



Test Report: 2014 258765 FCC PT74rev1

Applicant: Broadcast Microwave Services
12367 Crosthwaite Circle Dock 10
Poway, CA 92064

Equipment Under Test: HC4-6L

FCC ID: CNVHC4-6L

In Accordance With: FCC PART 74 Subpart F

Tested By: Nemko USA Inc.
2210 Faraday Ave.
Suite 150
Carlsbad, CA 92008

TESTED BY:  **DATE:** 30 July 2014
David Light, Wireless Engineer

APPROVED BY:  **DATE:** 30 July 2014
Bruce Ketterling, EMC Manager

Total Number of Pages: 50

DOCUMENT HISTORY

REVISION	DATE	COMMENTS
-	20 May 2014	Prepared By: David Light
-		Initial Release: Tom Tidwell

NOTE: Nemko USA, Inc. hereby makes the following statements so as to conform to Chapter 10 (Test Reports) Requirements of ANSI C63.4: 2003 "Methods and Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz":

- The unit described in this report was received at Nemko USA, Inc.'s facilities on 19 May 2014. Testing was performed on the unit described in this report on 19 May 2014.
- The Test Results reported herein apply only to the Unit actually tested, and to substantially identical Units.
- This report does not imply the endorsement of the Federal Communications Commission (FCC), NVLAP or any other government agency.

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NVLAP LAB CODE 200116-0

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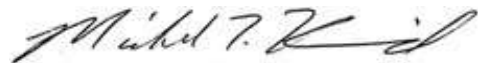
CERTIFICATION

Nemko USA, Inc., an independent Electromagnetic Compatibility (EMC) Test Laboratory, produced this Test Report.

Nemko USA, Inc.'s measurement facility is currently registered with the United States Federal Communications Commission (FCC) in accordance with the provisions of 47 United States Code (CFR) Part 2, Subpart I, Section 2.948(a). A current description of Nemko USA, Inc.'s measurement facility is on file with the FCC. Nemko USA Inc. has additionally satisfied the FCC that it complies with the requirements set forth in 47 CFR Part 2, Subpart I, Section 2.948(d) regarding the accreditation of EMC laboratories. As a result, the FCC has placed Nemko USA Inc. on its list of EMC laboratories approved to perform Declaration of Conformity (DOC) procedure testing.

The RFI testing, test data collection and test data evaluation were accomplished in accordance with the ANSI C63.4: 2003 Standard, and in accordance with the applicable sections of the FCC rules (47 CFR Parts 2 and 18)." digital devices. The testing was also accomplished in accordance with Industry Canada's ICES-003 standard for unintentional radiating device per EMCAB-3, Issue 3 (May 1998). The administrative summary of this test report provides a description of the test sample

I hereby certify that the test data, test data evaluation, and equipment configurations used to compile this test report are a true and accurate representation of the test sample's radio frequency interference characteristics as of the test date(s), and, for the design of the test sample.



Mike T. Krumweide, EMC Test Supervisor

Section 1. Summary of Test Results

General

All measurements are traceable to national standards.

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC PART 2 and FCC PART 74 Subpart F. The EUT is a 6 GHz digital video transmitter intended for helicopter applications.

Summary Of Test Data

Name Of Test	Para. No.	Result
RF Power Output	2.1046	PASS
Occupied Bandwidth	2.1049	PASS
Spurious Emissions at Antenna Terminals	2.1051	PASS
Field Strength of Spurious Emissions	2.1053	PASS
Modulation Characteristics	2.1047	PASS
Frequency Stability	2.1055	PASS

Revisions:

- 1) Corrected frequency stability data. Section 7.

Section 2. General Equipment Specification

Manufacturer:	Broadcast Microwave Services
Part No.:	8014521603
Model No.:	HC4-6L
Serial No.:	B1014
Test Voltage:	28Vdc
Frequency Range:	6.425 to 6.525 GHz
Date Received In Laboratory:	19 May 2014
Emission Designator(s):	6M00D7W 7M00D7W 8M00D7W

Section 3. RF Power Output

Para. No.: 2.1046(c)

Test Performed By: David Light	Date of Test: 19 May 2014
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Minimum Standard: Subpart F--Television Broadcast Auxiliary Stations
 Sec. 74.636 Power limitations.

(a) *On any authorized frequency, transmitter peak output power and the average power delivered to an antenna in this service must be the minimum amount of power necessary to carry out the communications desired and shall not exceed the values listed in the following table. Application of this principle includes, but is not to be limited to, requiring a licensee who replaces one or more of its antennas with larger antennas to reduce its antenna input power by an amount appropriate to compensate for the increased primary lobe gain of the replacement antenna(s). In no event shall the average equivalent isotropically radiated power (EIRP), as referenced to an isotropic radiator, exceed the values specified in the following table. In cases of harmful interference, the Commission may, after notice and opportunity for hearing, order a change in the effective radiated power of this station. The table follows:*

Frequency Band (MHz)	Maximum allowable transmitter power	Maximum allowable EIRP ²	
	Mobile (W)	Fixed (dBW)	Mobile (dBW)
2,025 to 2,110	12.0	+45	+35
2,450 to 2,483.5	12.0	+45	+35
6,425 to 6,525	12.0		+35
6,875 to 7,125	12.0	+55	+35
12,700 to 13,250	1.5	+55	+35
17,700 to 18,600		+55	
18,600 to 18,800 ¹		+35	
18,800 to 19,700		+55	

Test Results: EUT complies

Test Conditions:

Relative Humidity: 33%

Temperature: 23°C

Measurement Data :

Channel Bandwidth (MHz)	Modulation Type	RMS Output Power (Watts)	RMS Output Power (dBm)
8	QPSK	10.5	40.2
8	16QAM	10.5	40.2
8	64QAM	10.7	40.3
7	QPSK	10.5	40.2
7	16QAM	10.5	40.2
7	64QAM	10.7	40.3
6	QPSK	10.5	40.2
6	16QAM	10.5	40.2
6	64QAM	10.7	40.3

Test Equipment:

Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
RMS Power Meter	Agilent	E4418B	GB38410640	09-Aug-2013	09-Aug-2015
Power Sensor	Agilent	8481A	2842A07263	09-Aug-2013	09-Aug-2015

Section 4. Occupied Bandwidth

Para. No.: 2.1049

Test Performed By: David Light	Date of Test: 19 May 2014
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Minimum Standard: Part 74.637 (g) Occupied/Authorized bandwidth.

(g) The maximum bandwidth which will be authorized per frequency assignment is set out in the table which follows. Regardless of the maximum authorized bandwidth specified for each frequency band, the Commission reserves the right to issue a license for less than the maximum bandwidth if it appears that less bandwidth would be sufficient to support an applicant's intended communications.

Frequency Band (MHz)	Maximum authorized bandwidth (MHz)
1,990 to 2,110	18
6,425 to 6,525	25
6,875 to 7,125	25
12,700 to 13,250	25
17,700 to 19,700	80

Test Results: EUT Complies.

Test Data: See attached plots. The EUT was tested with an RF bandwidth of 6, 7 and 8 MHz (QPSK, 16QAM and 64QAM).

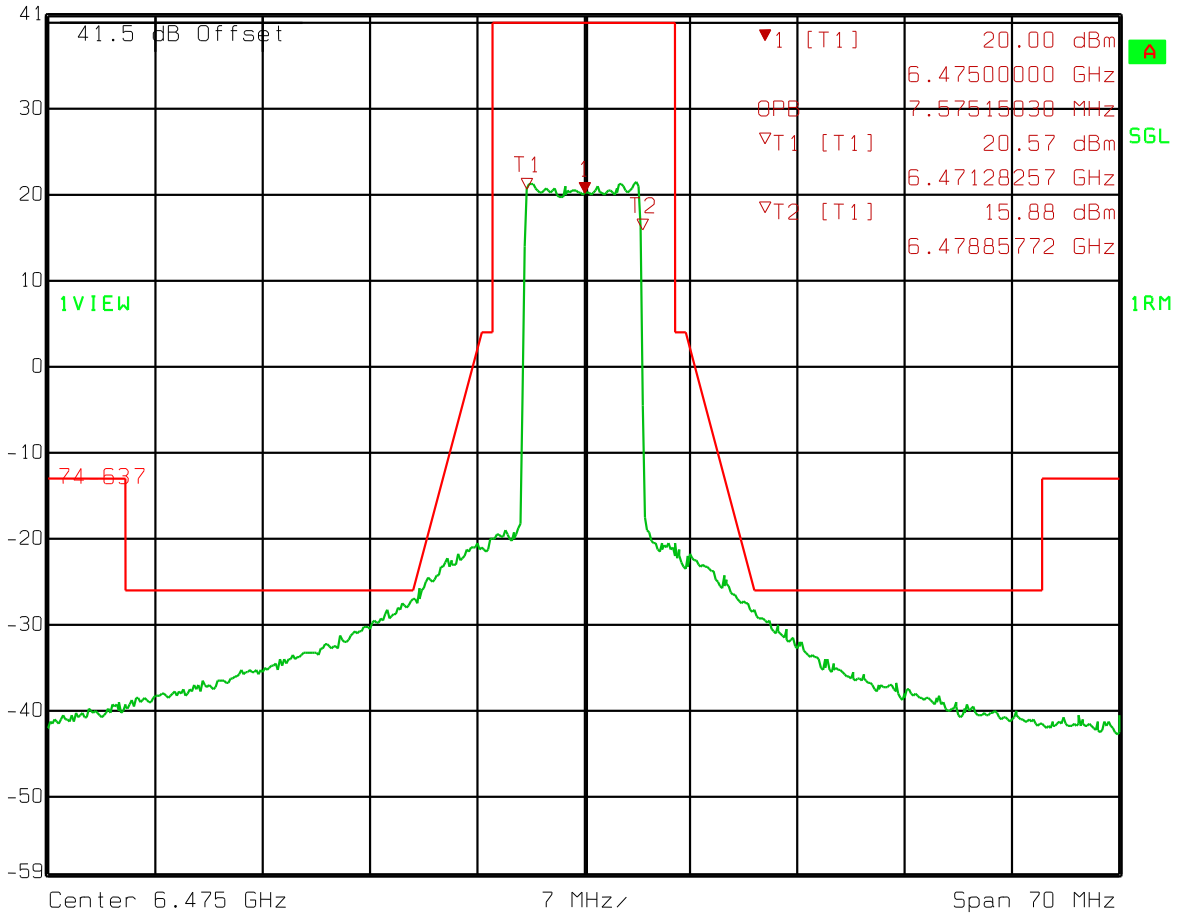
Test Equipment:

Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	15-Jul-2013	15-Jul-2015

QPSK 8MHz Bandwidth

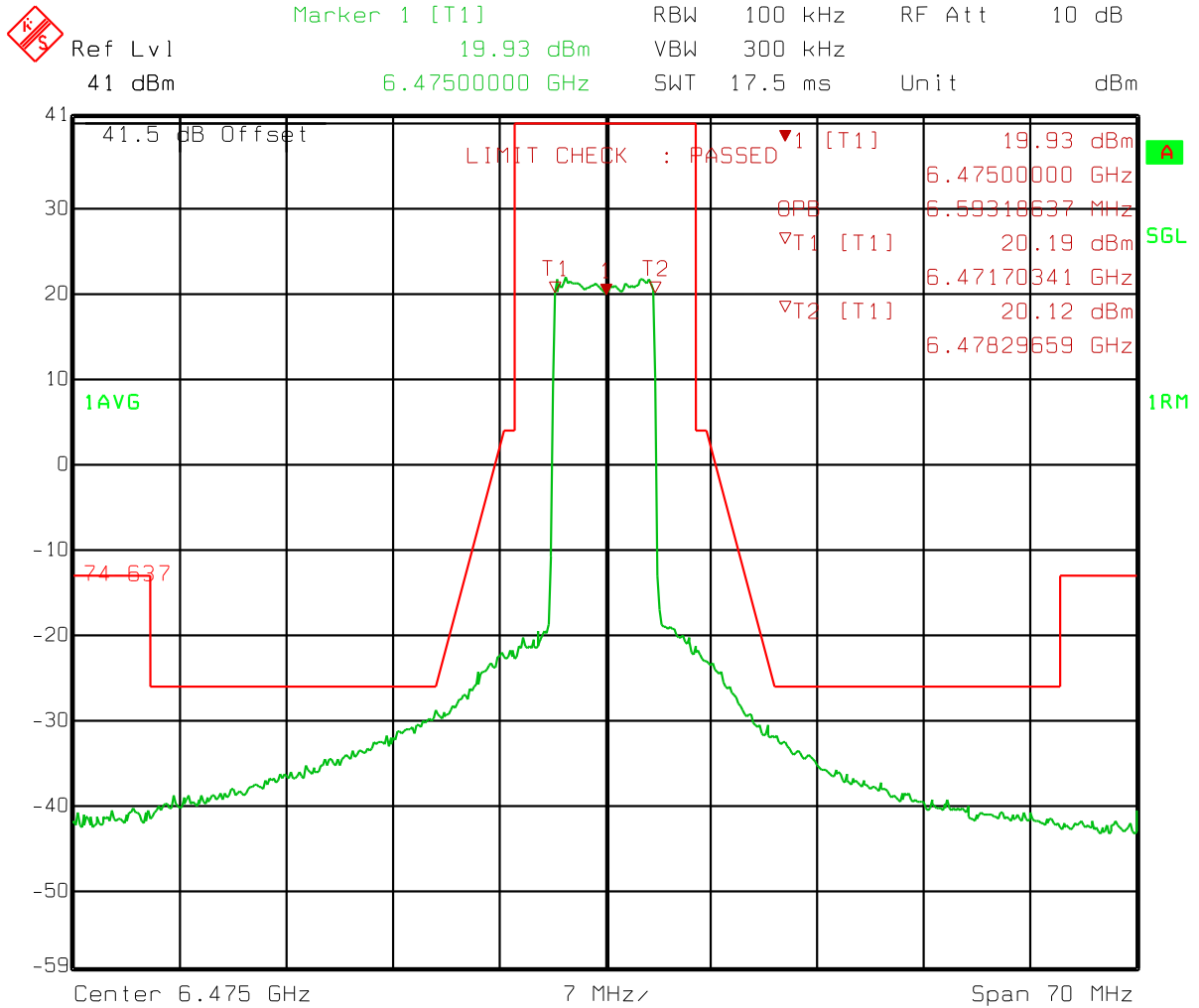


Marker 1 [T1] RBW 100 kHz RF Att 10 dB
 Ref Lvl 20.00 dBm VBW 300 kHz
 41 dBm 6.47500000 GHz SWT 17.5 ms Unit dBm



