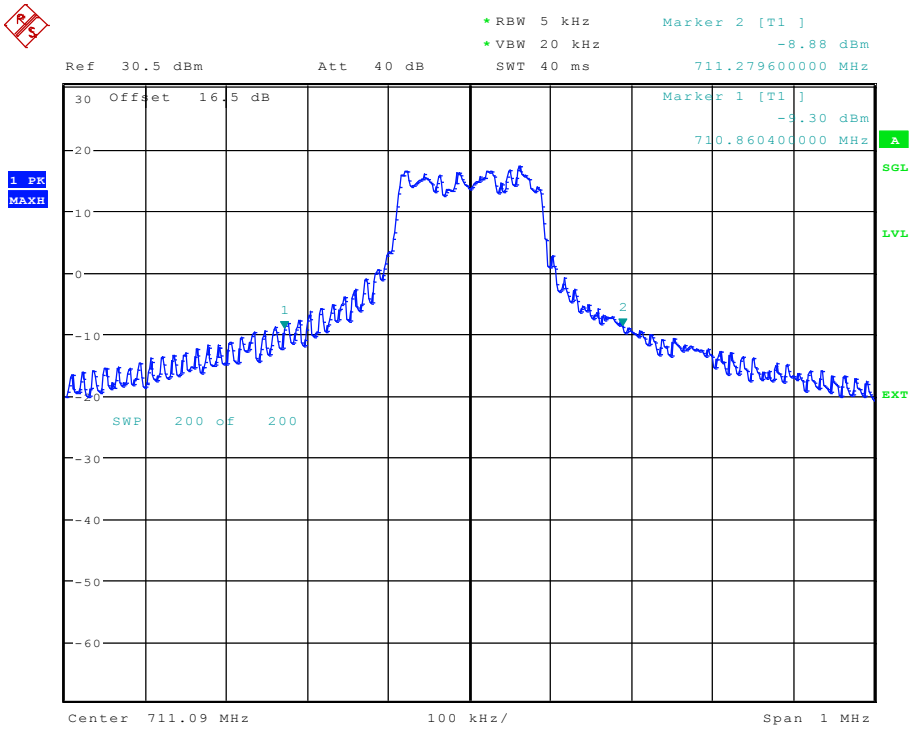
Date: 15.NOV.2014 14:46:00

711 MHz - 1 Resource Block - Low



Date: 11.DEC.2014 14:38:22

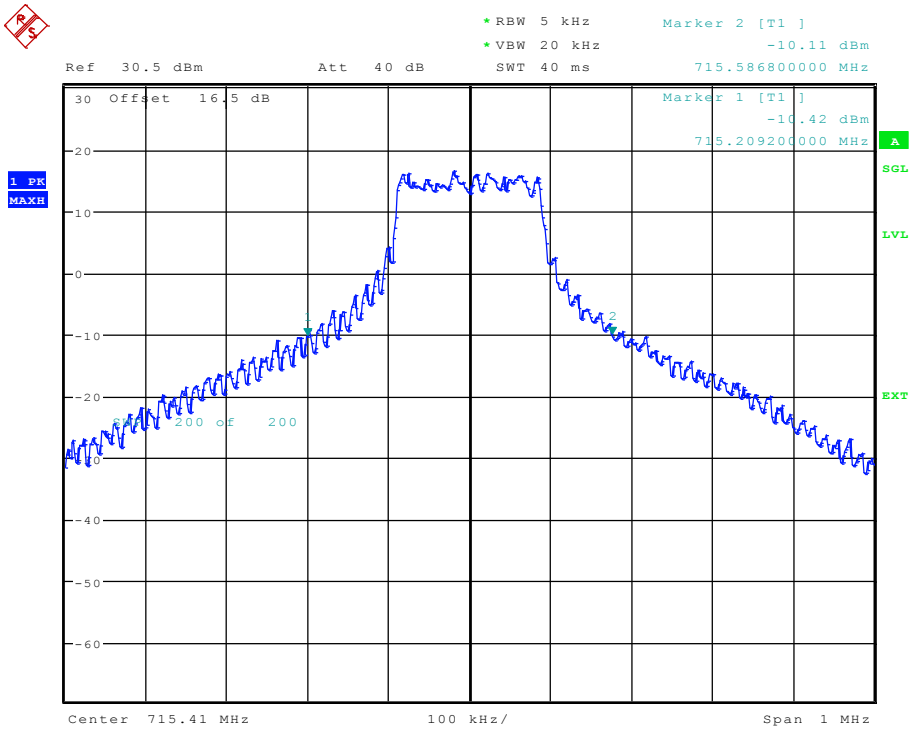
711 MHz - 1 Resource Block - Middle



Date: 11.DEC.2014 14:39:04

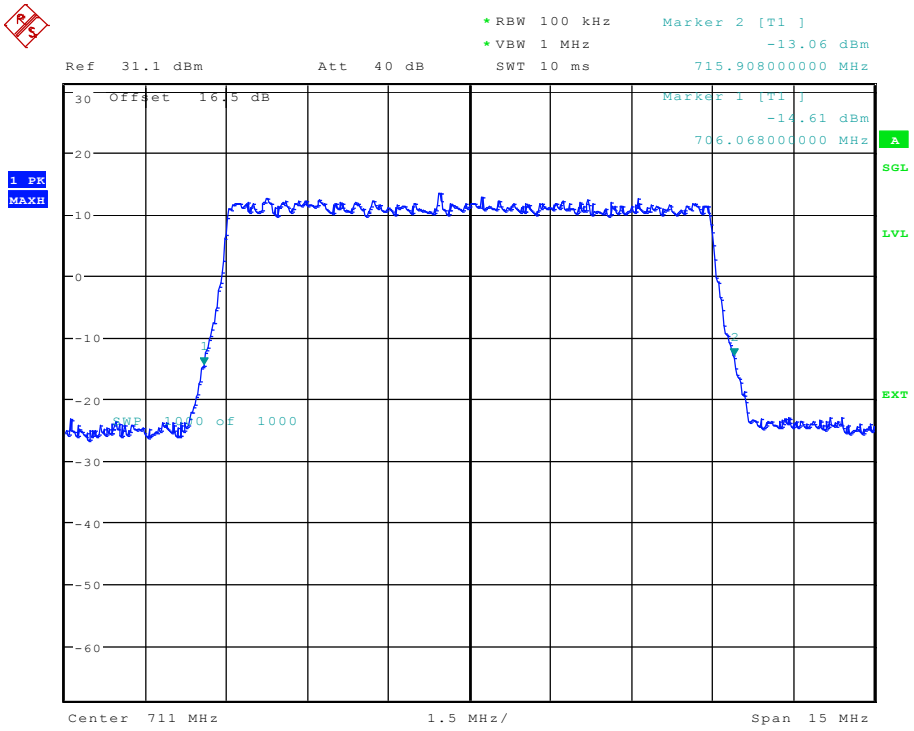
Product Service

711 MHz - 1 Resource Block - High



Date: 11.DEC.2014 14:39:44

711 MHz - All Resource Blocks



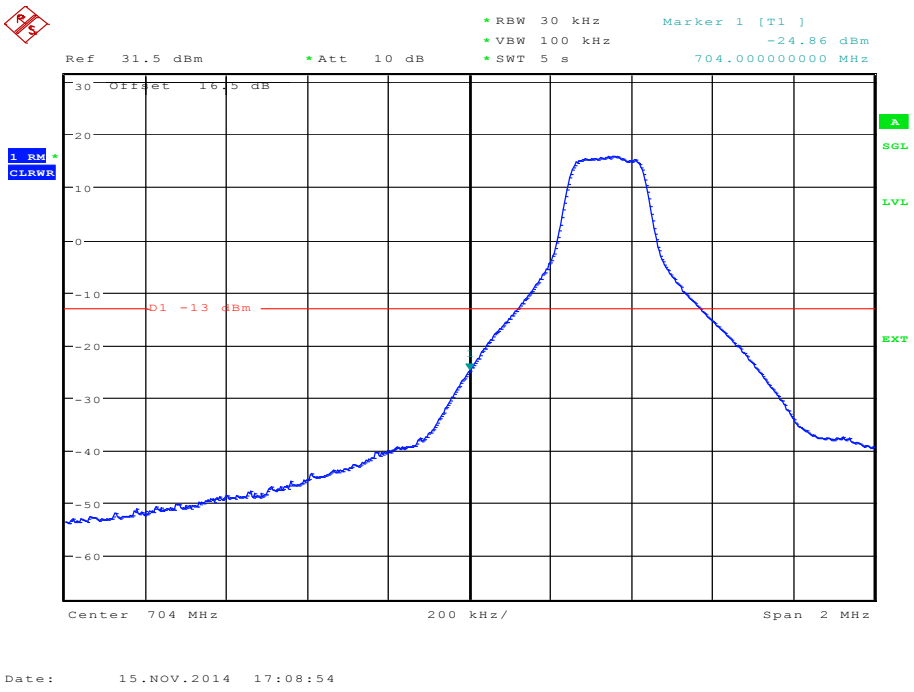
Date: 15.NOV.2014 14:59:56

Band Edge

5.0 MHz Bandwidth - QPSK

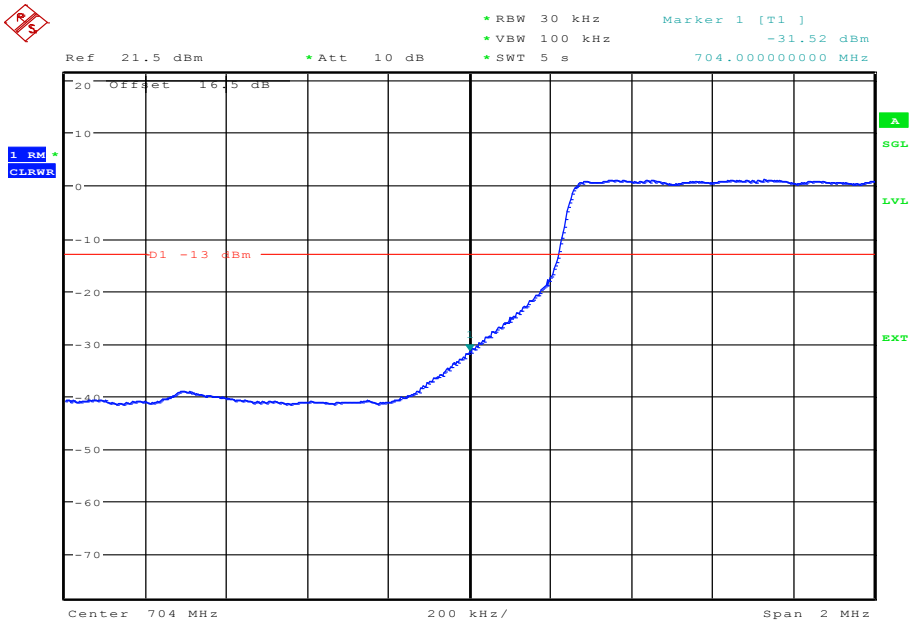
Band Edge (dBm)			
706.5 MHz		713.5 MHz	
1 Resource Block	All Resource Blocks	1 Resource Block	All Resource Blocks
Low		High	
-24.9	-31.5	-24.3	-32.5

706.5 MHz - 1 Resource Block - Low



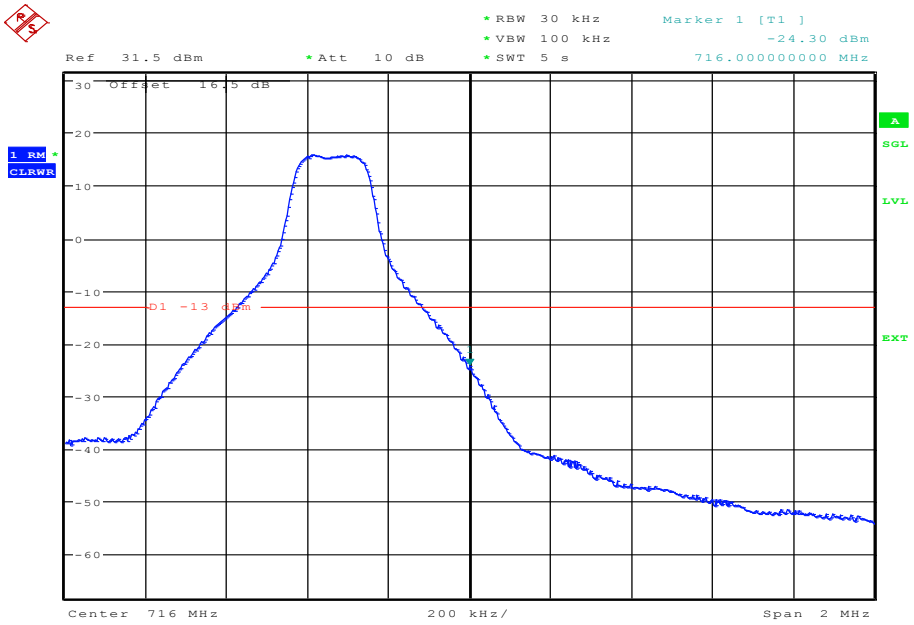
Product Service

706.5 MHz - All Resource Blocks



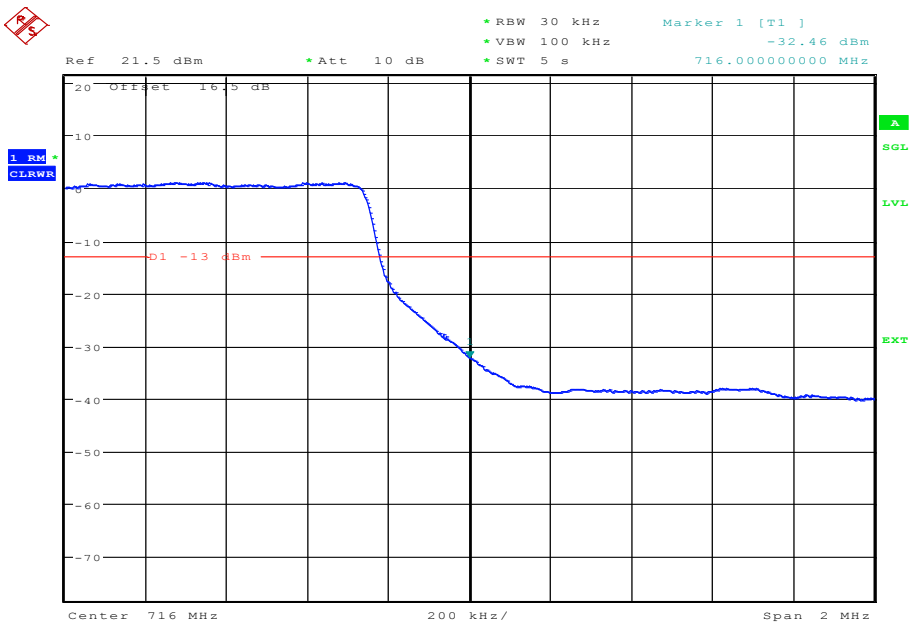
Product Service

713.5 MHz - 1 Resource Block - High



Date: 15.NOV.2014 12:15:38

713.5 MHz - All Resource Blocks

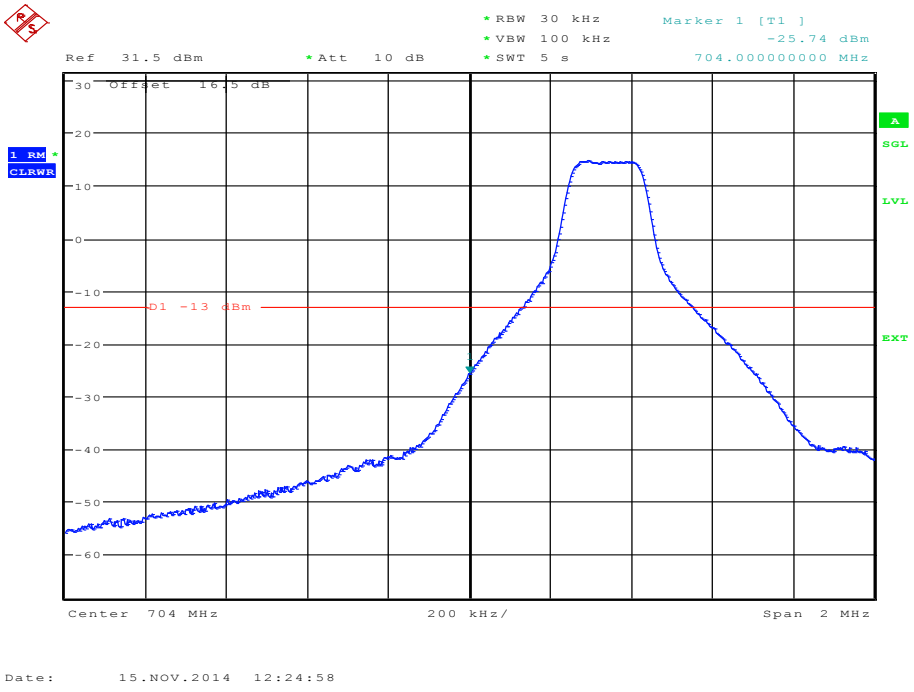


Date: 15.NOV.2014 11:46:05

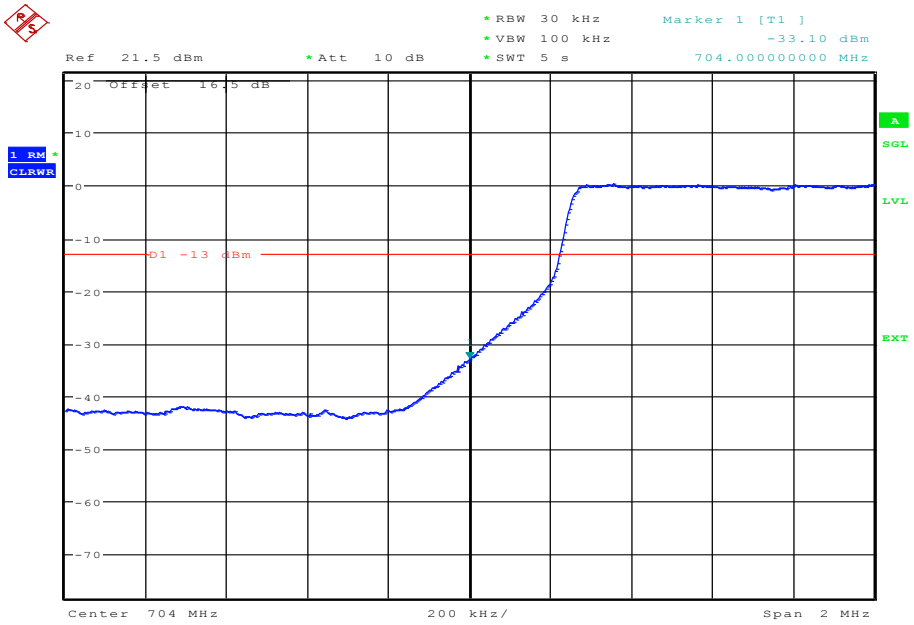
5.0 MHz Bandwidth - 16QAM

Band Edge (dBm)			
706.5 MHz		713.5 MHz	
1 Resource Block	All Resource Blocks	1 Resource Block	All Resource Blocks
Low		High	
-25.7	-33.1	-26.3	-33.3

706.5 MHz - 1 Resource Block - Low

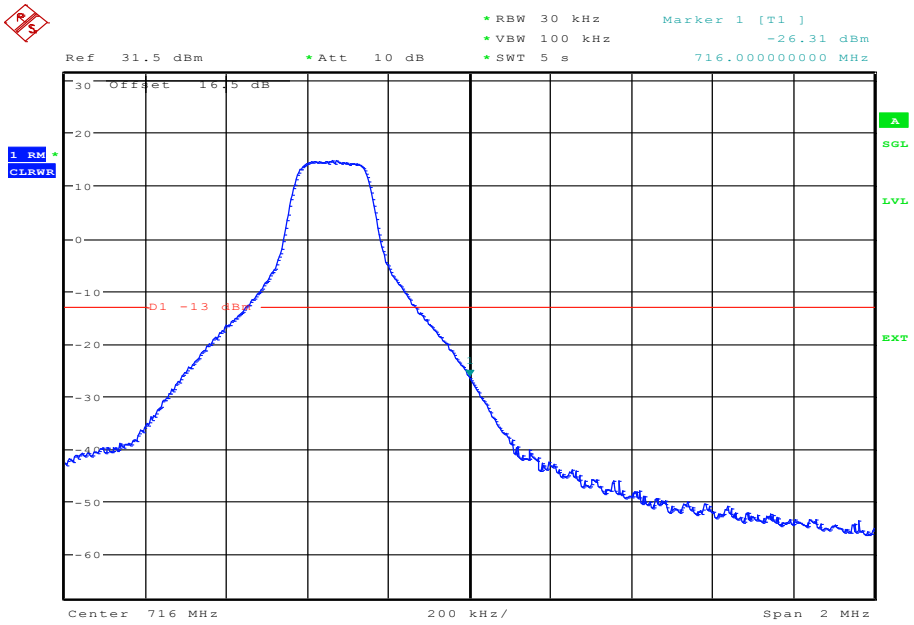


706.5 MHz - All Resource Blocks



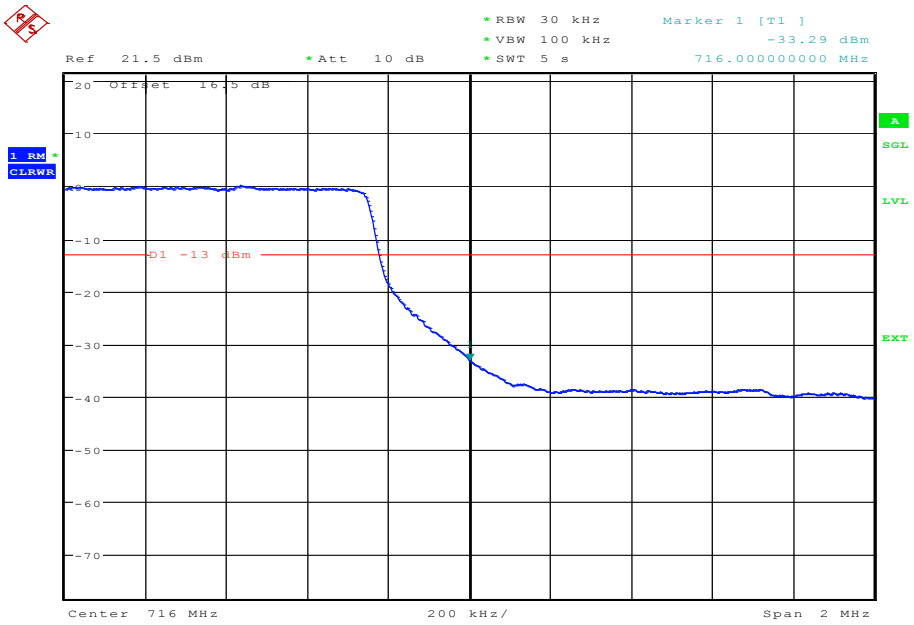
Product Service

713.5 MHz - 1 Resource Block - High



Date: 15.NOV.2014 13:17:17

713.5 MHz - All Resource Blocks

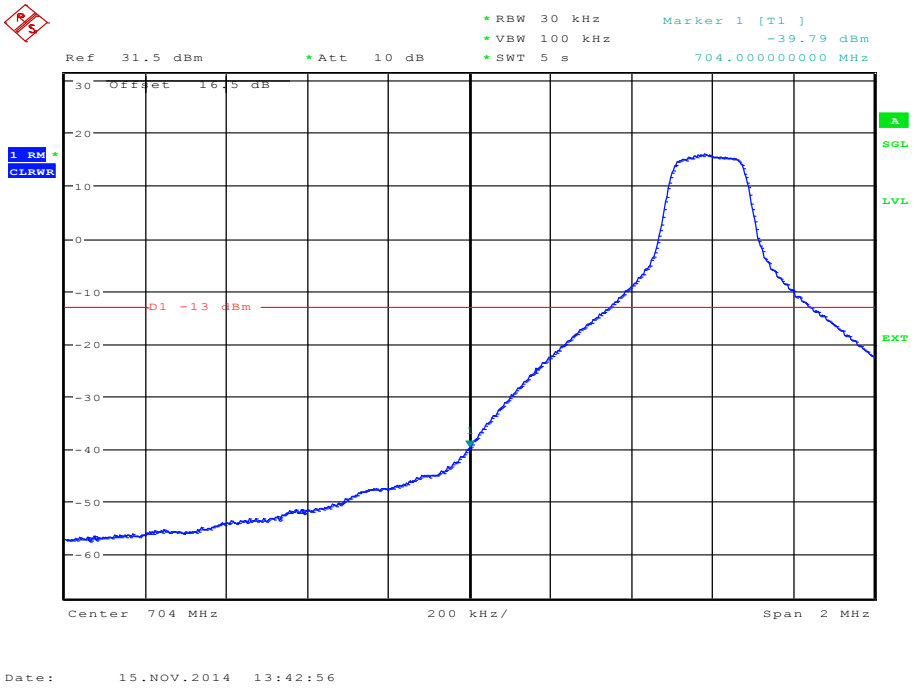


Date: 15.NOV.2014 12:46:04

10.0 MHz Bandwidth - QPSK

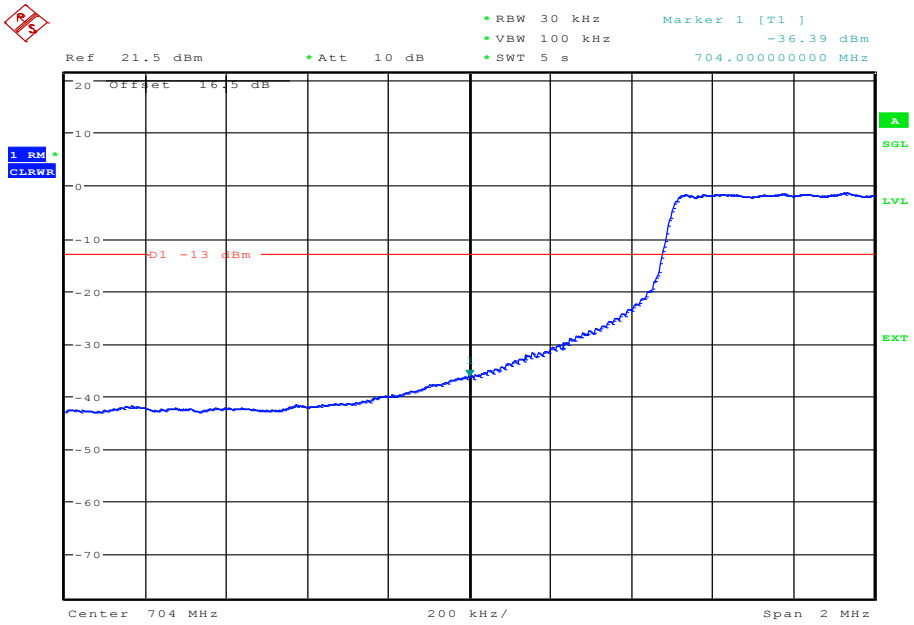
Band Edge (dBm)			
709.0 MHz		711.0 MHz	
1 Resource Block	All Resource Blocks	1 Resource Block	All Resource Blocks
Low		High	
-39.8	-36.4	-40.1	-35.8

