



RADIO TEST REPORT

47 CFR FCC PART 15.247
RSS-GEN ISSUE 4
RSS-247 ISSUE 1

Report Number:	CFR- CSMQMTDCDRP3EX-10212015
Test Dates:	8/ 13, 14, 17, 18 / 2015

EWO:	2064
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Model:	CSM-QMTDC-DRP-3-EX
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FCC ID:	EROQMTDCDRP3
IC:	5683C-QMTDCDRP3

FRN:	0005022819
ADDRESS:	15 Volvo Dr, Rockleigh, NJ 07647

Report Date: 10/21/2015

Test Result:	Pass
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Prepared by:

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Date: 10/21/2015

Reviewed by:

Mairaj Hussain, Global Compliance Manager

Date: 11/10/2015

FDD ID: EROQMTDCDRP3
IC: 5683C-QMTDCDRP3
FCC Registration #412871

Industry Canada Site #5683C-1 VCCI#3551

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Revision History

Revision	Description	Date
00	Initial release	10/21/2015
01	Up dated to RSS-247	11/10/15



1. Reference Standards

Measurements were performed according to the following procedures and standards:

- 1) ANSI C63.4: 2014
- 2) FCC Publication, "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247", June 5, 2014
- 3) Industry Canada RSS-Gen Issue 4
- 4) Industry Canada RSS-247 Issue 1
- 5) Industry Canada ICES-003 Issue 5

All measurements were performed in a 3-meter semi-anechoic chamber and the control room.

1.1 Test Facility

The 3-meter semi-anechoic chamber used to collect conducted and radiated emission data is located at 22 Link Drive, Rockleigh, New Jersey. This test facility has been placed on file with the FCC, Registration Number: 412871, and Industry Canada, Site Number: 5683C-1.

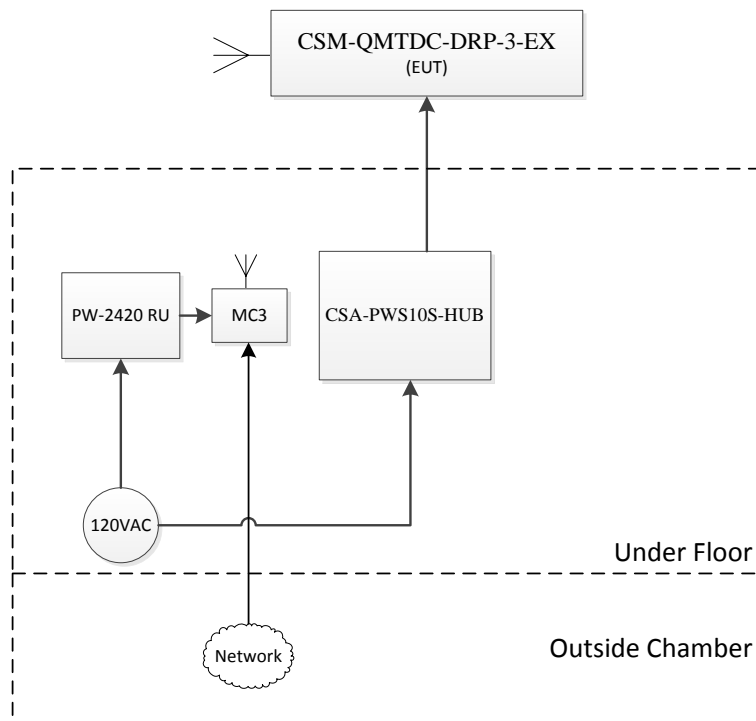
2. System Test Configuration

2.1 Product Description

The equipment under test (EUT) is a Digital QMT® Drap Motor for QMTDC Series, infiNET EX®, model: CSM-QMTDC-DRP-3-EX, manufactured by Crestron Electronics, Inc.

Model Number: CSM-QMTDC-DRP-3-EX

2.2 Block Diagram





2.3 EUT Setup Justification

The system was configured for testing in a representative user configuration with nominal interface data activity and typical loading.

2.4 EUT Exercise Software and Mode(s) of Operation

The EUT was configured to transmit continuously.

Channel 11 (2405 MHz)

Channel 18 (2440 MHz)

Channel 26 (2480 MHz)

2.5 Cables

Qty	Description	Length (m)	From - To	Shielded/Unshielded
1	Ethernet Cable	4	MC3 – Network	Unshielded
1	Cresnet	2	EUT – CSA-PWS10S-HUB	Shielded
1	MXHQ87PA3000	0.3	EUT – Rohde & Schwartz Spectrum Analyzer	Shielded

2.6 Special Accessories

There are no special accessories for compliance of this EUT.



2.7 Support equipment

No	Description	Manufacturer	Model No	Serial No
1	Control System	Crestron	MC3	11499887
2	ITE Power Supply	Crestron	PW-2420 RU	ROHS340986148/11
3	10 Channel Shade Power Supply Cresnet Hub	Crestron	CSA-PWS10S-HUB	X123059

2.8 Equipment Modification

There were no modifications installed during compliance measurements.

2.9 Test Equipment

Equipment Type	Frequency Range	Manufacturer	Model No.	Serial No.	Cal. Done by	Cal. Date	Cal. Due Date
R&S EMI Receiver	20 Hz – 40 GHz	ROHDE & SCHWARZ	ESU40	100076	R & S	10/23/2014	10/23/2016
Teseq Bilog Antenna	30 MHz – 2 GHz	Teseq	CBL 6112D	25231	Liberty Lab Inc.	12/16/2014	12/16/2016
ETS-Lindgren Double Ridge Horn Antenna	1 GHz – 18 GHz	ETS	3117	00047560	Liberty Lab Inc.	12/1/2014	12/1/2016
R&S Preamplifier	1GHz – 18 GHz	ROHDE & SCHWARZ	TS-PR18	100044	Liberty Lab Inc.	12/18/2013	12/18/2015
ETS-Lindgren Standard Gain Horn Antenna	18 GHz – 26.5 GHz	ETS	3160-09	00078911	Liberty Lab Inc.	12/3/2014	12/3/2016
R&S Preamplifier	18 GHz – 26.5 GHz	ROHDE & SCHWARZ	TS-PR26	100030	Liberty Lab Inc.	12/18/2013	12/18/2015

All instruments are calibrated in accordance with the manufacturer's recommendations.

All antennas are calibrated per ANSI C63.5.

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration system.



3. Test Results

3.1 Compliance Statement

Rule Section		Description	Date of Test (mm/dd/yy)	Test Engineer	Results
FCC	IC				
§15.203	§8.3 of RSS-Gen	Antenna Requirement	-	-	Complies
§15.247(a)(2)	§5.2(1) of RSS-247	6 dB Bandwidth, 500 kHz	8/13/15	Hirayr M. Kudyar	Complies
N/A	§6.6 of RSS-Gen	99% Occupied Bandwidth	8/13/15	Hirayr M. Kudyar	(for reporting purpose)
§15.247(b)(3)	§5.4(4) of RSS-247	Power Output, conducted, 1 Watt (30dBm)	8/13/15	Hirayr M. Kudyar	Complies
§15.247(d)	§A5.5 of RSS-247	Band Edge	8/13/15	Hirayr M. Kudyar	Complies
§15.247(d)	§5.5 of RSS-247	Conducted Spurious Emissions, -20 dBc	8/13/15	Hirayr M. Kudyar	Complies
§15.247(e)	§5.2(2) of RSS-247	Power Spectral Density (PSD), 8 dBm in any 3 kHz band.	8/13/15	Hirayr M. Kudyar	Complies
§15.205, §15.209, §15.247(d)	§5.5 of RSS-247; §8.9 of RSS-Gen	Radiated Spurious Emissions	8/17,18/15	Hirayr M. Kudyar	Complies
§15.207	§8.8 of RSS-Gen	Transmitter AC Power Line Conducted Emissions	8/13/15	Hirayr M. Kudyar	Complies

Note:

The channels selected for test were 11, 18, and 26.



3.2 Antenna Requirements

The product uses a SMD mounting antenna embedded into the PCB. The gain of the antenna is 2.1dBi. Please see antenna exhibit for more details.

Trace antenna is unique in the sense of complying with FCC §15.203, §15.204(b), and §15.204(c).



3.3 6 dB bandwidth

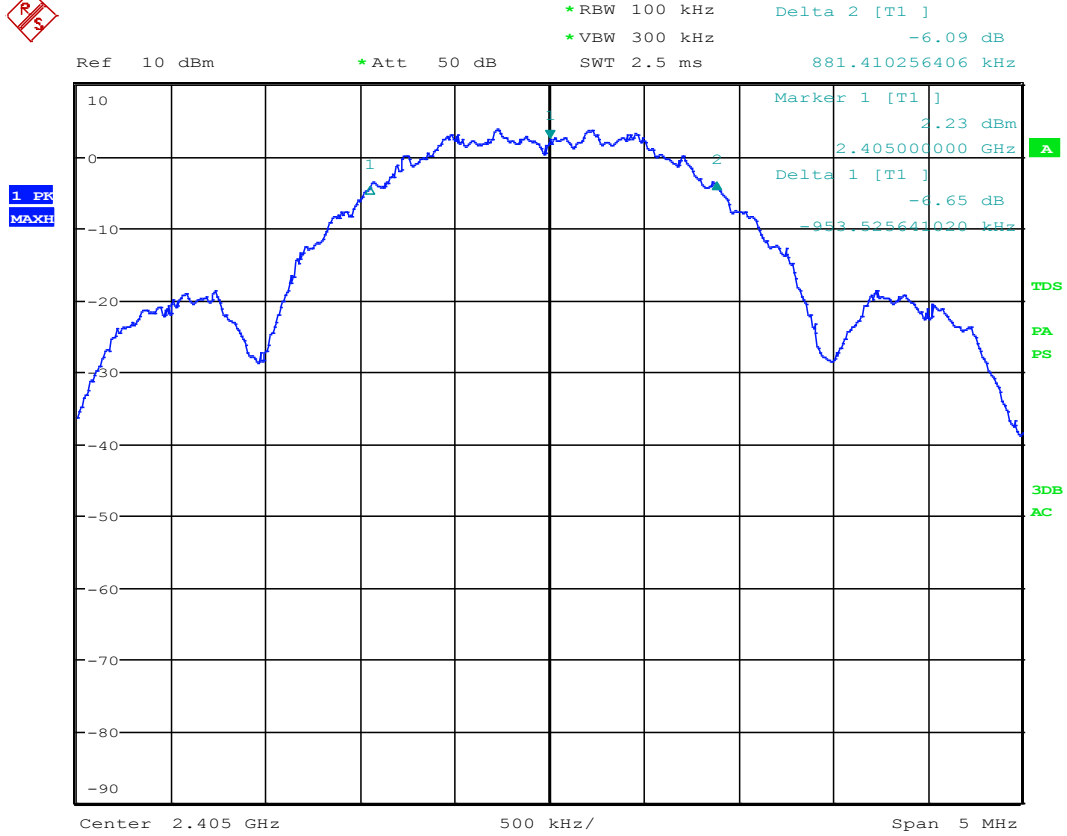
Criterion: The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 8.