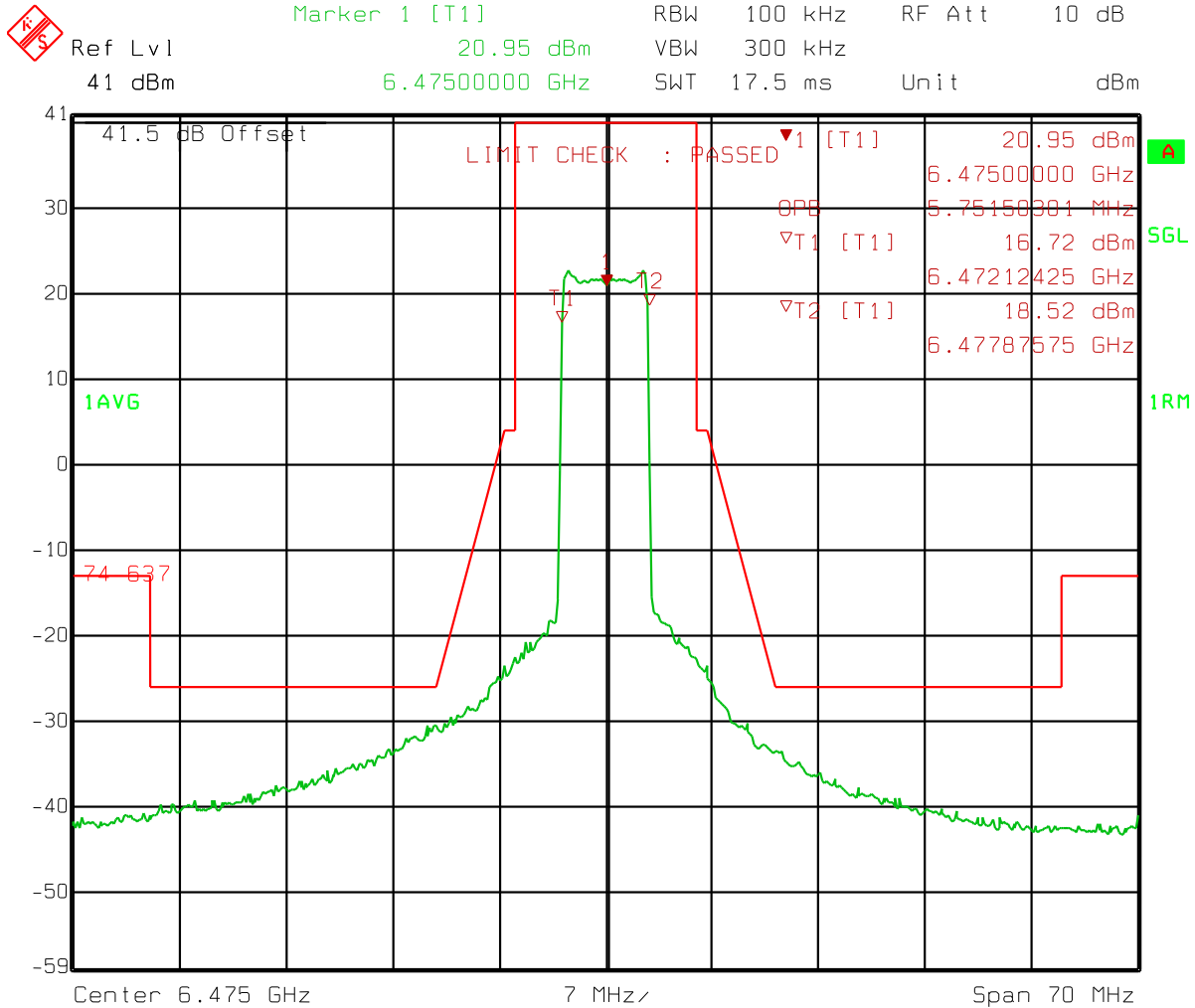
Date: 19.MAY 2014 07:37:41

QPSK 7MHz Bandwidth



Date: 19.MAY 2014 07:41:24

QPSK 6MHz Bandwidth

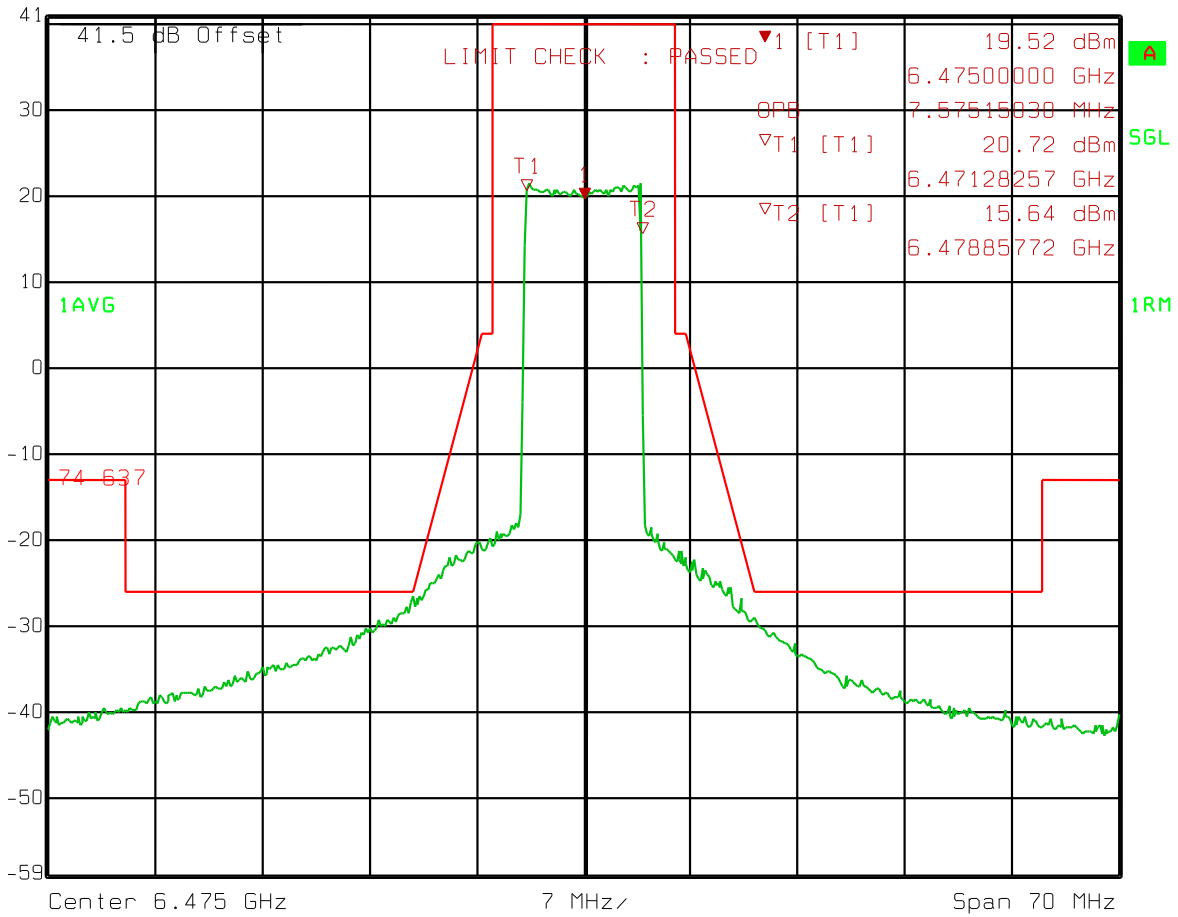


Date: 19.MAY 2014 07:43:31

16QAM 8 MHz Bandwidth

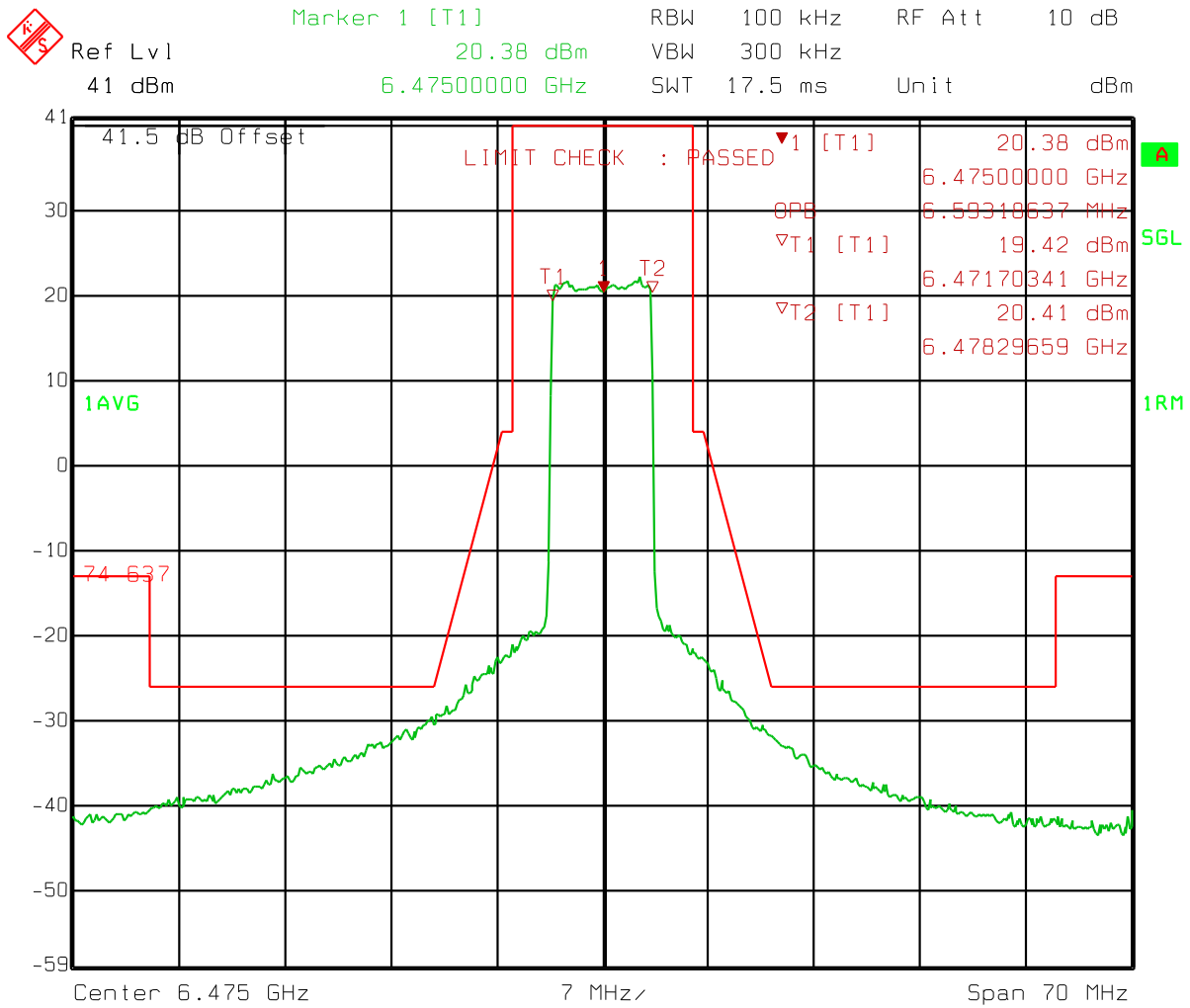


Marker 1 [T1] RBW 100 kHz RF Att 10 dB
 Ref Lvl 19.52 dBm VBW 300 kHz
 41 dBm 6.47500000 GHz SWT 17.5 ms Unit dBm



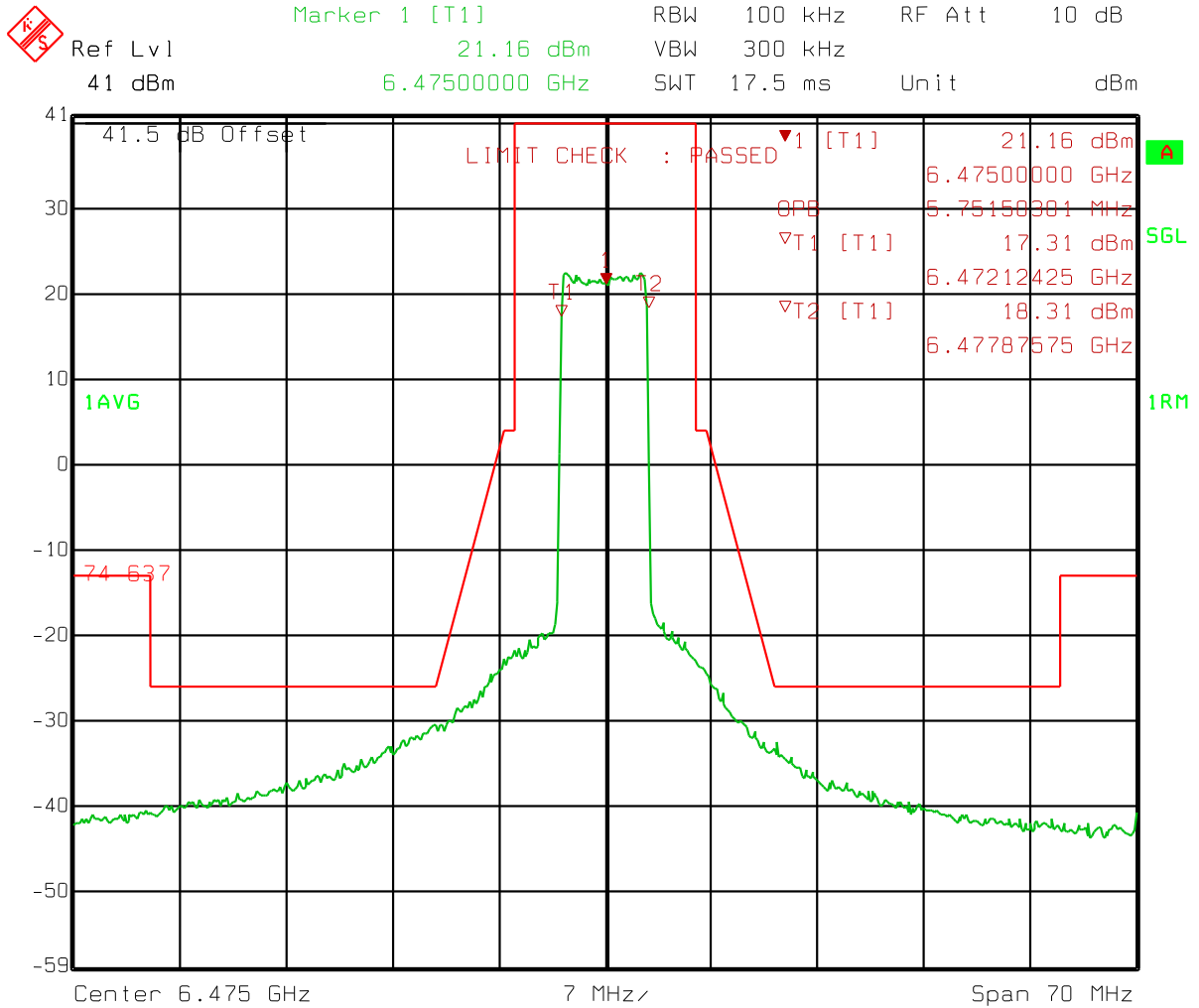
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16QAM 7 MHz Bandwidth



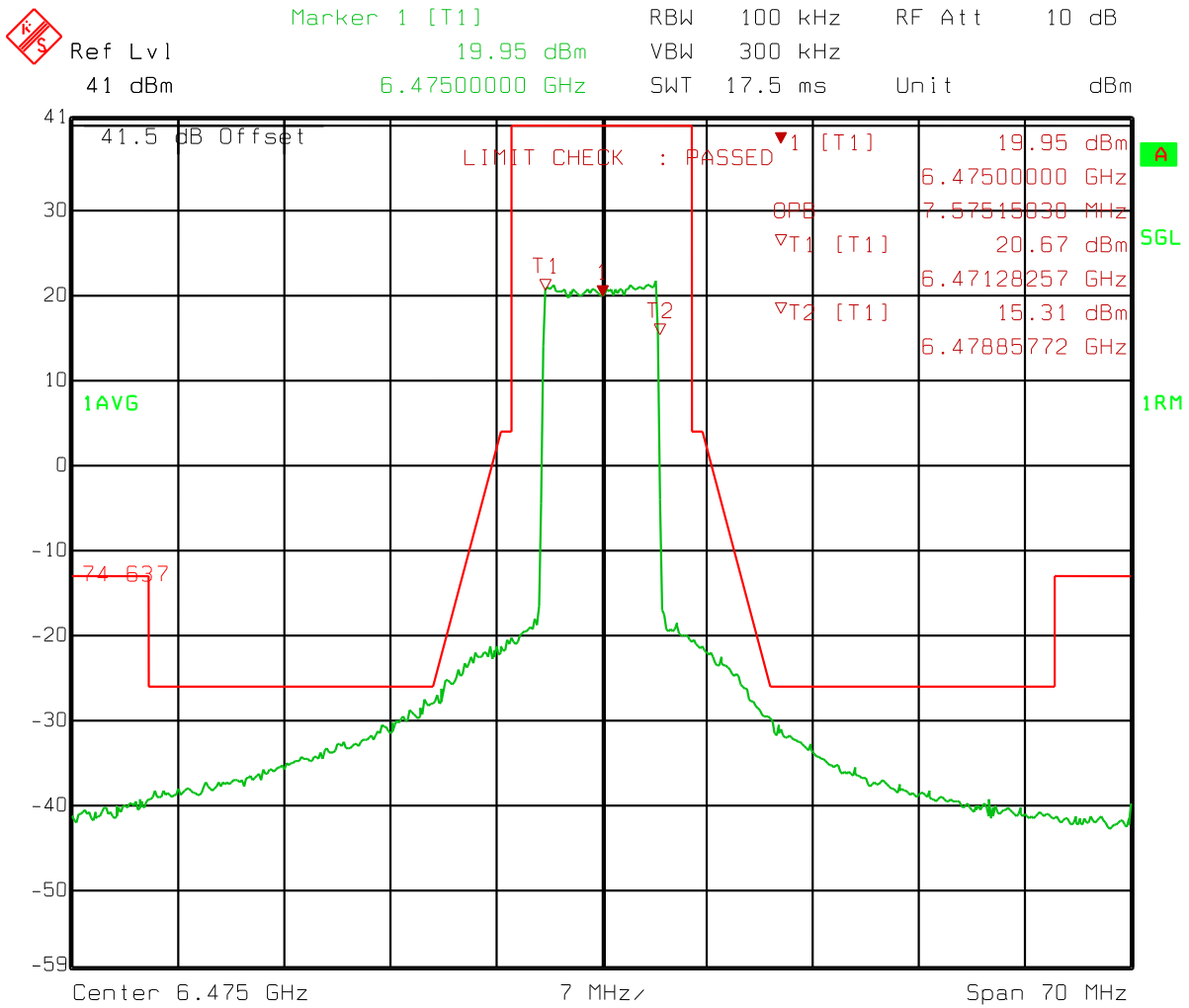
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16QAM 6 MHz Bandwidth