709 MHz - 1 Resource Block - Low



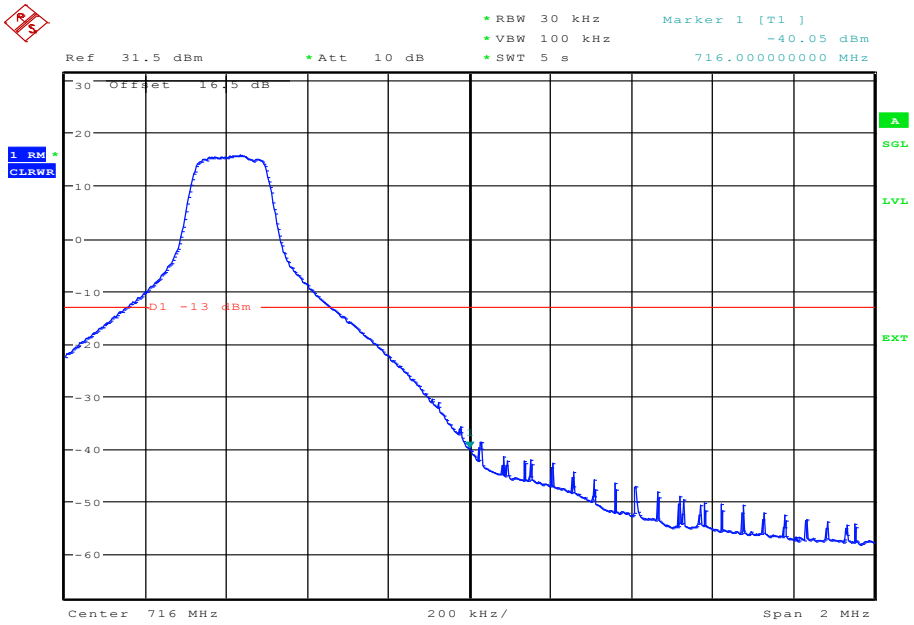
Product Service

709 MHz - All Resource Blocks



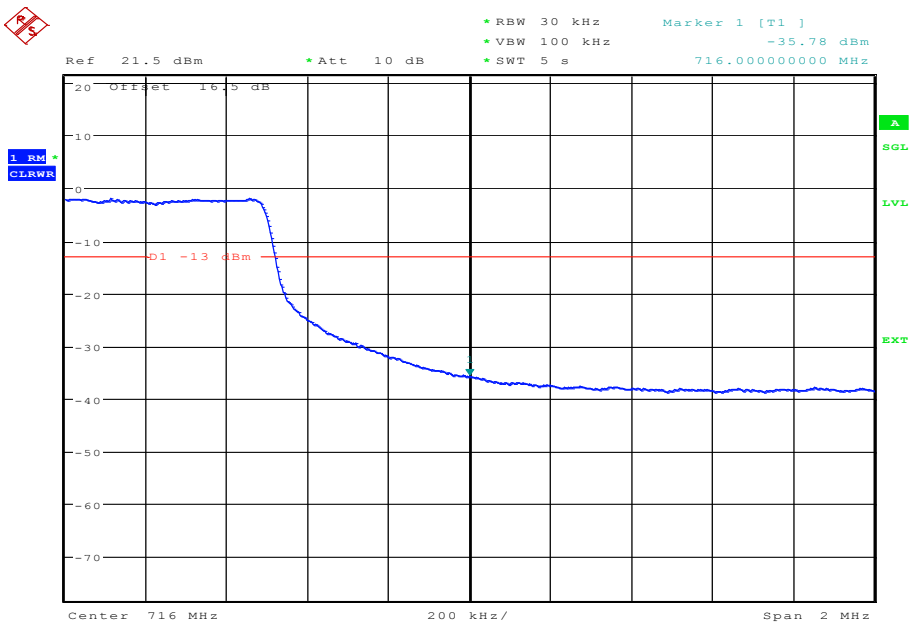
Product Service

711 MHz - 1 Resource Block - High



Date: 15.NOV.2014 14:17:24

711 MHz - All Resource Blocks

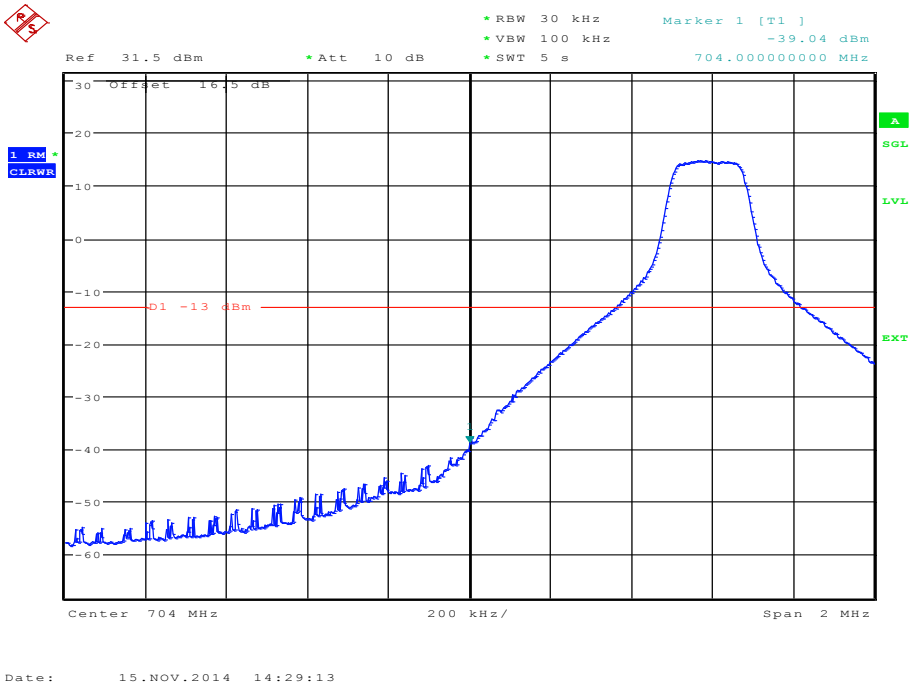


Date: 15.NOV.2014 14:08:12

10.0 MHz Bandwidth - 16QAM

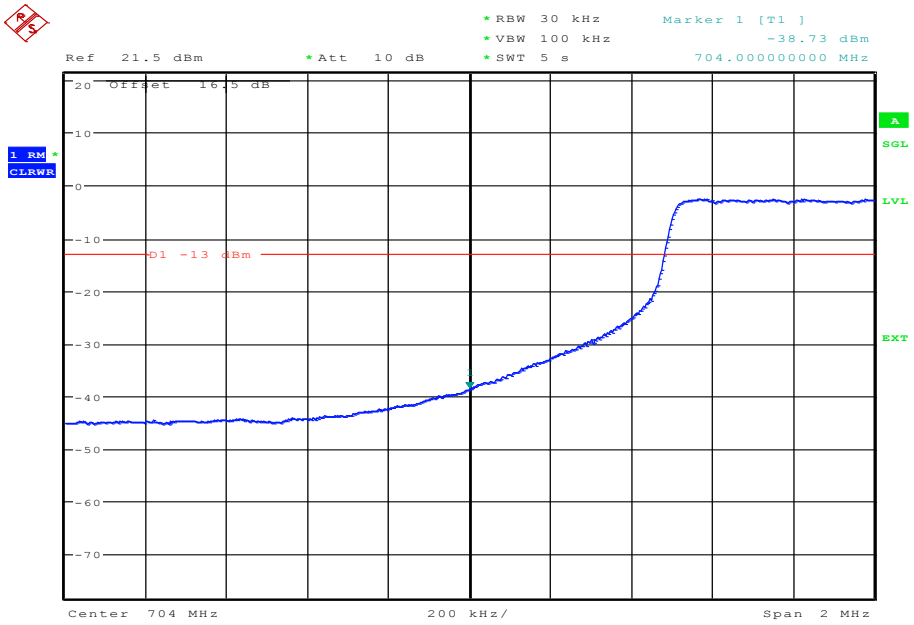
Band Edge (dBm)			
709.0 MHz		711.0 MHz	
1 Resource Block	All Resource Blocks	1 Resource Block	All Resource Blocks
Low		High	
-39.0	-38.7	-40.5	-37.5

709 MHz - 1 Resource Block - Low



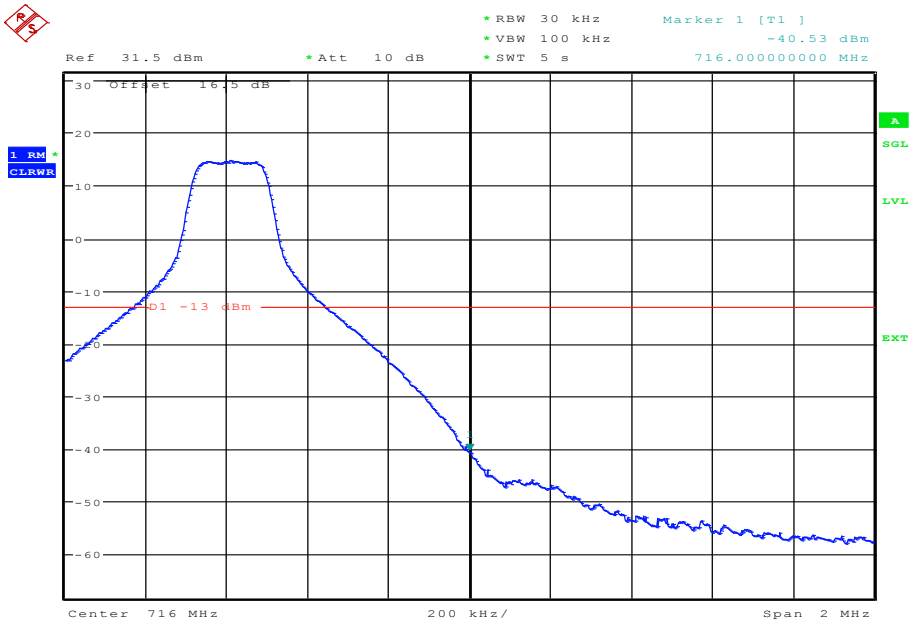
Product Service

709 MHz - All Resource Blocks



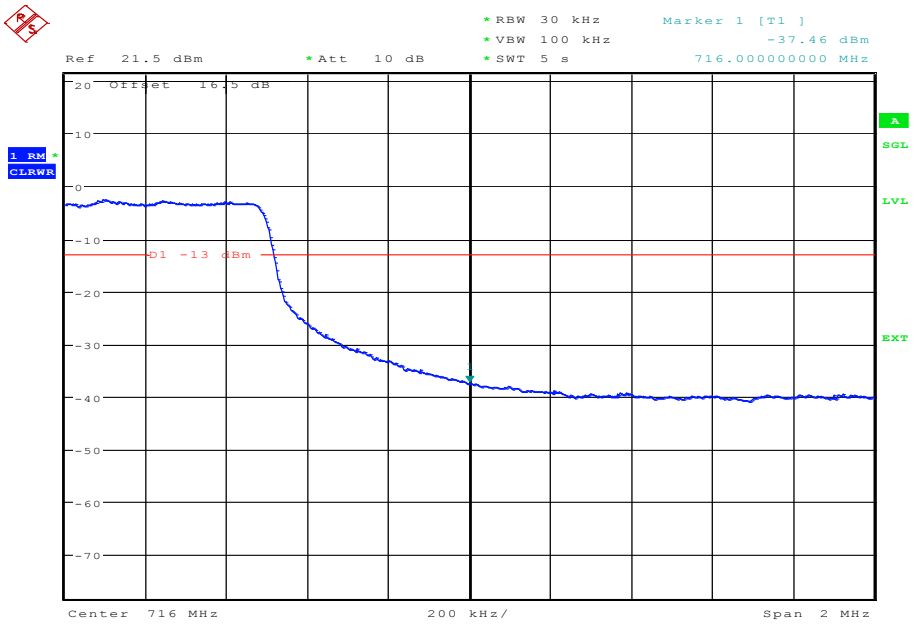
Product Service

711 MHz - 1 Resource Block - High



Date: 15.NOV.2014 15:12:59

711 MHz - All Resource Blocks



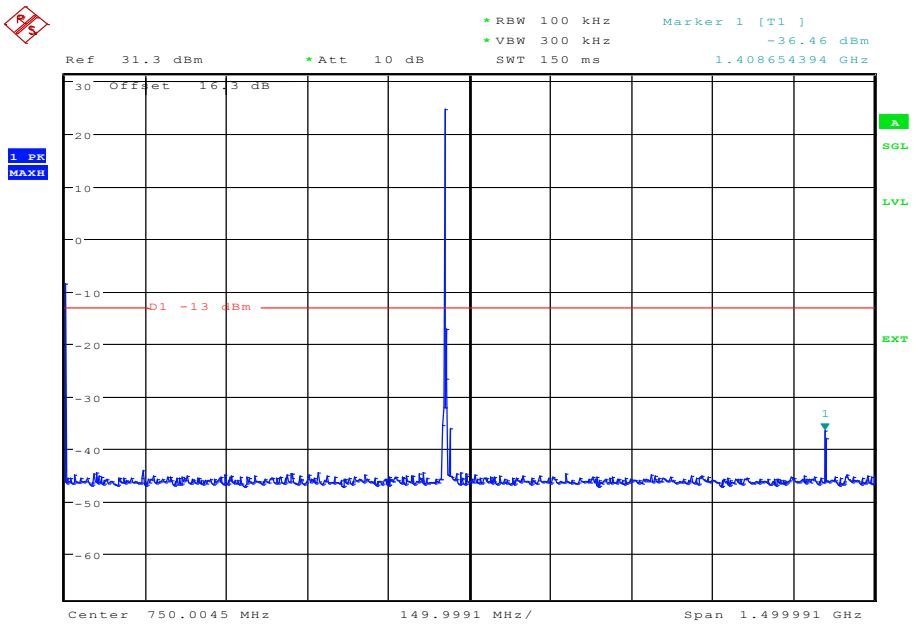
Date: 15.NOV.2014 15:00:40

Product Service

Conducted Spurious Emissions - Measurement Band 1

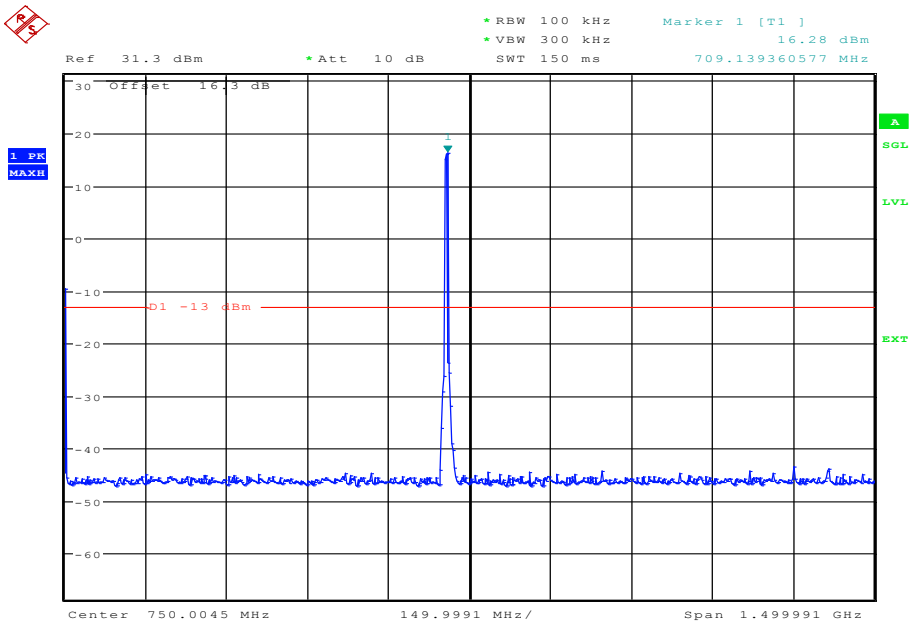
5.0 MHz Bandwidth - QPSK

706.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 10:50:35

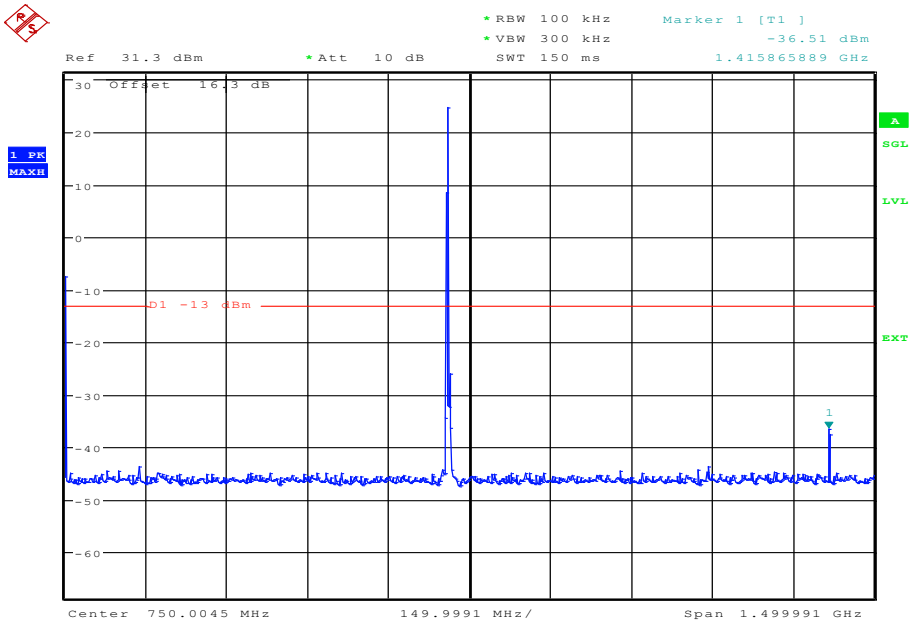
706.5 MHz - All Resource Blocks



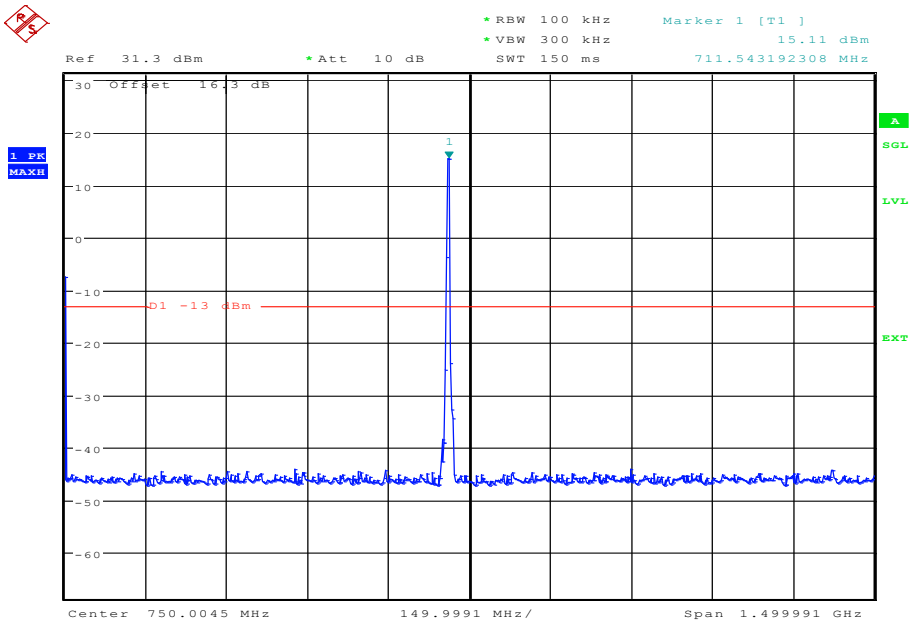
Date: 15.NOV.2014 10:07:38

Product Service

710 MHz - 1 Resource Block - Low

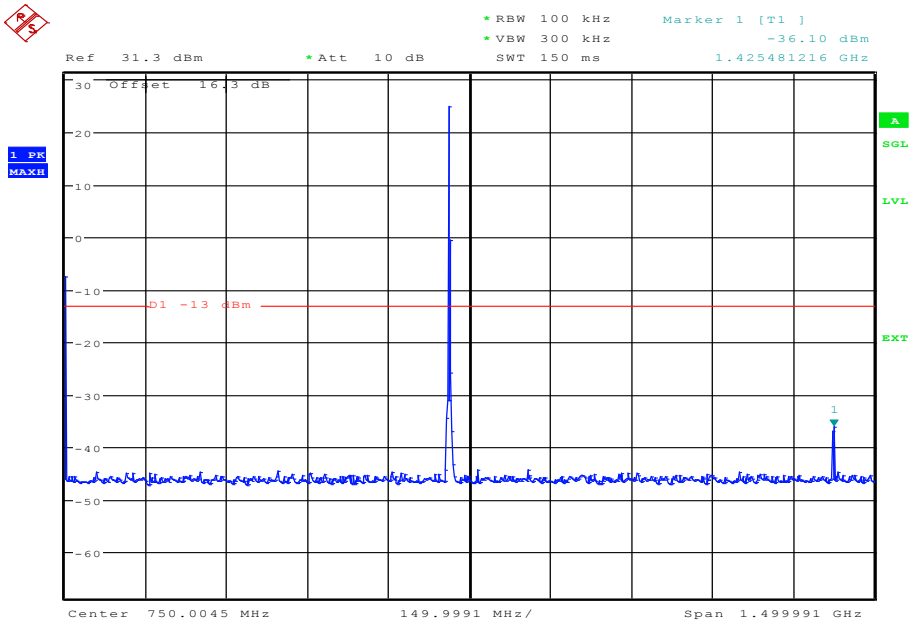


710 MHz - All Resource Blocks



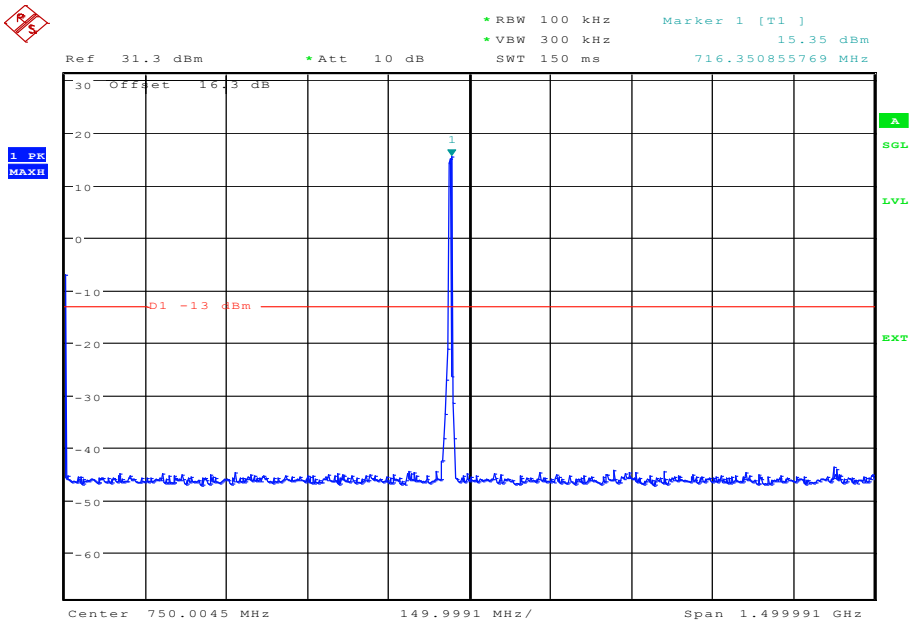
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 12:11:12

713.5 MHz - All Resource Blocks

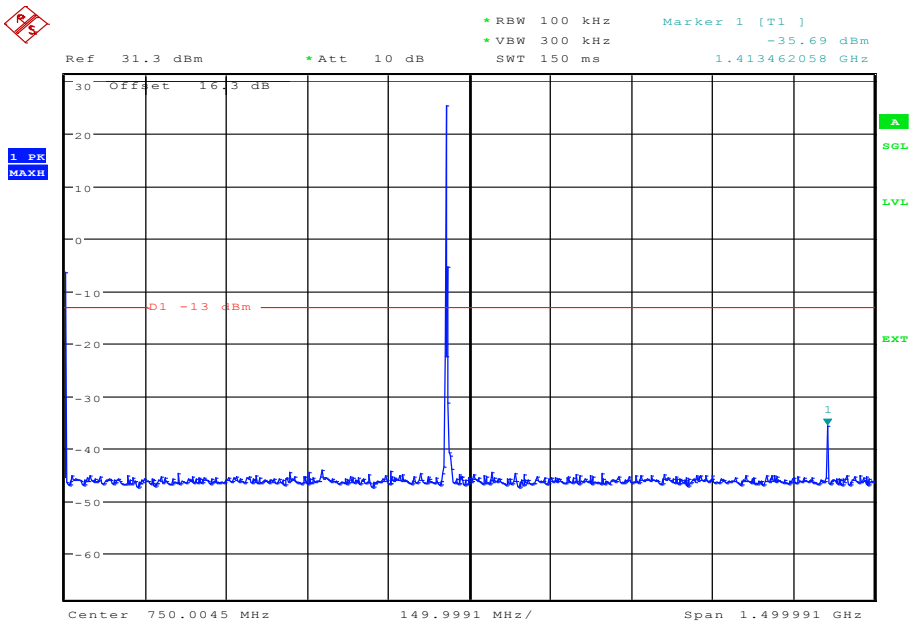


Date: 15.NOV.2014 11:52:05

Product Service

5.0 MHz Bandwidth - 16QAM

706.5 MHz - 1 Resource Block - Middle



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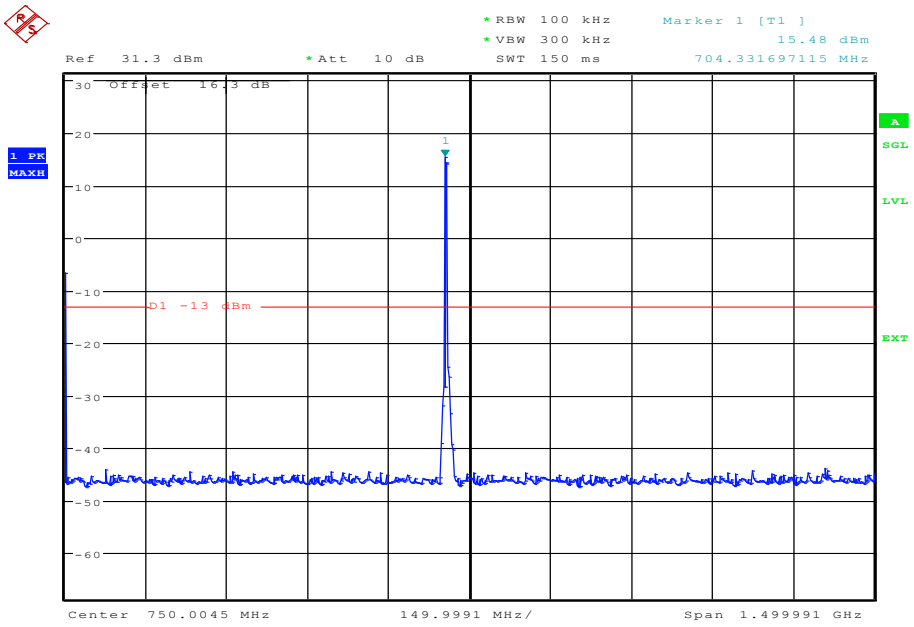
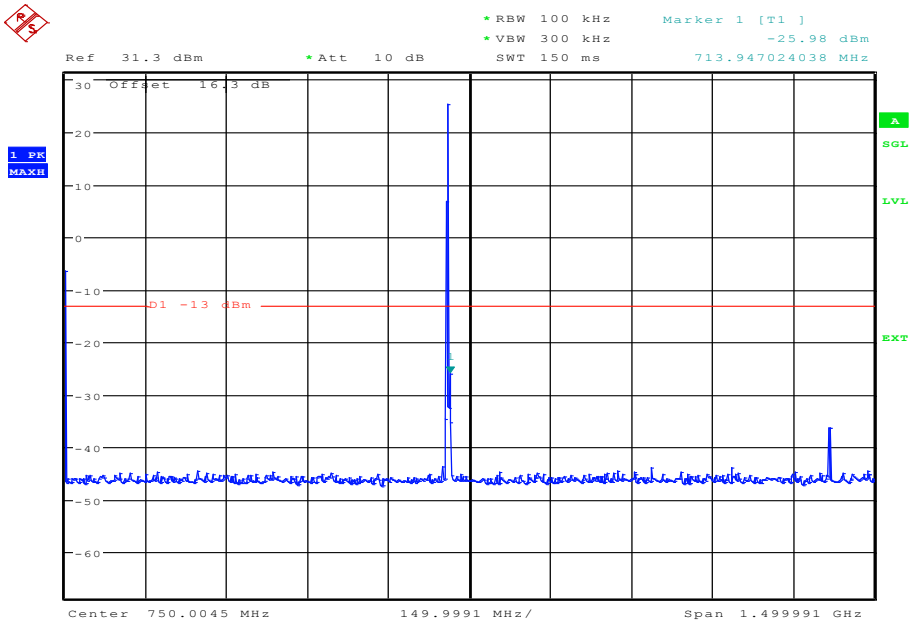
706.5 MHz - All Resource Blocks