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

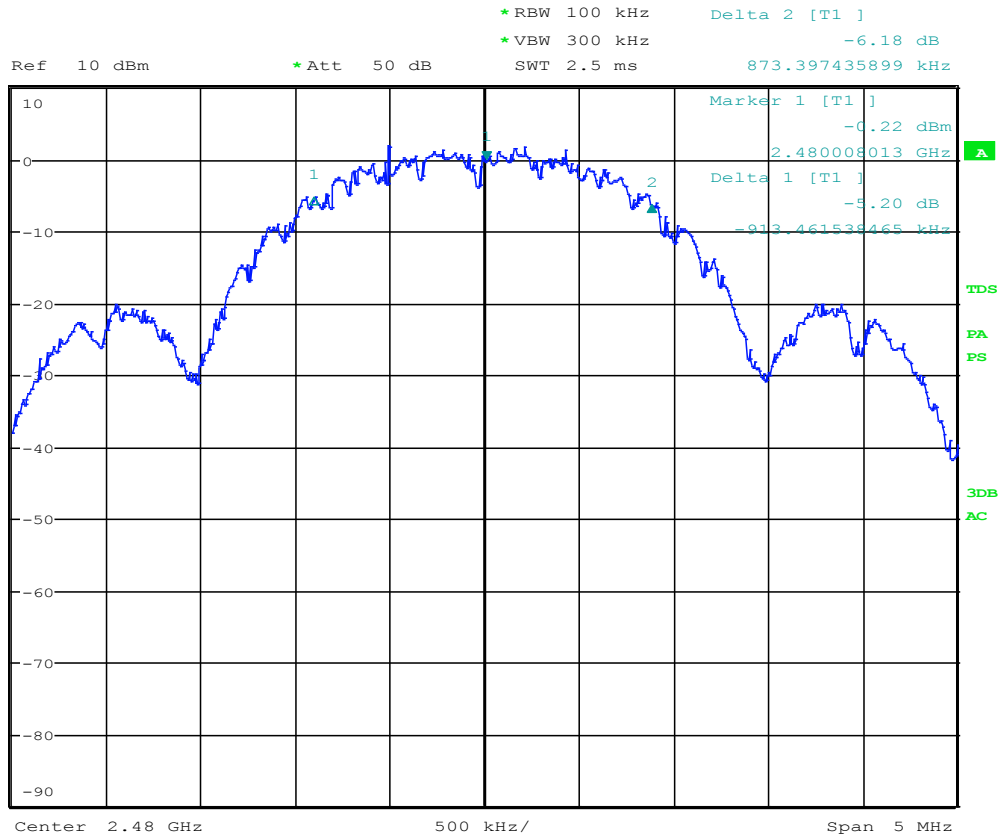
Channel	Frequency(MHz)	6 dB Bandwidth(kHz)
11	2405	1834.9
18	2440	1859.0
26	2480	1786.9

6 dB Bandwidth, Channel 11:



Date: 13.AUG.2015 11:19:23

6 dB Bandwidth, Channel 26:



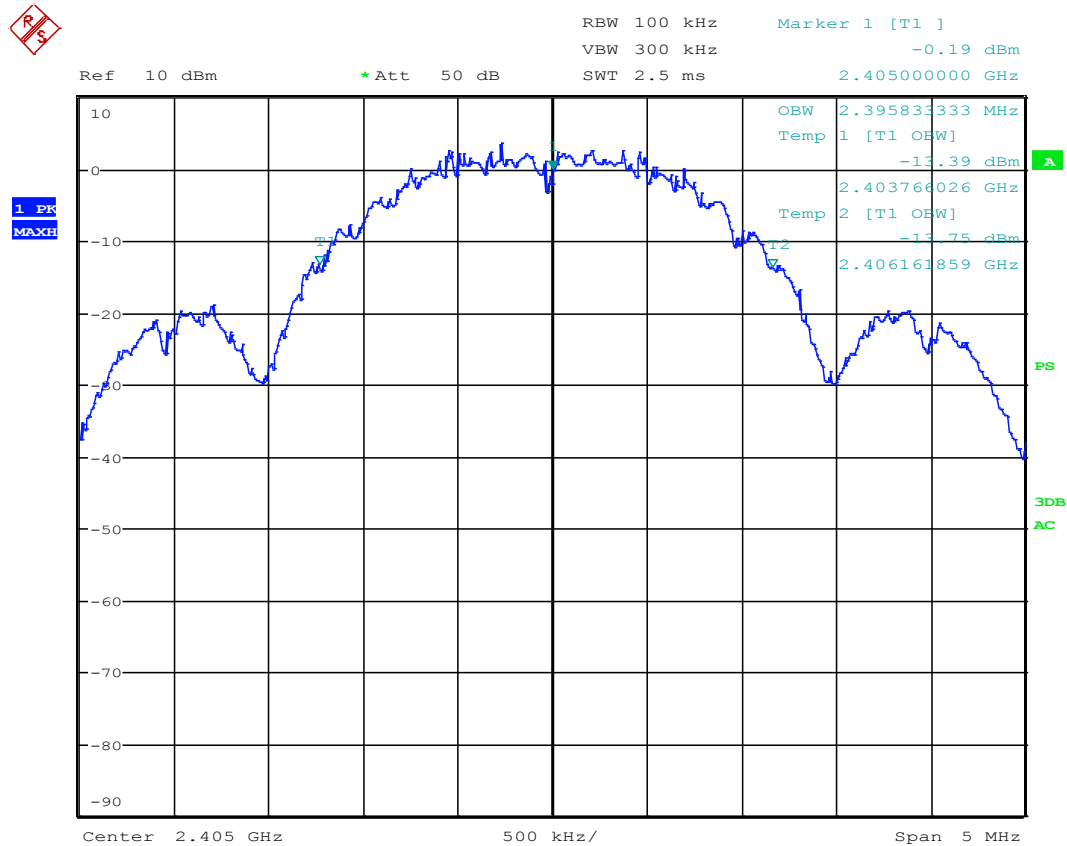
Date: 13.AUG.2015 11:38:00

3.2 99% Bandwidth

Performance Criterion: The minimum 26dB bandwidth from the Peak.

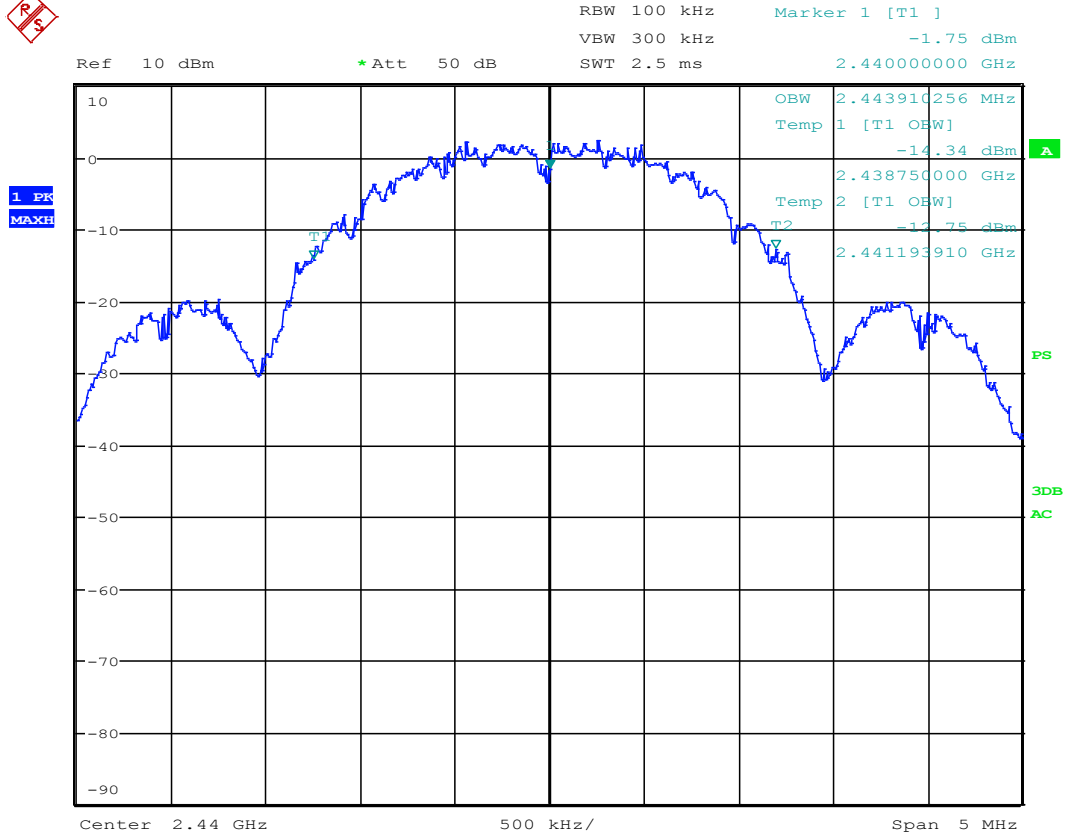
Channel	Frequency(MHz)	99% dB Bandwidth(MHz)
11	2405	2.3958
18	2440	2.4439
26	2480	2.4199

99% dB Bandwidth, Channel 11:



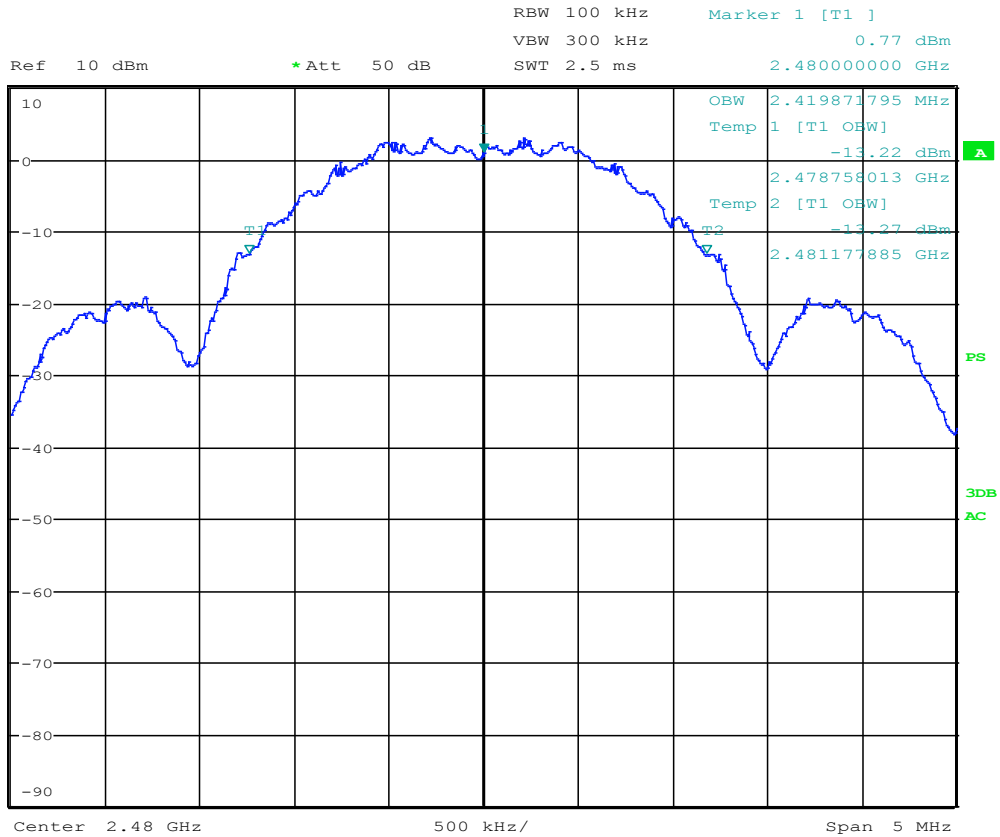
Date: 13.AUG.2015 12:17:18

99% dB Bandwidth, Channel 18:



Date: 13.AUG.2015 12:11:38

99% dB Bandwidth, Channel 26:



Date: 13.AUG.2015 12:06:54



3.3 Power Output

Criterion: The maximum peak conducted output power shall not exceed 1 Watt or 30 dBm

Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 9.1.1

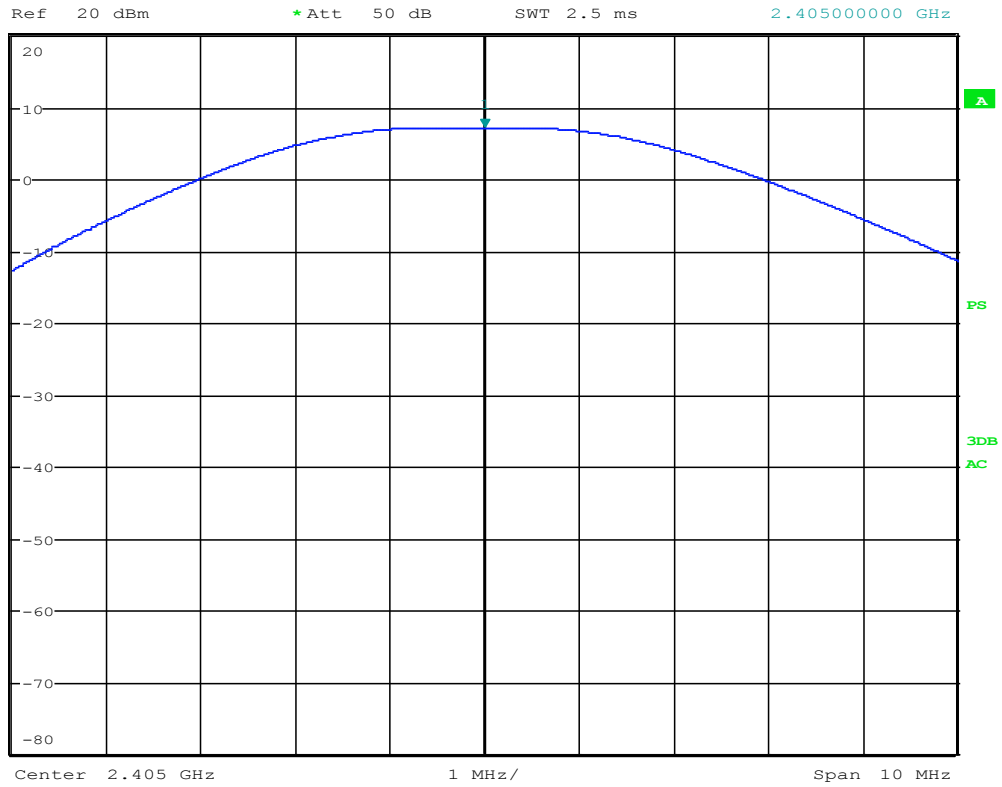
- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW \geq 3 \times RBW.
- c) Set span \geq 3 \times RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

Channel	Frequency(MHz)	Output Power Setting (dBm)	Measured Power	
			dBm	mW
11	2405	8	7.10	5.13
18	2440	8	6.76	4.74
26	2480	8	6.51	4.48

Power Output, Channel 11:



*RBW 3 MHz Marker 1 [T1]
 *VBW 10 MHz 7.10 dBm
 SWT 2.5 ms 2.40500000 GHz



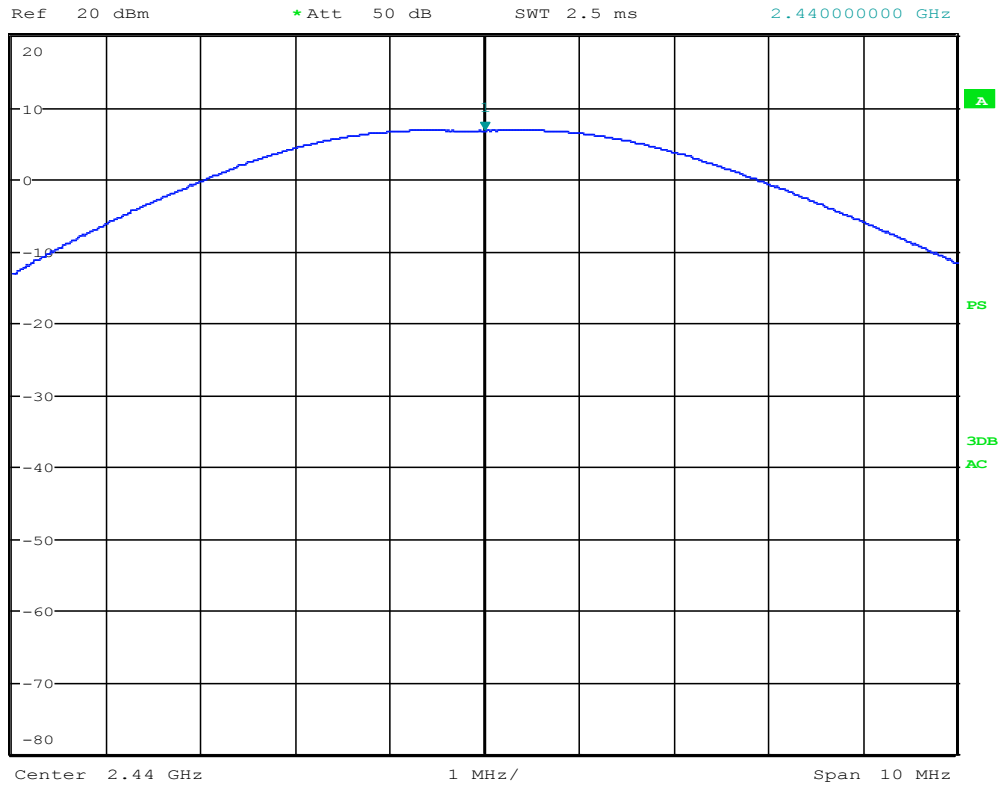
Date: 13.AUG.2015 12:43:38



Power Output, Channel 18:



*RBW 3 MHz Marker 1 [T1]
*VBW 10 MHz 6.76 dBm
SWT 2.5 ms 2.44000000 GHz



Date: 13.AUG.2015 12:48:14



3.4 Band Edge Conducted

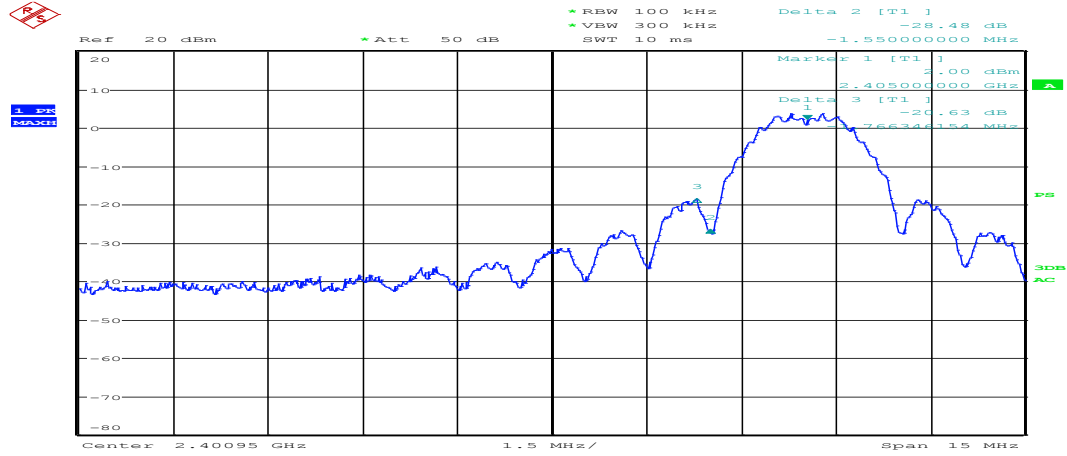
Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 11