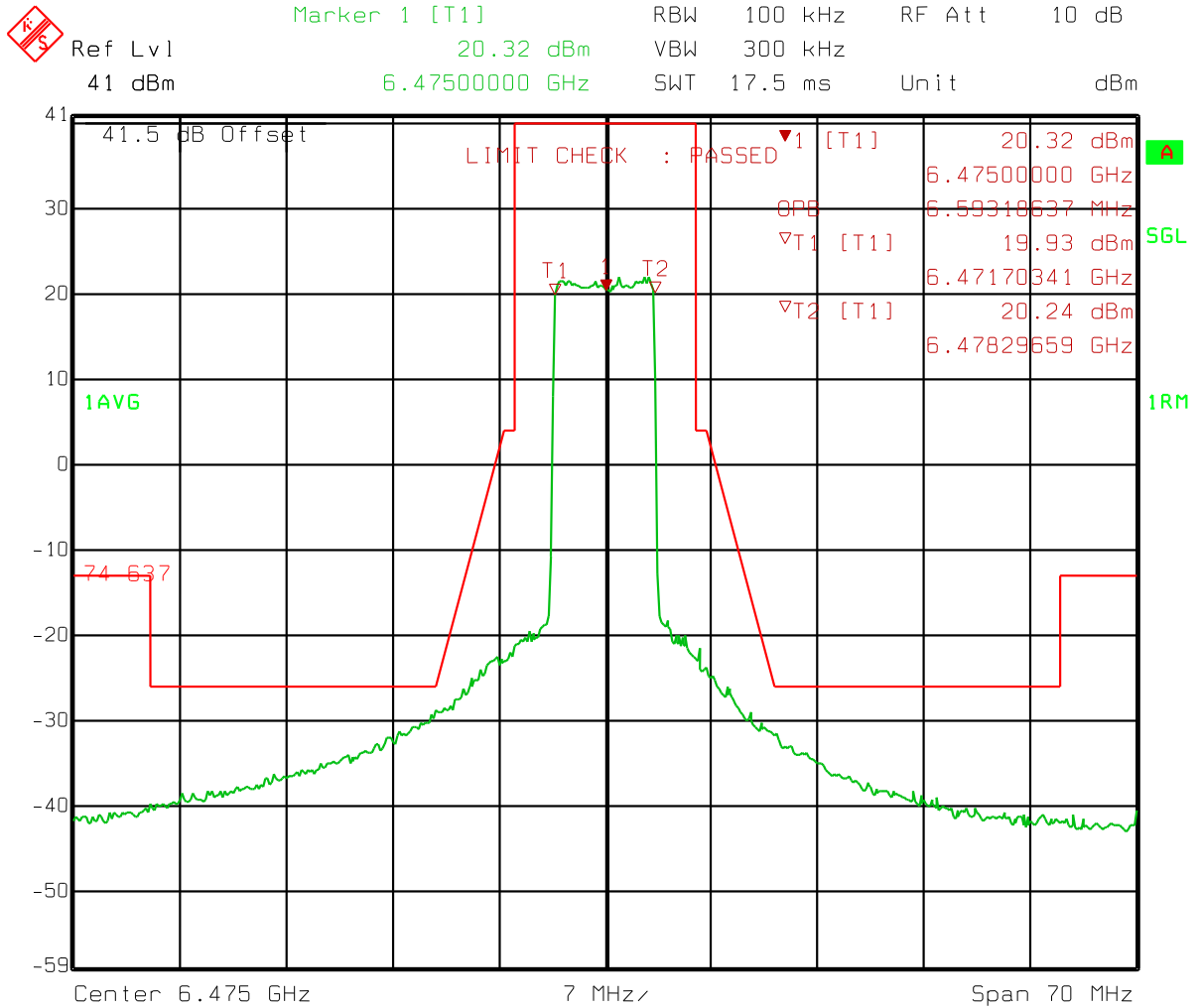
Date: 19.MAY 2014 07:44:10

64QAM 8 MHz Bandwidth



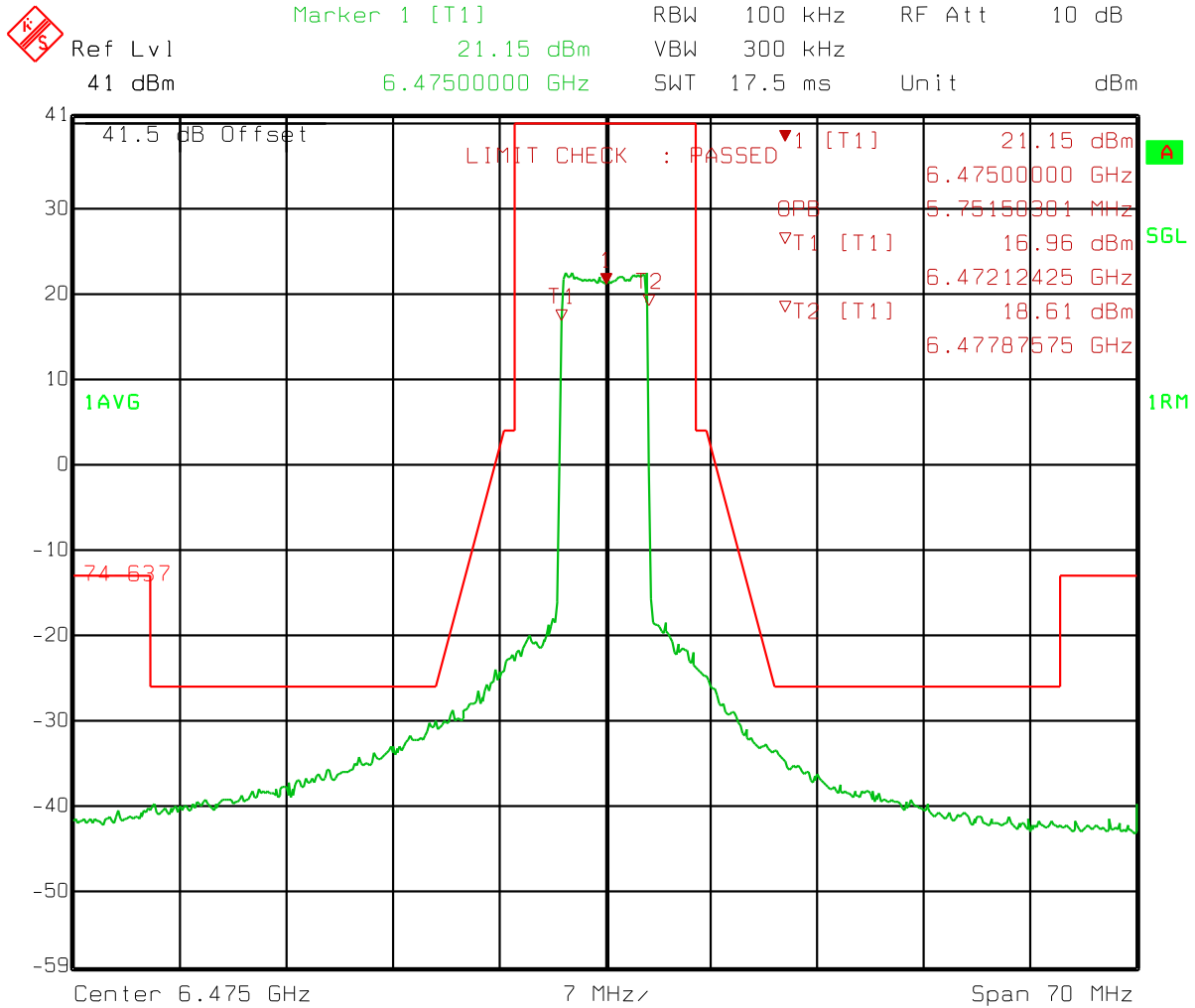
Date: 19.MAY 2014 07:39:22

64QAM 7 MHz Bandwidth



Date: 19.MAY 2014 07:42:51

64QAM 6 MHz Bandwidth



Date: 19.MAY 2014 07:44:56

Section 5. Spurious Emissions at Antenna Terminals

Para. No.: 2.1051

Test Performed By: David Light	Date of Test: 19 May 2014
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Minimum Standard: Part 74.637 Emissions and emission limitations

(a) The mean power of emissions shall be attenuated below the mean transmitter power (P_{MEAN}) in accordance with the following schedule:

(1) When using frequency modulation:

(i) On any frequency removed from the assigned (center) frequency by more than 50% up to and including 100% of the authorized bandwidth: At least 25 dB in any 100 kHz reference bandwidth (B_{REF});

(ii) On any frequency removed from the assigned (center) frequency by more than 100% up to and including 250% of the authorized bandwidth: At least 35 dB in any 100 kHz reference bandwidth;

(iii) On any frequency removed from the assigned (center) frequency by more than 250% of the authorized bandwidth: At least $43 + 10 \log_{10} (P_{MEAN}$ in watts) dB, or 80 dB, whichever is the lesser attenuation, in any 100 kHz reference bandwidth.

(2) When using transmissions employing digital modulation techniques:

(i) For operating frequencies below 15 GHz, in any 4 kHz reference bandwidth (B_{REF}), the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 50 decibels:

$$A = 35 + 0.8 (G - 50) + 10 \text{ Log}_{10} B.$$

(Attenuation greater than 80 decibels is not required.)

Where:

A = Attenuation (in decibels) below the mean output power level.

G = Percent removed from the carrier frequency.

B = Authorized bandwidth in megahertz.

(c) For purposes of compliance with the emission limitation requirements of this section:

(3) For demonstrating compliance with the attenuation requirements for frequency modulation and digital modulation in paragraph (a) of this section, the resolution bandwidth (B_{RES}) of the measuring equipment used for measurements removed from the center frequency by more than 250 percent of the authorized bandwidth shall be 100 kHz for operating frequencies below

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EQUIPMENT: HC4-6L

FCC ID: CNVHC4-6L

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1 GHz, and 1 MHz for operating frequencies above 1 GHz. The resolution bandwidth for frequencies removed from the center frequency by less than 250 percent of the authorized bandwidth shall be the reference bandwidth (B_{REF}) specified in the individual emission limitations, but may be reduced to not less than one percent of the authorized bandwidth (B), adjusted upward to the nearest greater resolution bandwidth available on the measuring equipment. In all cases, if B_{RES} and B_{REF} are not equal, then the attenuation requirement must be increased (or decreased) as determined by a factor of $10 \log_{10} [(B_{REF} \text{ in megahertz}) / (B_{RES} \text{ in megahertz})]$ decibels, where a positive factor indicates an increase in the attenuation requirement and a negative factor indicates a decrease in the attenuation requirement.

Test Results: EUT Complies. Emissions were investigated from 30 MHz to 40 GHz .

Test Data: See attached Plots

The EUT was investigated using all three modulation schemes but identical results were obtained for all mode of operations.

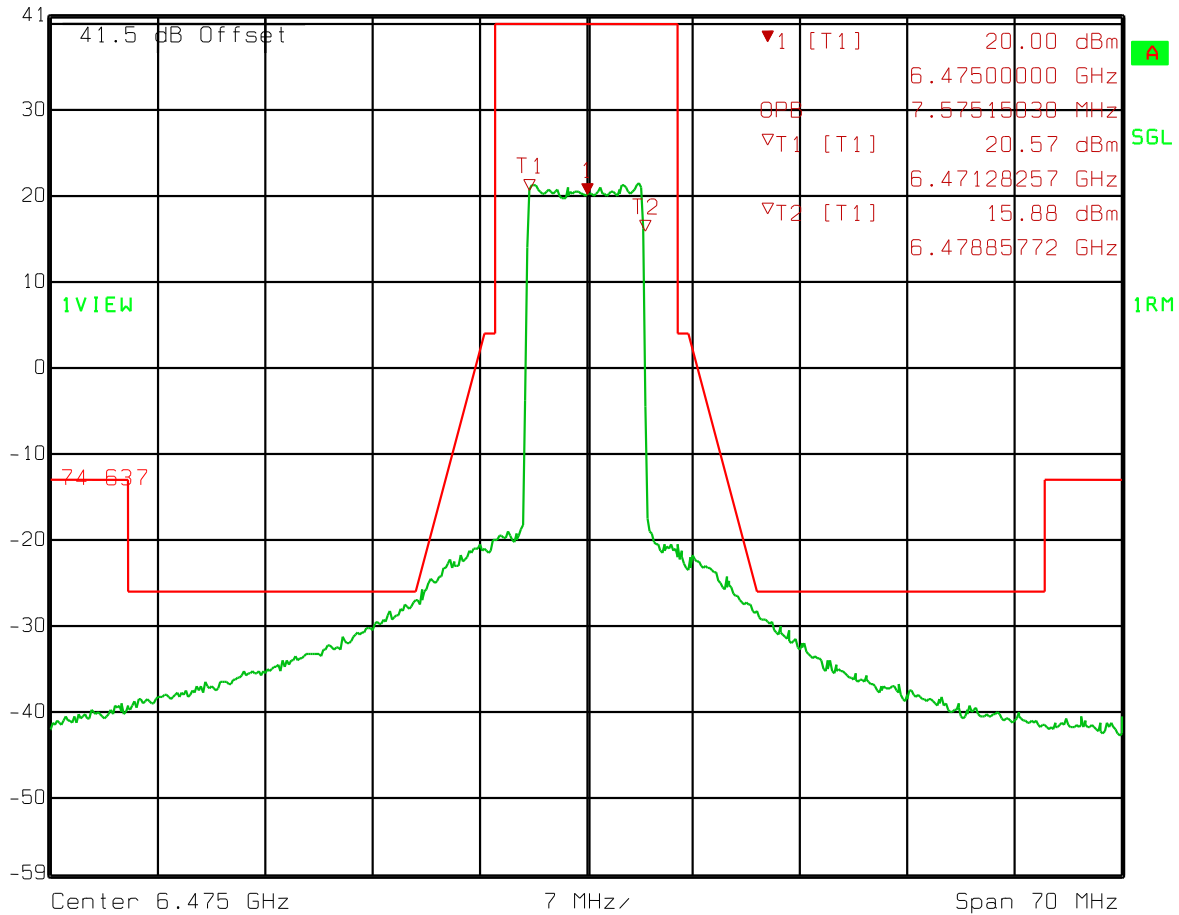
Test Equipment:

Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	15-Jul-2013	15-Jul-2015

Test Data

**Emission Mask
 8 MHz QPSK**

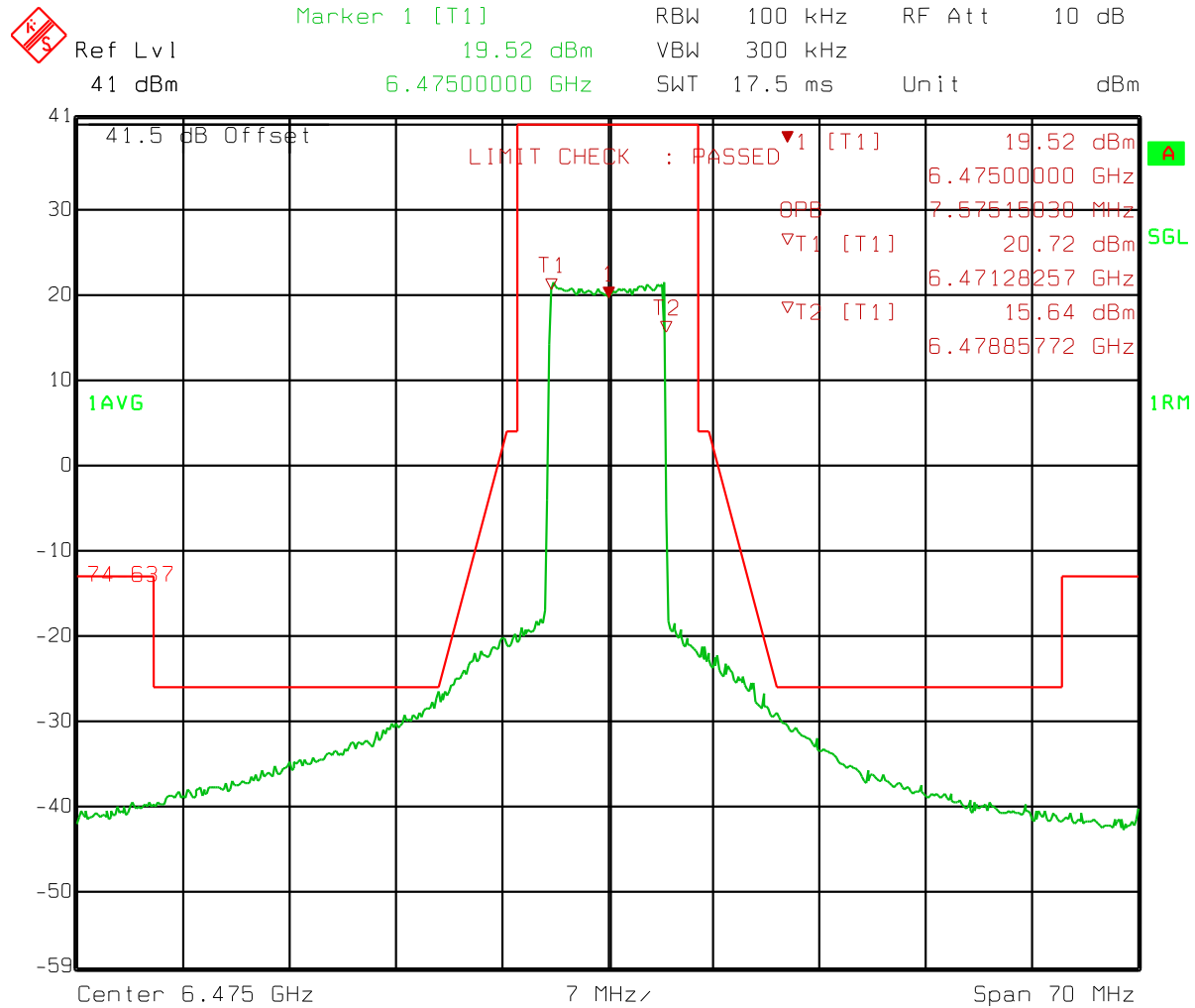

 Ref Lvl 41 dBm
 Marker 1 [T1] 20.00 dBm
 RBW 100 kHz
 RF Att 10 dB
 VBW 300 kHz
 Unit dBm
 SWT 17.5 ms



Date: 19.MAY 2014 07:37:41

Test Data

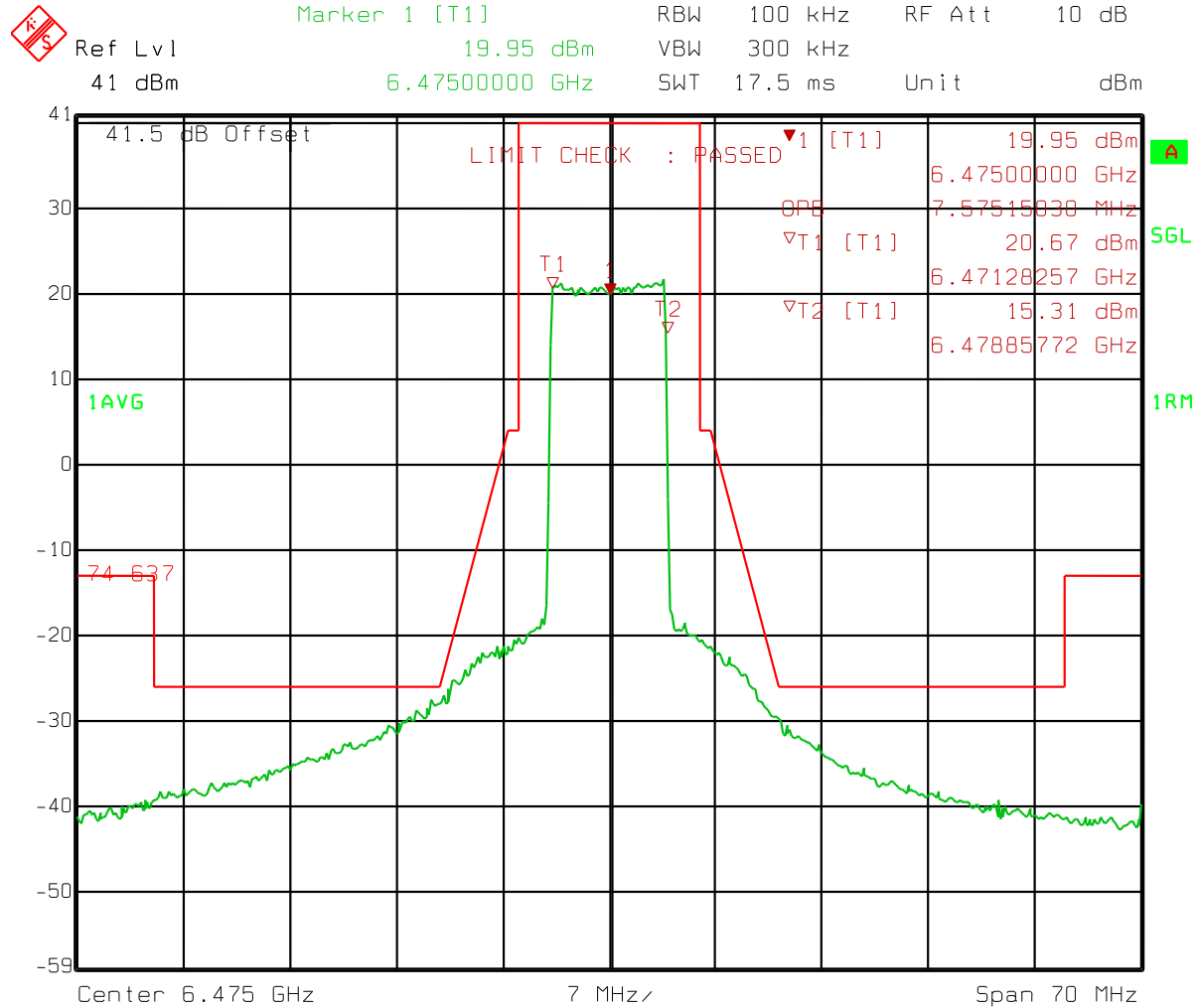
Emission Mask
 8 MHz 16QAM



Date: 19.MAY 2014 07:38:20

Test Data

**Emission Mask
 8 MHz 64QAM**



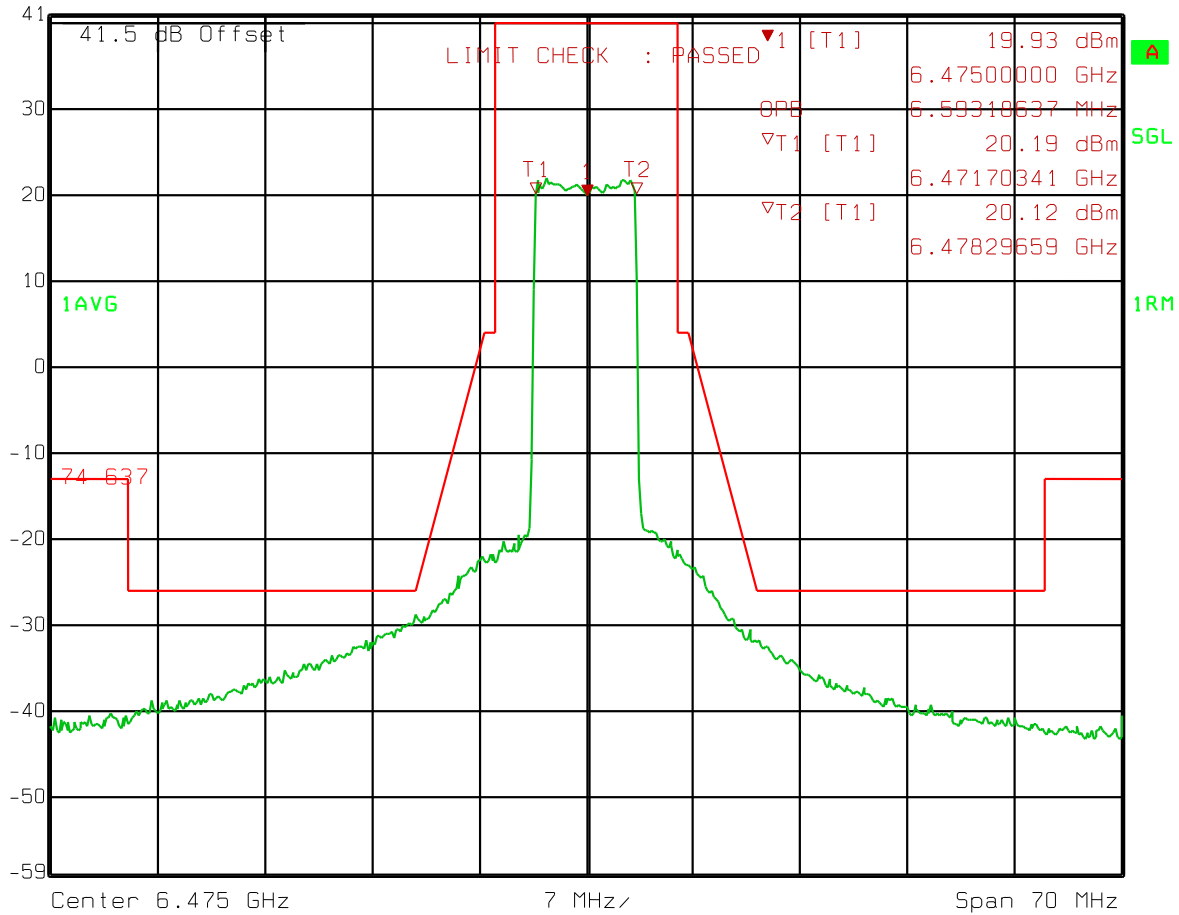
Date: 19.MAY 2014 07:39:22

Test Data

**Emission Mask
 7 MHz QPSK**



Ref Lvl 41 dBm
 Marker 1 [T1] 19.93 dBm
 6.4750000 GHz
 RBW 100 kHz RF Att 10 dB
 VBW 300 kHz
 SWT 17.5 ms Unit dBm