Date: 15.NOV.2014 12:22:10

Product Service

710 MHz - 1 Resource Block - Low



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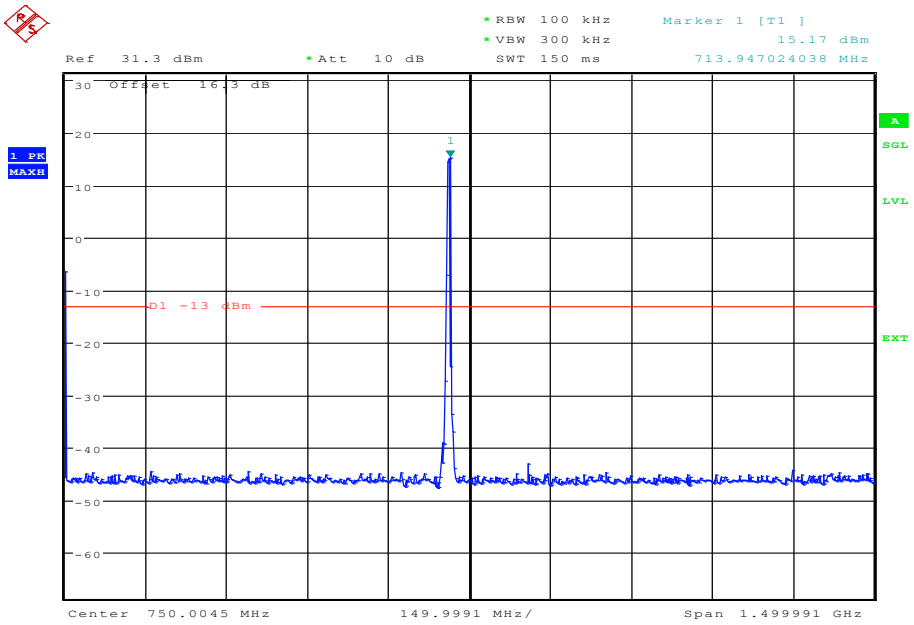
710 MHz - All Resource Blocks



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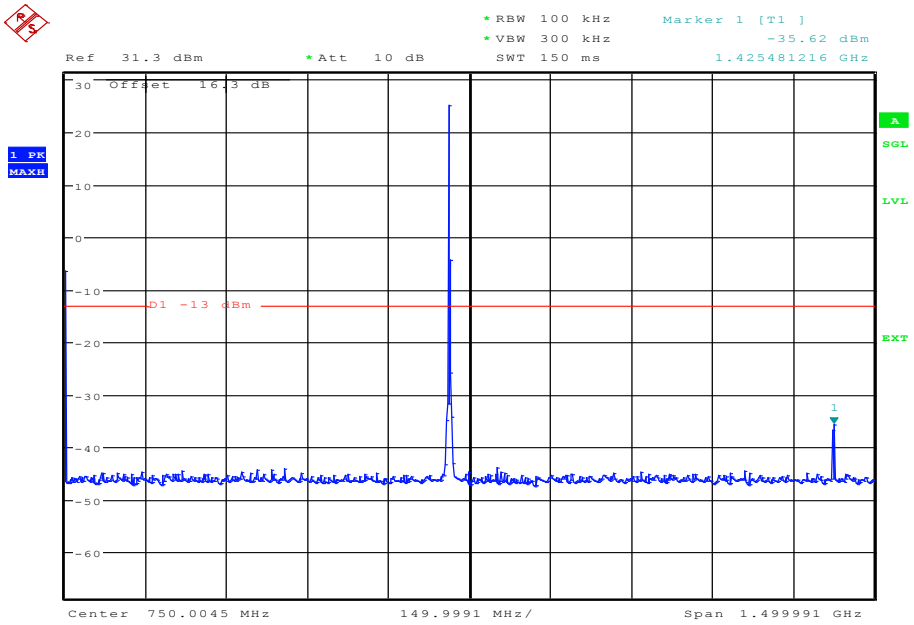
Product Service

713.5 MHz - 1 Resource Block - Low



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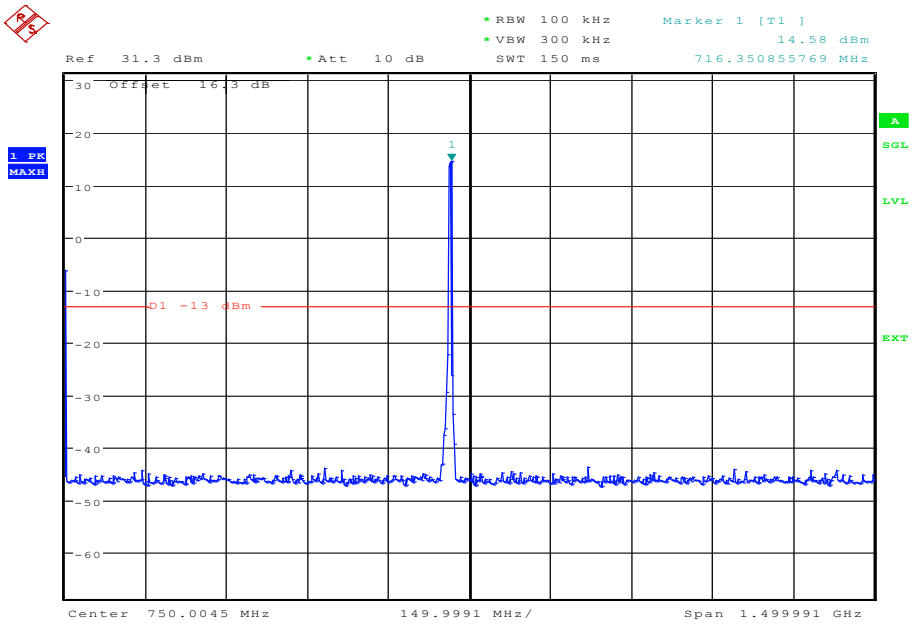
713.5 MHz - All Resource Blocks



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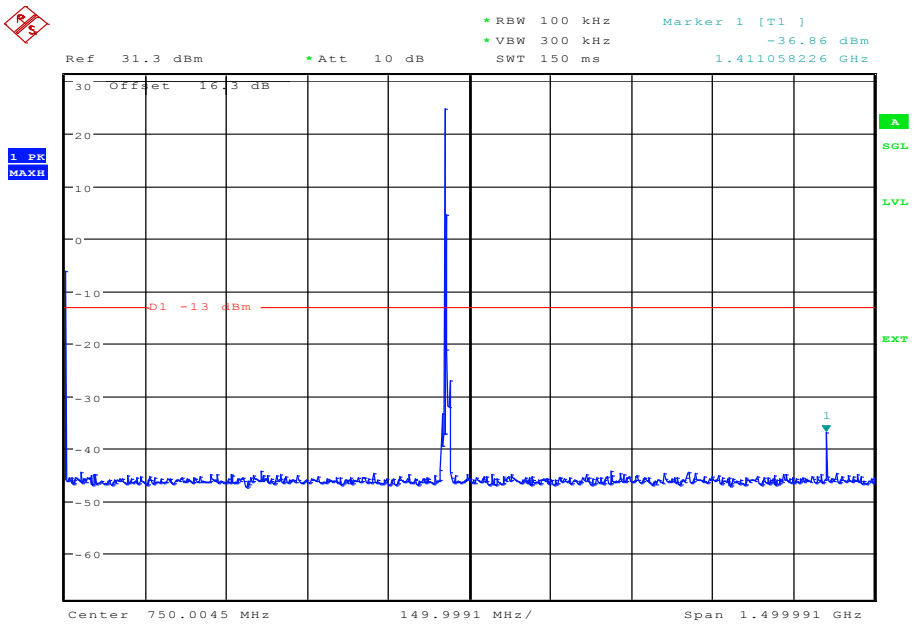
Product Service

10.0 MHz Bandwidth - QPSK

709 MHz - 1 Resource Block - Low



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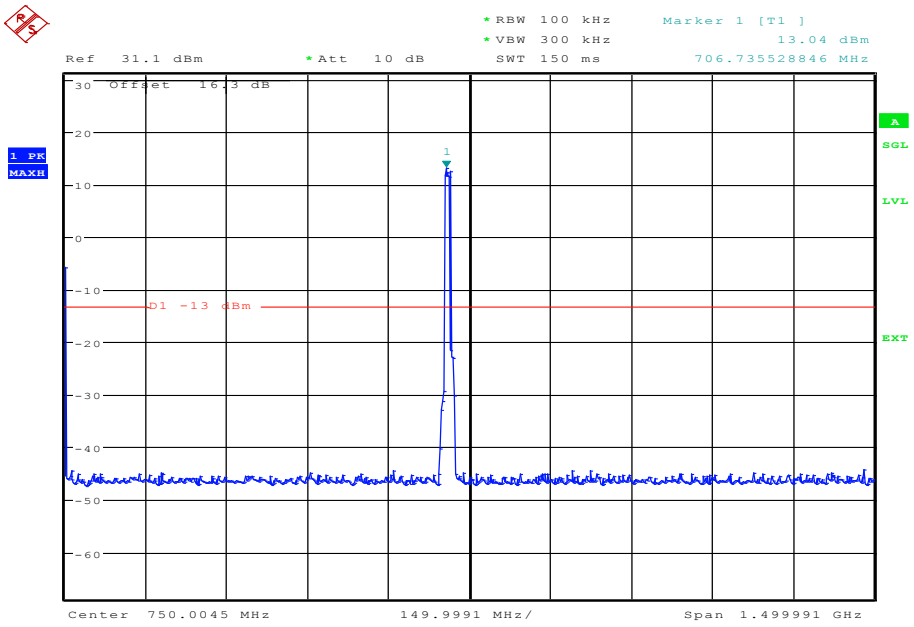
709 MHz - All Resource Blocks



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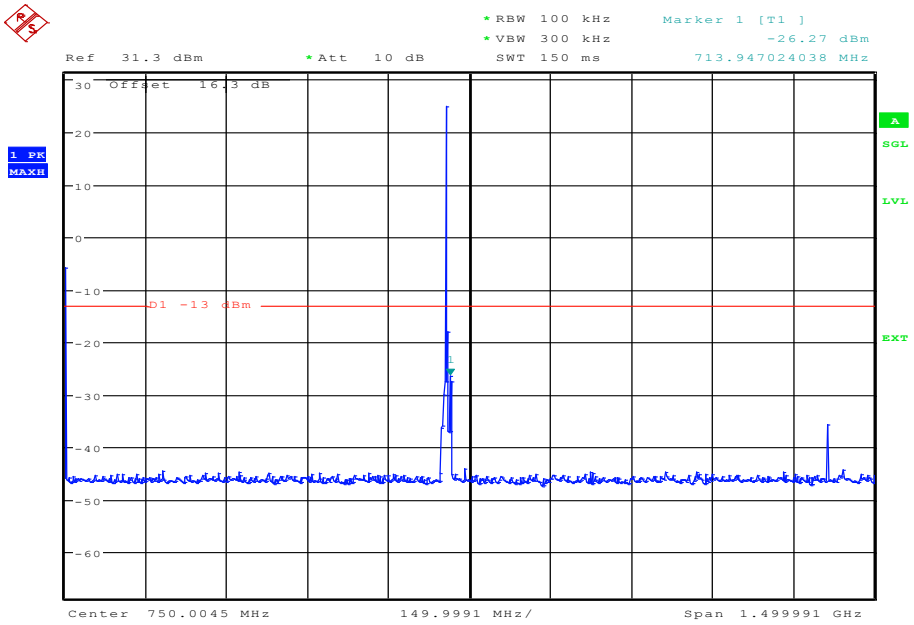
Product Service

710 MHz - 1 Resource Block - Low



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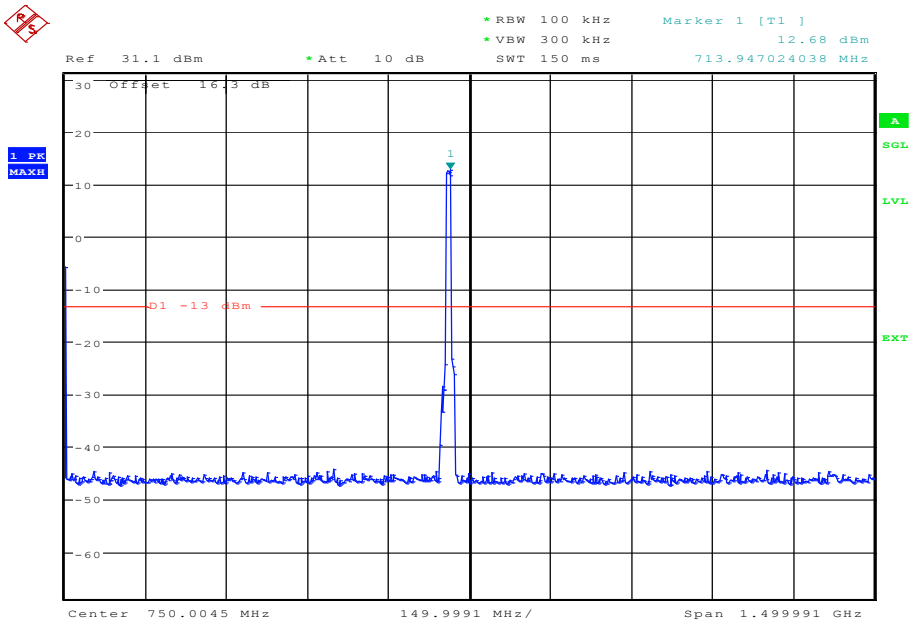
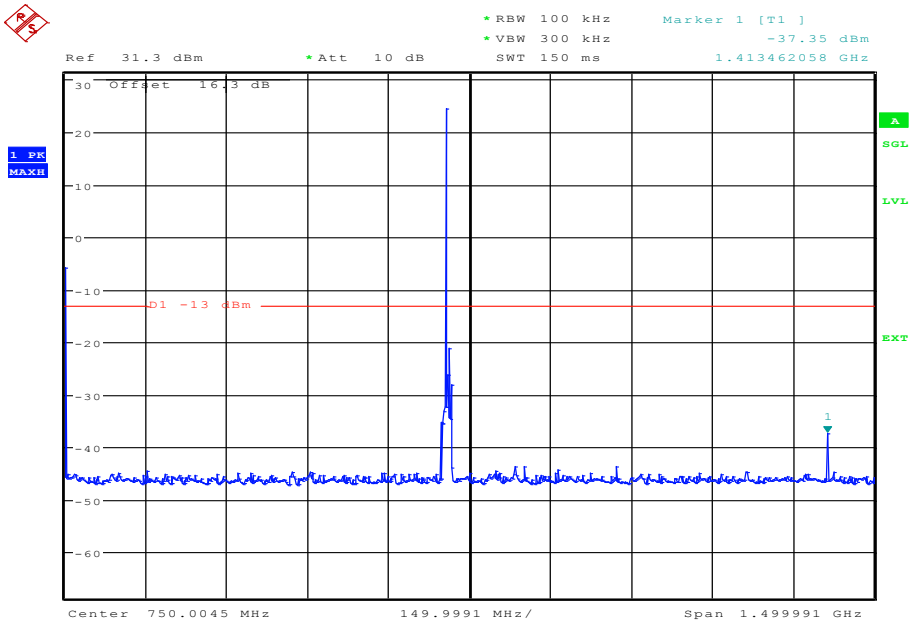
710 MHz - All Resource Blocks



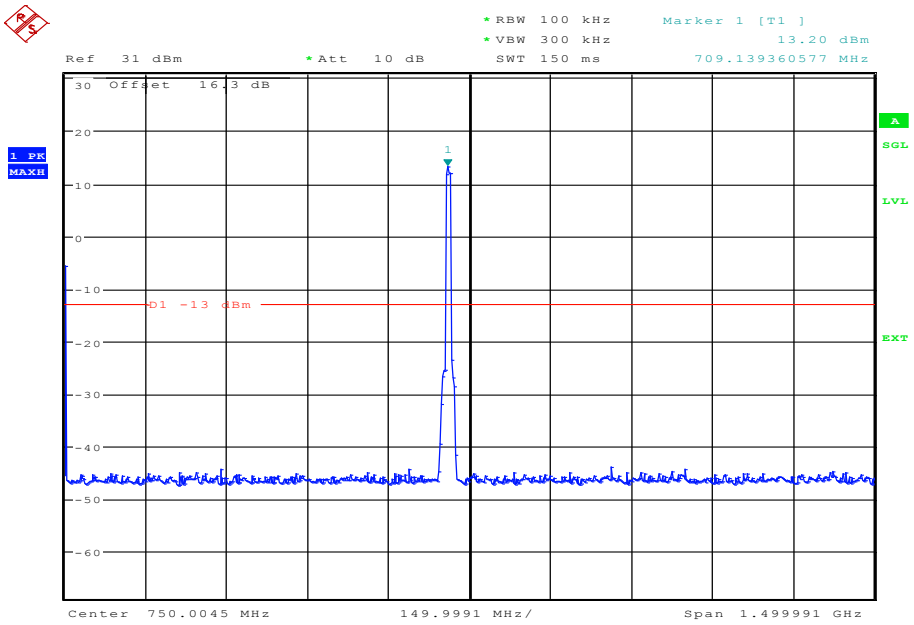
Date: 15.NOV.2014 13:53:58

Product Service

711 MHz - 1 Resource Block - Low



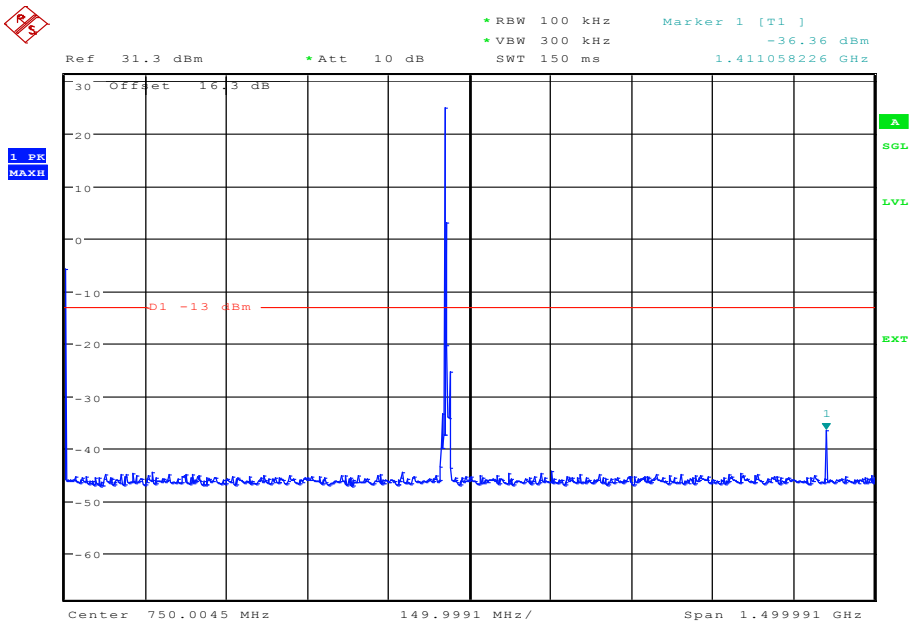
711 MHz - All Resource Blocks



Product Service

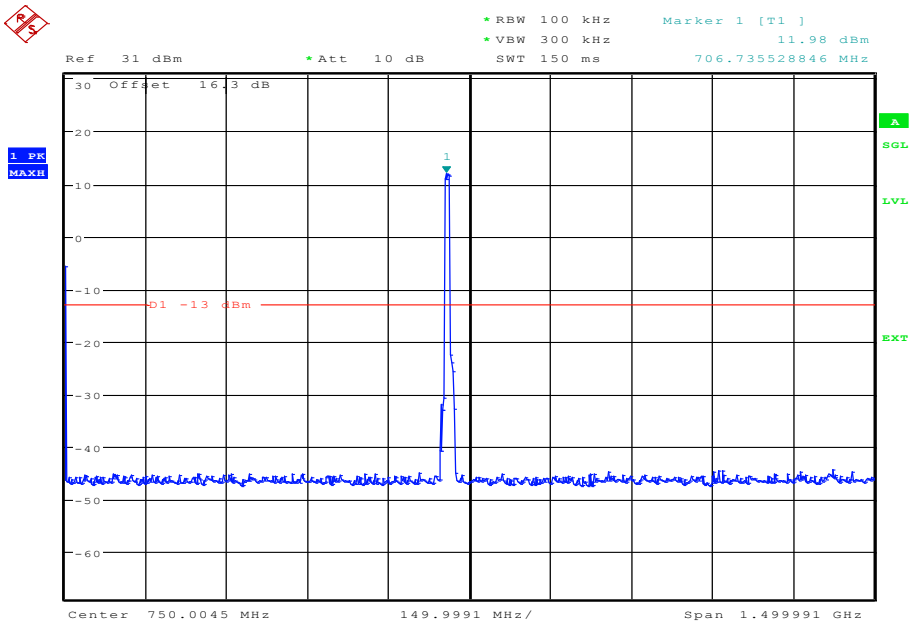
10.0 MHz Bandwidth - 16QAM

709 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 14:37:57

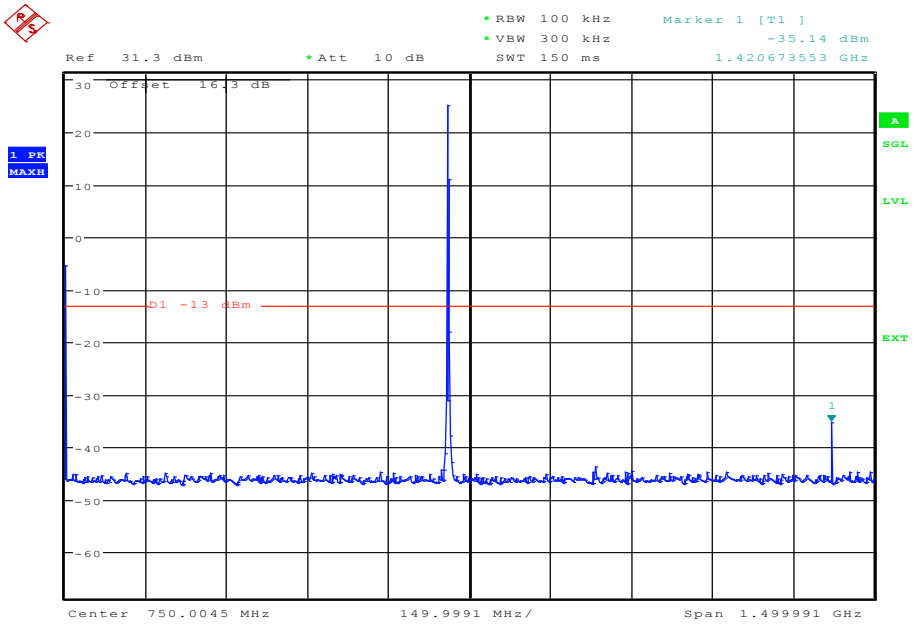
709 MHz - All Resource Blocks



Date: 15.NOV.2014 14:25:07

Product Service

710 MHz - 1 Resource Block - Middle



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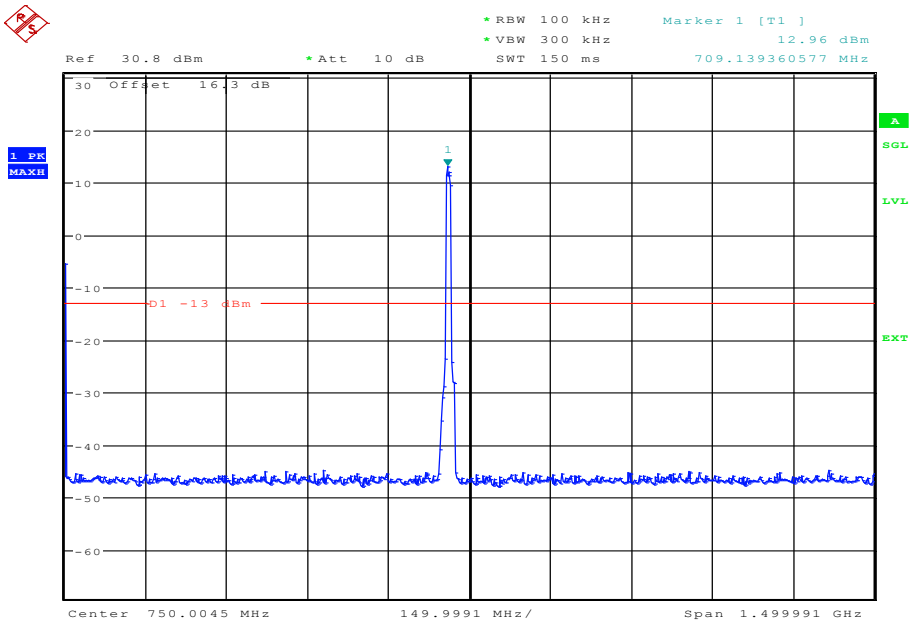
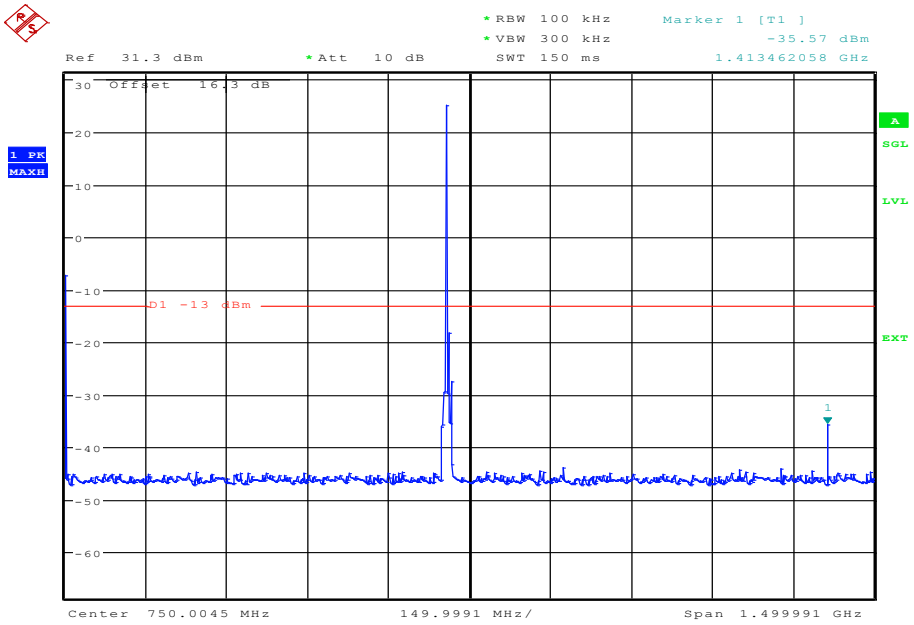
710 MHz - All Resource Blocks