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

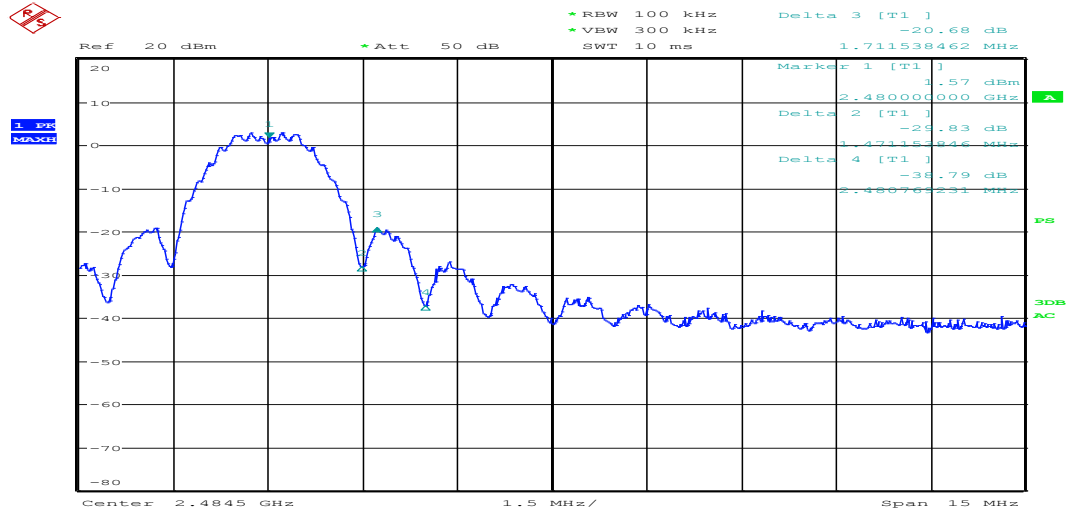
- a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (*i.e.*, 20 dBc).
- b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (*i.e.*, 30 dBc).
- c) In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

Band Edge, Channel 11:



Date: 13.AUG.2015 15:37:46

Band Edge, Channel 26:



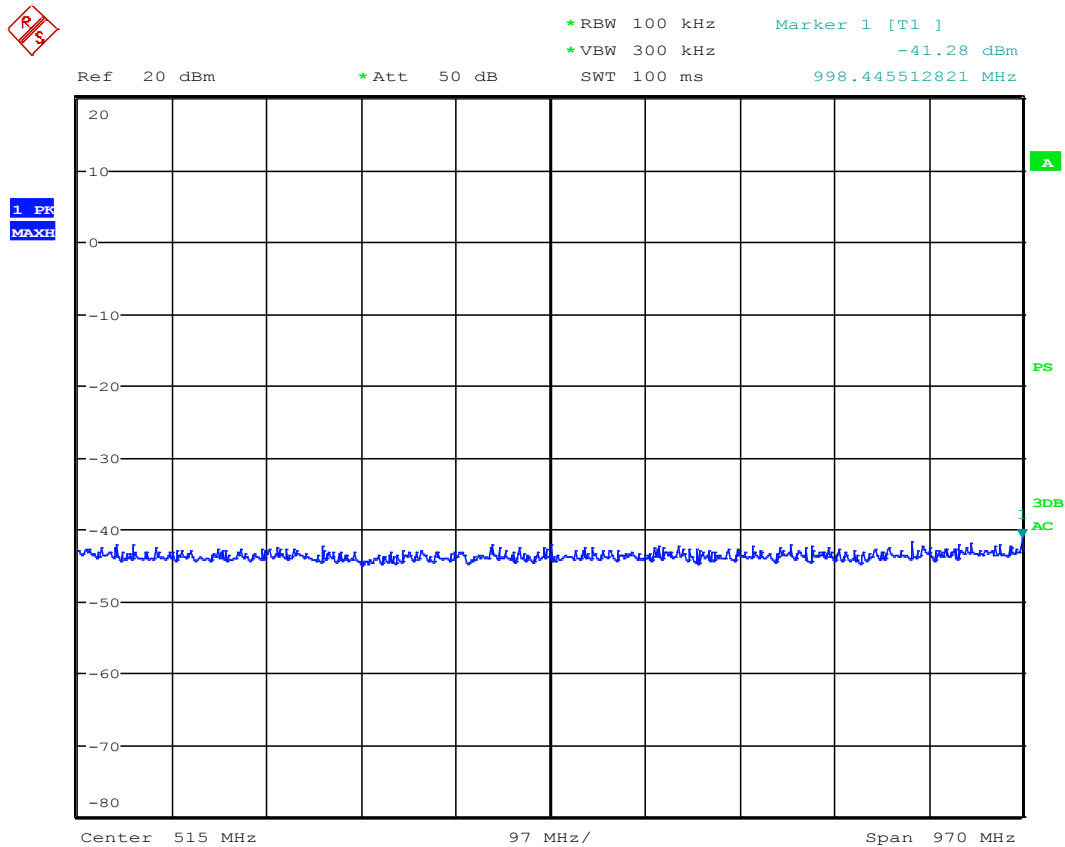
Date: 13.AUG.2015 15:45:38

3.5 Conducted Spurious Emissions

Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

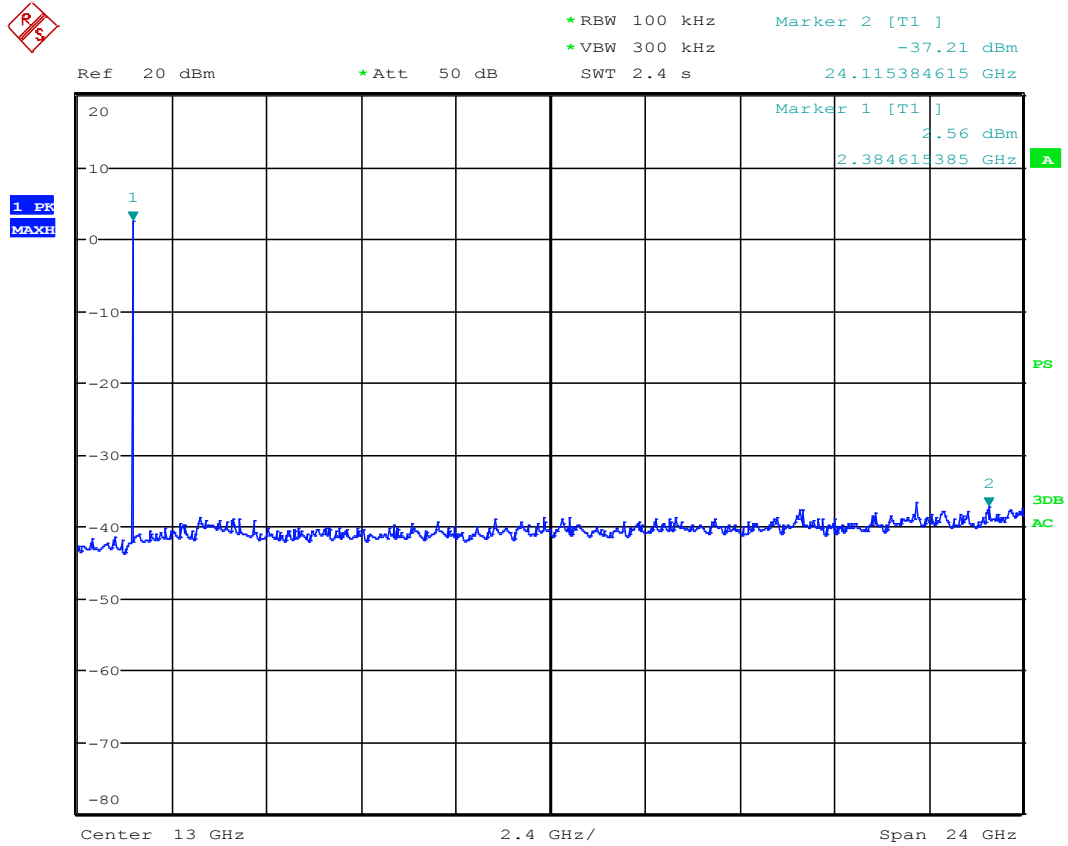
Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 11

Conducted Spurious Emission, 30MHz to 1GHz, Channel 11:



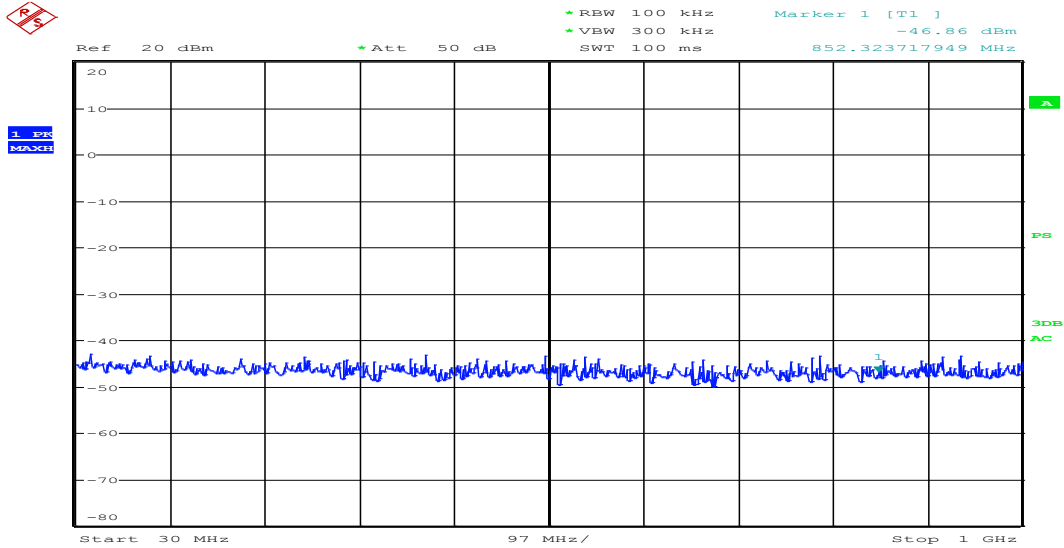
Date: 13.AUG.2015 15:59:16

Conducted Spurious Emission, 1GHz to 25GHz, Channel 11:



Date: 13.AUG.2015 16:25:48

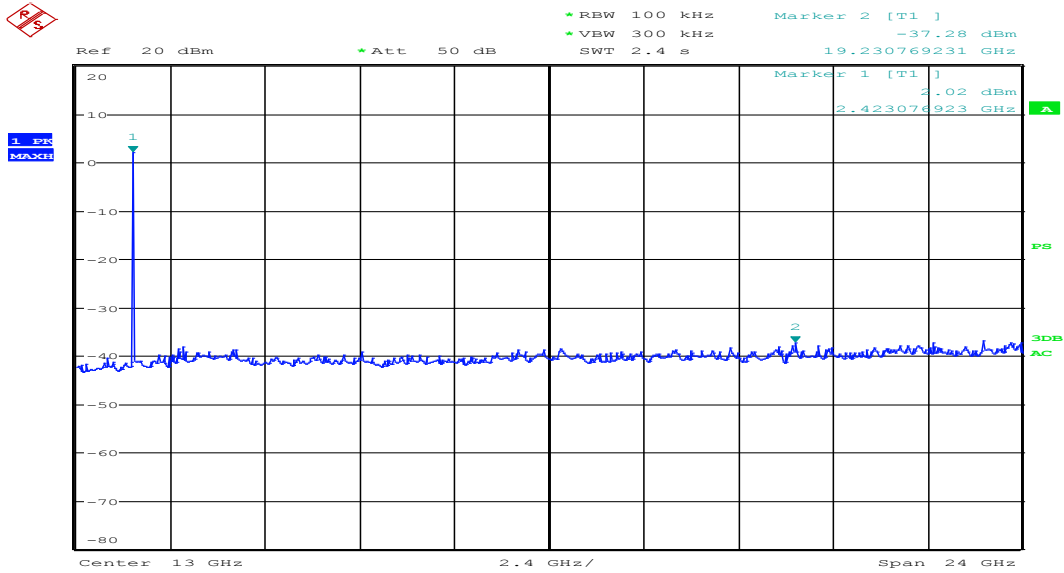
Conducted Spurious Emission, 30MHz to 1GHz, Channel 18:



Date: 13.AUG.2015 15:55:08

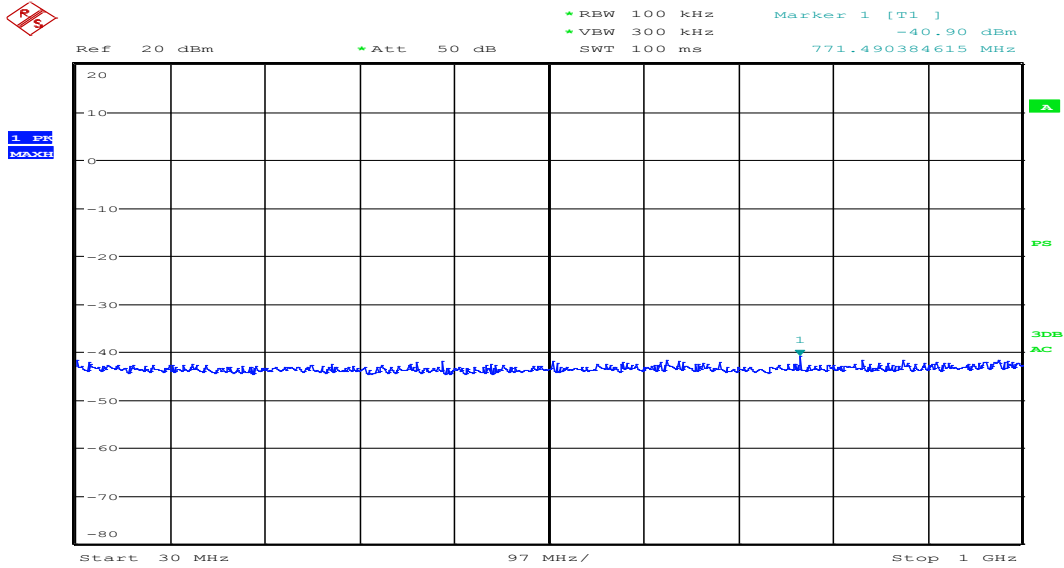


Conducted Spurious Emission, 1GHz to 25GHz, Channel 18:



Date: 13.AUG.2015 16:27:59

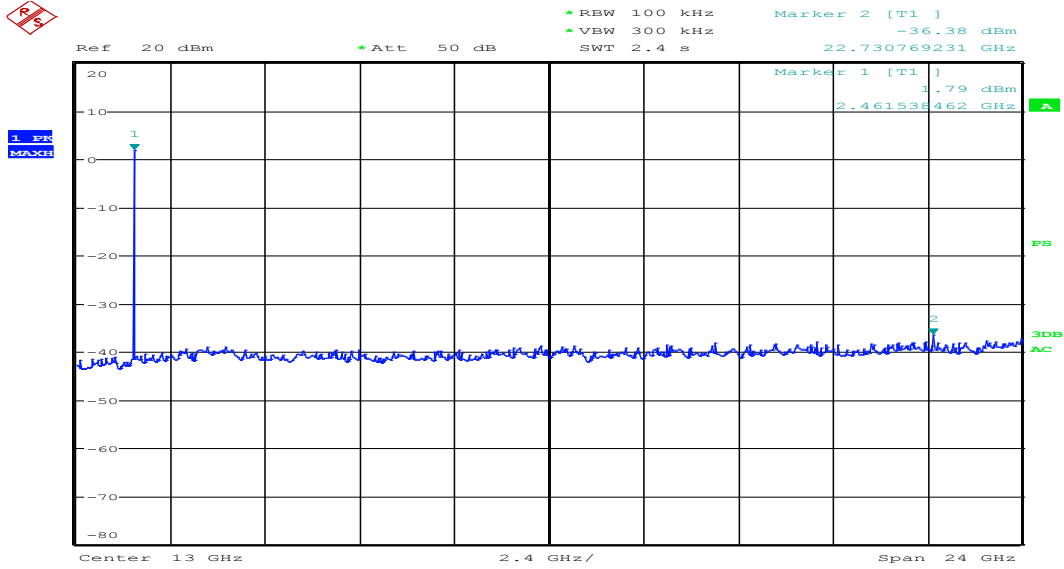
Conducted Spurious Emission, 30MHz to 1GHz, Channel 26:



Date: 13.AUG.2015 16:01:03



Conducted Spurious Emission, 1GHz to 25GHz, Channel 26:



Date: 13.AUG.2015 16:21:24



3.6 Power Spectral Density

Criterion: The Power Spectral Density shall not be greater than 8dBm in any 3 KHz band.

Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 10.2

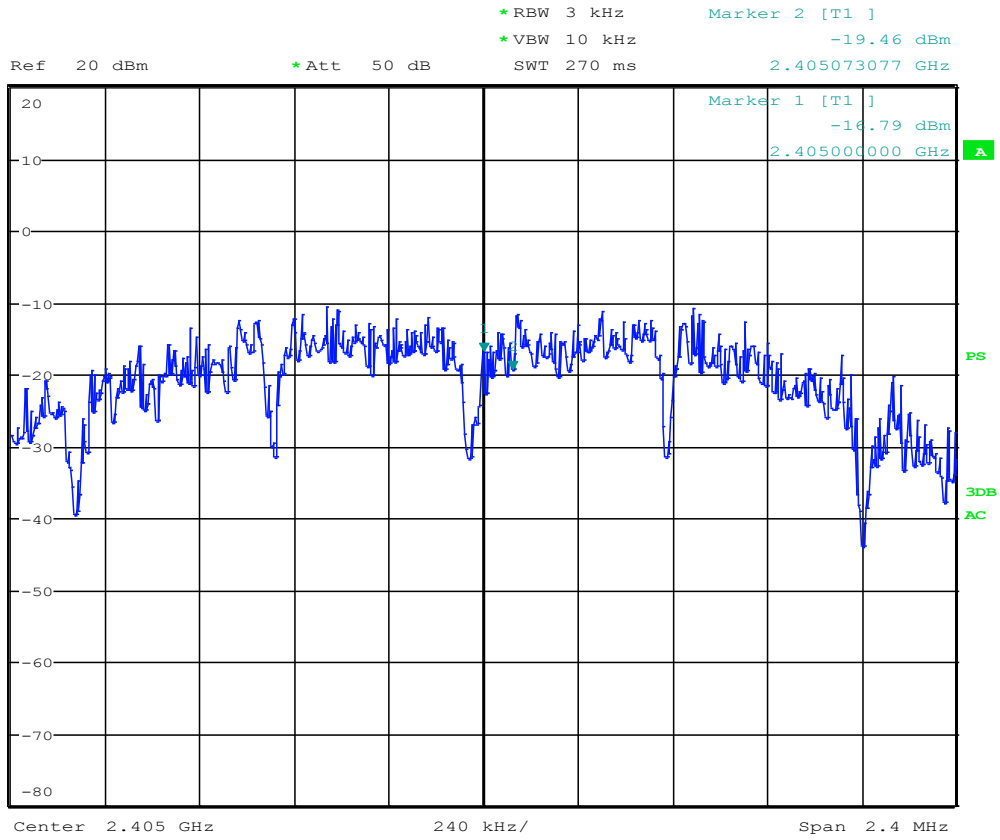
Set analyzer center frequency to DTS channel center frequency.