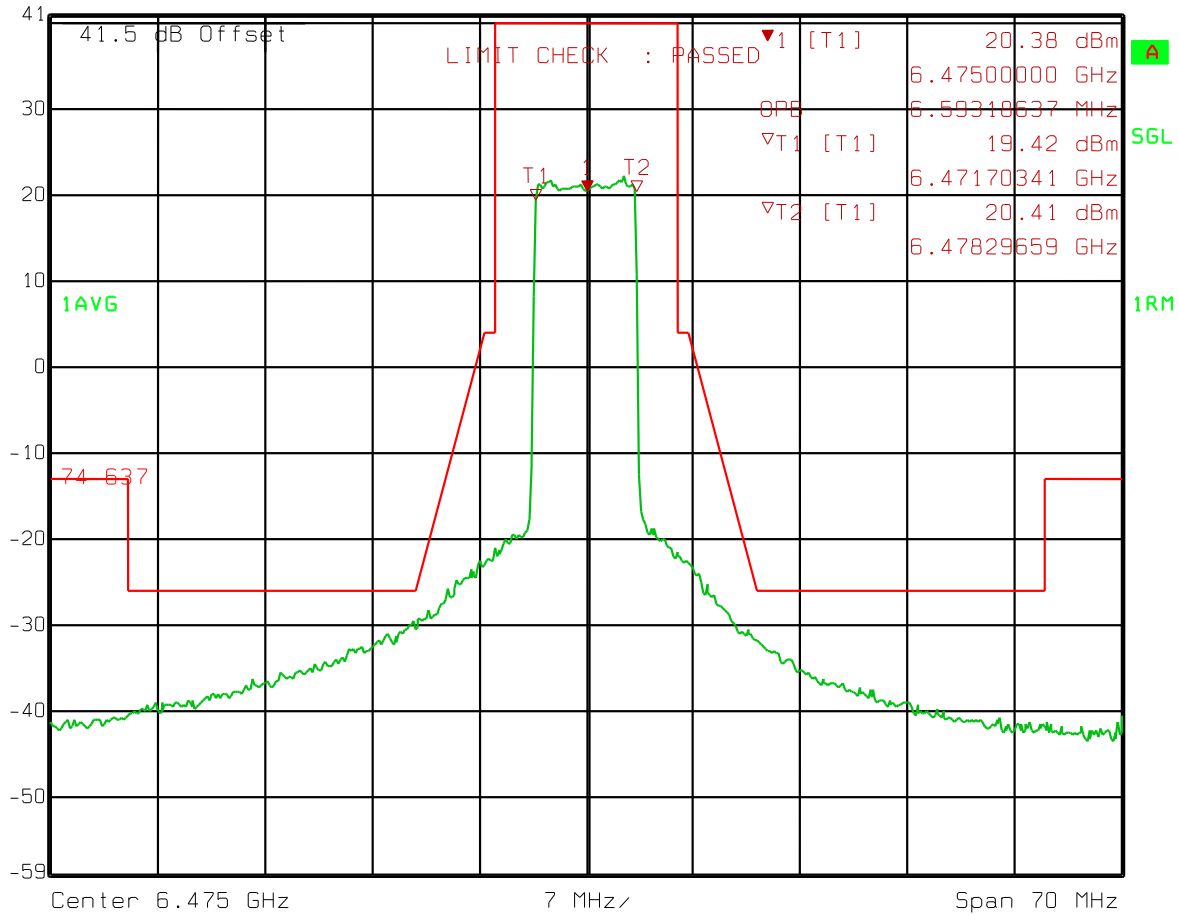
Date: 19.MAY 2014 07:41:24

Test Data

Emission Mask
 7 MHz 16QAM



Ref Lvl 41 dBm
 Marker 1 [T1] 20.38 dBm
 6.47500000 GHz
 RBW 100 kHz RF Att 10 dB
 VBW 300 kHz
 SWT 17.5 ms Unit dBm



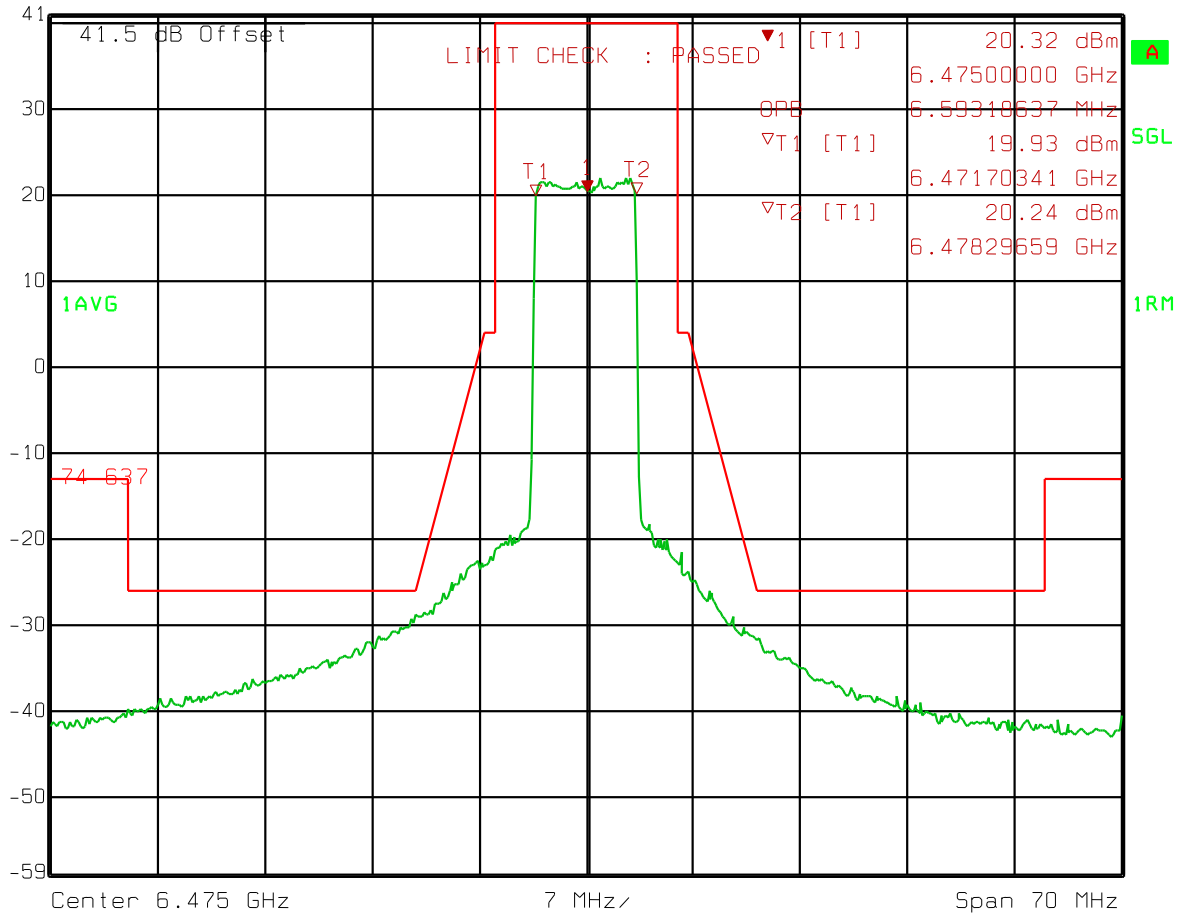
Date: 19.MAY 2014 07:42:17

Test Data

Emission Mask
 7 MHz 64QAM



Ref Lvl 41 dBm
 Marker 1 [T1] 20.32 dBm
 6.47500000 GHz
 RBW 100 kHz RF Att 10 dB
 VBW 300 kHz
 SWT 17.5 ms Unit dBm



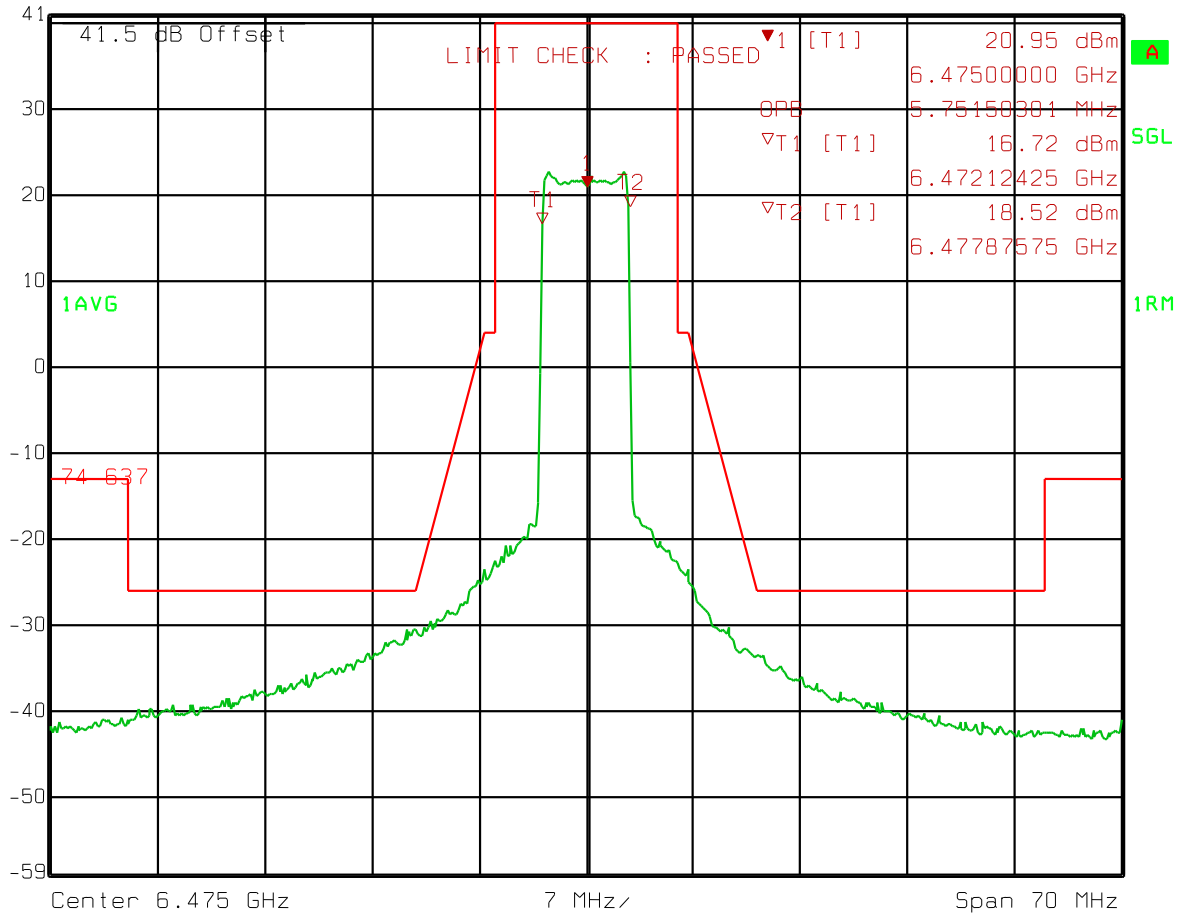
Date: 19.MAY 2014 07:42:51

Test Data

Emission Mask
 6 MHz QPSK



Ref Lvl 41 dBm
 Marker 1 [T1] 20.95 dBm
 6.47500000 GHz
 RBW 100 kHz RF Att 10 dB
 VBW 300 kHz
 SWT 17.5 ms Unit dBm



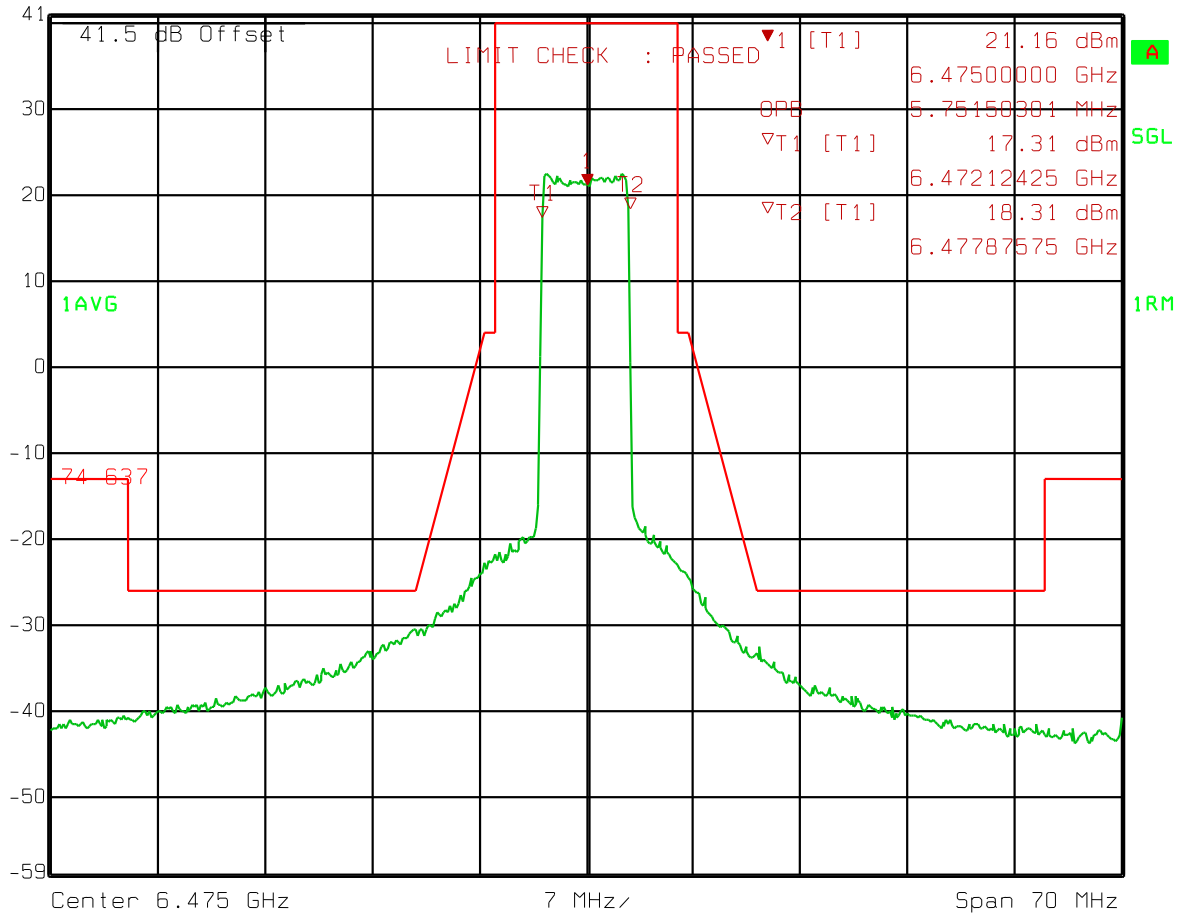
Date: 19.MAY 2014 07:43:31

Test Data

**Emission Mask
 6 MHz 16QAM**



Ref Lvl 41 dBm
 Marker 1 [T1] 21.16 dBm
 6.47500000 GHz
 RBW 100 kHz RF Att 10 dB
 VBW 300 kHz
 SWT 17.5 ms Unit dBm