Date: 15.NOV.2014 14:47:52

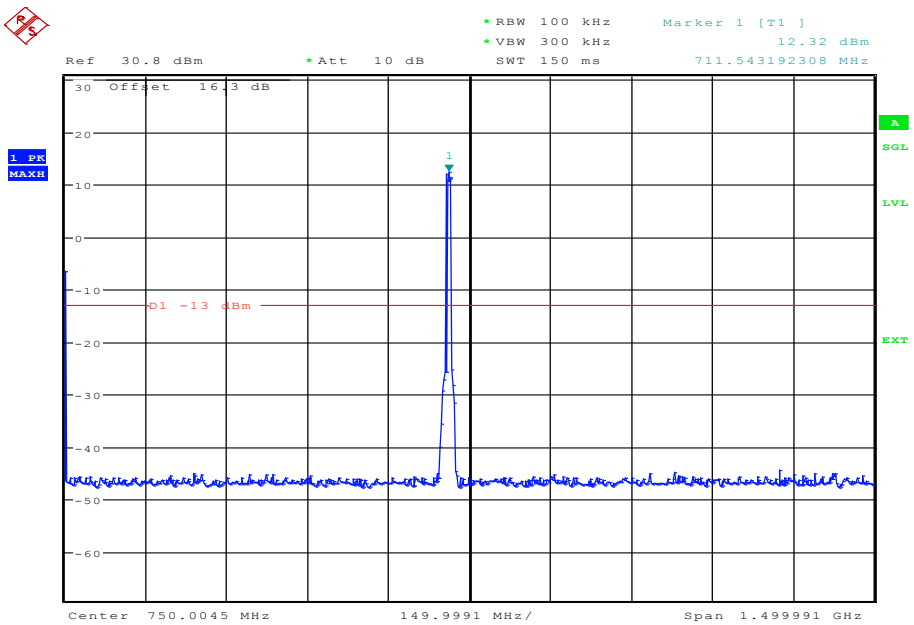
Product Service

711 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:08:24

711 MHz - All Resource Blocks



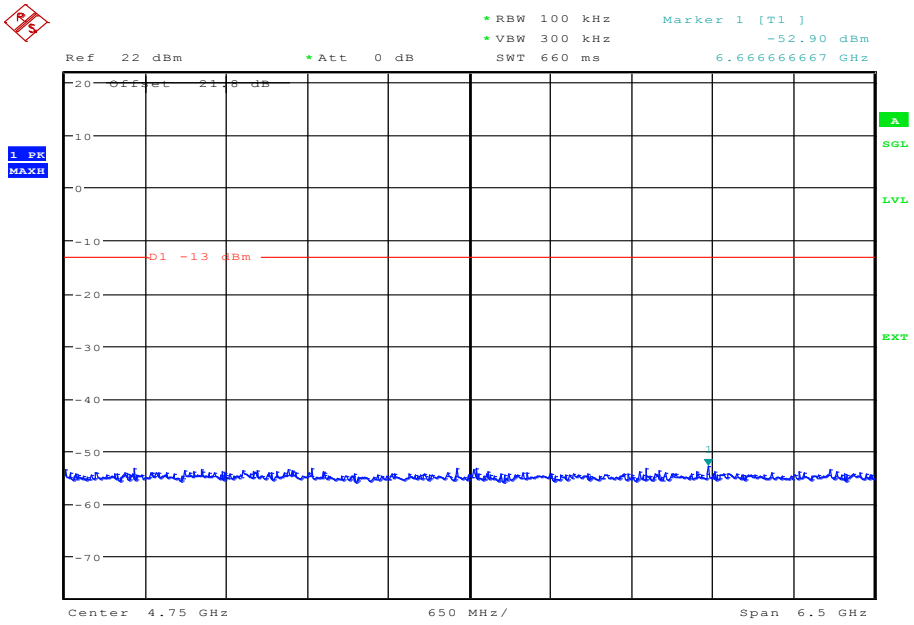
Date: 15.NOV.2014 15:05:10

Product Service

Conducted Spurious Emissions - Measurement Band 2

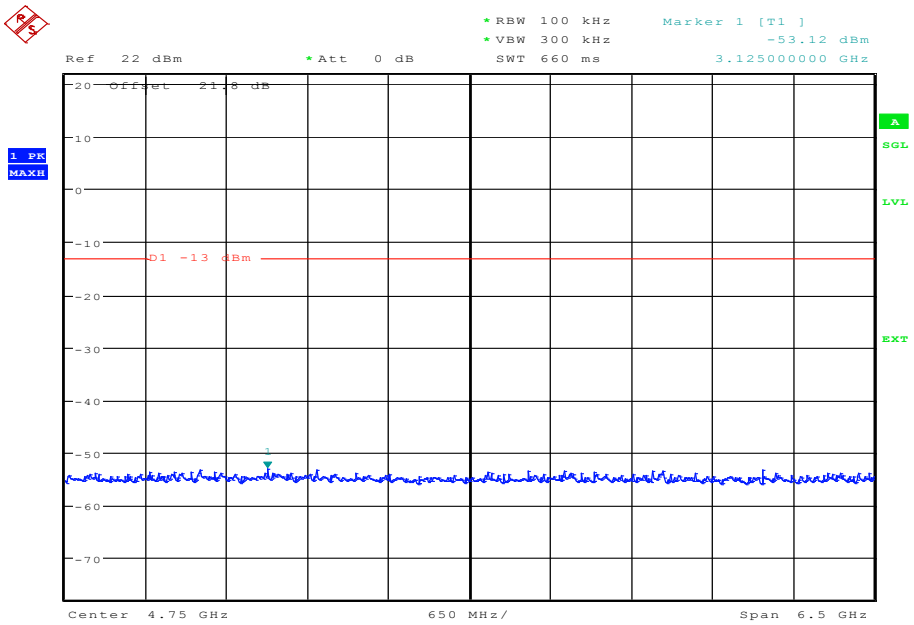
5.0 MHz Bandwidth - QPSK

706.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:17:51

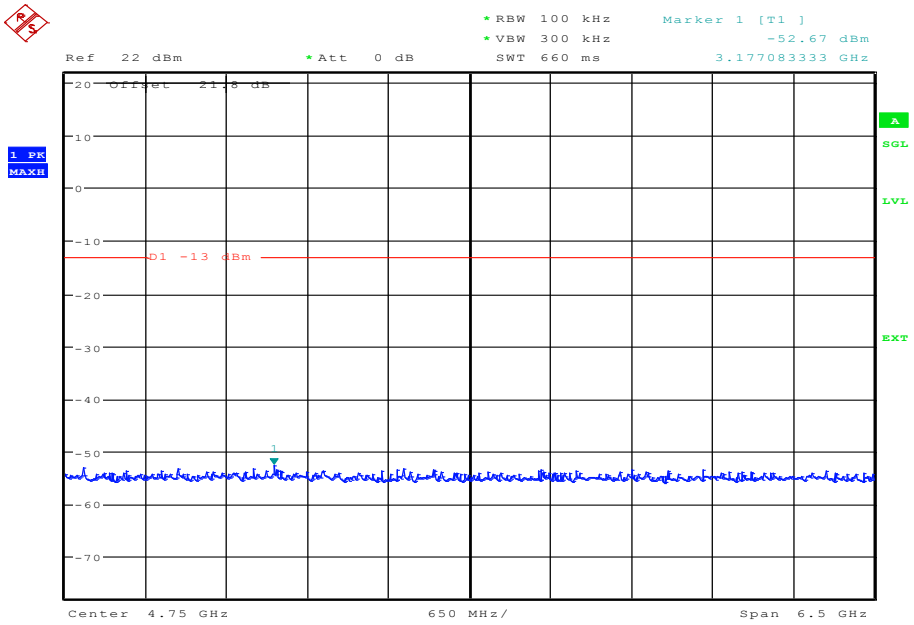
706.5 MHz - All Resource Blocks



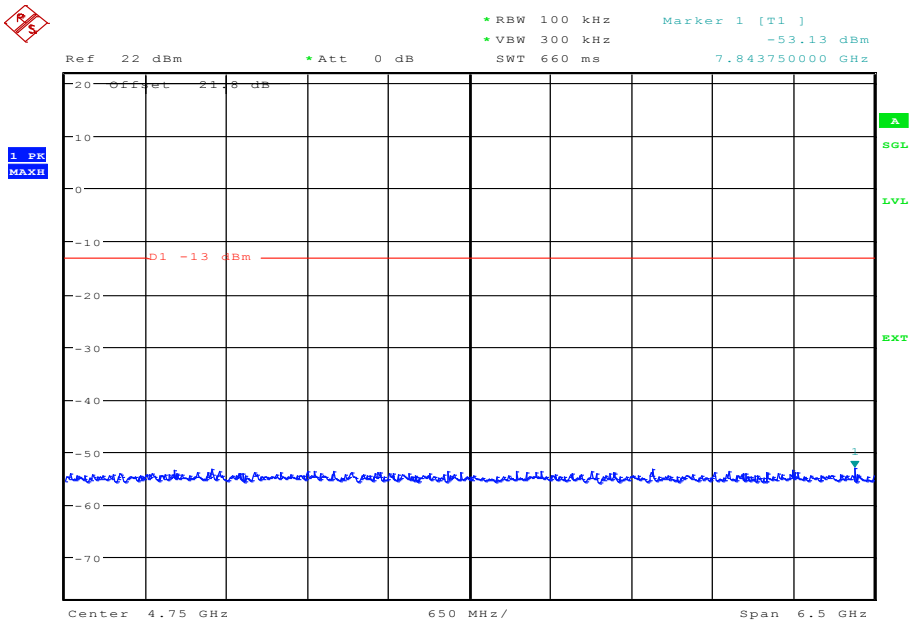
Date: 15.NOV.2014 16:13:24

Product Service

710 MHz - 1 Resource Block - Low

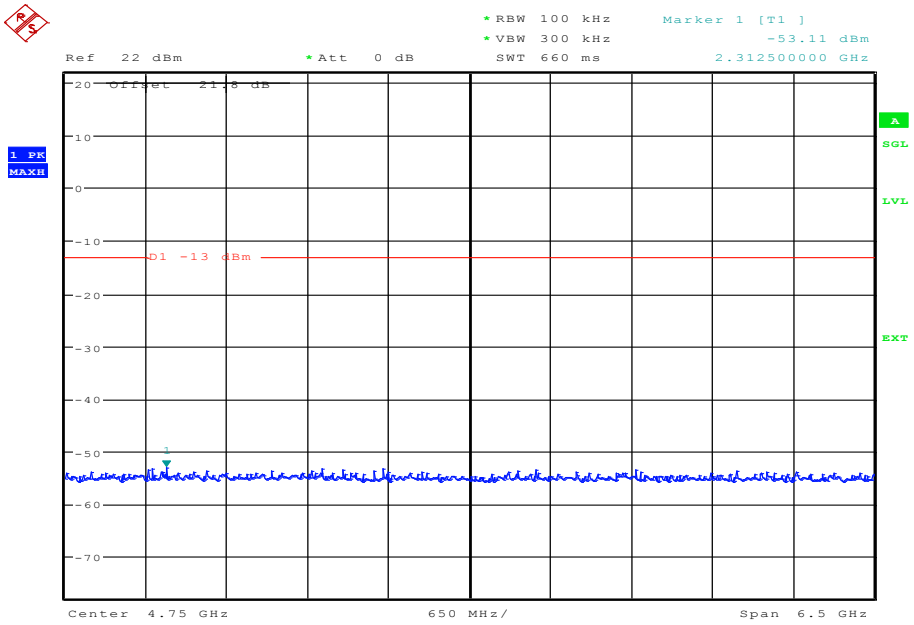


710 MHz - All Resource Blocks



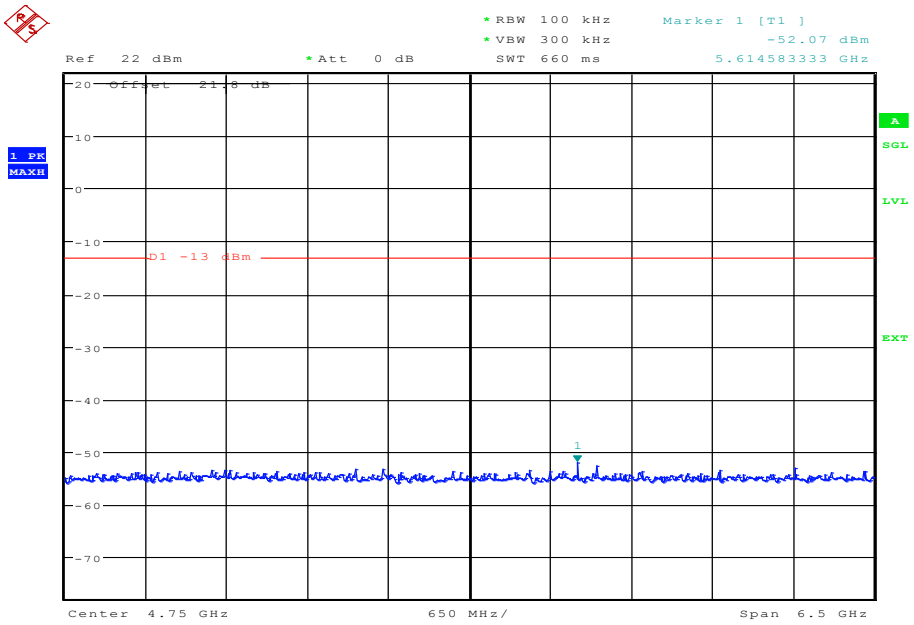
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:32:56

713.5 MHz - All Resource Blocks

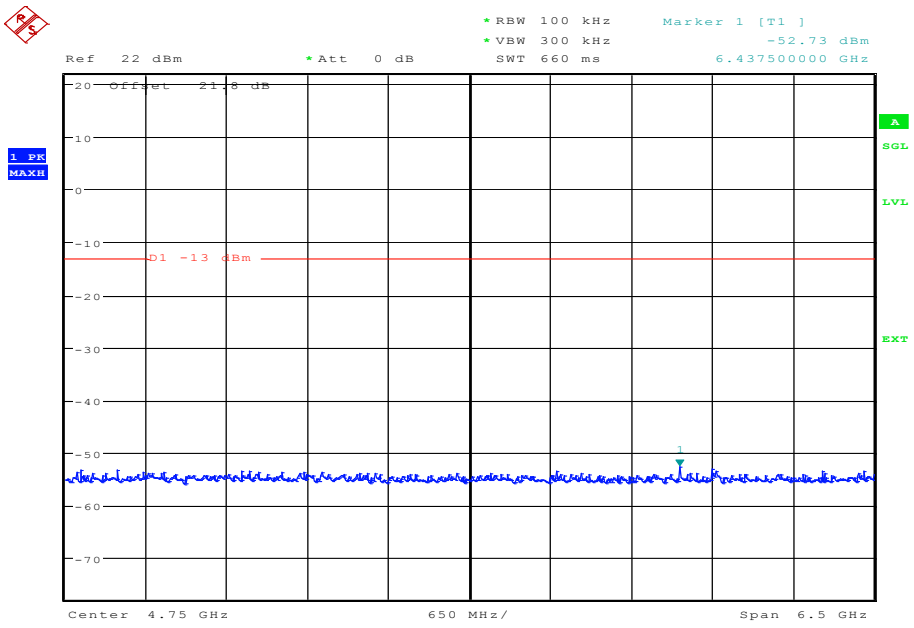


Date: 15.NOV.2014 16:30:18

Product Service

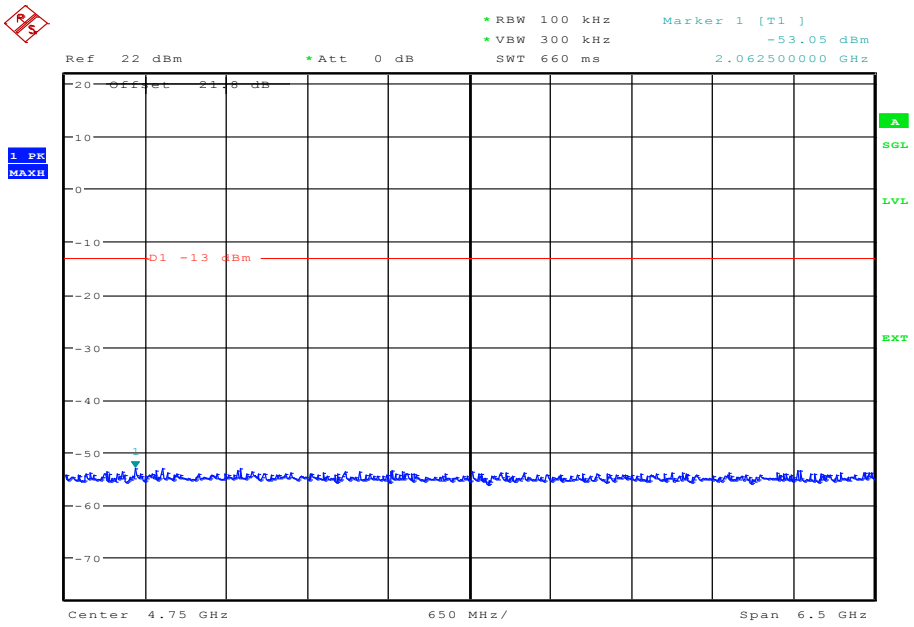
5.0 MHz Bandwidth - 16QAM

706.5 MHz - 1 Resource Block - Middle



Date: 15.NOV.2014 16:49:23

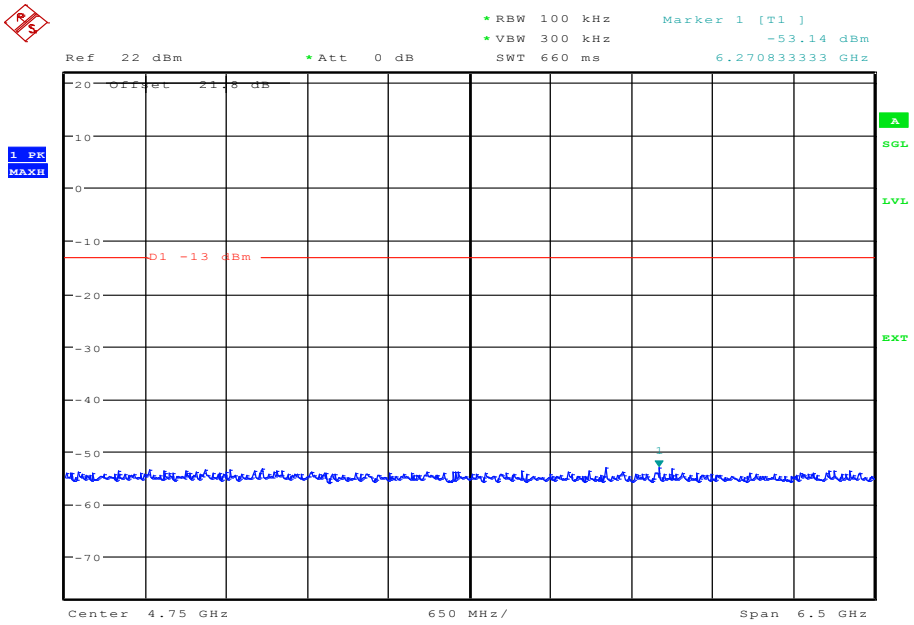
706.5 MHz - All Resource Blocks



Date: 15.NOV.2014 16:51:58

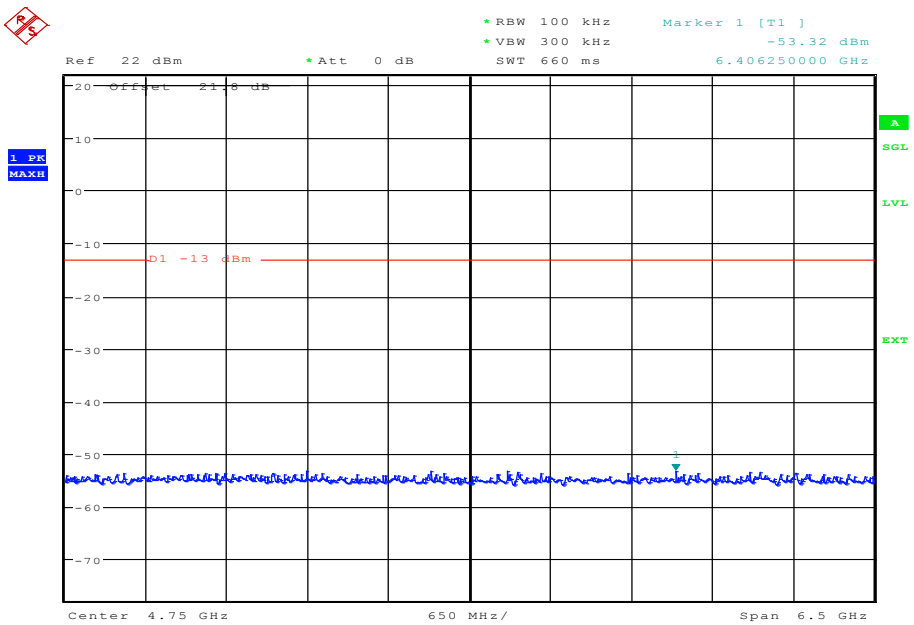
Product Service

710 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:46:37

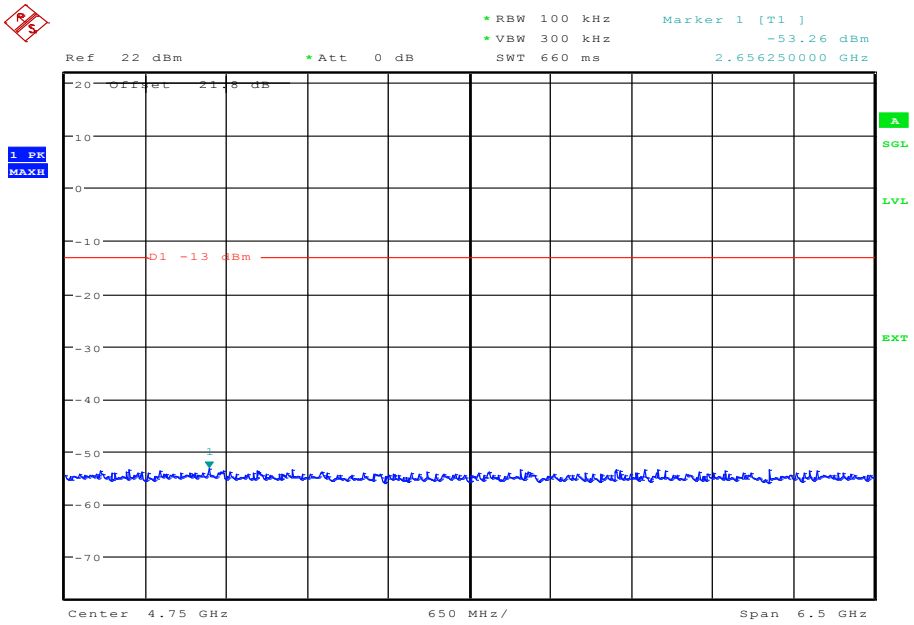
710 MHz - All Resource Blocks



Date: 15.NOV.2014 16:43:58

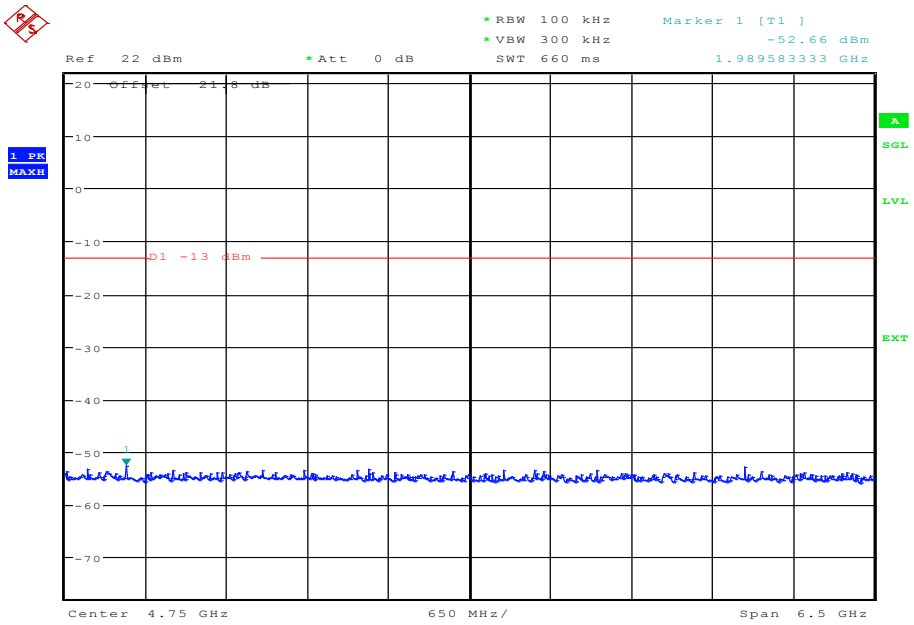
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:37:04

713.5 MHz - All Resource Blocks

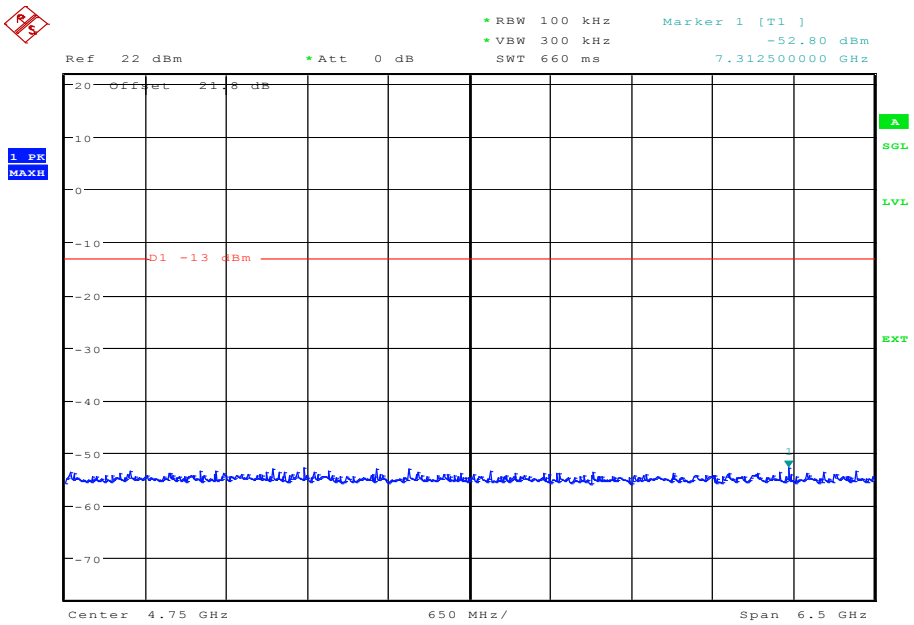


Date: 15.NOV.2014 16:41:04

Product Service

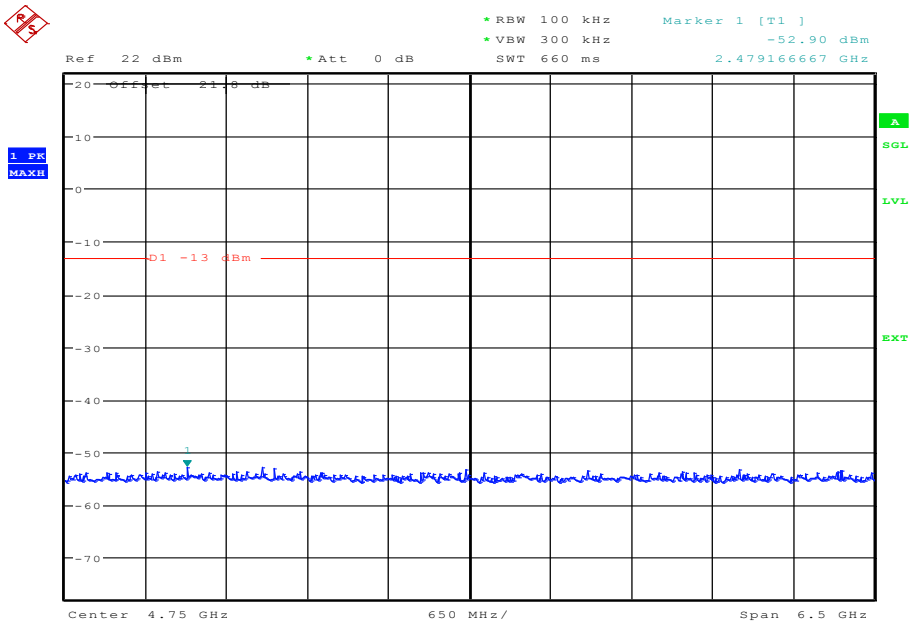
10.0 MHz Bandwidth - QPSK

709 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:49:53

709 MHz - All Resource Blocks



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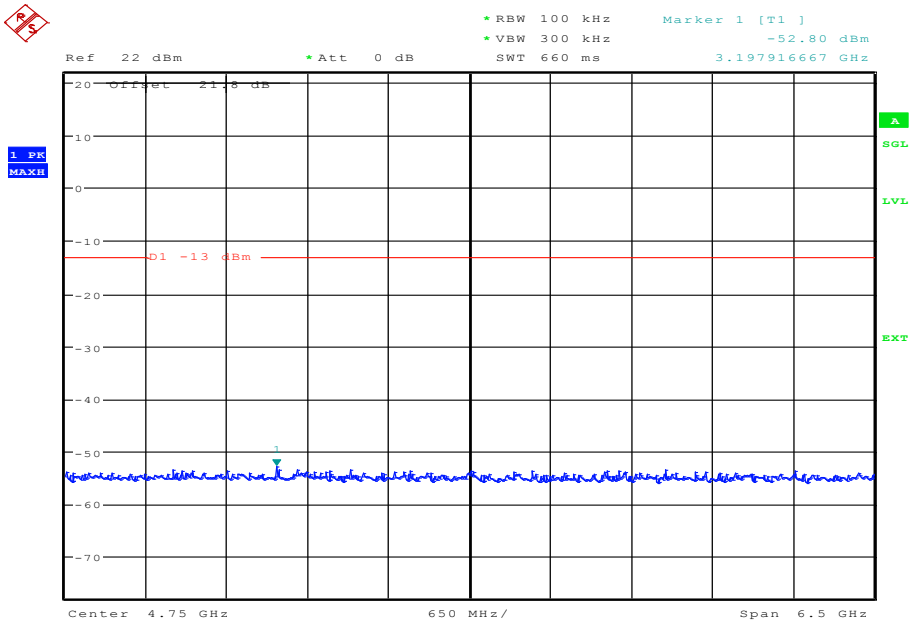
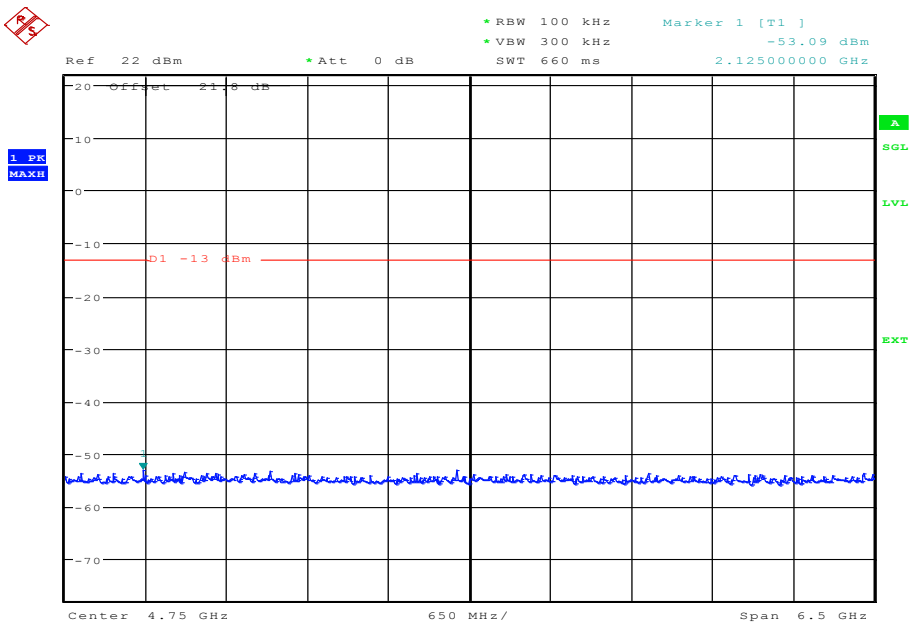
Product Service