- b) Set the span to 1.5 times the *DTS bandwidth*.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Channel	Frequency(MHz)	Power Spectral Density (dBm)
11	2405	-10.00
18	2440	-8.99
26	2480	-8.41



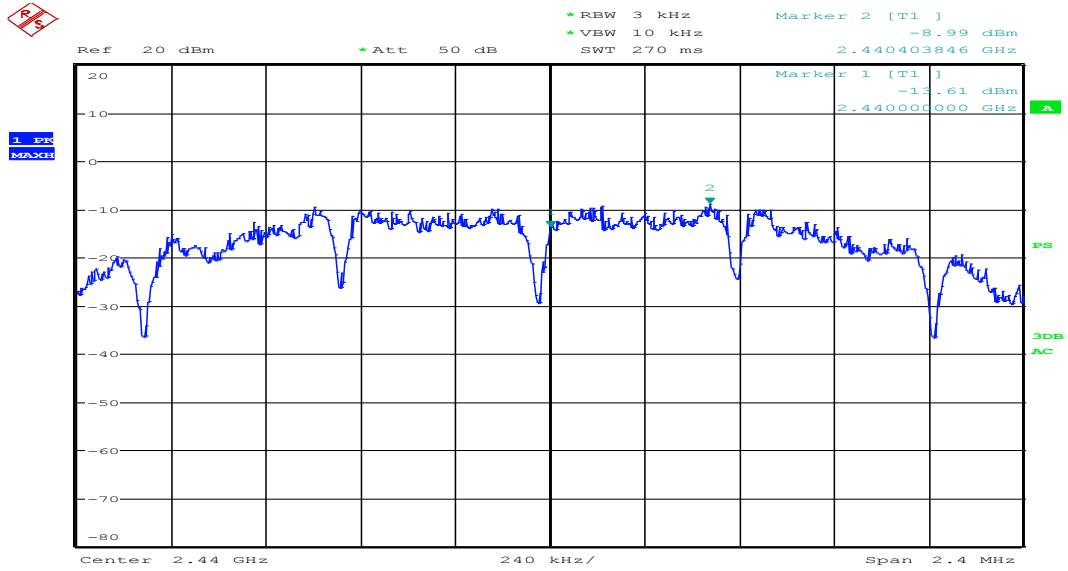
Power Spectral Density, Channel 11:



Date: 13.AUG.2015 16:37:02



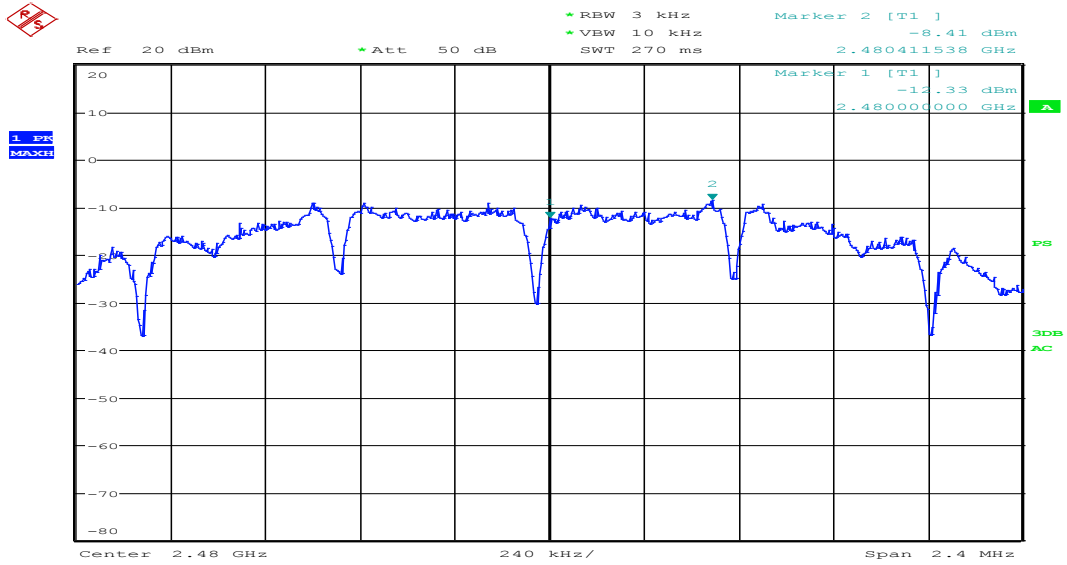
Power Spectral Density, Channel 18:



Date: 13.AUG.2015 16:42:13



Power Spectral Density, Channel 26:



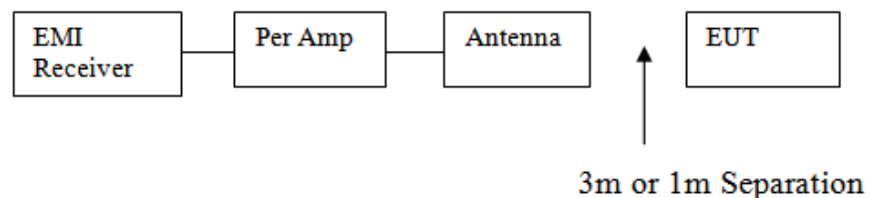
Date: 13.AUG.2015 16:50:35

3.7 Radiated Spurious Emissions

Criterion: Radiated spurious emissions which fall in the restricted bands must comply with the radiated emission limits specified in FCC § 15.209(a) and Table 2 of IC RSS-Gen.

Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 11
Radiated spurious emission was performed from 30 MHz to the tenth harmonics of the carrier. For each scan of radiated emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1meter (m) and 4m in order to maximize the observed levels. Measurements in both horizontal and vertical polarities were made and the data was recorded. All radiated emission measurements, up to 18 GHz, were performed at 3m distance between an antenna and the EUT. All radiated emission measurements, above 18 GHz, were performed at 1m distance between an antenna and the EUT.

Block Diagram:



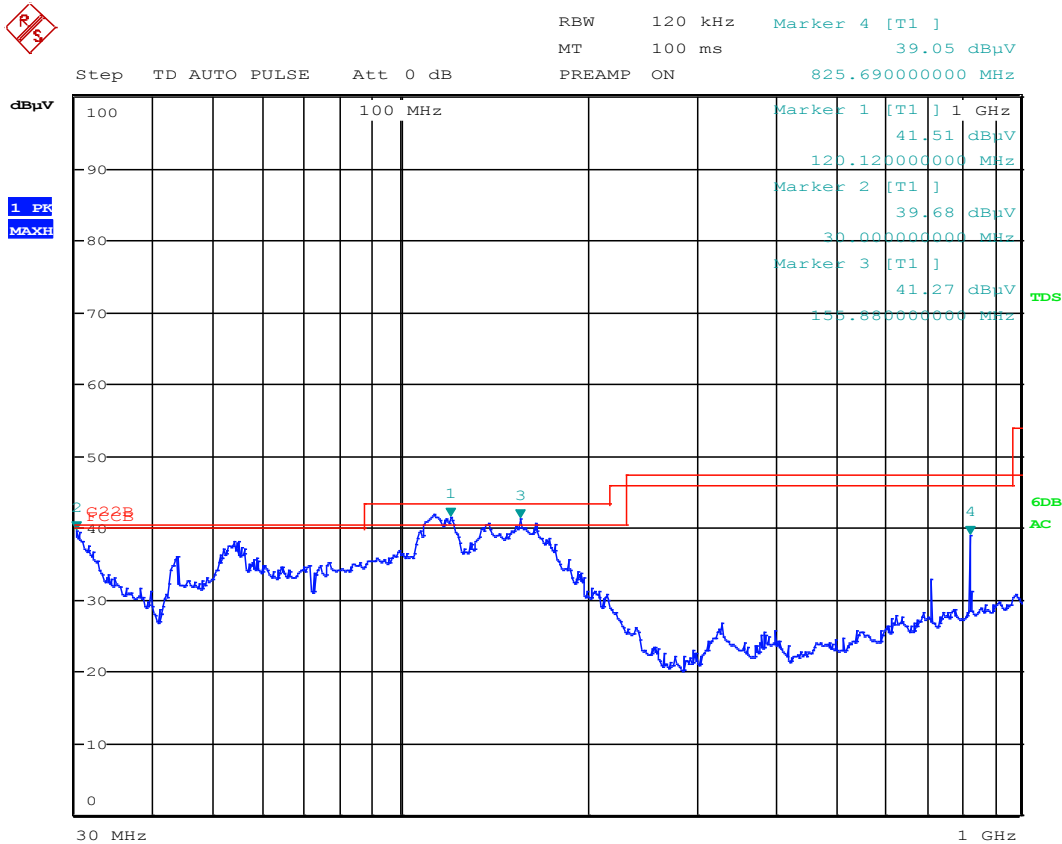
The peak level of radiated emissions above 1 GHz was measured with a resolution bandwidth (RBW) of 1 MHz and a Video Band Width (VBW) of 3 MHz. Average level was measured with VBW of 10Hz, Duty Cycle



Correction Factor (DCCF) was applied to the harmonics.

Over the 30MHz to 18GHz frequency range, the EUT was distanced 3 meters from the receive antenna (bilog or double ridge) and tested only in the orientation seen in the Figure below. The position and orientation of the integral antenna within the EUT is shown as a short line in red at the edge of the lower base of the EUT, in relation to three orthogonal directions marked "X", "Y" and "Z" in black, as seen in the same Figure. The EUT antenna projection in the X-Z plane was oriented approximately 45 degrees from Z and X axes, where the Z axis is pointing to the receiving antenna and the Y axis is pointing to the ceiling of the test chamber.