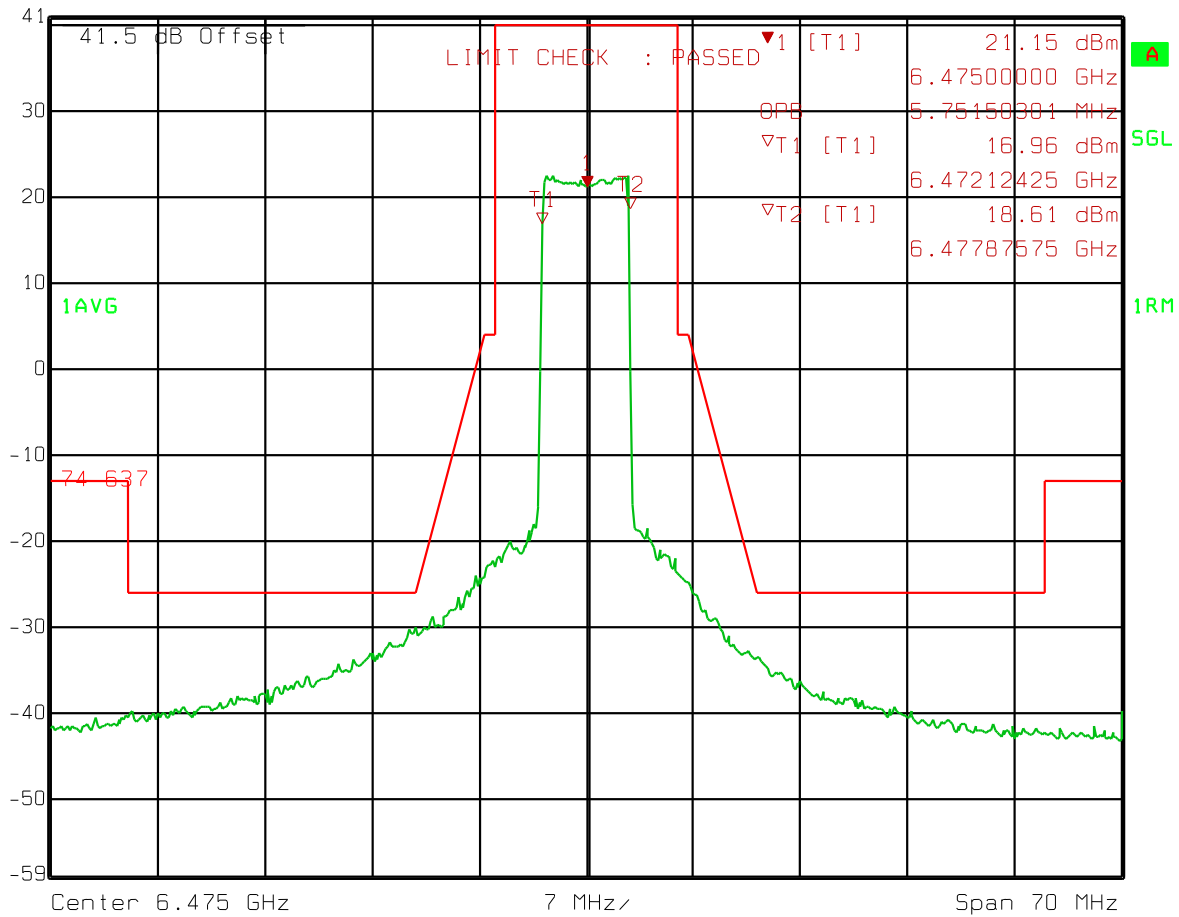
Date: 19.MAY 2014 07:44:10

Test Data

Emission Mask
 6 MHz 64QAM



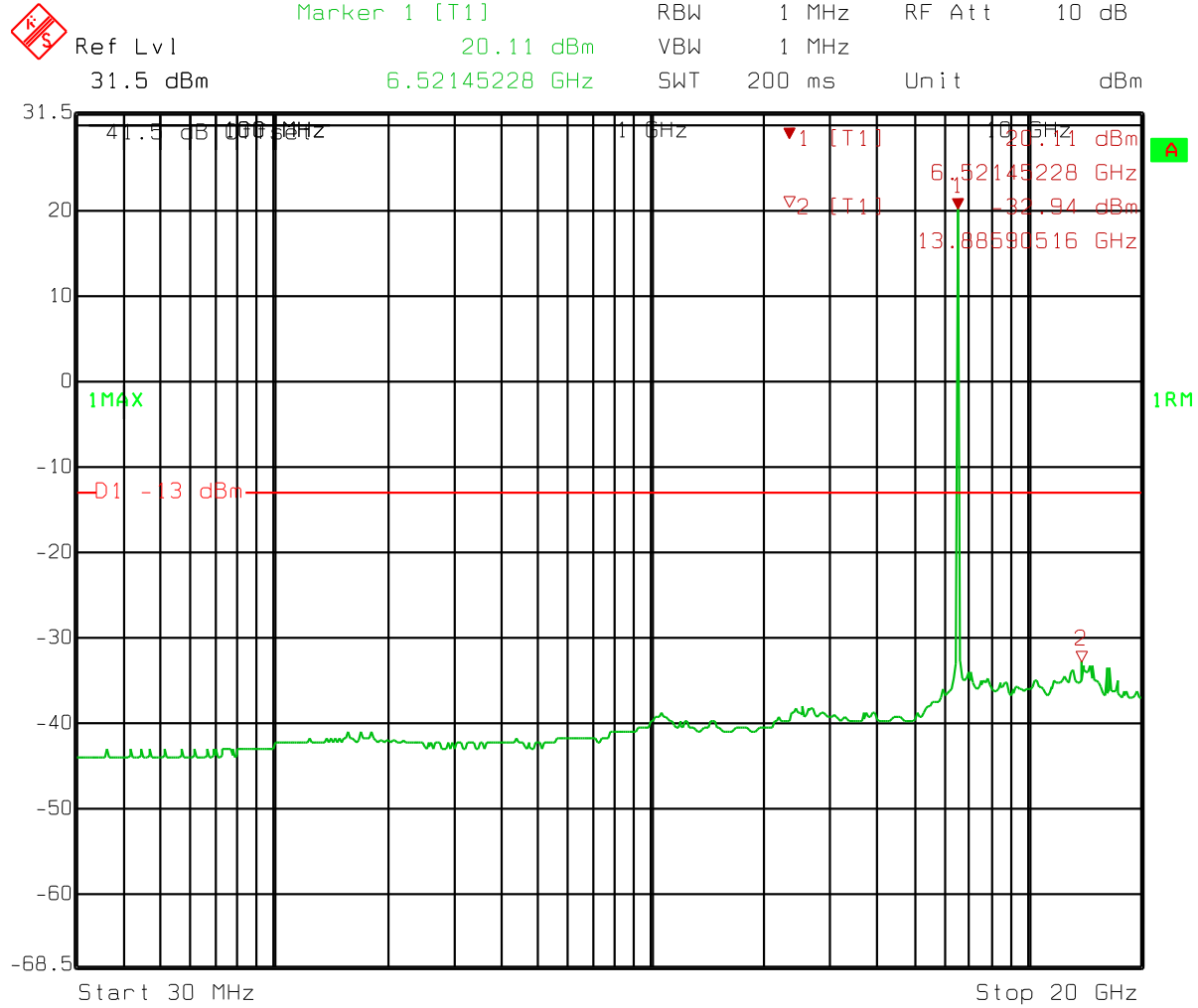
Ref Lvl 41 dBm
 Marker 1 [T1] 21.15 dBm
 6.47500000 GHz
 RBW 100 kHz RF Att 10 dB
 VBW 300 kHz
 SWT 17.5 ms Unit dBm



Date: 19.MAY 2014 07:44:56

Test Data

Conducted Spurious Emissions
8 MHz
QPSK

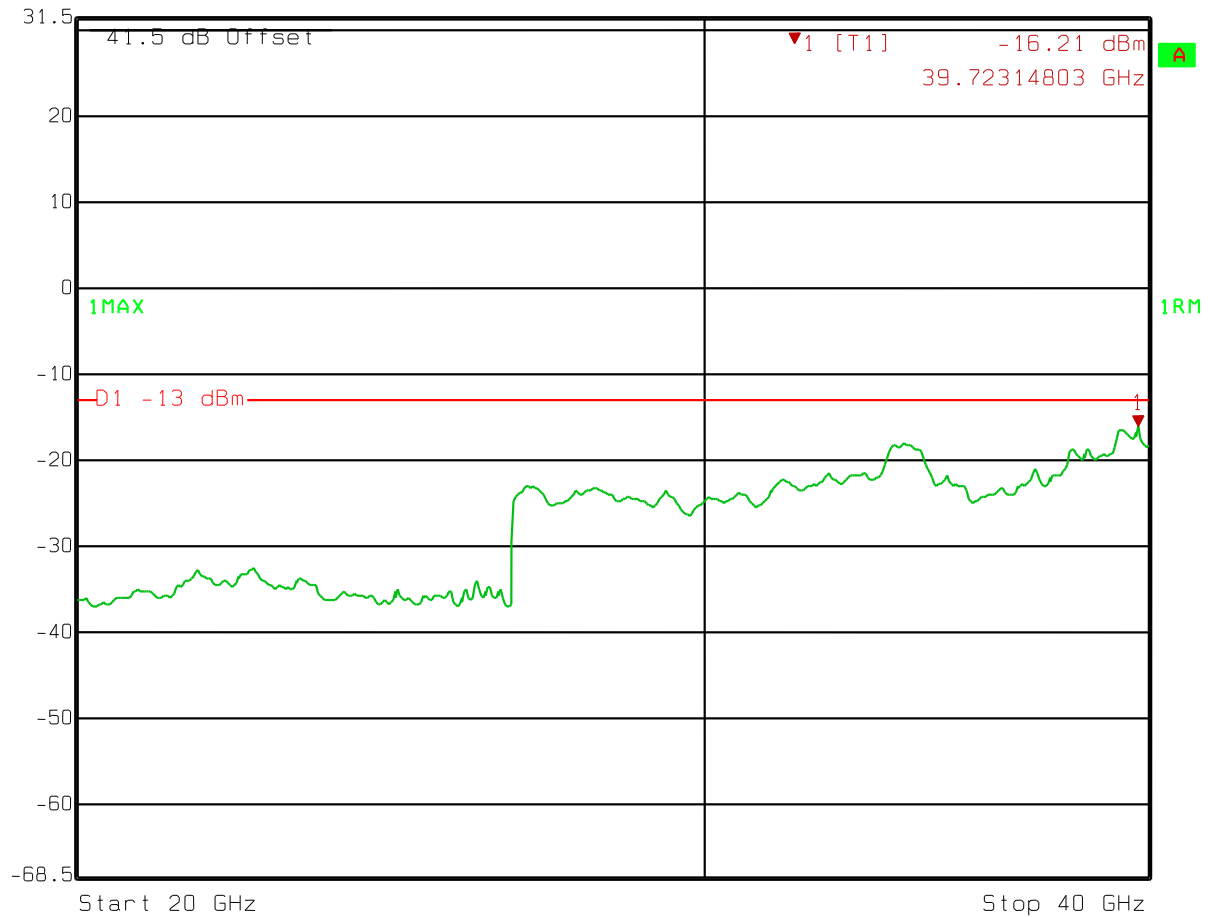


Date: 19.MAY 2014 07:56:06

Test Data

Conducted Spurious Emissions
 8 MHz
 QPSK

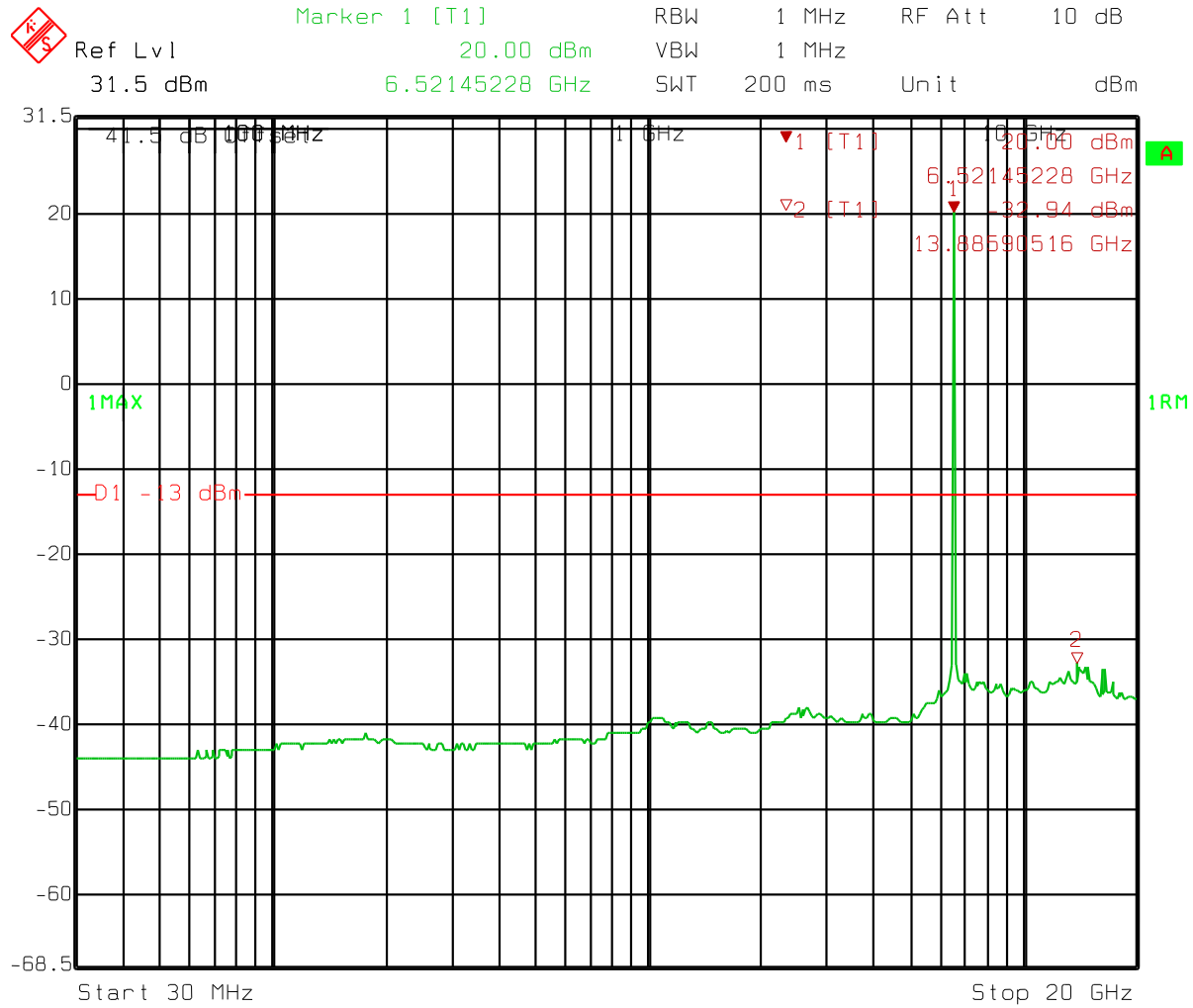
	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
	Ref Lvl		-16.21 dBm	VBW	1 MHz
	31.5 dBm		39.72314803 GHz	SWT	300 ms
				Unit	dBm



Date: 19.MAY 2014 07:56:52

Test Data

Conducted Spurious Emissions
 8 MHz
 16QAM

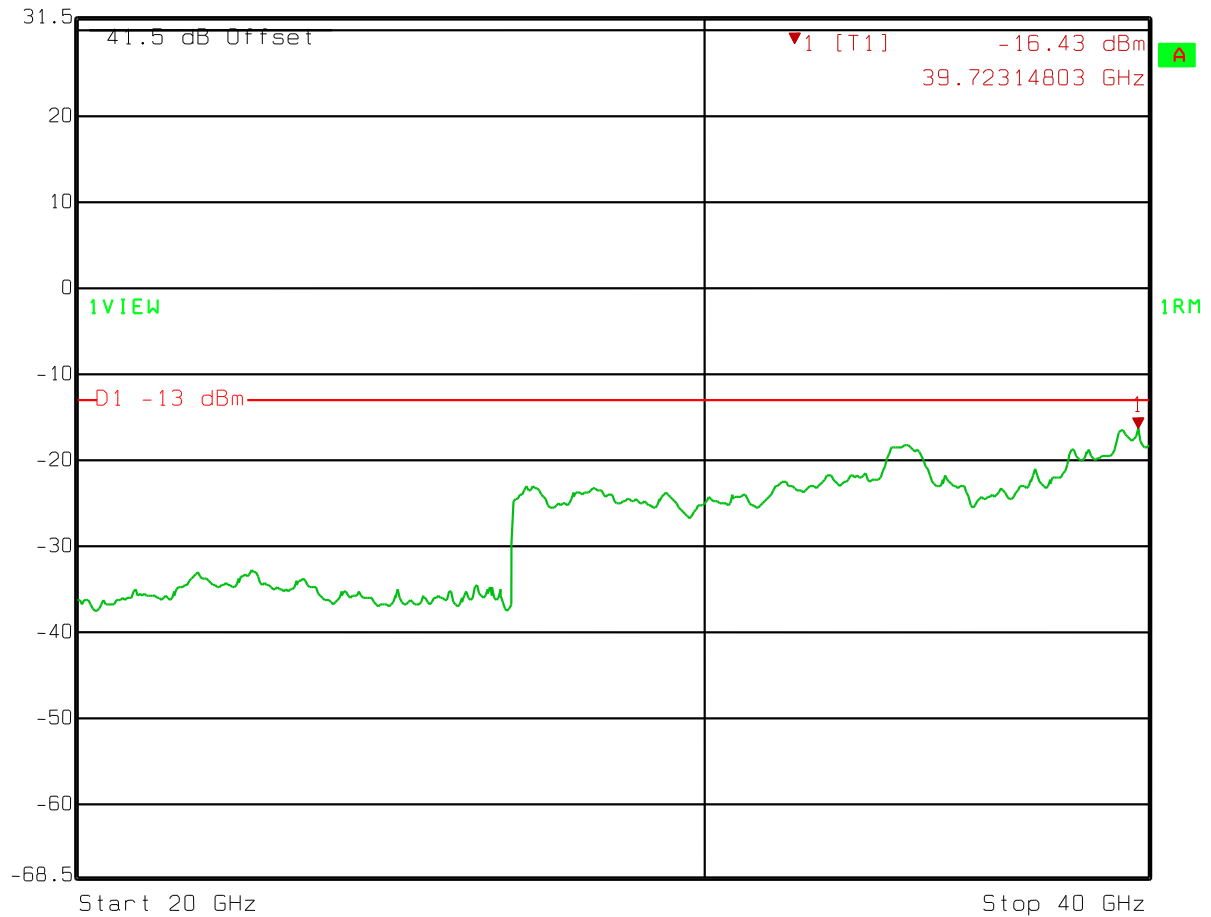


Date: 19.MAY 2014 07:58:44

Test Data

Conducted Spurious Emissions
 8 MHz
 16QAM

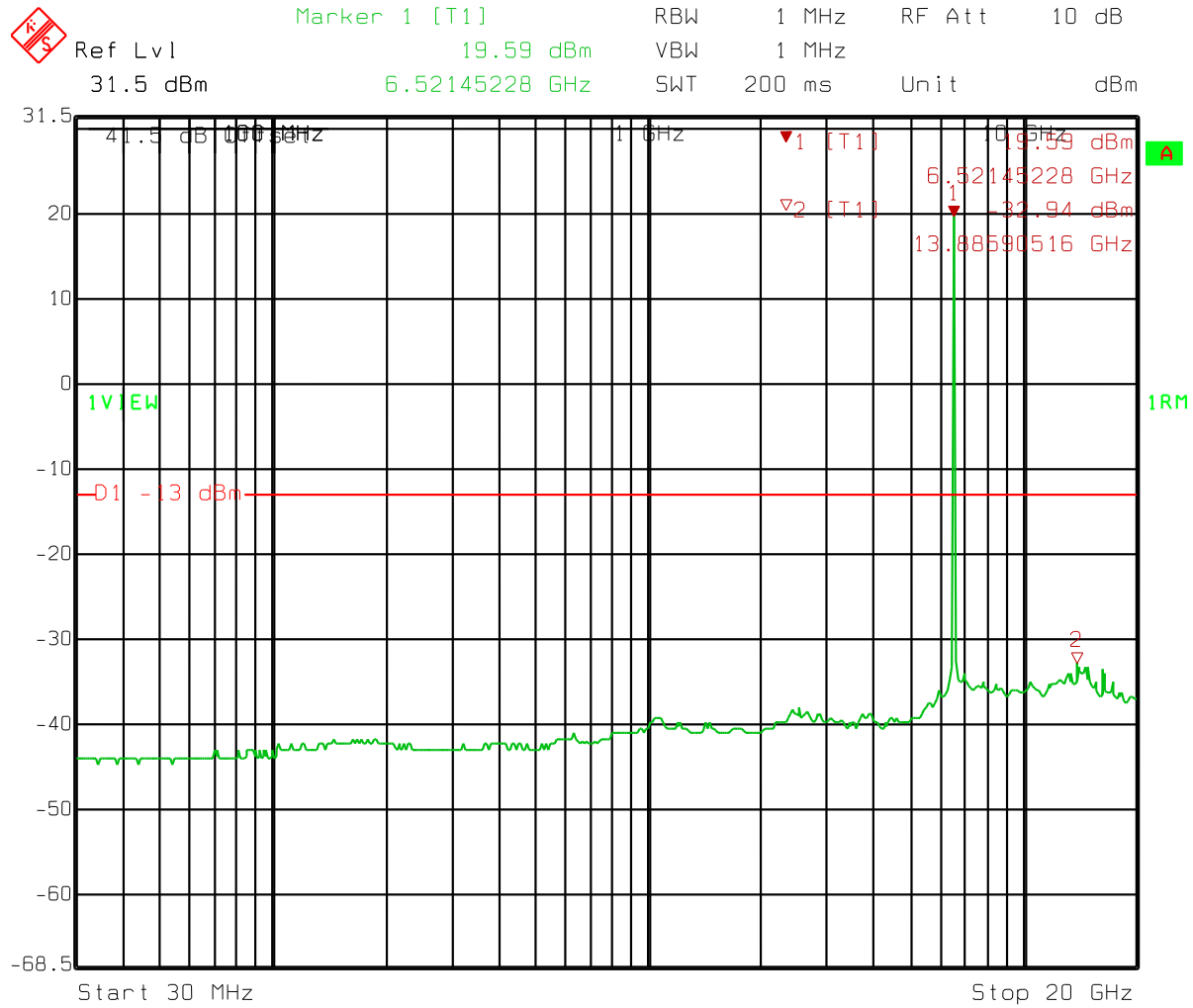
	Ref Lvl	31.5 dBm	Marker 1 [T1]	-16.43 dBm	RBW	1 MHz	RF Att	10 dB
			39.72314803 GHz		VBW	1 MHz		
					SWT	300 ms	Unit	dBm