710 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:59:26

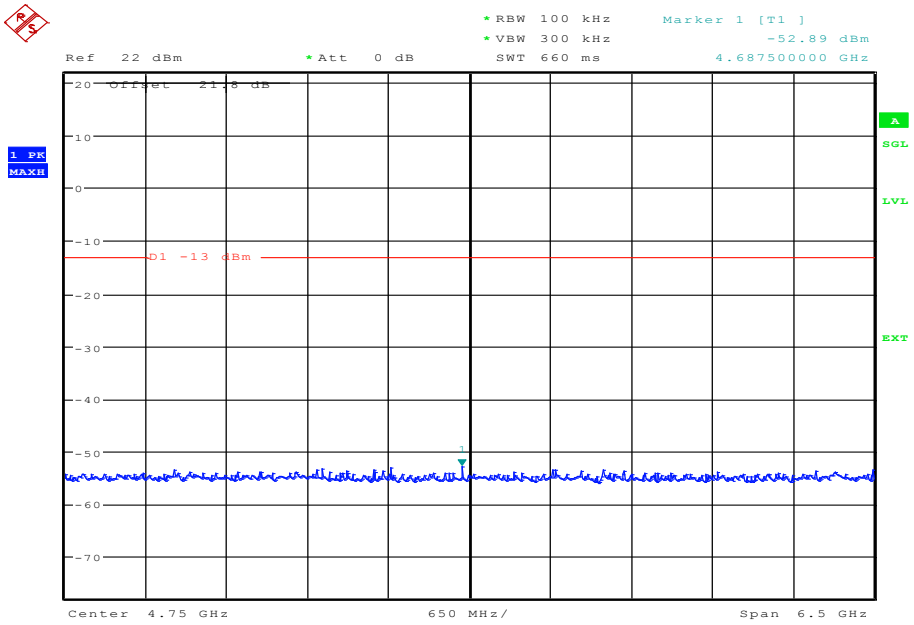
710 MHz - All Resource Blocks



Date: 15.NOV.2014 15:56:48

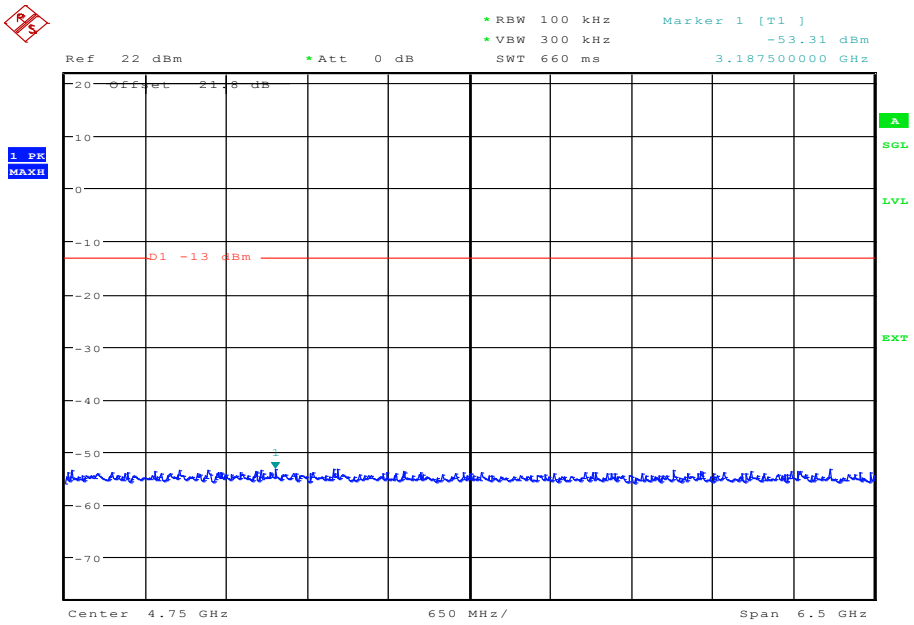
Product Service

711 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:04:20

711 MHz - All Resource Blocks

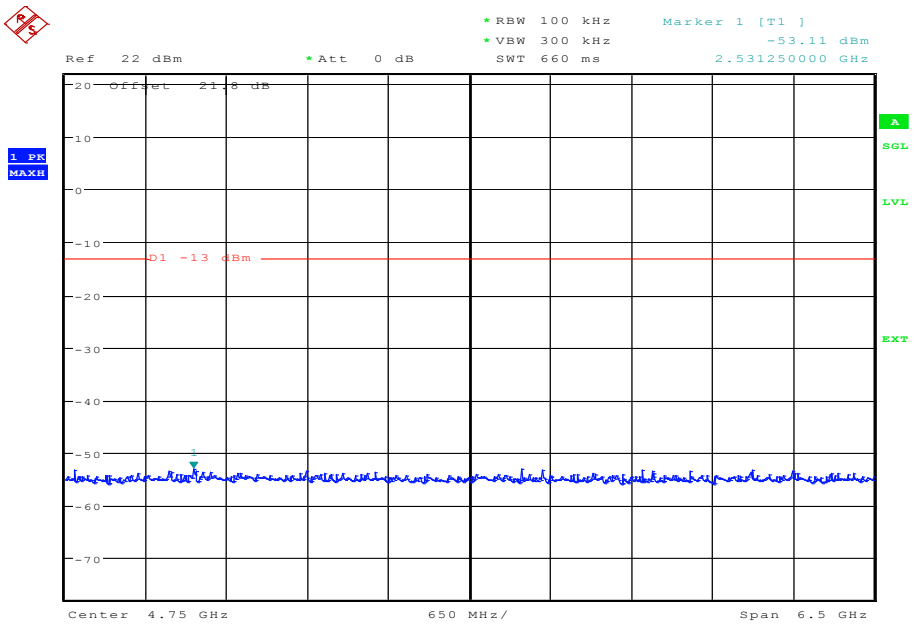


Date: 15.NOV.2014 16:07:59

Product Service

10.0 MHz Bandwidth - 16QAM

709 MHz - 1 Resource Block - Low



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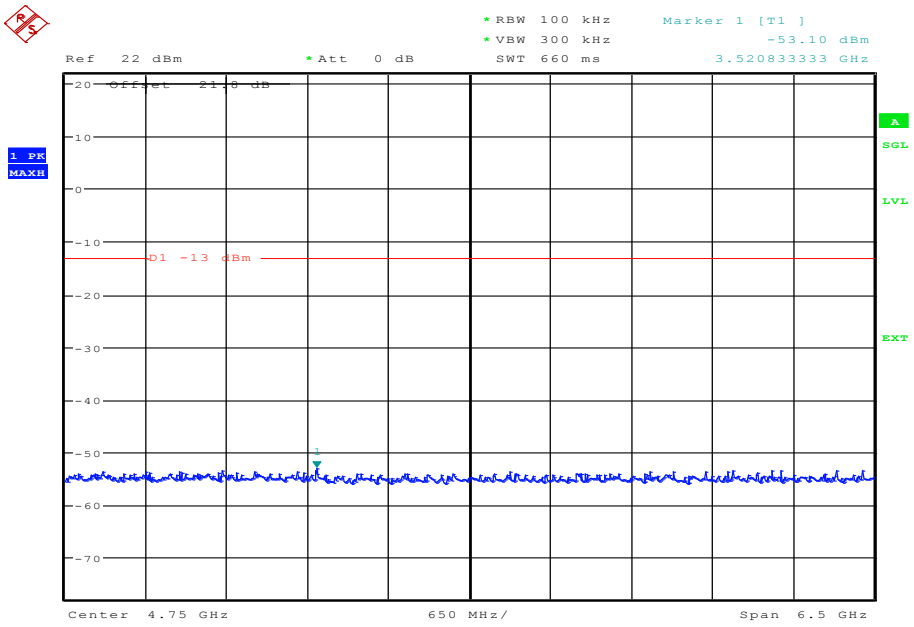
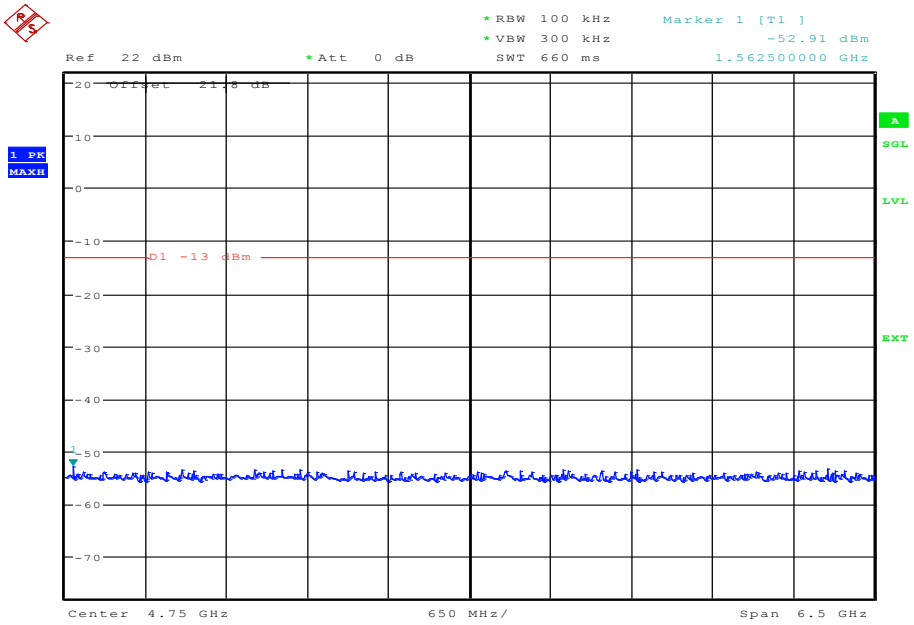
709 MHz - All Resource Blocks



Date: 15.NOV.2014 15:41:26

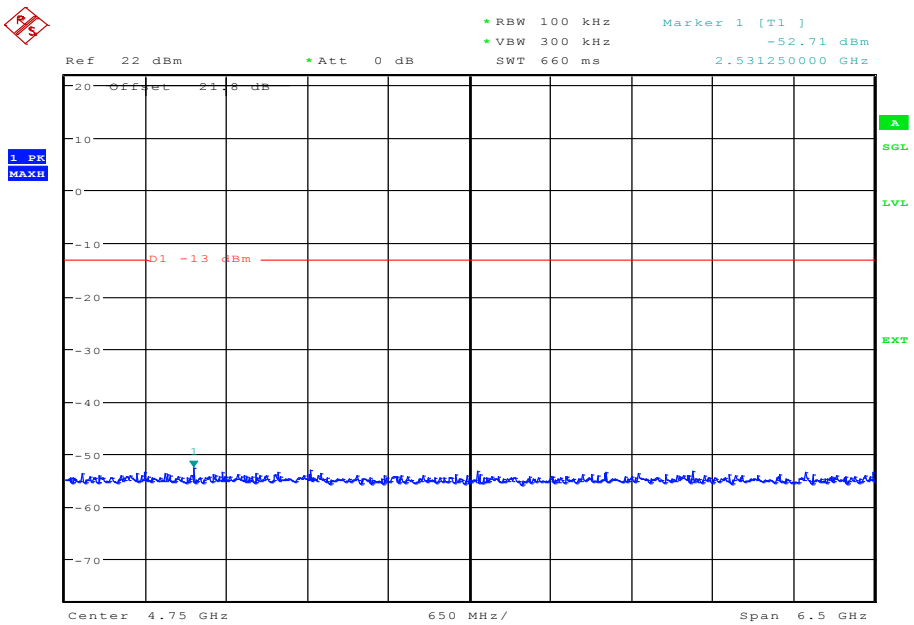
Product Service

710 MHz - 1 Resource Block - Middle



Date: 15.NOV.2014 15:30:25

710 MHz - All Resource Blocks



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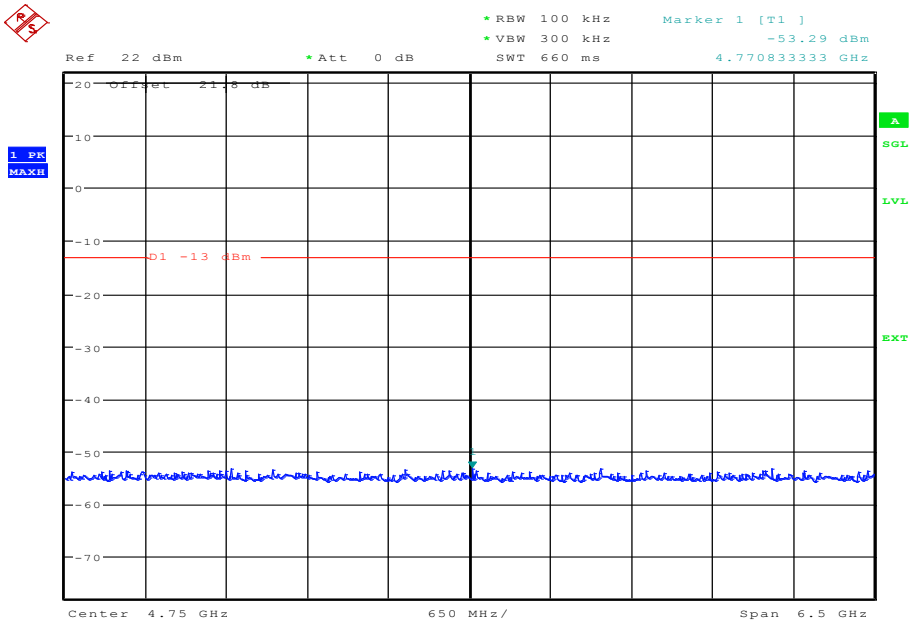
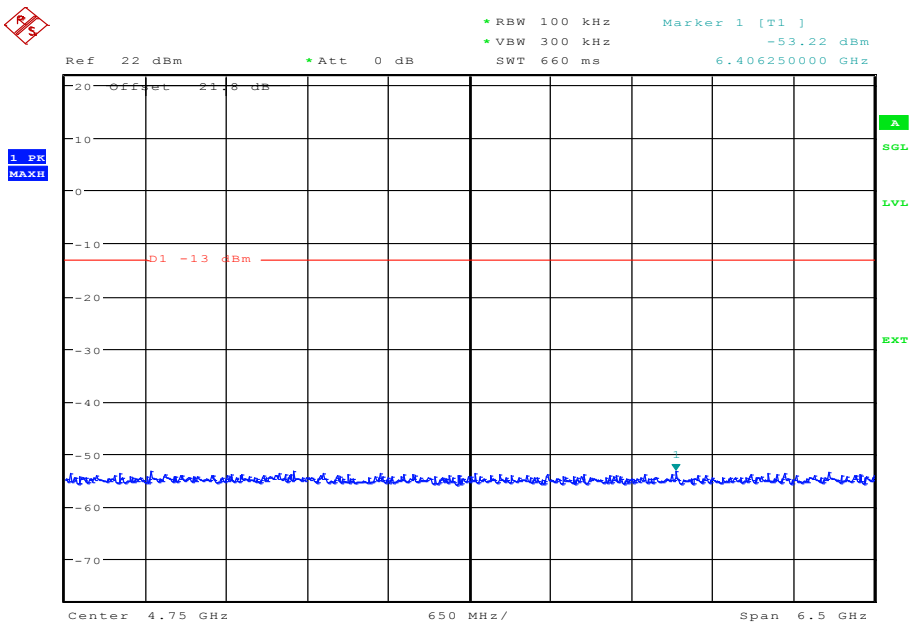
Product Service

711 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:27:14

711 MHz - All Resource Blocks



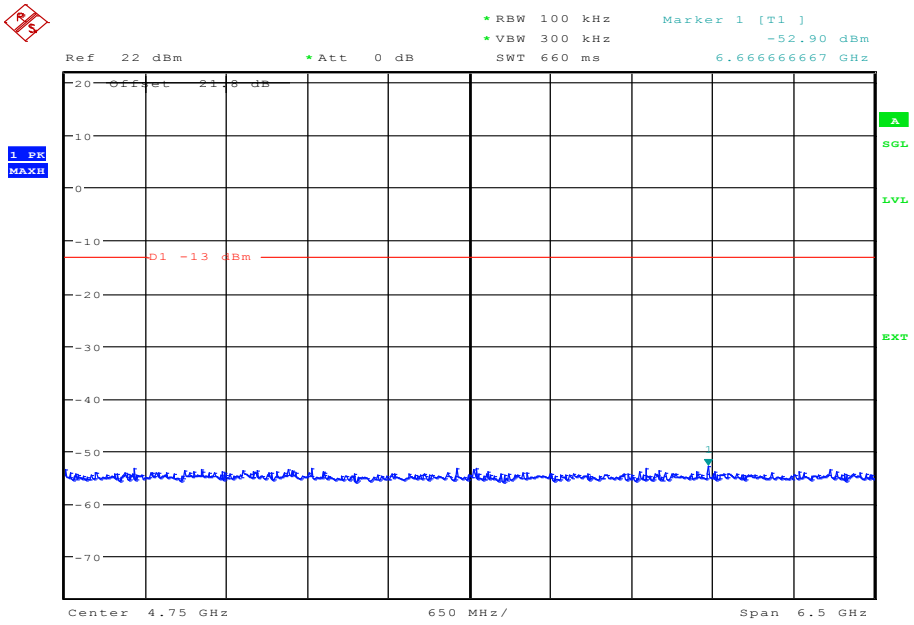
Date: 15.NOV.2014 15:38:19

Product Service

Conducted Spurious Emissions - Measurement Band 2

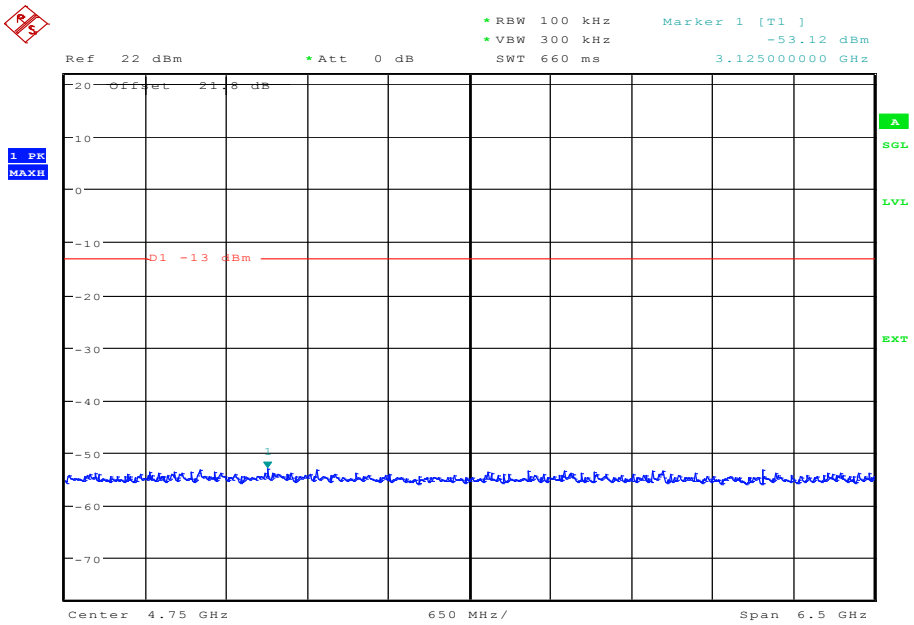
5.0 MHz Bandwidth - QPSK

706.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:17:51

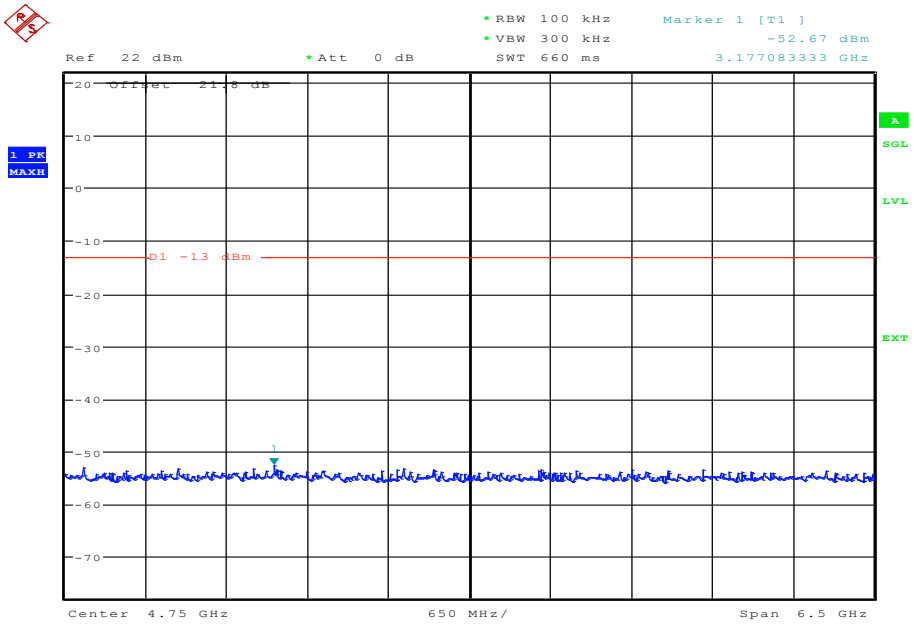
706.5 MHz - All Resource Blocks



Date: 15.NOV.2014 16:13:24

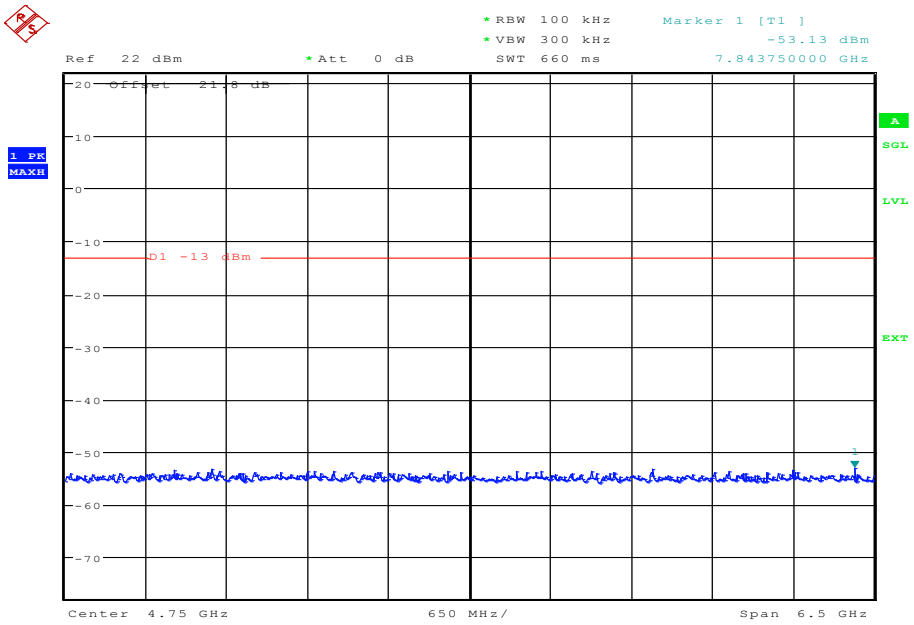
Product Service

710 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:23:57

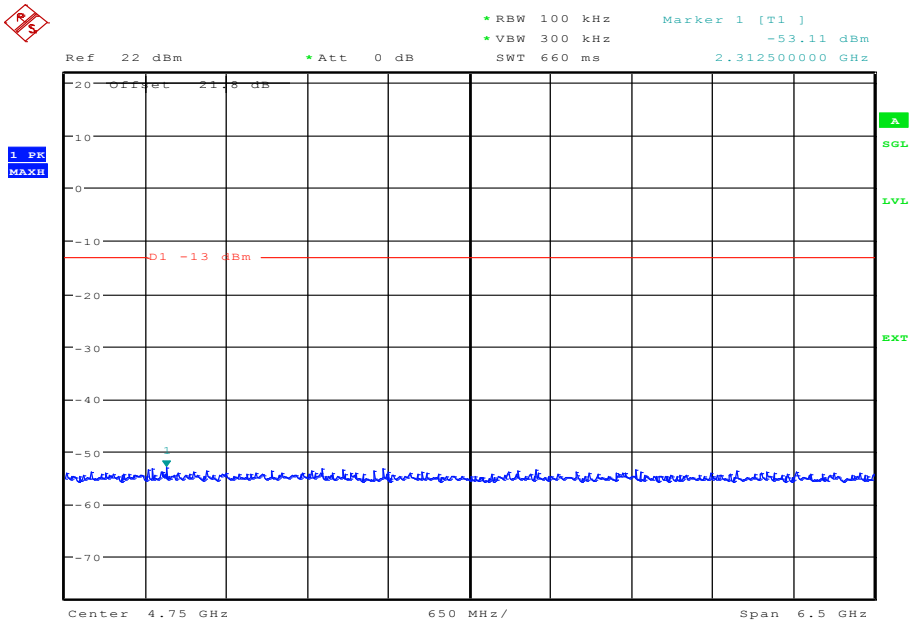
710 MHz - All Resource Blocks



Date: 15.NOV.2014 16:27:35

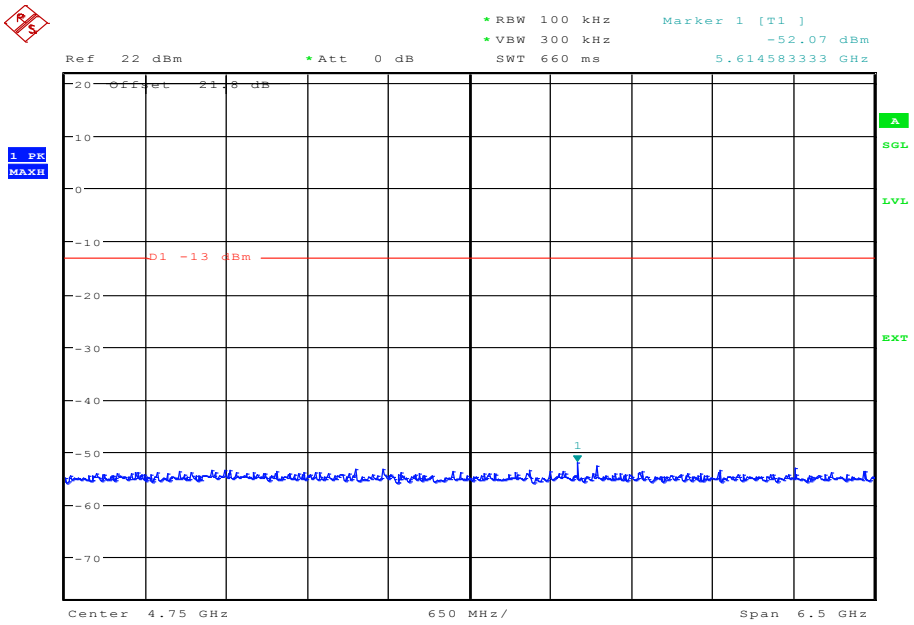
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:32:56