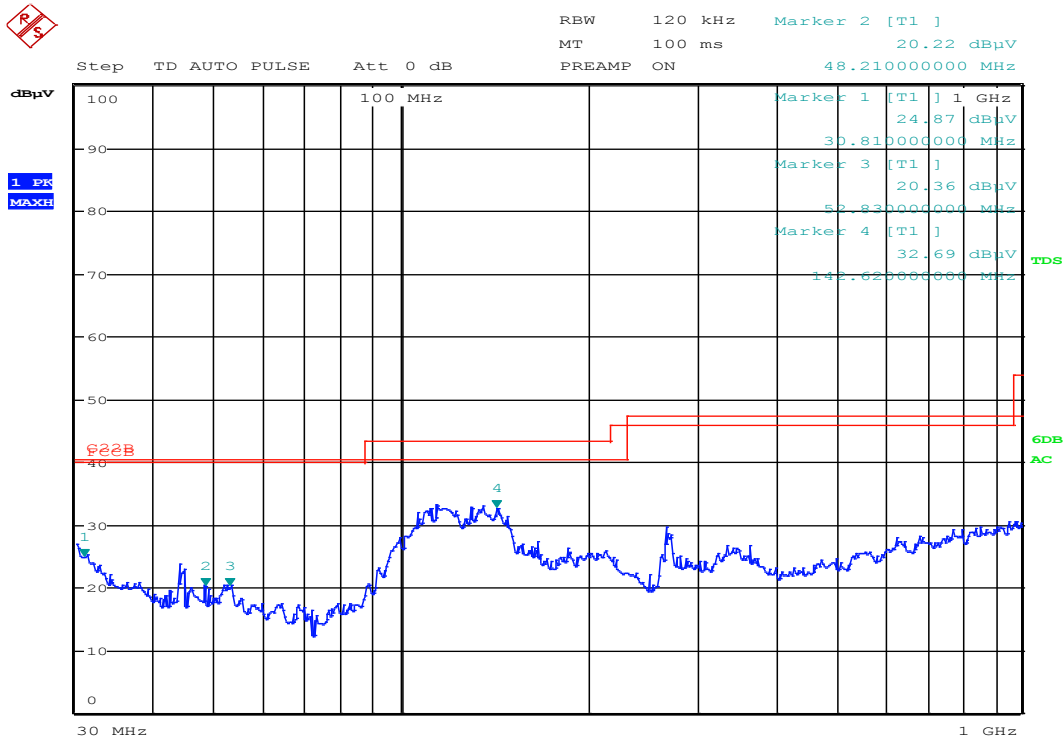
30MHz-1GHz VERTICAL:



Date: 14.AUG.2015 10:45:30



30MHz-1GHz HORIZONTAL:

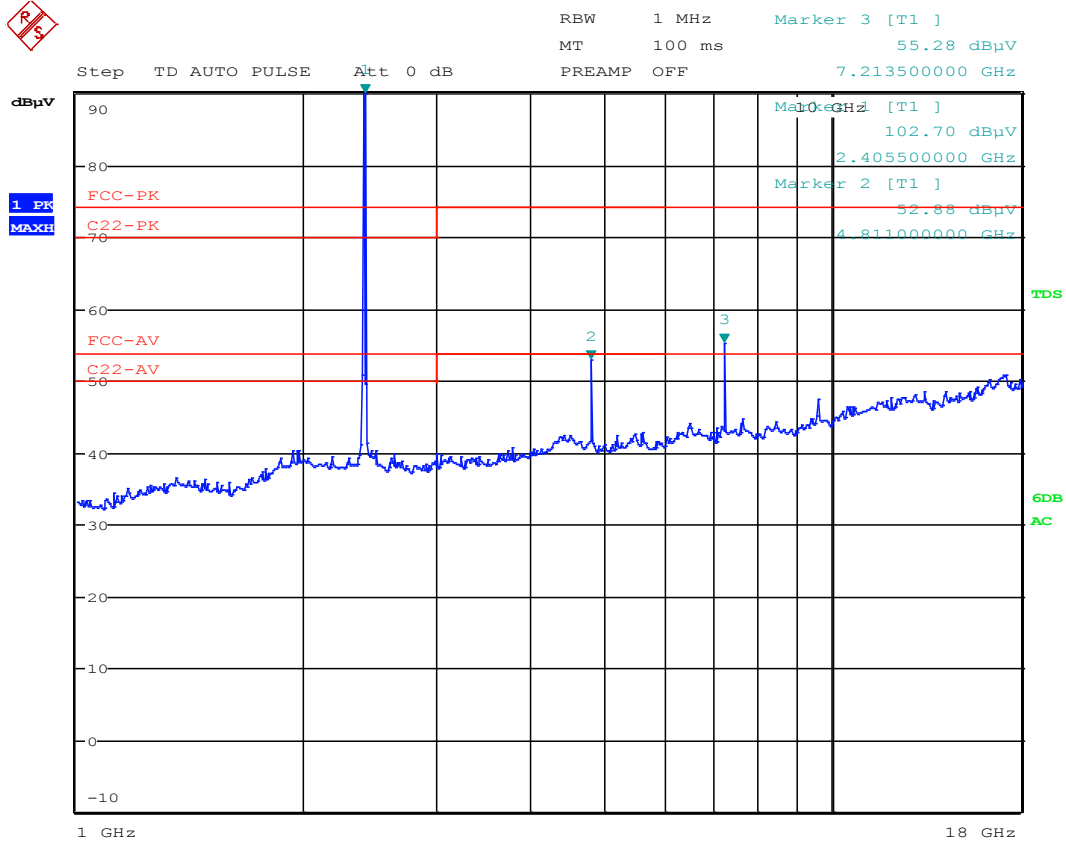


Date: 14.AUG.2015 14:50:42

Antenna		Turntable Azimuth Angle (degrees)	Frequency (MHz)	Measured Level (dBuV/m)	FCC Class B		CISPR 22 Class B	
Polarity	Height (cm)				Limit (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Margin (dB)
v	86	194	30.42	37.2	40	2.8	40.5	3.3
v	88	4	46.62	35.8	40	4.2	40.5	4.7
v	103	1	54.33	35.1	40	4.9	40.5	5.4
v	96	357	113.19	35.4	43.5	8.1	40.5	5.1
h	253	231	113.22	37.5	43.5	6	40.5	3
v	86	343	120.81	32.8	43.5	10.7	40.5	7.7
v	87	331	135.75	35.6	43.5	7.9	40.5	4.9
v	86	355	143.25	34	43.5	9.5	40.5	6.5