Date: 19.MAY 2014 07:57:55

Test Data

Conducted Spurious Emissions
 8 MHz
 64QAM

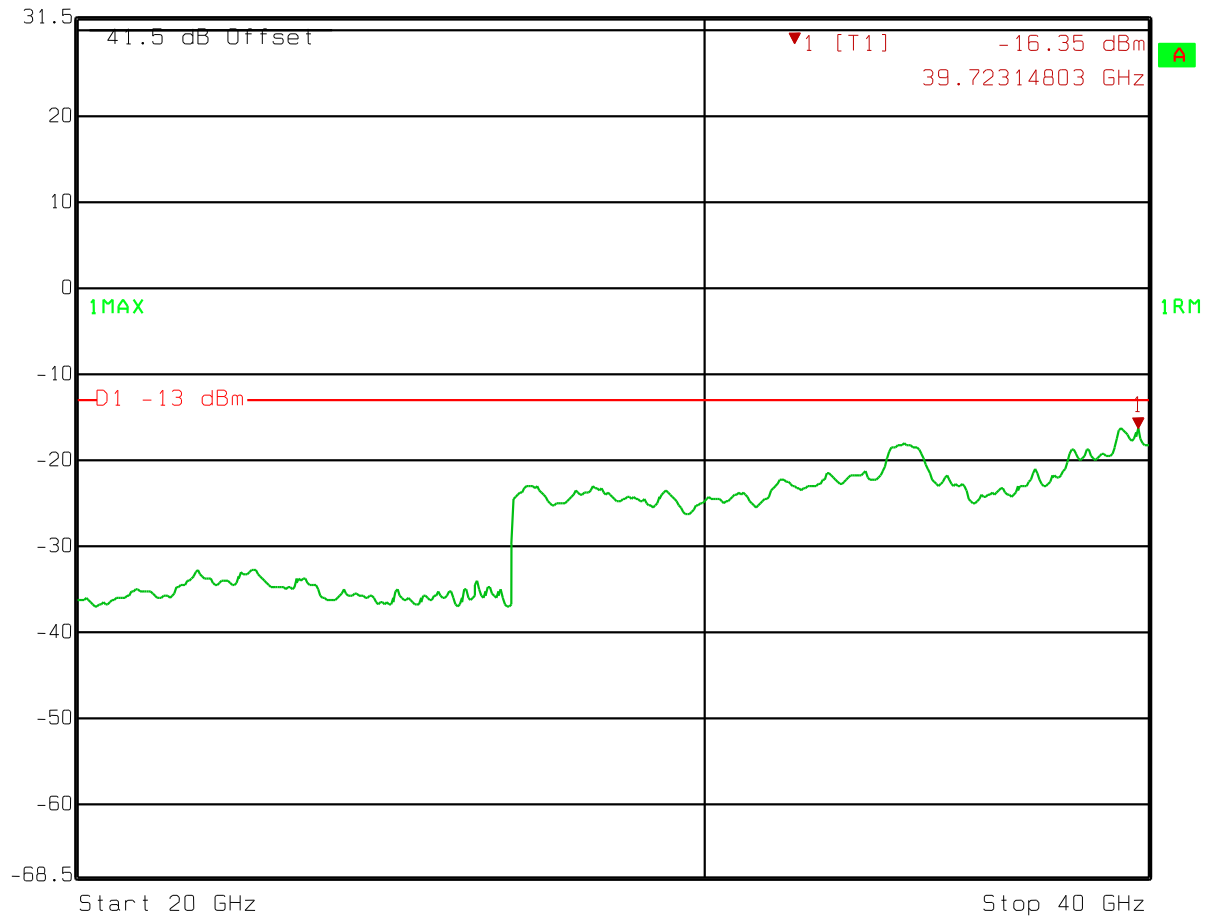


Date: 19.MAY 2014 07:59:49

Test Data

Conducted Spurious Emissions
8 MHz
64QAM

 Marker 1 [T1] RBW 1 MHz RF Att 10 dB
Ref Lvl -16.35 dBm VBW 1 MHz
31.5 dBm 39.72314803 GHz SWT 300 ms Unit dBm

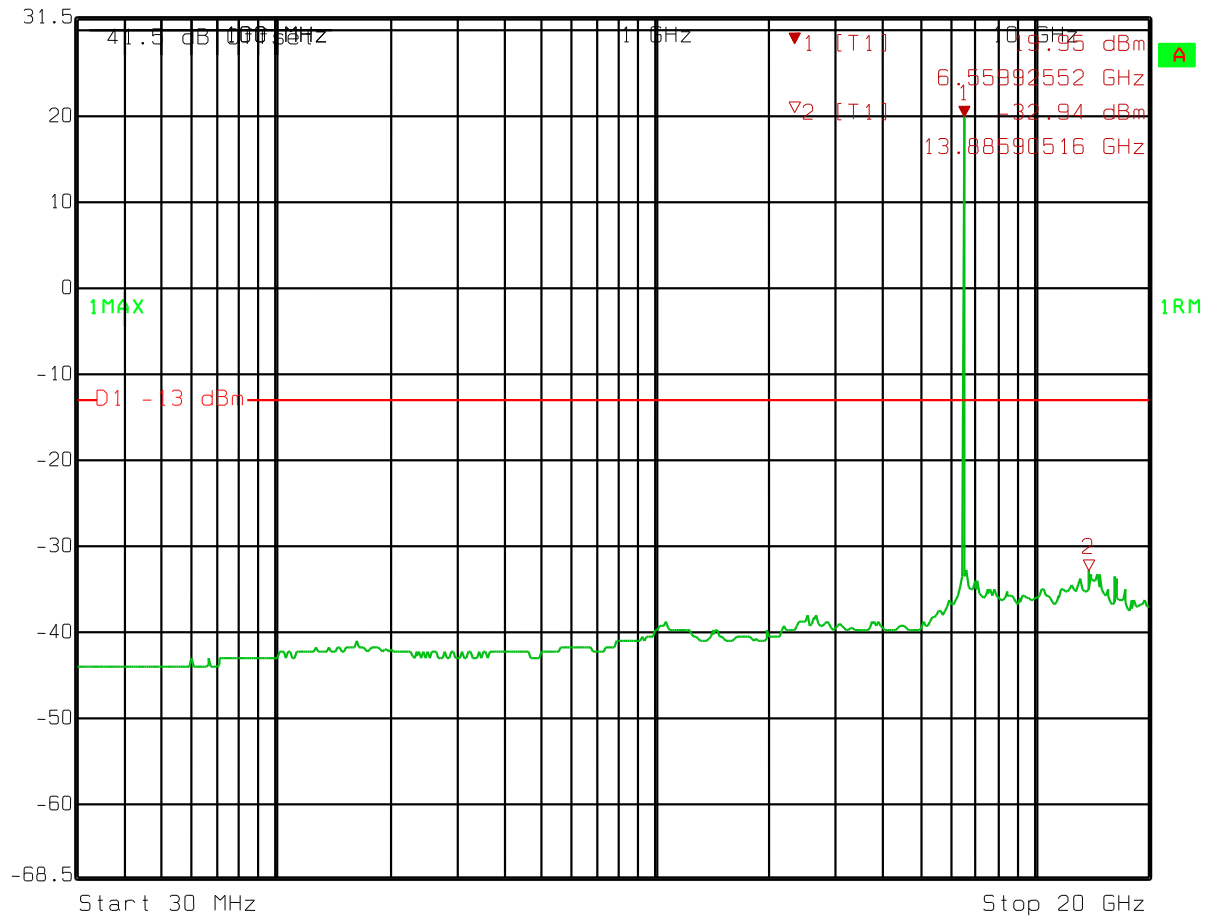


Date: 19.MAY 2014 08:00:47

Test Data

Conducted Spurious Emissions
 7 MHz
 QPSK


 Marker 1 [T1] RBW 1 MHz RF Att 10 dB
 Ref Lvl 19.95 dBm VBW 1 MHz
 31.5 dBm 6.55992552 GHz SWT 200 ms Unit dBm

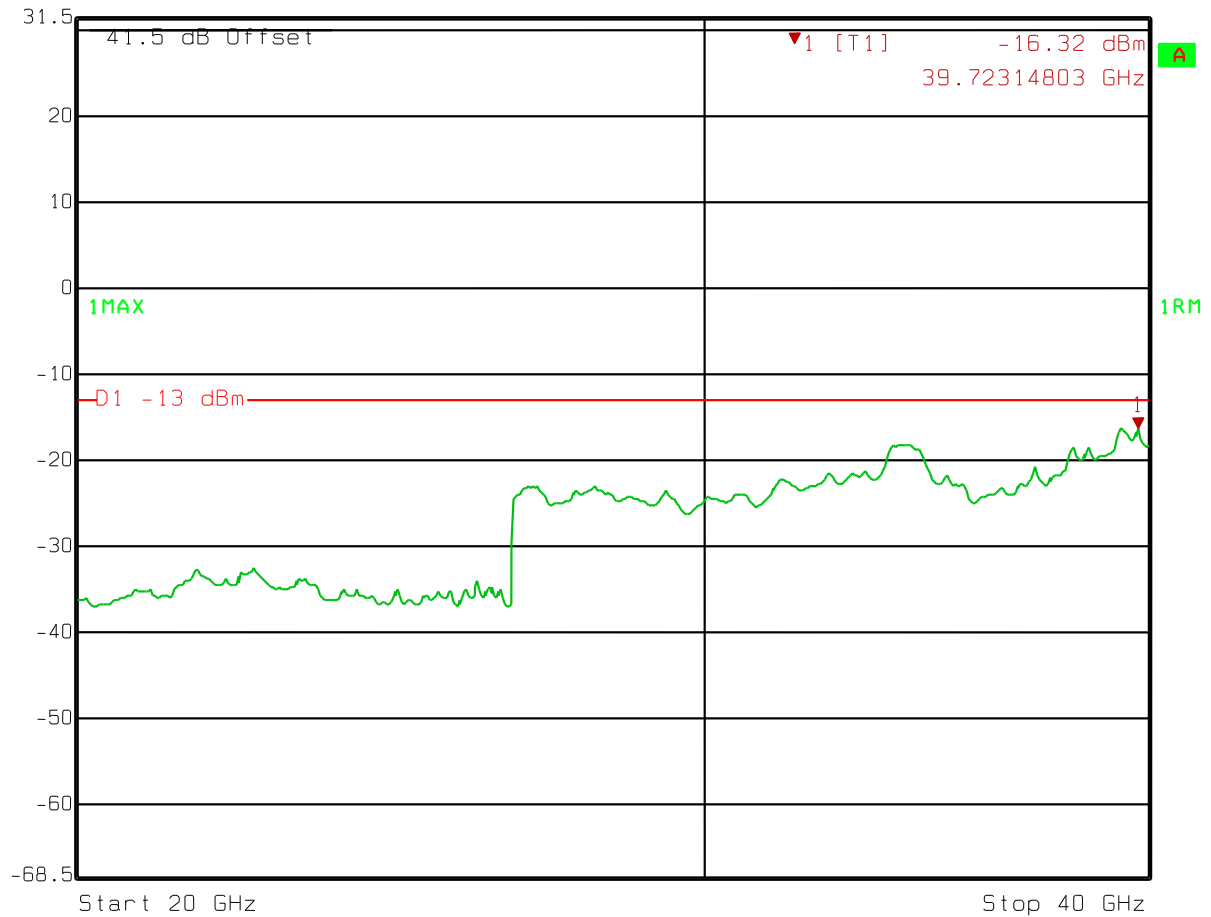


Date: 19.MAY 2014 08:02:19

Test Data

Conducted Spurious Emissions
 7 MHz
 QPSK

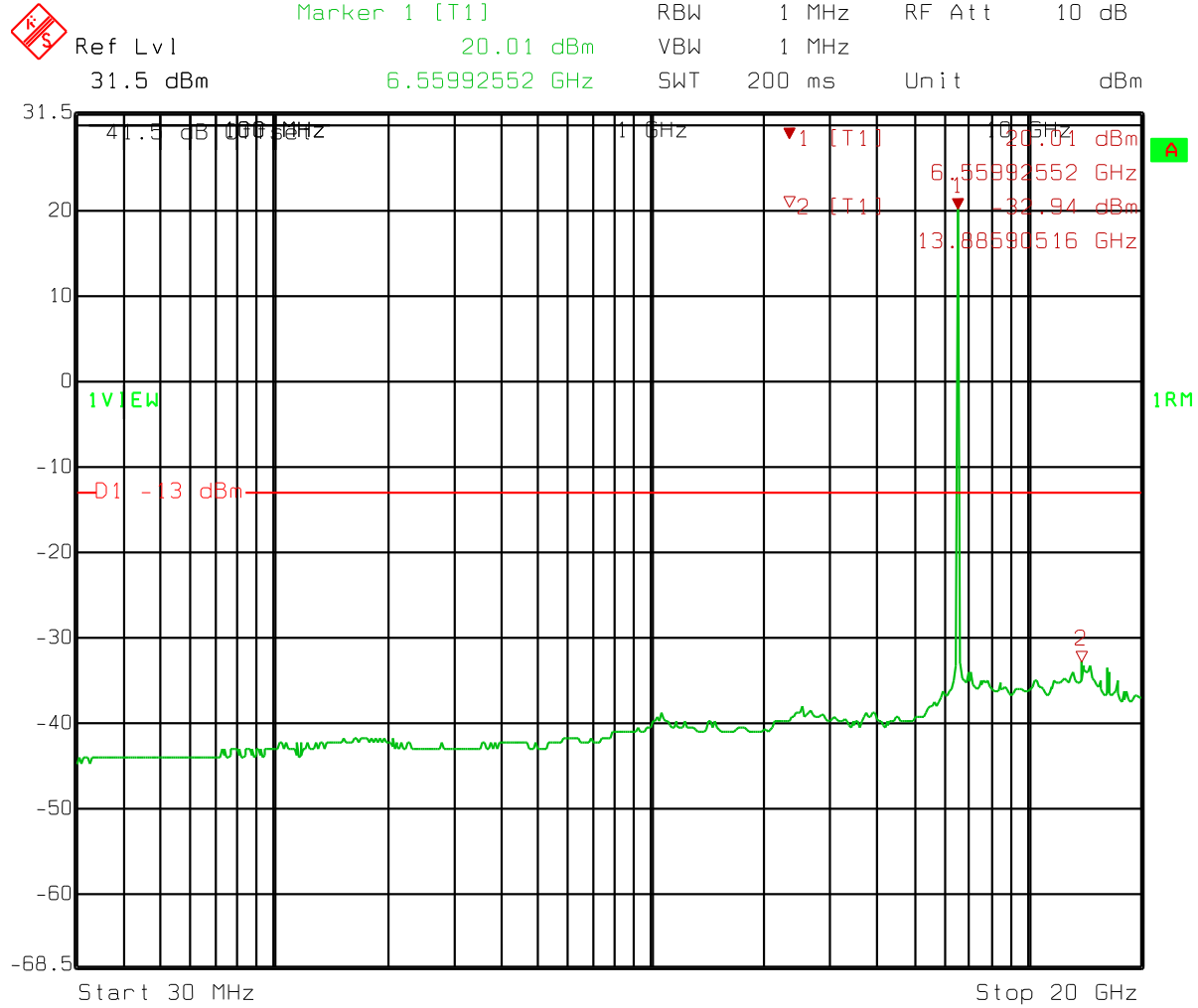
	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
Ref Lvl	-16.32 dBm	VBW	1 MHz		
31.5 dBm	39.72314803 GHz	SWT	300 ms	Unit	dBm