713.5 MHz - All Resource Blocks

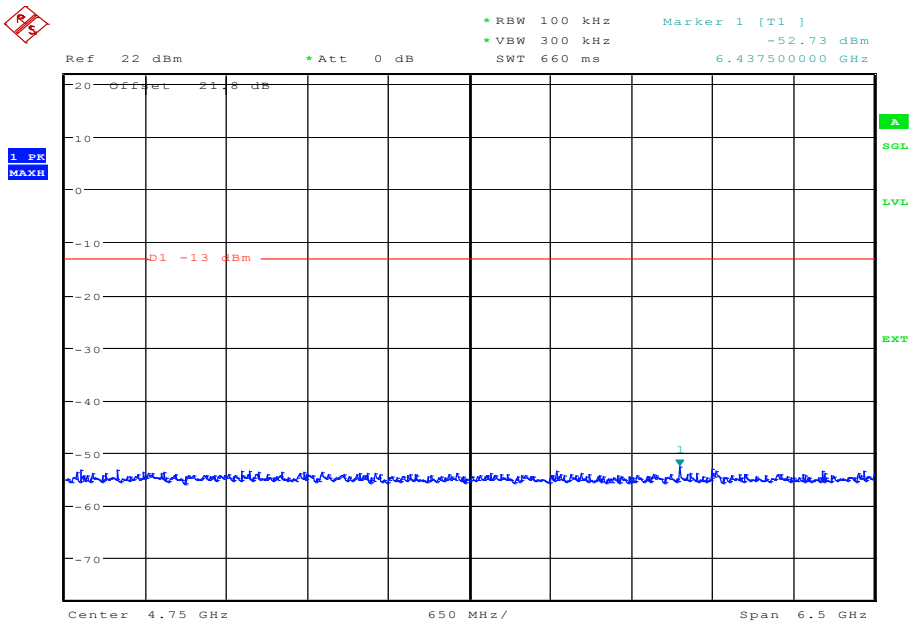


Date: 15.NOV.2014 16:30:18

Product Service

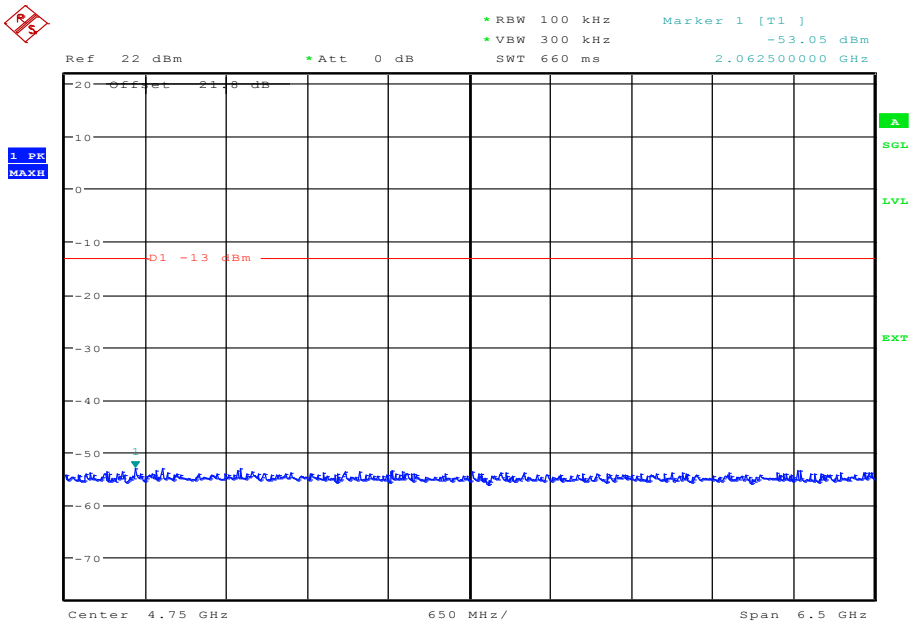
5.0 MHz Bandwidth - 16-QAM

706.5 MHz - 1 Resource Block - Middle



Date: 15.NOV.2014 16:49:23

706.5 MHz - All Resource Blocks



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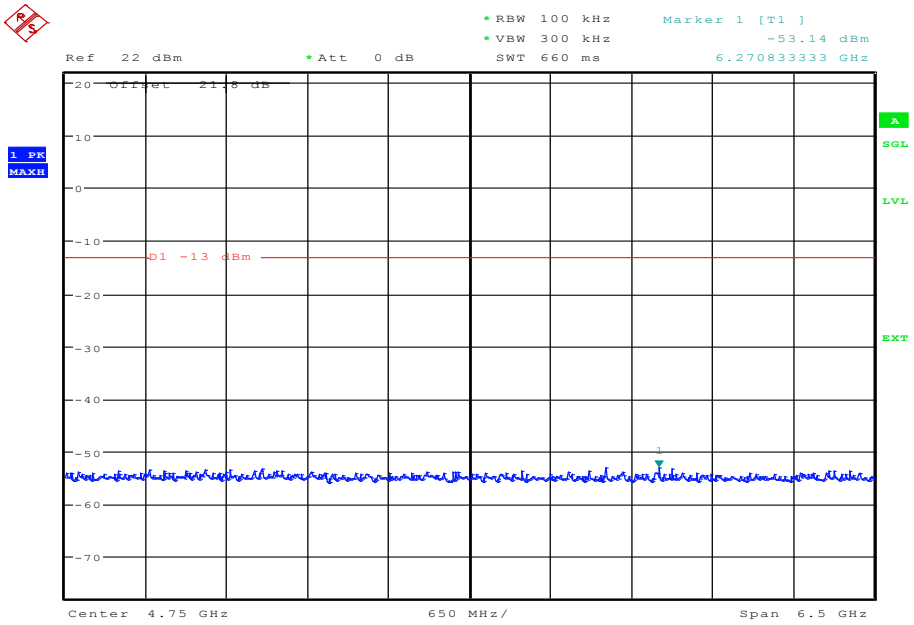
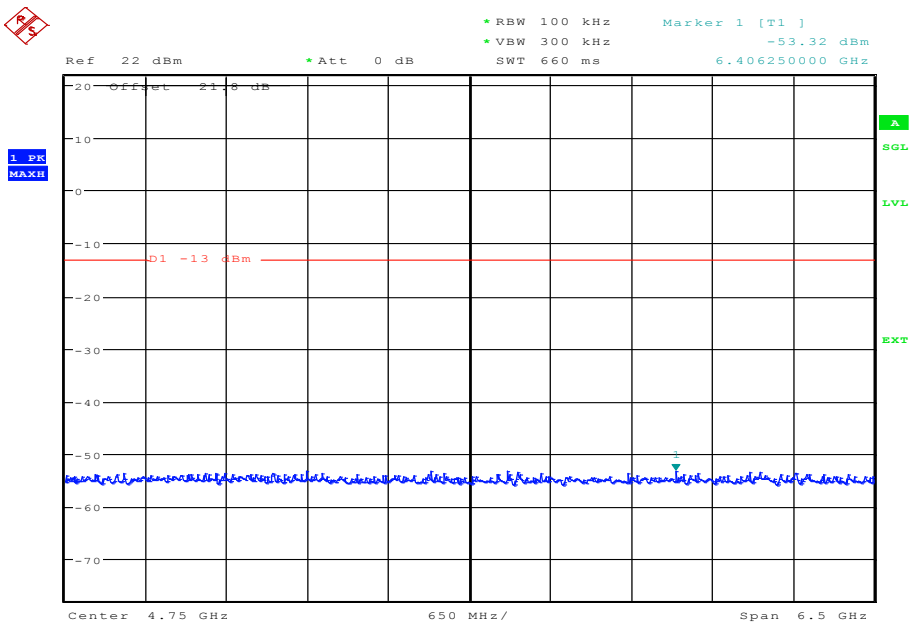
Product Service