Date: 19.MAY 2014 08:01:37

Test Data

Conducted Spurious Emissions
7 MHz
16QAM

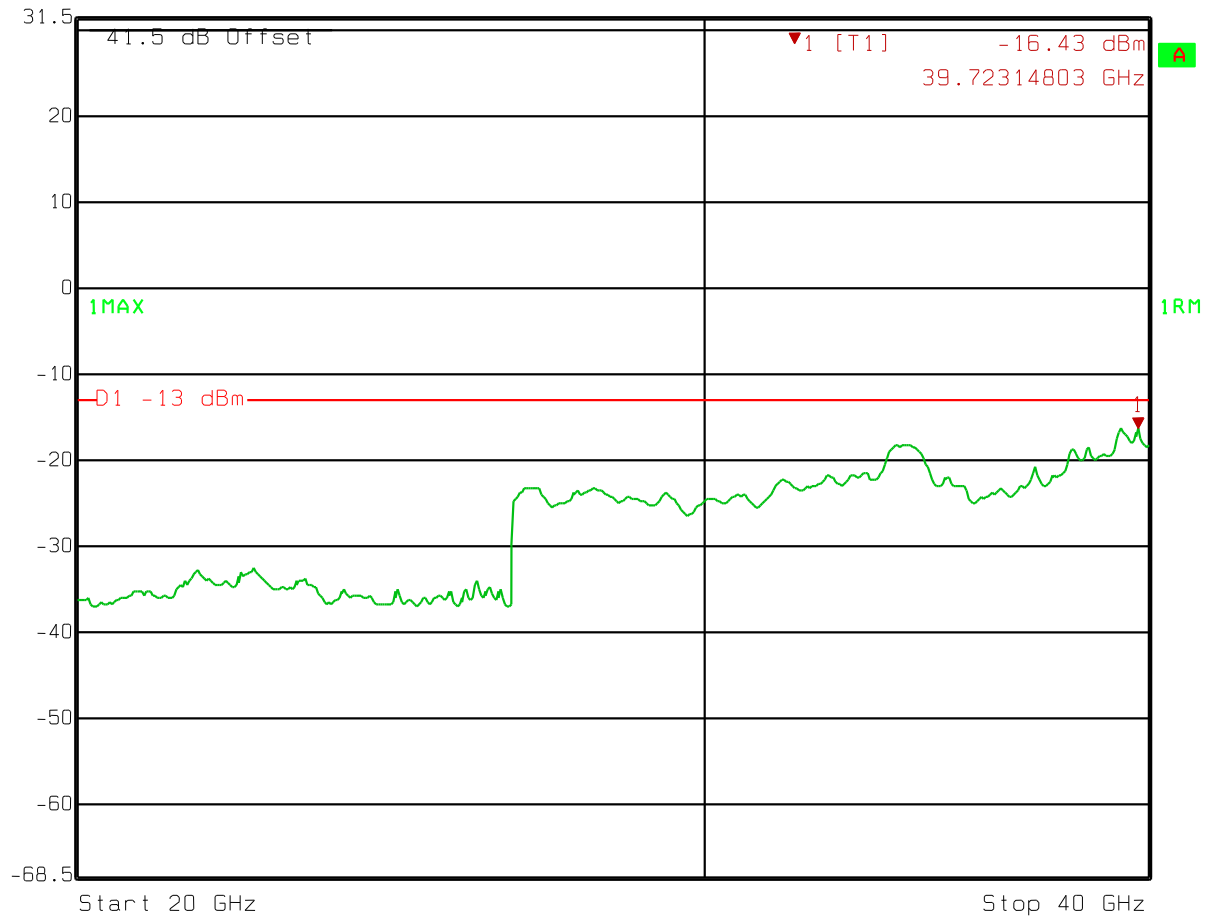


Date: 19.MAY 2014 08:06:20

Test Data

Conducted Spurious Emissions
7 MHz
16QAM

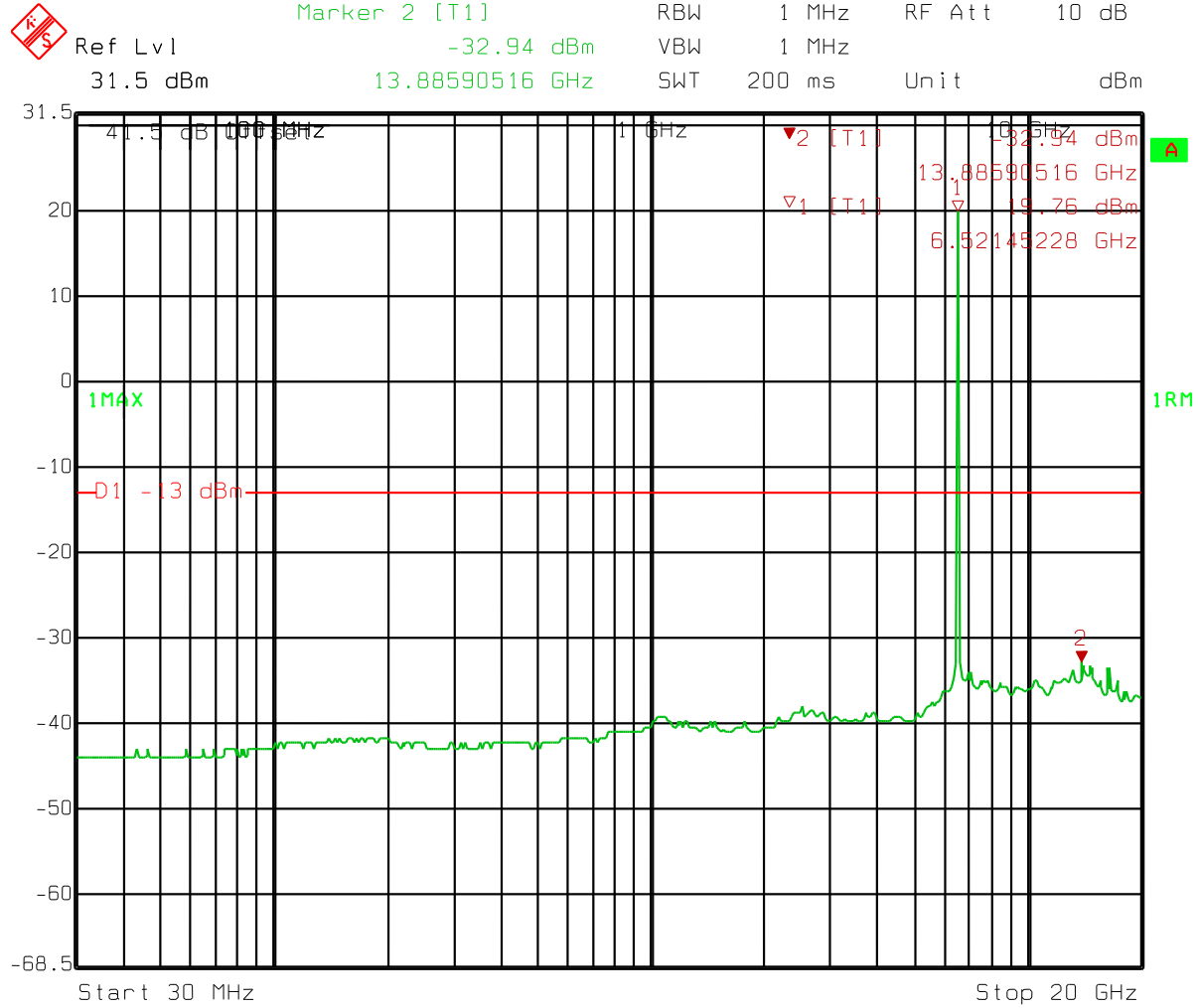
 Marker 1 [T1] RBW 1 MHz RF Att 10 dB
Ref Lvl -16.43 dBm VBW 1 MHz
31.5 dBm 39.72314803 GHz SWT 300 ms Unit dBm



Date: 19.MAY 2014 08:07:05

Test Data

Conducted Spurious Emissions
7 MHz
64QAM

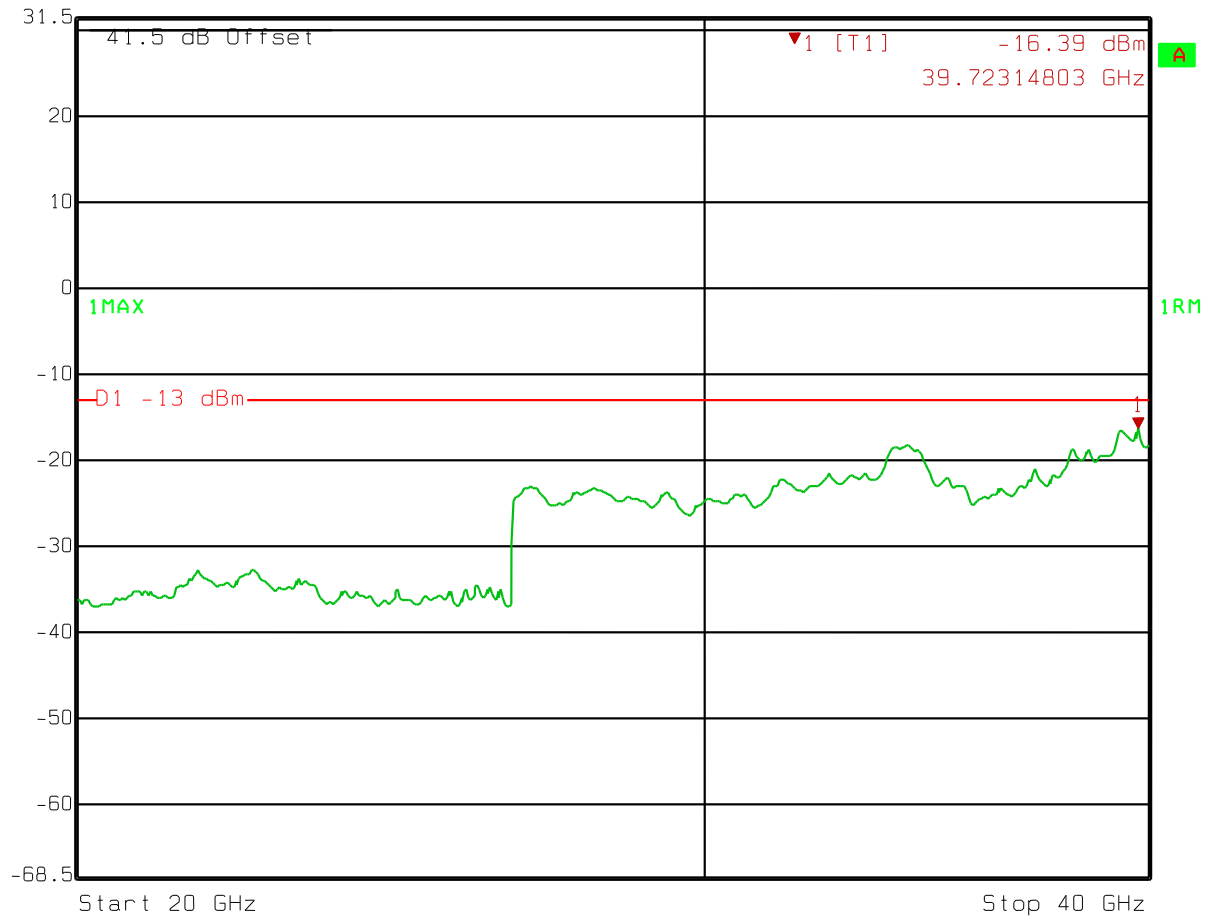


Date: 19.MAY 2014 08:08:53

Test Data

Conducted Spurious Emissions
 7 MHz
 64QAM

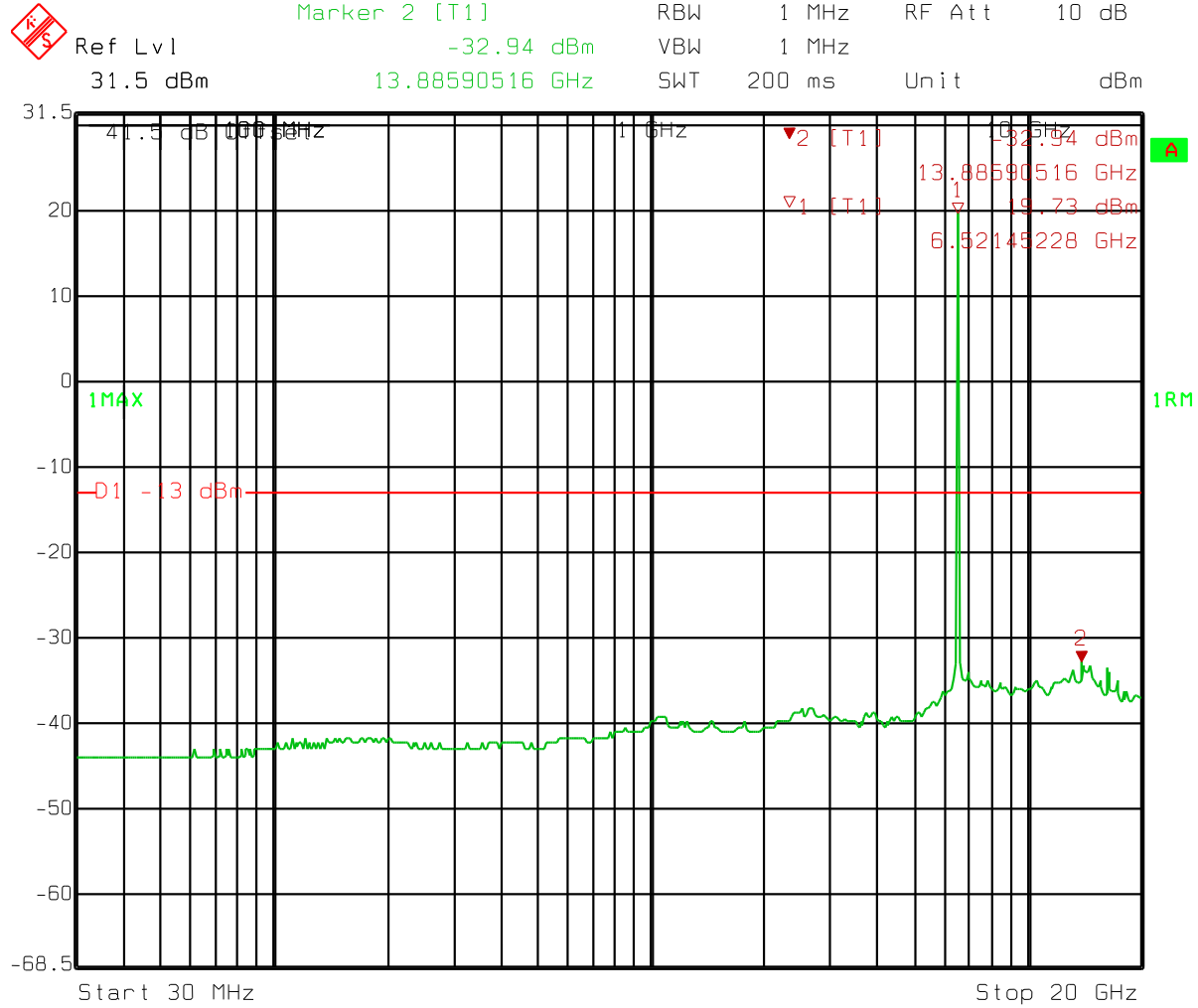
	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
Ref Lvl	-16.39 dBm	VBW	1 MHz		
31.5 dBm	39.72314803 GHz	SWT	300 ms	Unit	dBm



Date: 19.MAY 2014 08:08:18

Test Data

Conducted Spurious Emissions
6 MHz
QPSK

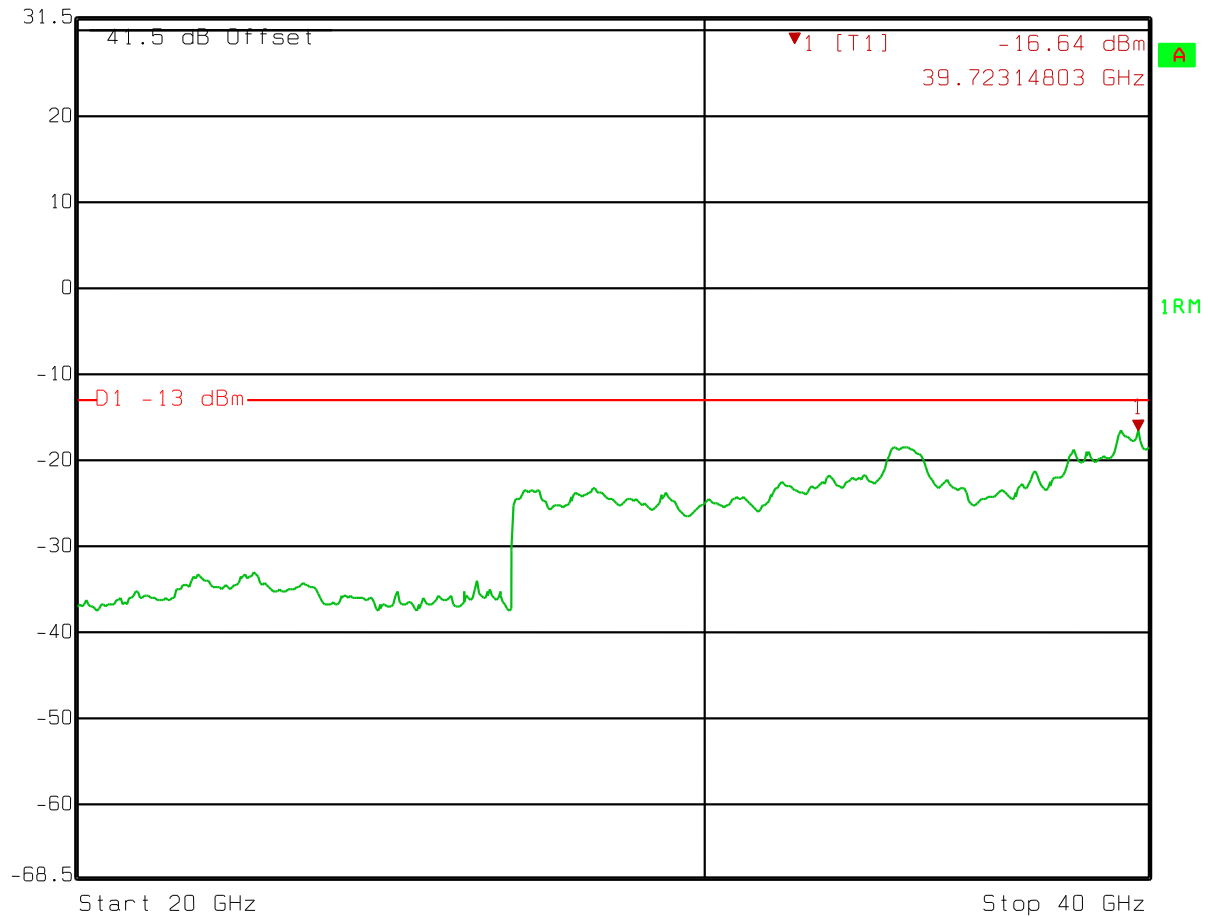


Date: 19.MAY 2014 08:10:13

Test Data

Conducted Spurious Emissions
6 MHz
QPSK

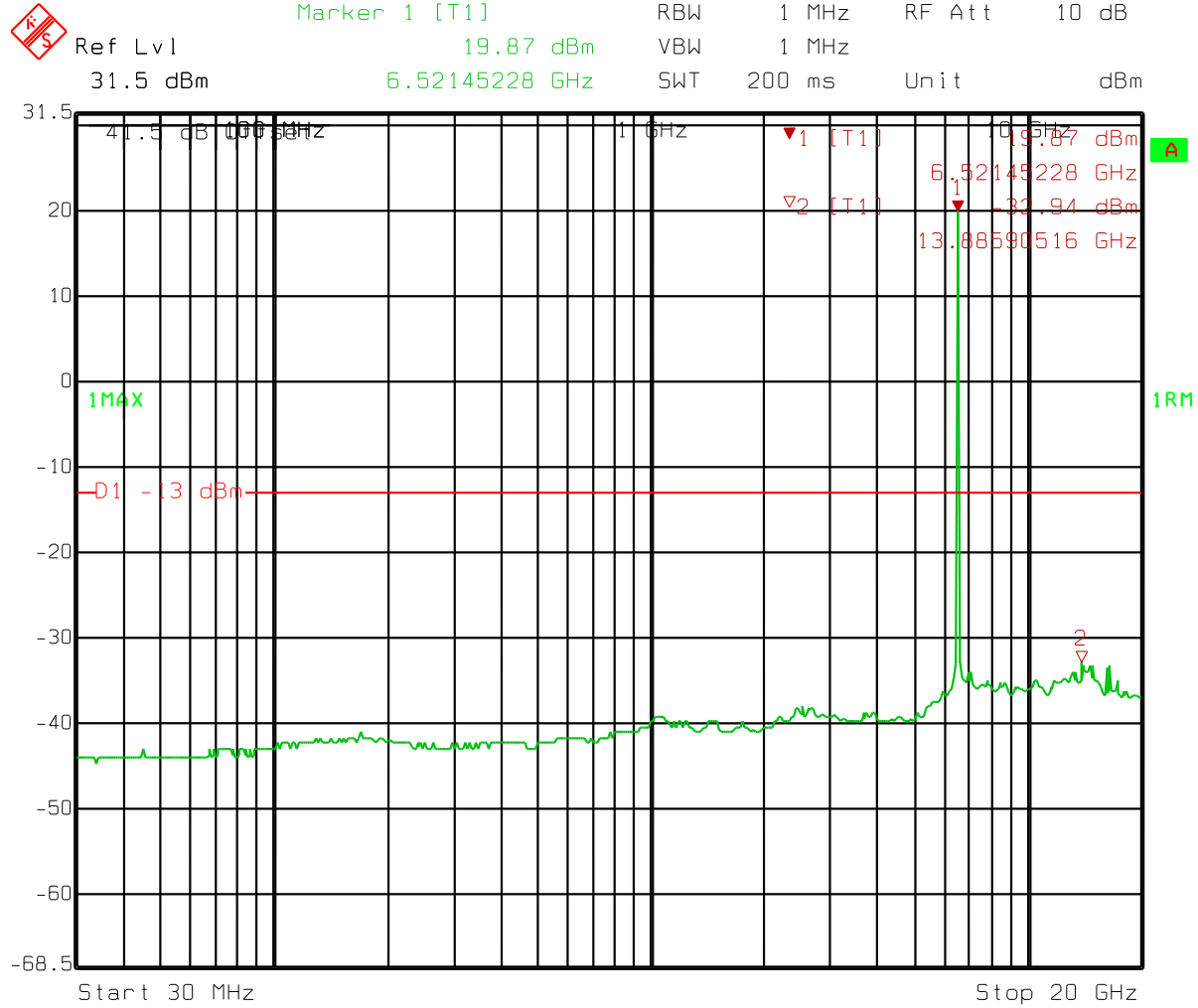
 Marker 1 [T1] RBW 1 MHz RF Att 10 dB
Ref Lvl -16.64 dBm VBW 1 MHz
31.5 dBm 39.72314803 GHz SWT 300 ms Unit dBm