710 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:46:37

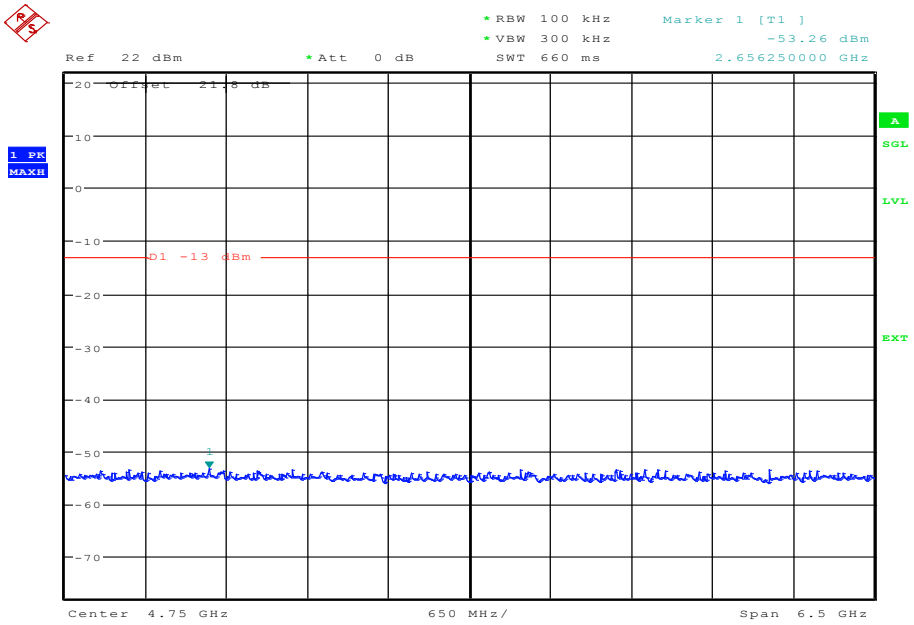
710 MHz - All Resource Blocks



Date: 15.NOV.2014 16:43:58

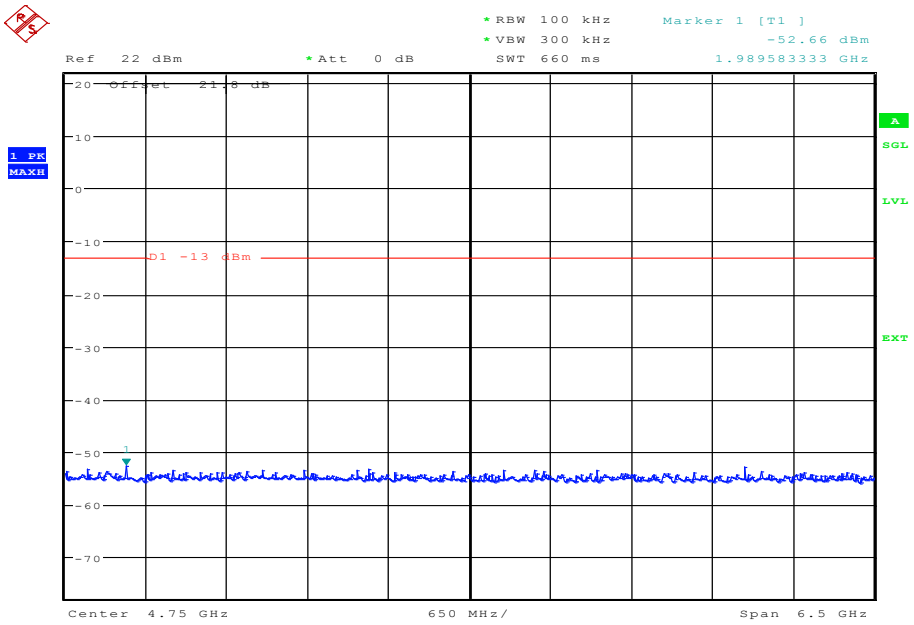
Product Service

713.5 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:37:04

713.5 MHz - All Resource Blocks

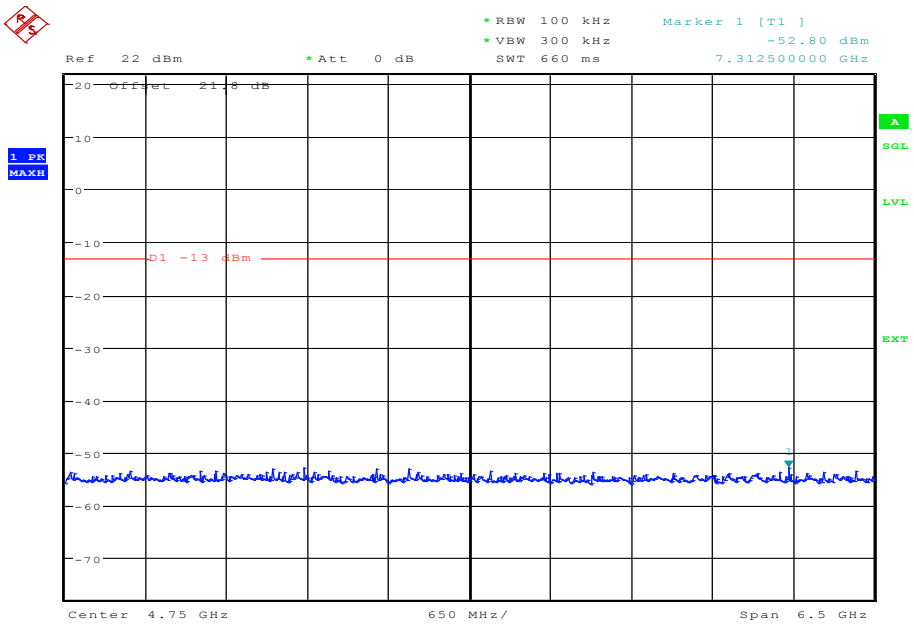


Date: 15.NOV.2014 16:41:04

Product Service

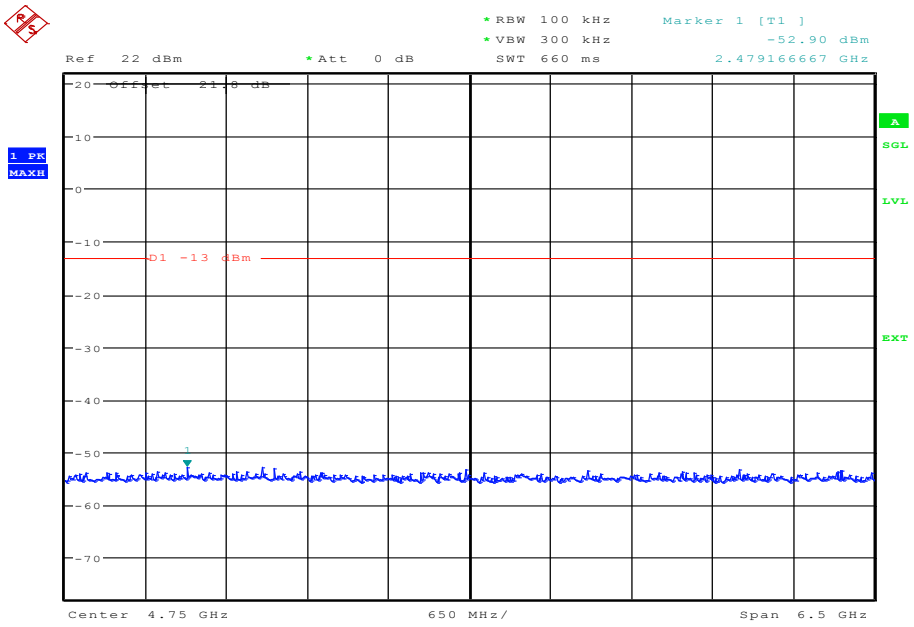
10.0 MHz Bandwidth - QPSK

709 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:49:53

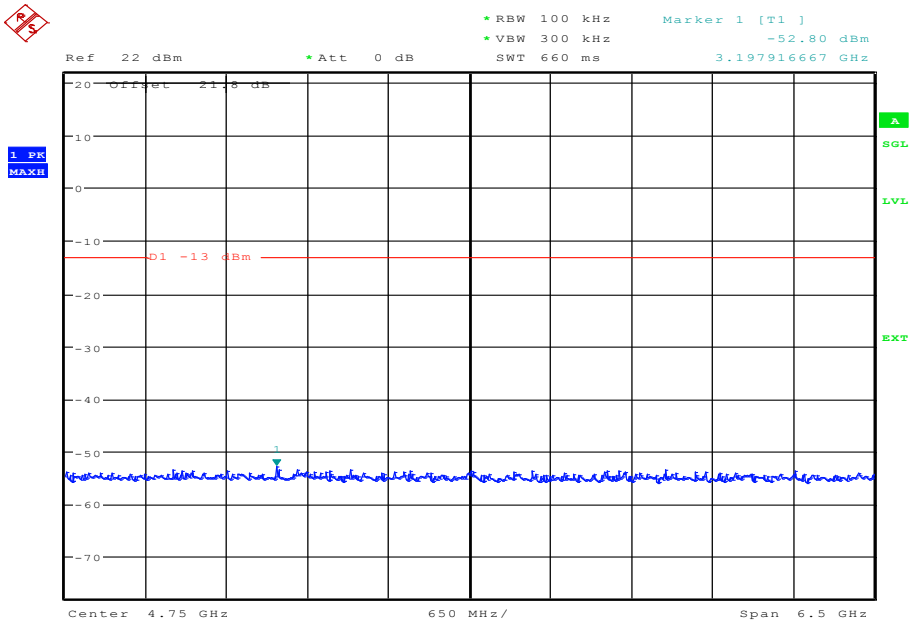
709 MHz - All Resource Blocks



Date: 15.NOV.2014 15:53:09

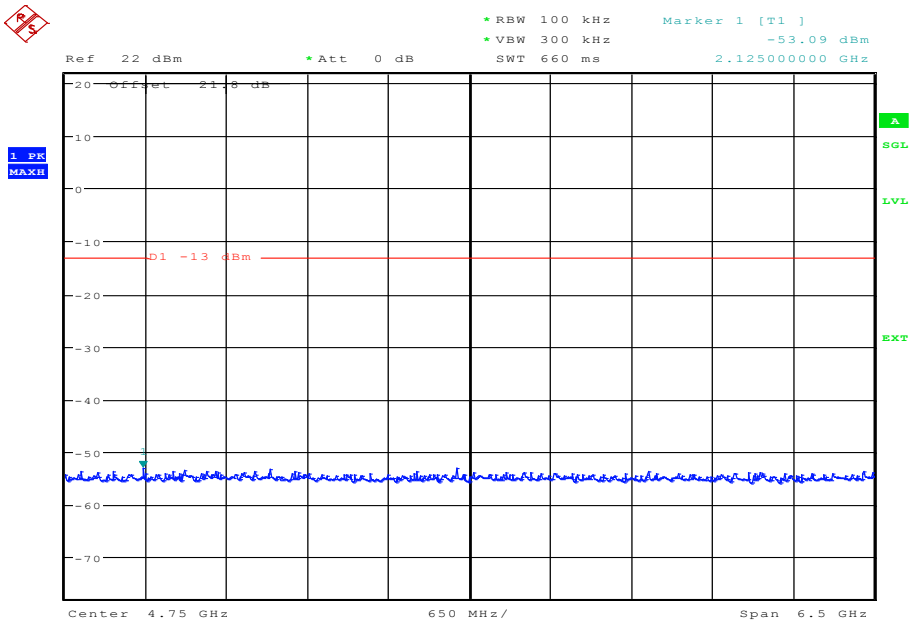
Product Service

710 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:59:26

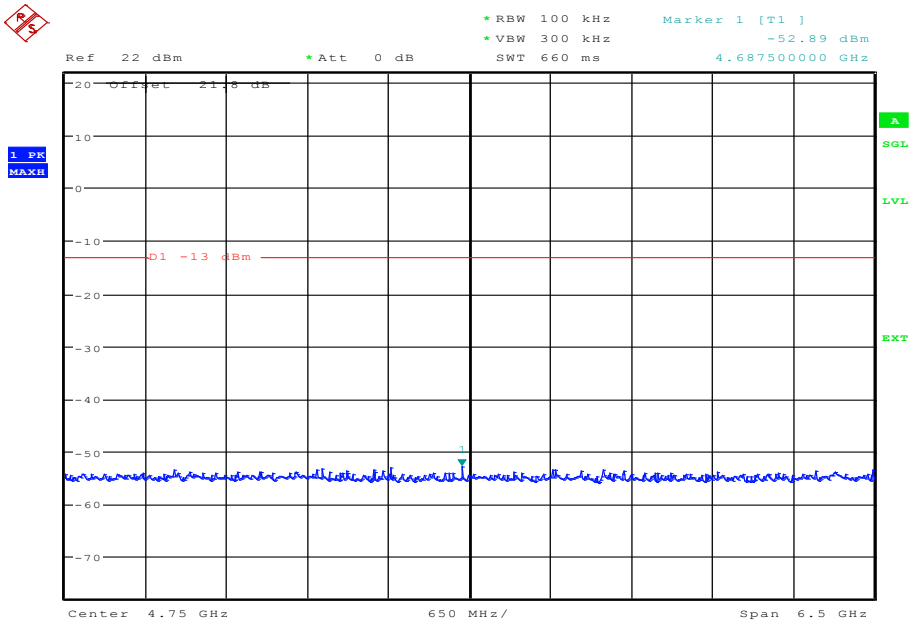
710 MHz - All Resource Blocks



Date: 15.NOV.2014 15:56:48

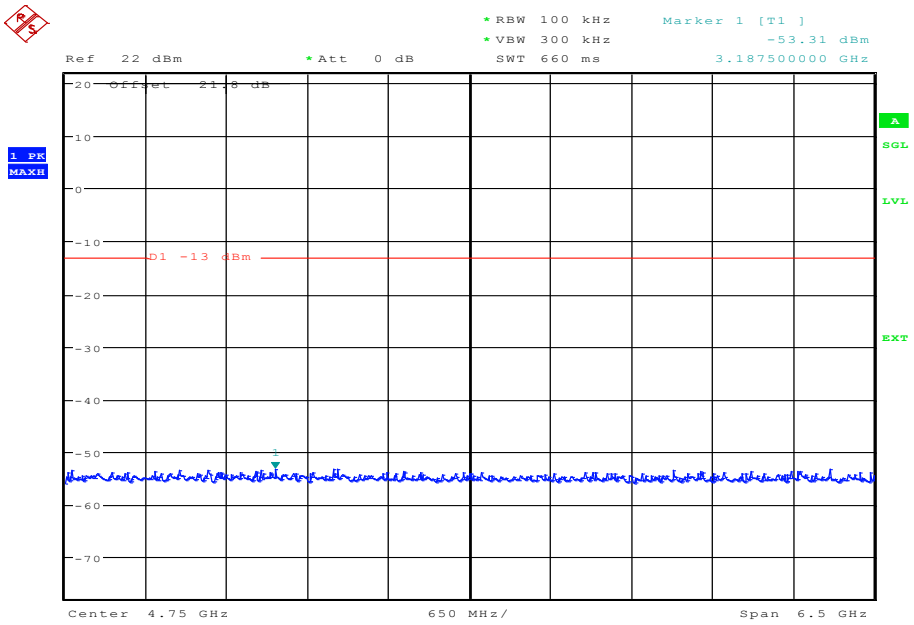
Product Service

711 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 16:04:20

711 MHz - All Resource Blocks

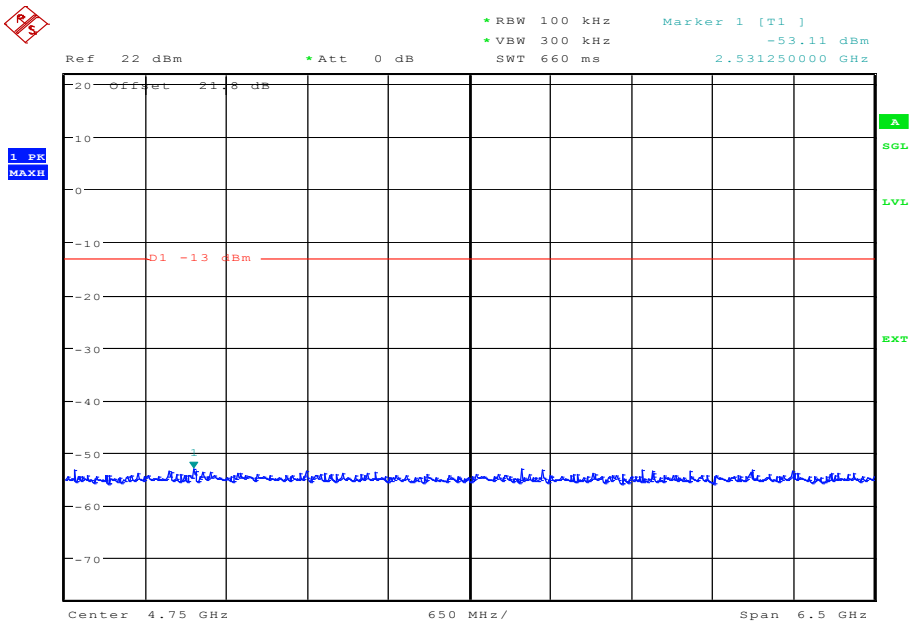


Date: 15.NOV.2014 16:07:59

Product Service

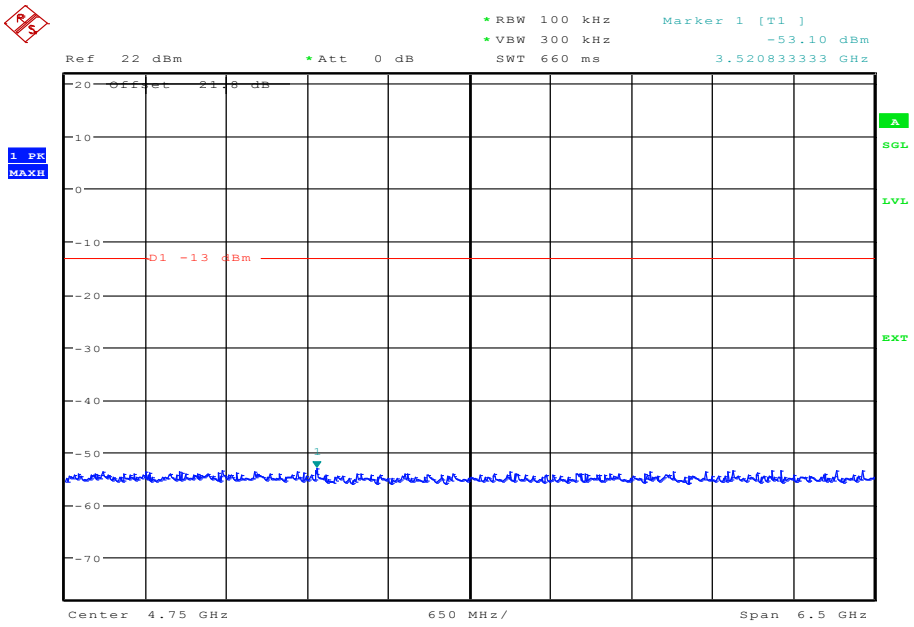
10.0 MHz Bandwidth - 16-QAM

709 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:46:06

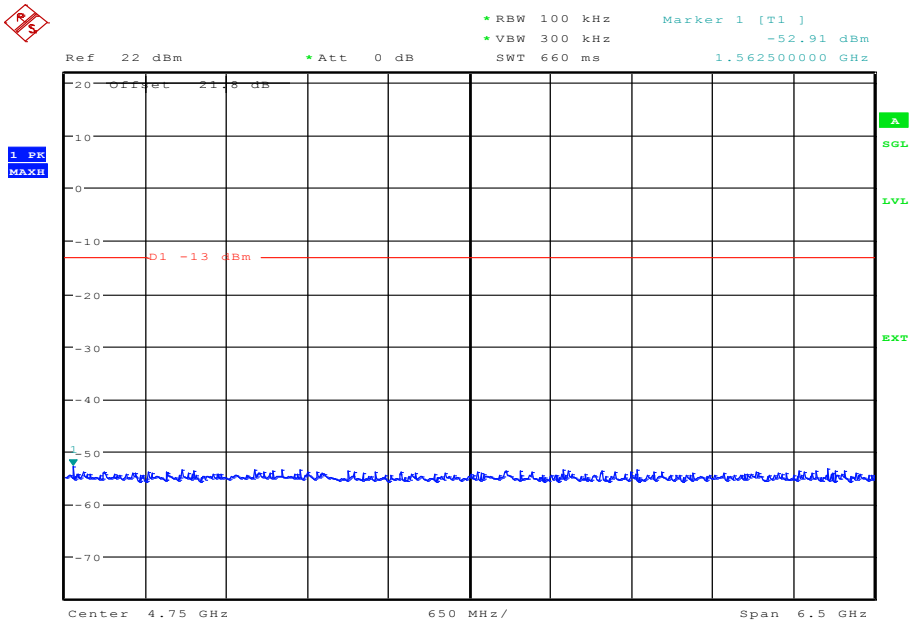
709 MHz - All Resource Blocks



Date: 15.NOV.2014 15:41:26

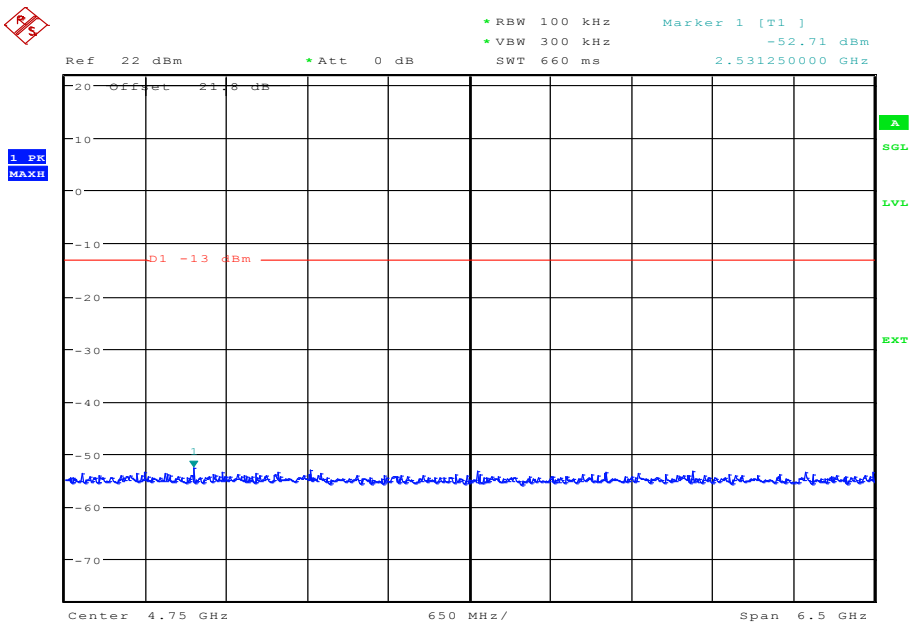
Product Service

710 MHz - 1 Resource Block - Middle



Date: 15.NOV.2014 15:30:25

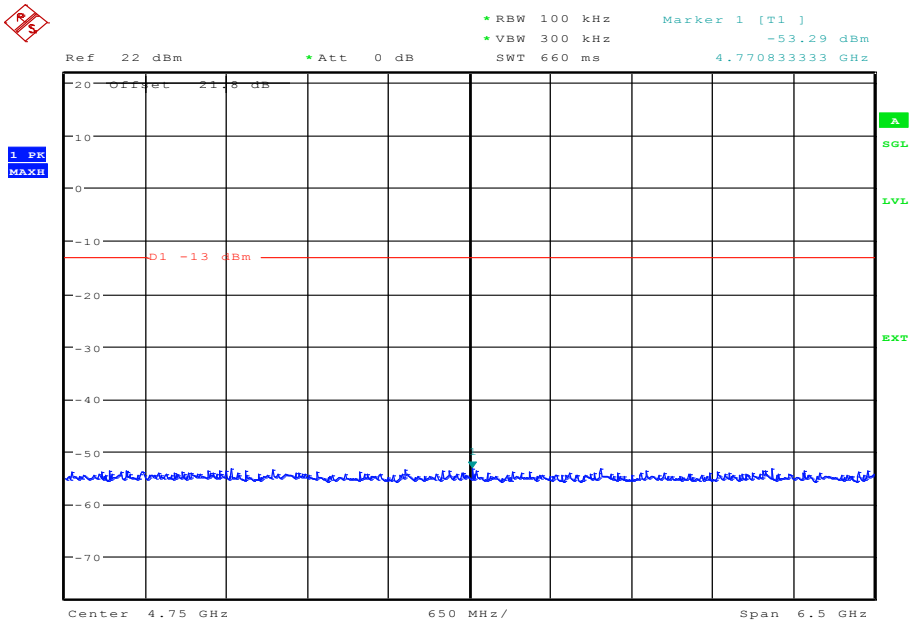
710 MHz - All Resource Blocks



Date: 15.NOV.2014 15:33:07

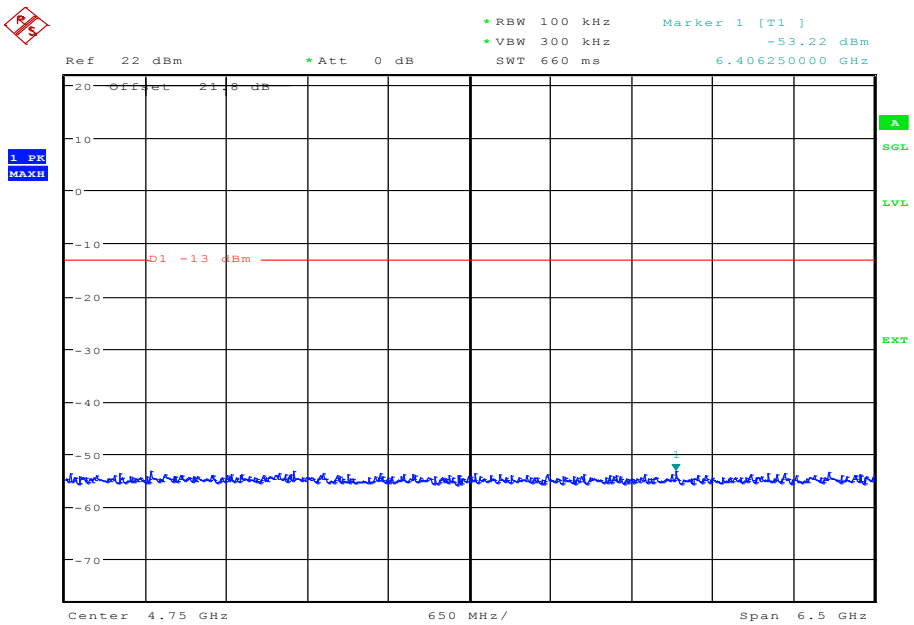
Product Service

711 MHz - 1 Resource Block - Low



Date: 15.NOV.2014 15:27:14

711 MHz - All Resource Blocks



Date: 15.NOV.2014 15:38:19

Product Service

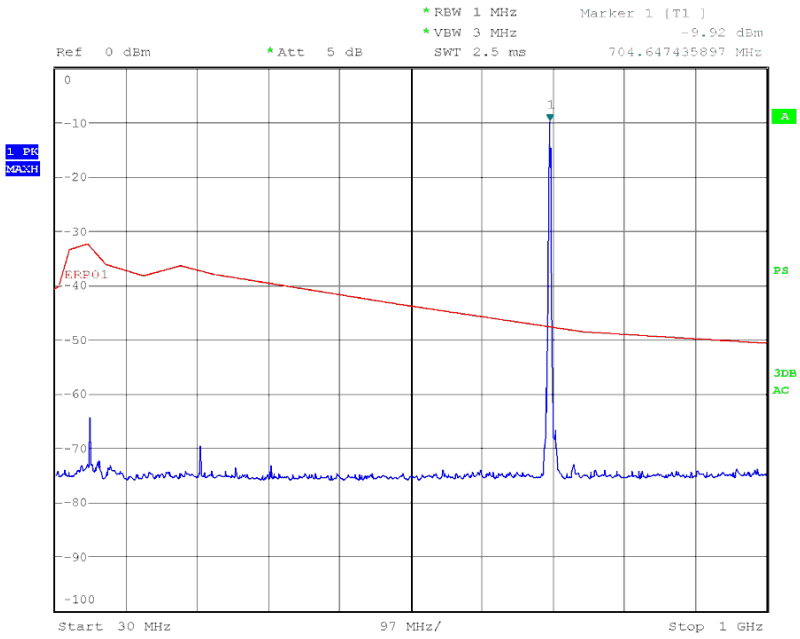
Radiated Emissions

5.0 MHz Bandwidth – QPSK

1 Resource Block - Low

706.5 MHz

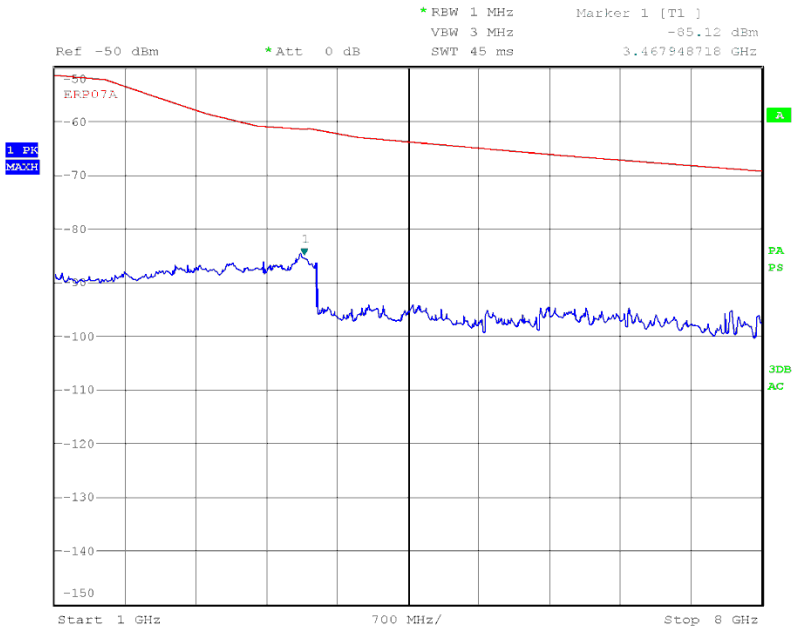
30 MHz to 1 GHz



Date: 8.DEC.2014 20:04:10

Product Service

1 GHz to 8 GHz

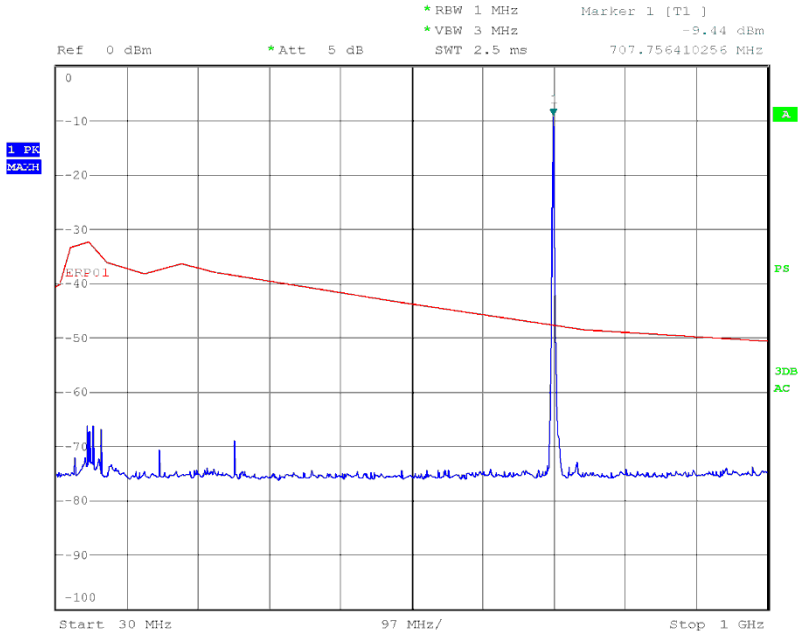


Date: 8.DEC.2014 22:35:11

710.0 MHz

1 Resource Block - Low

30 MHz to 1 GHz



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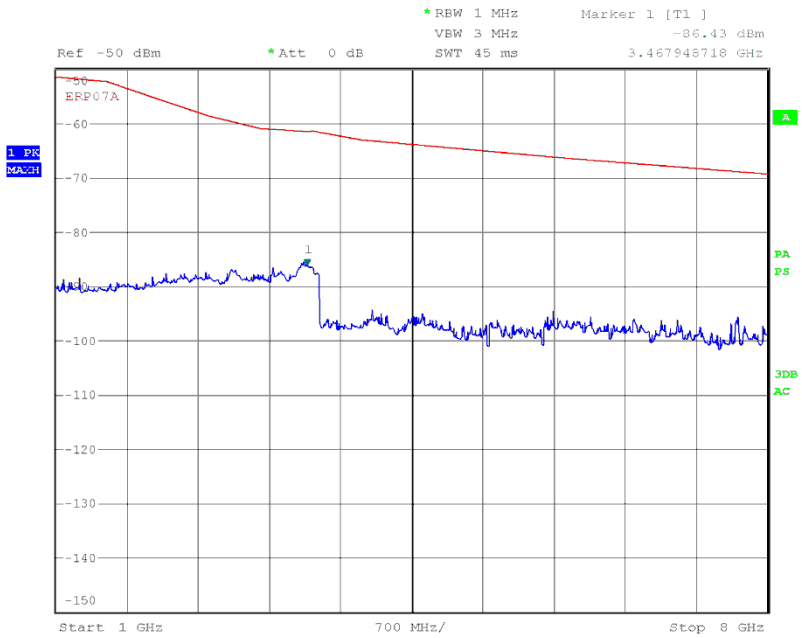
1 GHz to 8 GHz



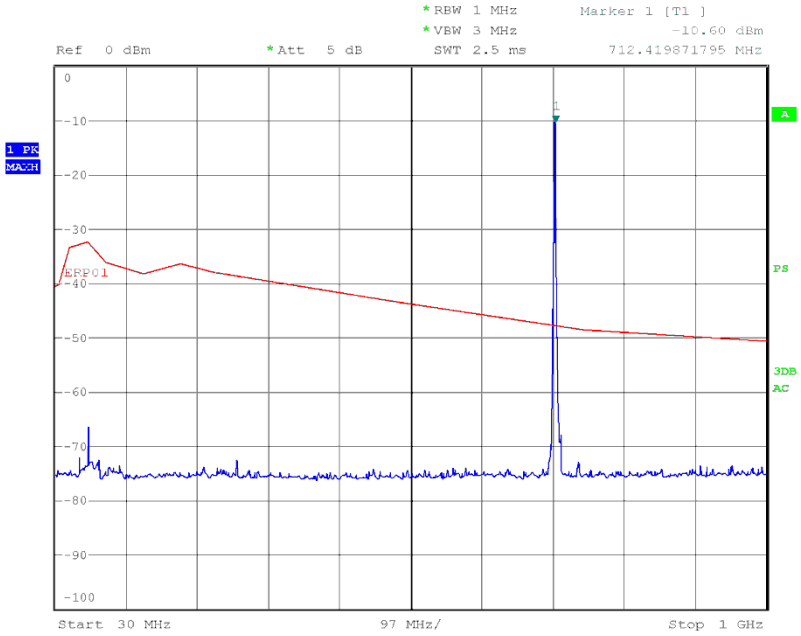
Date: 8.DEC.2014 22:41:41

Product Service

713.5 MHz

1 Resource Block - Low

30 MHz to 1 GHz



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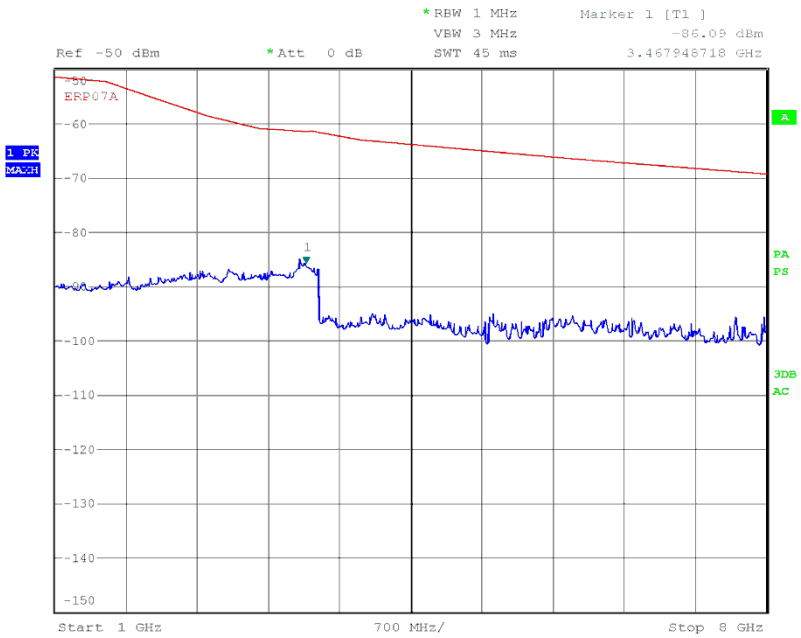
1 GHz to 8 GHz



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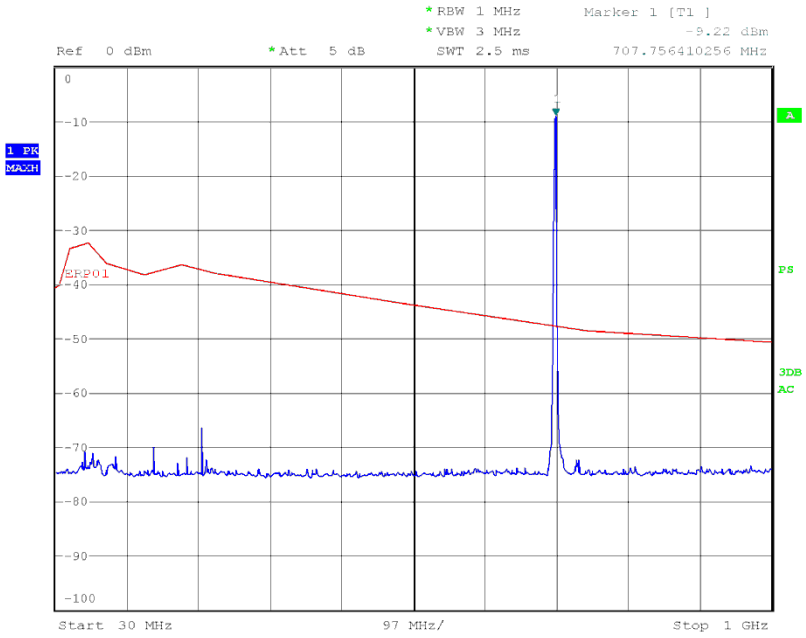
5.0 MHz Bandwidth – 16-QAM

1 Resource Block - Mid

706.5 MHz

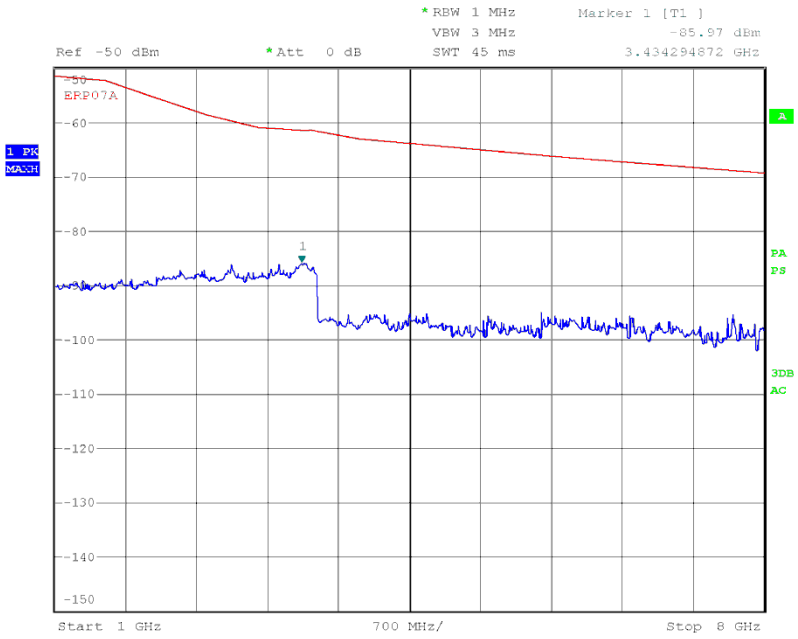
30 MHz to 1 GHz



Date: 8.DEC.2014 20:18:47

Product Service

1 GHz to 8 GHz



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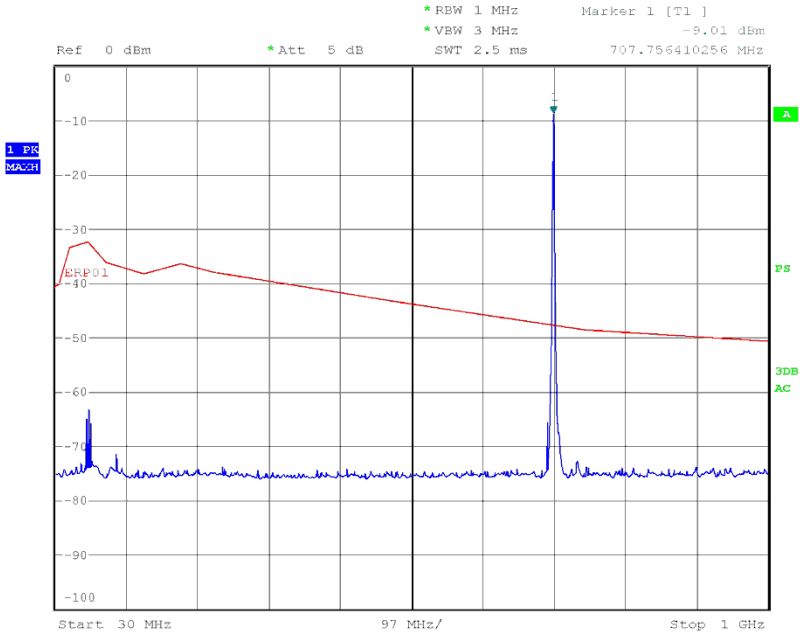
710.0 MHz

1 Resource Block - Low

30 MHz to 1 GHz



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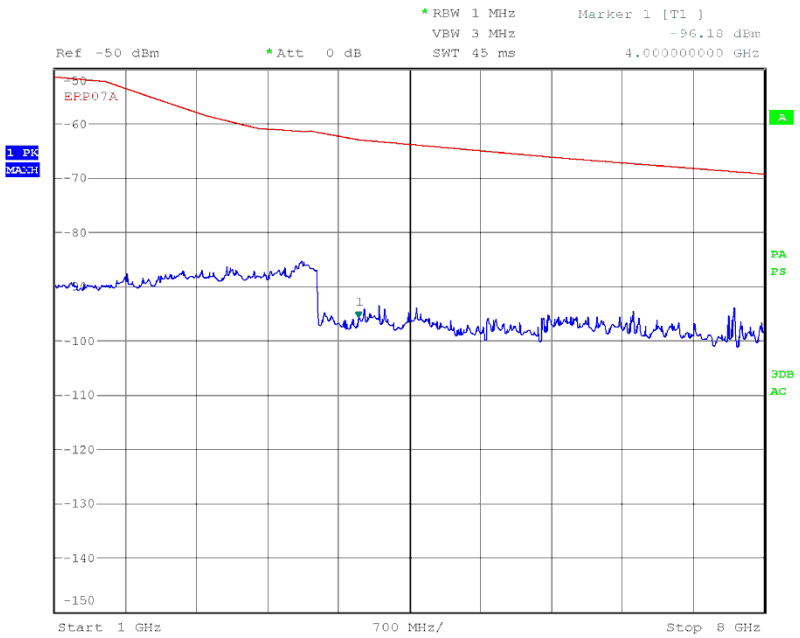
1 GHz to 8 GHz

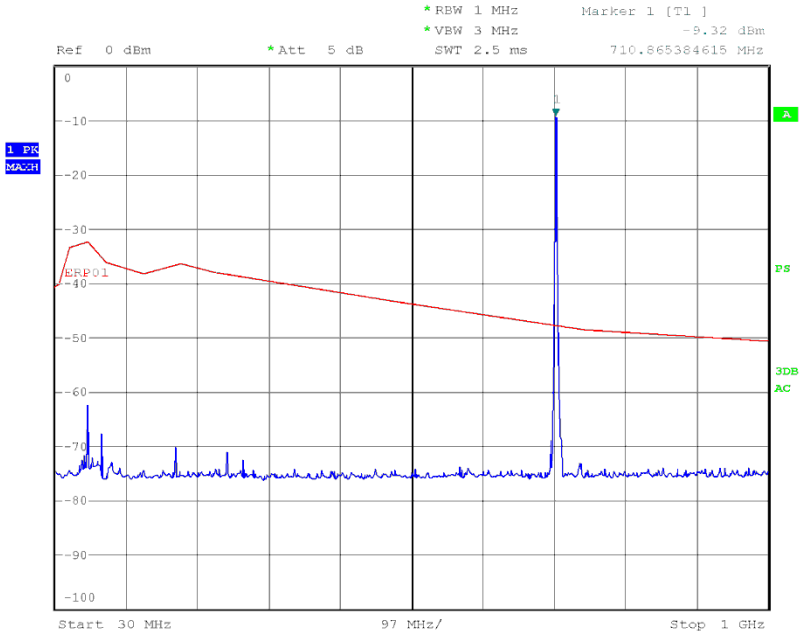


Date: 8.DEC.2014 22:23:29

713.5 MHz

1 Resource Block - Low

30 MHz to 1 GHz



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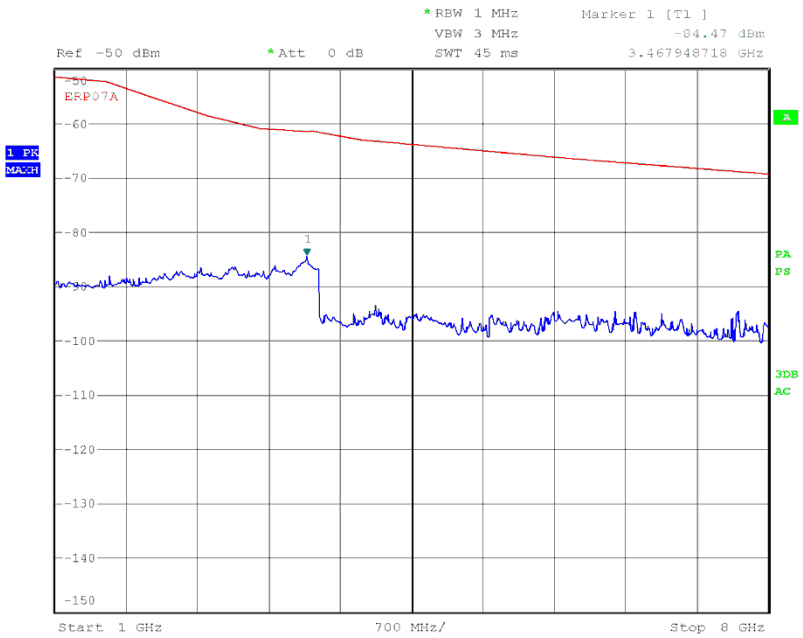
1 GHz to 8 GHz



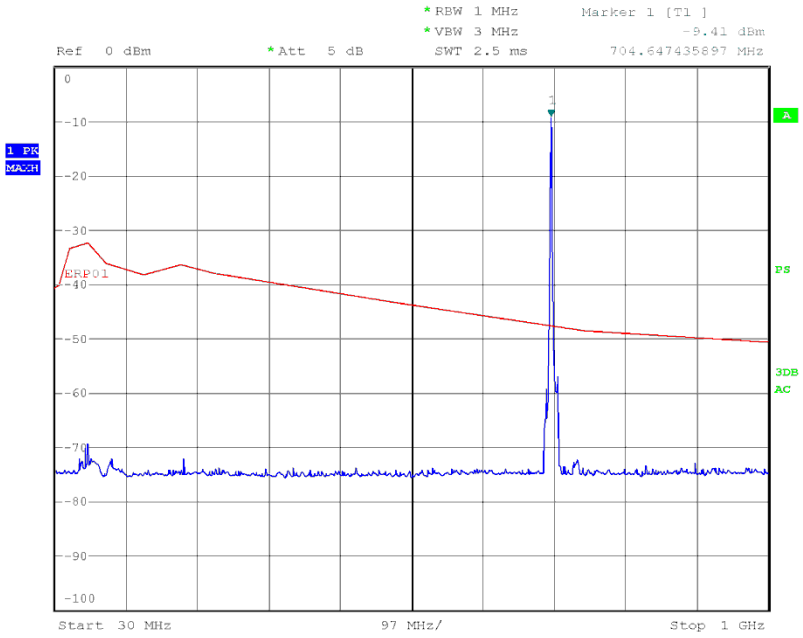
Date: 8.DEC.2014 21:59:06

10.0 MHz Bandwidth – QPSK

1 Resource Block - Low

709.0 MHz

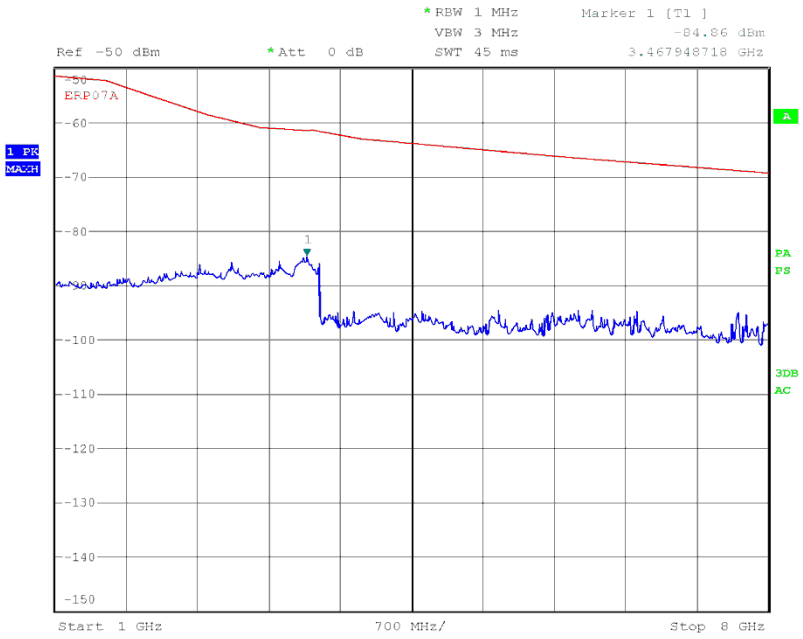
30 MHz to 1 GHz



Date: 8.DEC.2014 19:44:40

Product Service

1 GHz to 8 GHz



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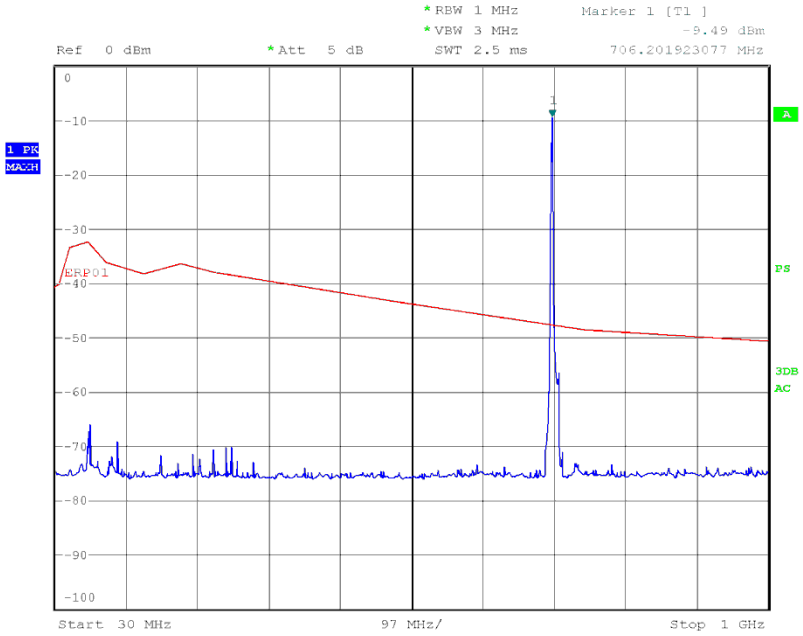
Product Service

1 Resource Block – Low

710.0 MHz

30 MHz to 1 GHz



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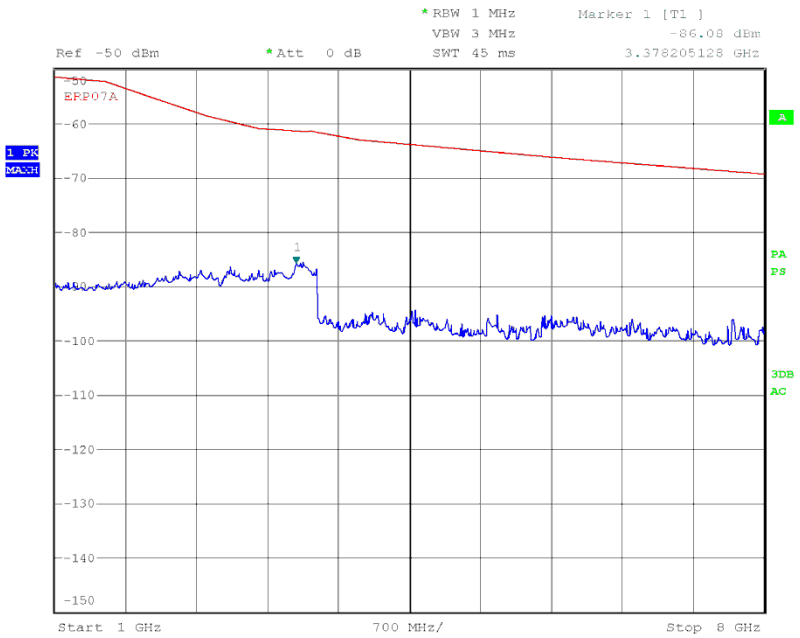
1 GHz to 8 GHz

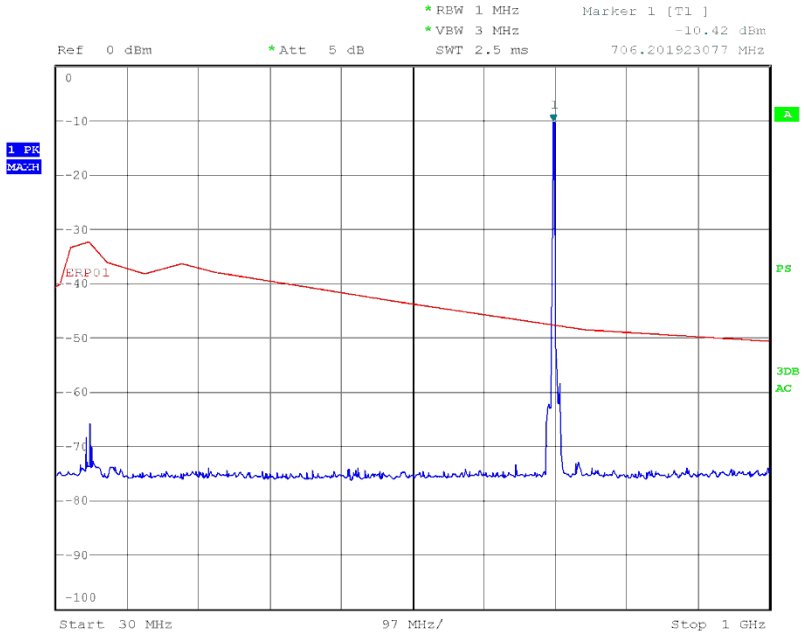


Date: 8.DEC.2014 22:53:31

711.0 MHz

1 Resource Block - Low

30 MHz to 1 GHz



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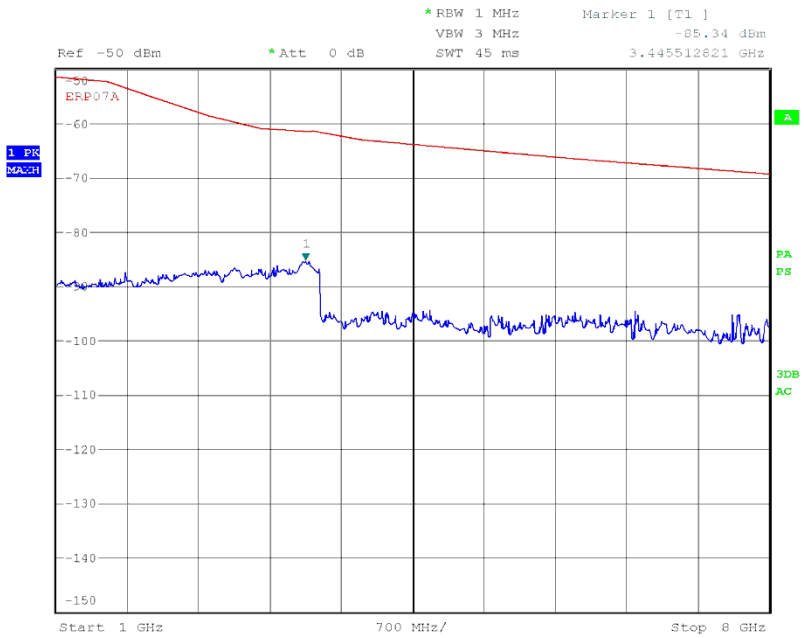
1 GHz to 8 GHz



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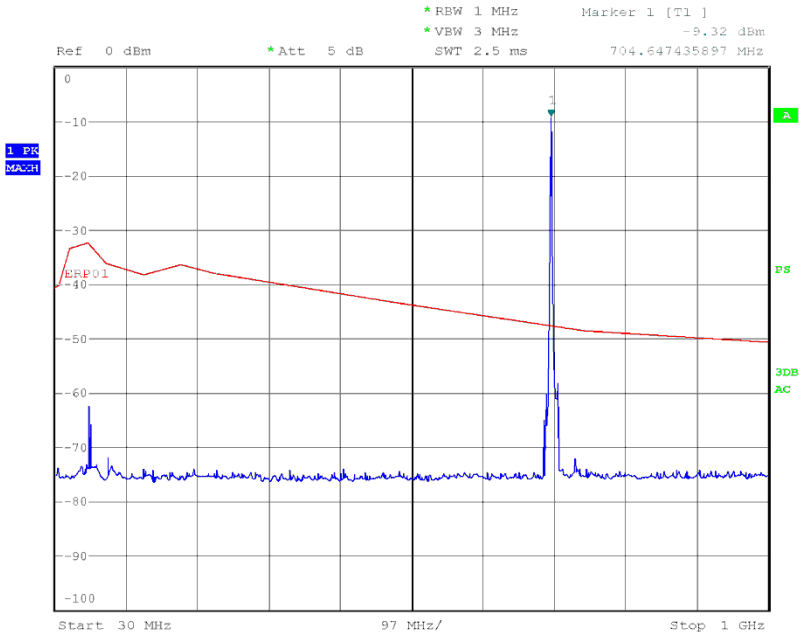
Product Service

10.0 MHz Bandwidth – 16-QAM

1 Resource Block - Low

709.0 MHz

30 MHz to 1 GHz



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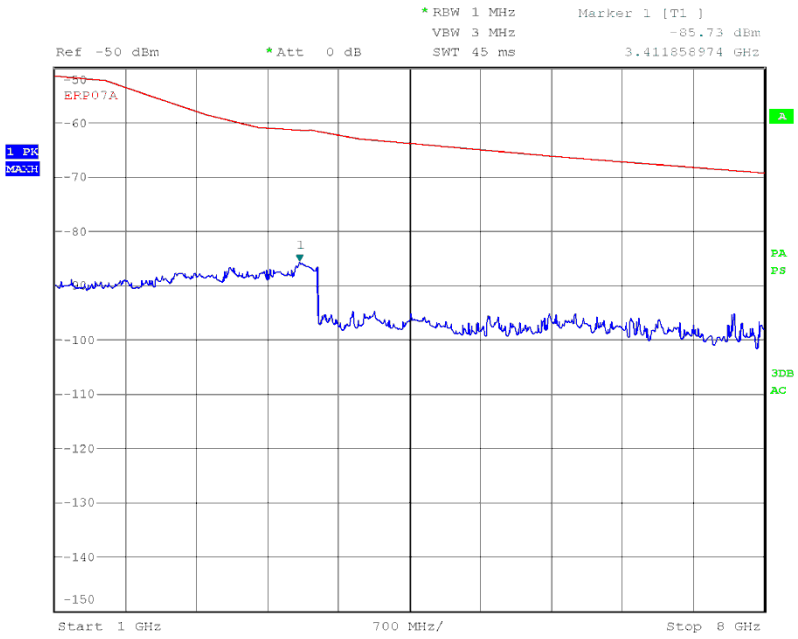
Product Service

1 GHz to 8 GHz



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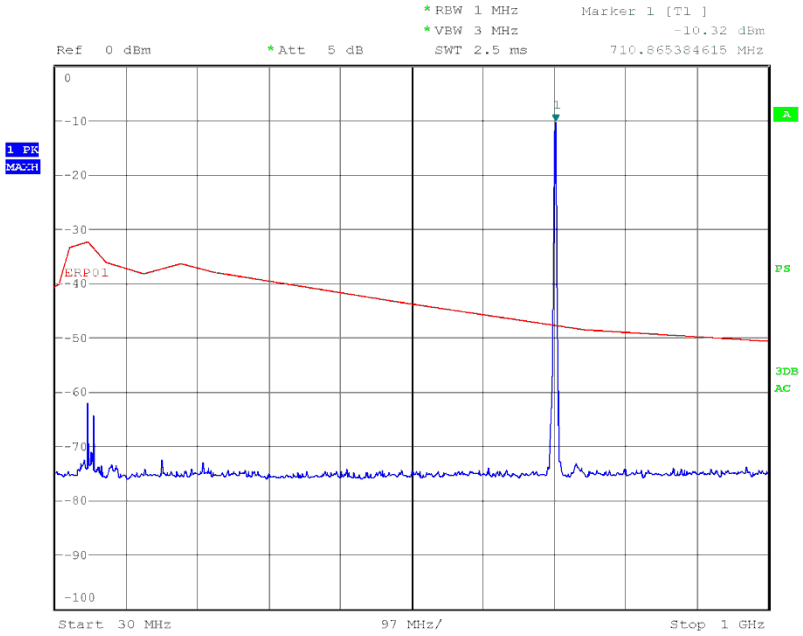
Product Service

1 Resource Block - Mid

710.0 MHz

30 MHz to 1 GHz



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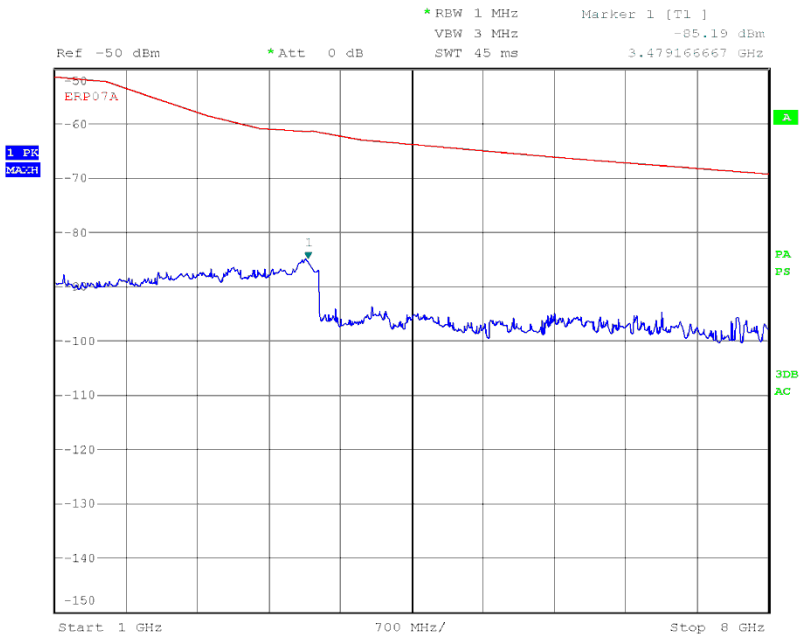
1 GHz to 8 GHz



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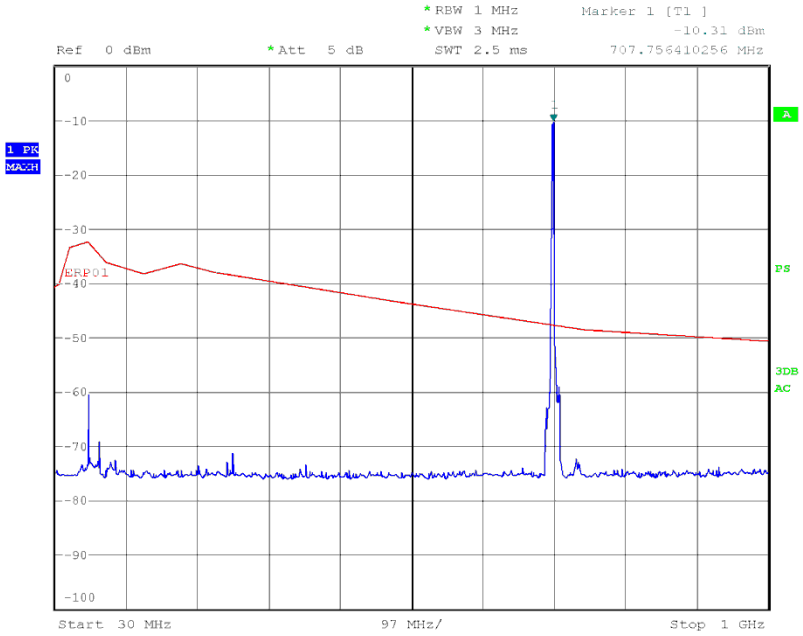
711.0 MHz

1 Resource Block - Low

30 MHz to 1 GHz



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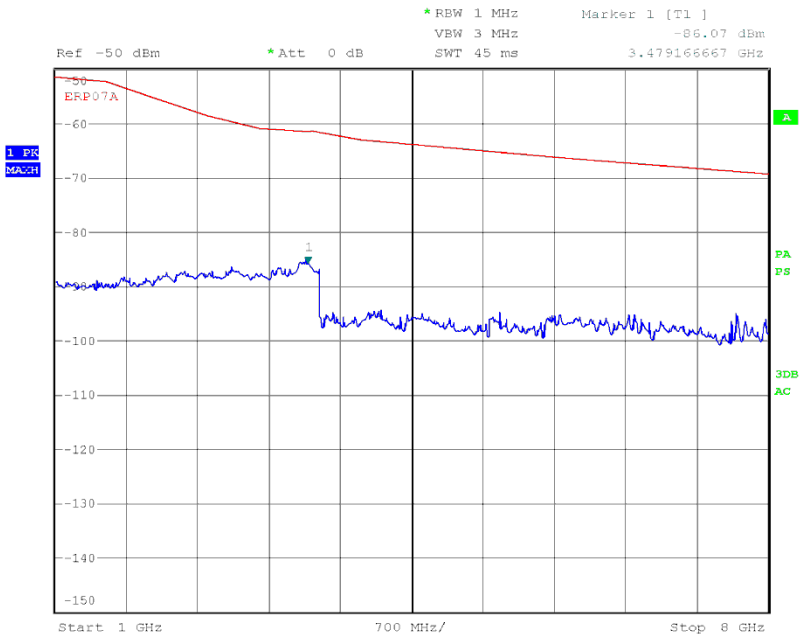
1 GHz to 8 GHz



Date: 8.DEC.2014 23:04:56

Limit Clause 27.53 (g)

Conducted Emissions:	-13 dBm
Band Edge:	
Radiated Emissions:	

2.4 FREQUENCY STABILITY

2.4.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1055
FCC CFR 47 Part 27, Clause 27.54

2.4.2 Equipment Under Test and Modification State

SHV31 S/N: IMEI 004401115315885 - Modification State 0

2.4.3 Date of Test

20 November 2014

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Procedure

The EUT was configured to transmit on all resource blocks with a 10 MHz channel bandwidth on the middle channel, 710.0 MHz. In accordance with 2.1055, the temperature was varied from +50°C to -30°C in 10° steps. These measurements were performed with voltage set to nominal as declared by the manufacturer. The frequency error was recorded using the measurement function of the communications test set.

At 20°C, the EUT supply voltage was also reduced to the end point voltage as declared by the manufacturer and the frequency error recorded.

The test results were reviewed and compared with the Band Edge measurement results to ensure that the fundamental remained within the authorised frequency band of operation. It was confirmed that the EUT complied with this requirement.

2.4.6 Environmental Conditions

Ambient Temperature	19.8°C
Relative Humidity	41.6%

Product Service

2.4.7 Test Results

4.0 V DC Supply

Frequency Stability

Under Temperature Variations

10 MHz Bandwidth - QPSK

Frequency Error (Hz)		
710.0 MHz		
Supply Voltage	Temperature Interval ºC	All Resource Blocks
3.7 V DC	+20	5.19
4.0 V DC	-30	4.01
4.0 V DC	-20	5.39
4.0 V DC	-10	5.05
4.0 V DC	0	3.36
4.0 V DC	+10	3.53
4.0 V DC	+20	4.45
4.0 V DC	+30	-3.78
4.0 V DC	+40	-3.79
4.0 V DC	+50	-3.71

10 MHz Bandwidth – 16-QAM

Frequency Error (Hz)		
710.0 MHz		
Supply Voltage	Temperature Interval ºC	All Resource Blocks
3.7 V DC	+20	4.42
4.0 V DC	-30	-3.25
4.0 V DC	-20	3.75
4.0 V DC	-10	-4.29
4.0 V DC	0	4.65
4.0 V DC	+10	4.15
4.0 V DC	+20	3.85
4.0 V DC	+30	-4.11
4.0 V DC	+40	-5.04
4.0 V DC	+50	-3.86

Limit Clause

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorised bands of operation.

Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1- Power Limits and Duty Cycle					
Power Supply Unit	Farnell	LT30-2	41	-	O/P Mon
Power Supply Unit	Hewlett Packard	6282A	132	-	TU
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	2-May-2015
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	4-Jun-2015
Multimeter	Fluke	75 Mk3	455	12	23-Jul-2015
Attenuator (10dB)	Weinschel	47-10-34	481	12	28-Mar-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	18-Jan-2015
Screened Room (5)	Rainford	Rainford	1545	24	10-Jan-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Multimeter	Iso-tech	IDM101	2419	12	7-Oct-2015
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	9-Jan-2015
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
Antenna (Log Periodic)	Schaffner	UPA6108	3109	12	16-May-2015
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	16-Jul-2015
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	18-Sep-2015
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	11-Aug-2015
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	3-Sep-2015
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	21-Mar-2015
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	22-Sep-2015
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	22-Sep-2015
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	7-Nov-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Sep-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	18-Jan-2015
Section 2.2 - Modulation Characteristics					
Power Supply Unit	Hewlett Packard	6282A	132	-	TU
Attenuator (10dB)	Weinschel	47-10-34	481	12	28-Mar-2015
Multimeter	Iso-tech	IDM101	2419	12	7-Oct-2015
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Combiner/Splitter	Weinschel	1506A	3877	12	21-Mar-2015
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	7-Nov-2015

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.3 - Emission Limits					
Power Supply Unit	Hewlett Packard	6282A	132	-	TU
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	2-May-2015
Attenuator (10dB)	Weinschel	47-10-34	481	12	28-Mar-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	18-Jan-2015
Screened Room (5)	Rainford	Rainford	1545	24	10-Jan-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Multimeter	Iso-tech	IDM101	2419	12	7-Oct-2015
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	9-Jan-2015
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	4-Feb-2015
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	3-Sep-2015
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	21-Mar-2015
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	7-Nov-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Sep-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	18-Jan-2015
Section 2.4 - Frequency Stability					
Power Supply Unit	Farnell	LT30-2	41	-	O/P Mon
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	4-Jun-2015
Communications Tester	Rohde & Schwarz	CMU 200	442	12	8-Dec-2014
Multimeter	Fluke	75 Mk3	455	12	23-Jul-2015
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Power Supply Unit	Farnell	D302T	609	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	18-Jan-2015
Digital Temperature Indicator	Fluke	51	2267	12	24-Sep-2015
Digital Thermometer	Digitron	T208	2831	12	31-Jul-2015
Hygrometer	Rotronic	I-1000	2891	12	16-Jul-2015
Power Supply	Farnell	LT30-2	2903	-	TU
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	6-Nov-2015
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2014
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	12-Dec-2014
True RMS Multimeter	Fluke	179	4007	12	31-Jul-2015
2 Metre SMA Type Cable	Rhophase	3PS-1801A-2000-3PS	4111	12	7-Nov-2015
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	7-Nov-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	18-Jan-2015

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	MU
Modulation Characteristics	-
Frequency Stability	± 18 Hz
Emission Limits	Radiated Emissions ; 30 MHz to 1 GHz ; ± 5.1 dB Radiated Emissions ; 1 GHz to 40 GHz ; 6.2 dB ERP / EIRP ; ± 3.0 dB Band Edge ; 30 MHz to 1 GHz ; ± 5.1 dB Band Edge ; 1 GHz to 40 GHz ; ± 6.2 dB Emission Bandwidth: ± 145kHz (All RB's – 10MHz) ± 76kHz (All RB's – 5MHz) ± 9kHz (1 RB – 5MHz/10MHz) Conducted Emissions: ± 3.454 dB
Power Limits and Duty Cycle	Conducted Power ; ± 0.7 dB ERP / EIRP ; ± 3.0 dB

Product Service

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

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