Date: 19.MAY 2014 08:10:51

Test Data

Conducted Spurious Emissions
 6 MHz
 16QAM

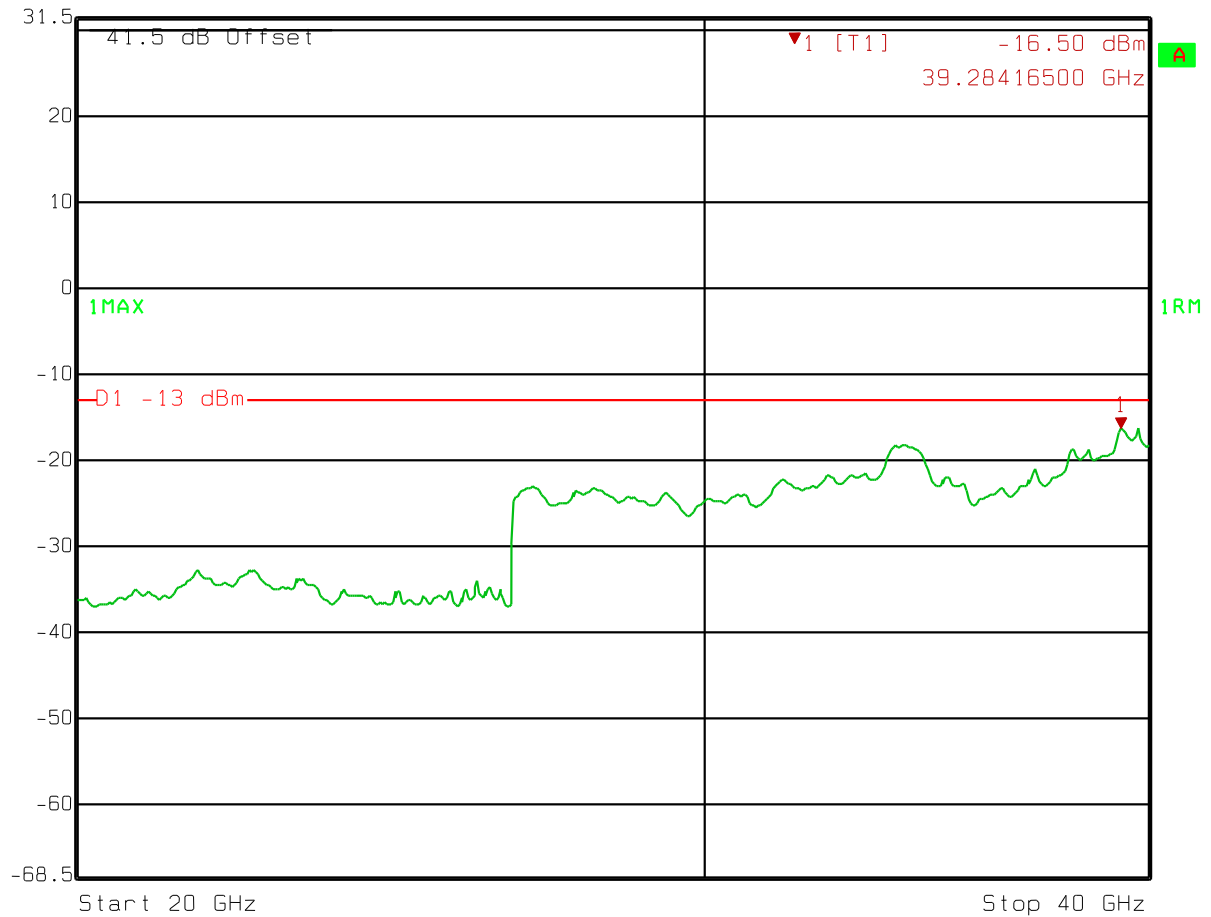


Date: 19.MAY 2014 08:12:05

Test Data

Conducted Spurious Emissions
 6 MHz
 16QAM

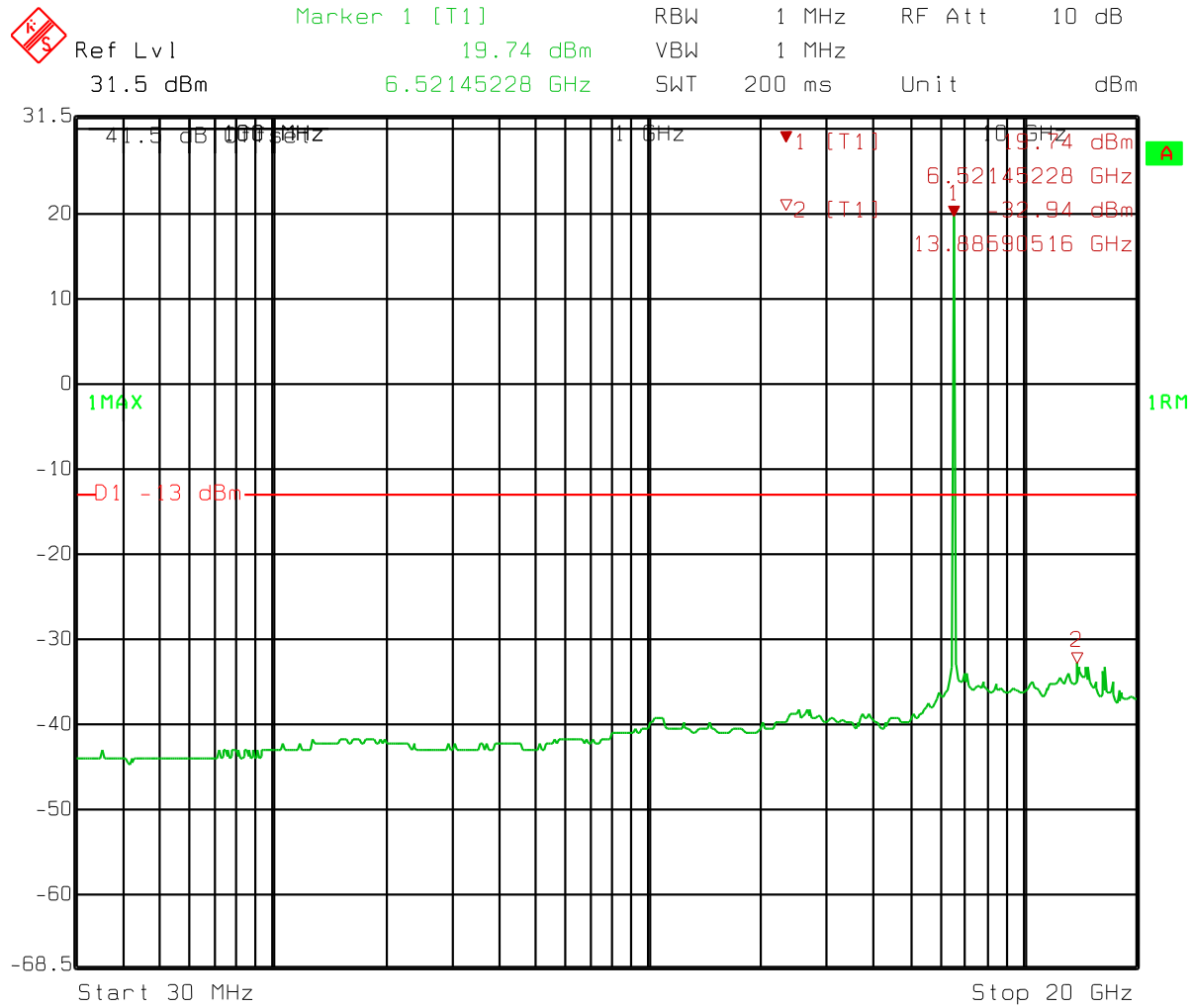
	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
Ref Lvl	-16.50 dBm	VBW	1 MHz		
31.5 dBm	39.28416500 GHz	SWT	300 ms	Unit	dBm



Date: 19.MAY 2014 08:11:30

Test Data

Conducted Spurious Emissions
 6 MHz
 64QAM

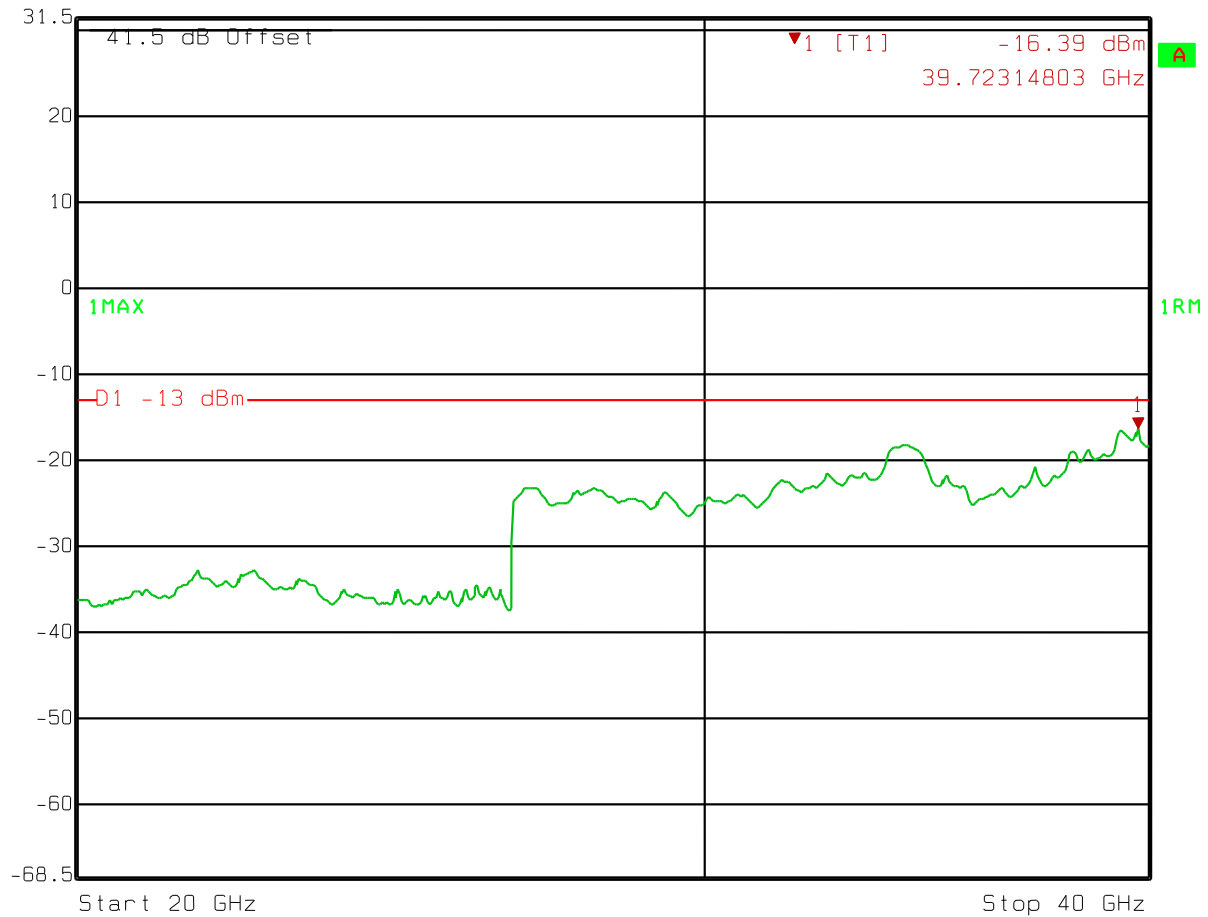


Date: 19.MAY 2014 08:13:05

Test Data

Conducted Spurious Emissions
 6 MHz
 64QAM


 Marker 1 [T1] RBW 1 MHz RF Att 10 dB
 Ref Lvl -16.39 dBm VBW 1 MHz
 31.5 dBm 39.72314803 GHz SWT 300 ms Unit dBm



Date: 19.MAY 2014 08:13:32

Section 6. Field Strength of Spurious

Para. No.: 2.1053

Test Performed By: David Light	Date of Test: 19 May 2014
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Minimum Standard: Part 74.637

Test Results: EUT Complies. Emissions were searched from 30 MHz to 40 GHz with the antenna port terminated into a 50 ohm load. No spurious emissions level within 20dB of the limit was observed. All emissions measured were proved by substitution method.

Test Data: Emissions were searched from 30 MHz to 40 GHz with the antenna port terminated into a 50 ohm load. No spurious emissions level within 20dB of the limit was observed. All emissions measured were proved by substitution method.

Test Equipment:

Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
Antenna, DRWG	EMCO	3115	2505	31-Oct-2012	31-Oct-2014
Preamplifier	Sonoma	310 N	130607	21-Nov-2013	21-Nov-2014
Antenna, Horn	EMCO	3160-10	9704-1049	Verify before use	NA
Antenna, Horn	EMCO	3160-09	9705-1079	Verify before use	NA
Preamplifier	Hewlett Packard	8449A	2749A00159	20-Aug-2013	20-Aug-2014
Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	15-Jul-2013	15-Jul-2015
Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	02-Apr-2014	02-Apr-2015

Section 7. Frequency Stability

Para. No.: 2.1055

Test Performed By: David Light	Date of Test: 19 May 2014
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Minimum Standard: 2.1055 Frequency Stability vs Temperature Variation and Power Supply Voltage Variation.

Minimum Standard: Part 74.661

Test Results: Complies

Measurement Data:

		Standard Test Frequency			6475.000000		MHz
	Frequency (MHz)	Test Voltage	Frequency Error (%)	Limit (%)	Frequency Error (Hz)	Limit (+/-Hz)	Comment
20	6475.001061	28.0	0.000002	0.005	1061	323750.0	
20	6475.000551	24.0	0.000000	0.005	551	323750.0	
20	6475.001880	32.0	0.000000	0.005	1188	323750.0	
50	6475.000978	28.0	0.000000	0.005	978	323750.0	
40	6475.002811	28.0	0.000000	0.005	2811	323750.0	
30	6475.001422	28.0	0.000000	0.005	1422	323750.0	
10	6475.006633	28.0	-0.000001	0.005	-6633	323750.0	
0	6475.009130	28.0	-0.000001	0.005	-9130	323750.0	
-10	6475.010022	28.0	-0.000002	0.005	-10022	323750.0	
-20	6475.017255	28.0	-0.000003	0.005	-17255	323750.0	
-30	6475.018001	28.0	-0.000003	0.005	-18001	323750.0	
Notes:							

Test Equipment:

Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
TV Test Receiver	R&S	EFA	831589/006	11 -Nov-2013	11-Nov-2014
Vector Signal Generator	Agilent	MXG	MY47420363	07-May-2014	07-May-2015

Section 8. Modulation Characteristics

Para. No.: 2.1047

Test Performed By: Declaration by Manufacturer

Minimum Standard: Part 2.1047

Test Results: Complies

Measurement Data:

Modulation Characteristics:

The HC4 uses the DVB-T standard (EN 300 744) for the broadcast transmission of digital terrestrial video. The DVB-T standard utilizes coded orthogonal frequency-division multiplexing modulation, from here on abbreviated as COFDM, consisting of 1705 individual subcarriers (aka "2K" mode) capable of QPSK, 16QAM, or 64QAM modulation schemes. Each of the modulation schemes, also known as constellation types, share the same maximum symbol amplitude. The subcarrier spacing and symbol rate are dependent on the modulation bandwidth setting; configurable between 6, 7, and 8MHz OBW. The chart below provides the subcarrier spacing and unpadded symbol duration per subcarrier for the available modulation bandwidth settings. Increases in the order of the modulation scheme from QPSK to 16QAM to 64QAM provide an increase in the number of data bits-per-symbol (2, 4, and 6 bits-per-symbol respectively), providing an increased end-to-end data rate (up to 31Mbps) at the expense of signal robustness. The modulation bandwidth and modulation scheme are user selectable settings.

2K-mode DVB-T Characteristics (All constellation types)				
Mod BW Setting (MHz)	Sub-carrier Quantity	Sub-carrier Spacing (kHz)	Symbol Duration (uS)	Anticipated OBW (MHz)
8	1705	4.464	224.01	7.606
7	1705	3.906	256.02	6.655
6	1705	3.348	298.69	5.704

The DVB-T standard is published as EN 300 744, *Framing structure, channel coding and modulation for digital terrestrial television* and is available from the European Telecommunications Standards Institute (ETSI) website at <http://www.etsi.org>