Sample Plots

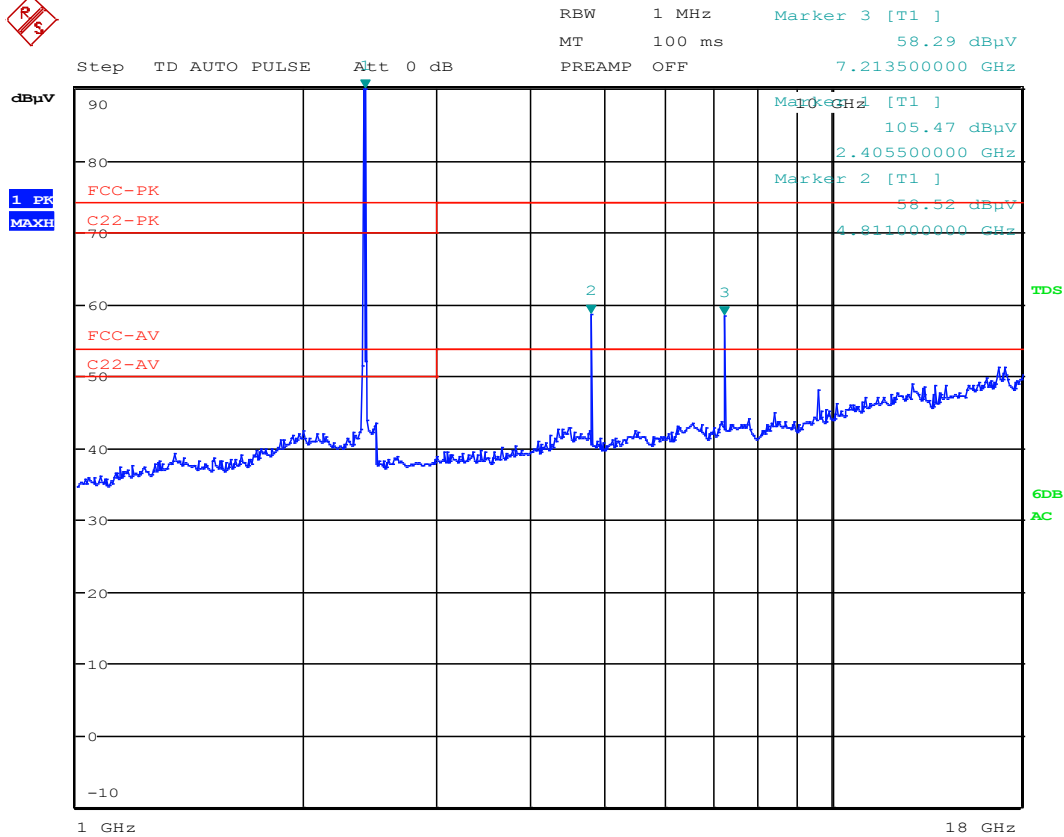
1GHz-18GHz VERTICAL: Channel 11



Date: 17.AUG.2015 12:53:22

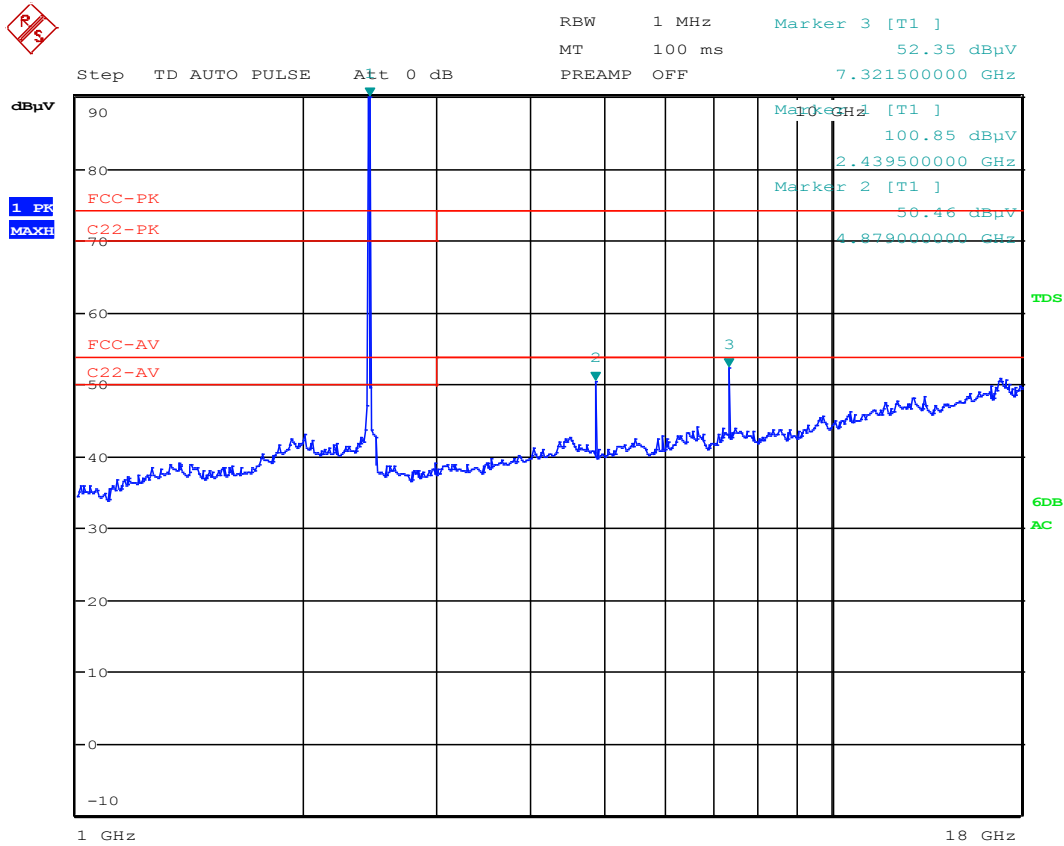


1GHz-18GHz HORIZONTAL: Channel 11



Date: 17.AUG.2015 15:03:29

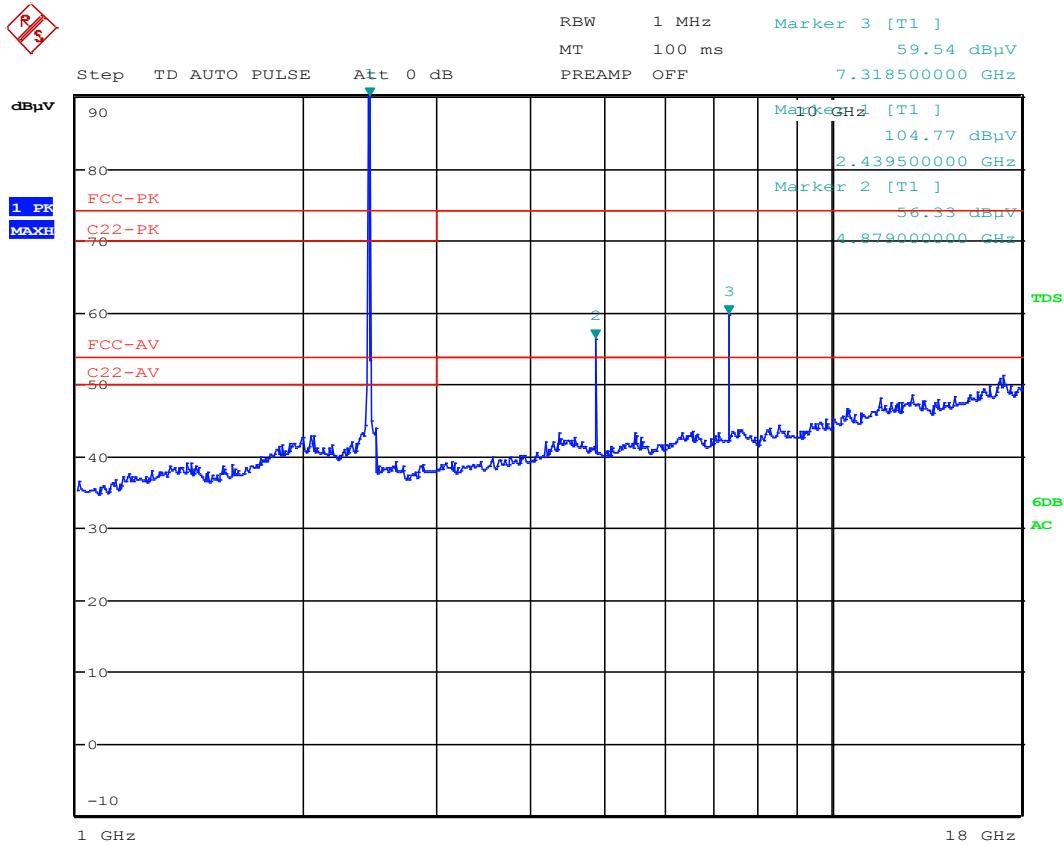
1GHz-18GHz VERTICAL: Channel 18



Date: 17.AUG.2015 16:11:16



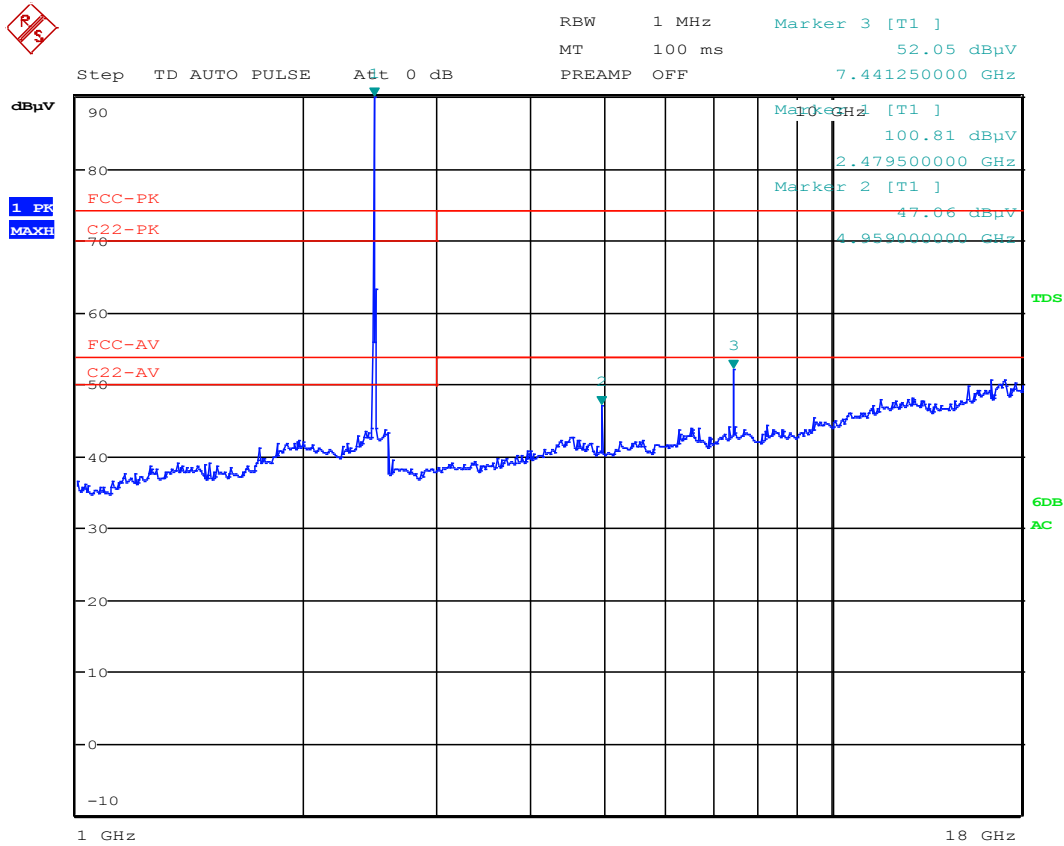
1GHz-18GHz HORIZONTAL: Channel 18



Date: 17.AUG.2015 16:16:44



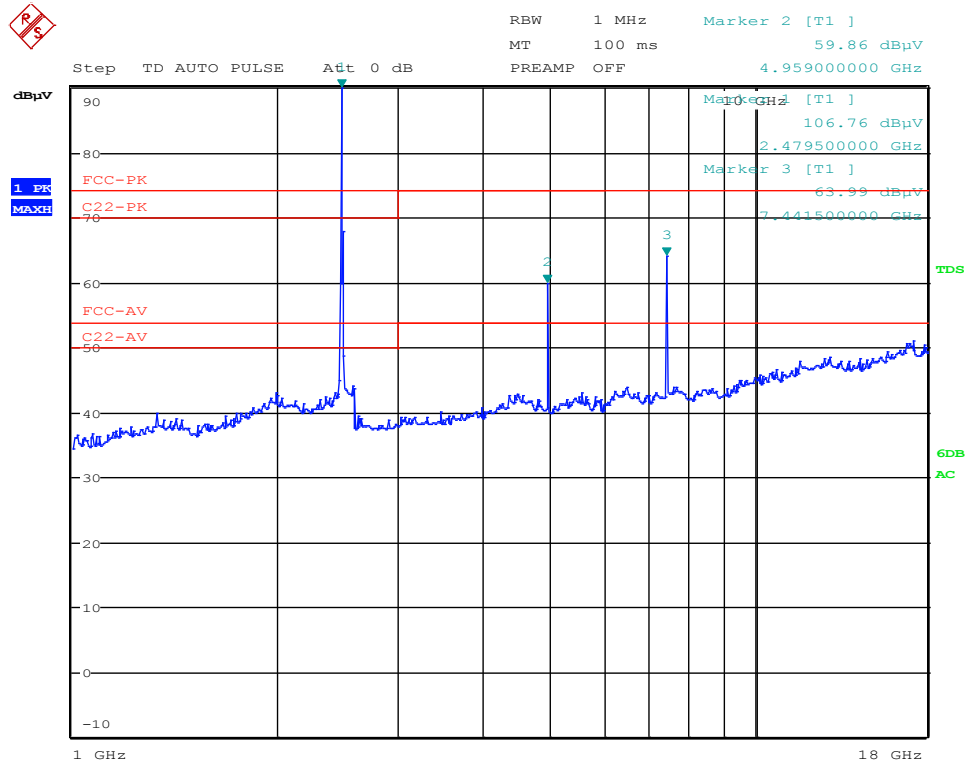
1GHz-18GHz VERTICAL: Channel 26



Date: 17.AUG.2015 17:21:34



1GHz-18GHz HORIZONTAL: Channel 26



Date: 17.AUG.2015 17:03:02

Note: No emissions found above 18GHz



Radiated EMI Data (1 – 25GHz)

Ch #	Freq (MHz)	Ant (V/H)	Meas Level (dBuV/m)		Duty Cycle (dB)[2]	Corr Level (dBuV/m)		3-meter FCC Limits (dBuV/m)		FCC Margin (dB)	
			PK	AV		PK	AV	PK	AV	PK	AV
11	2390	H	44.7	39.4	-11.76	44.7	27.7	74	54	29.3	26.3
	2405	H	105.5								
	4780	H	61.5	55.0	-11.76	61.5	43.2	74	54	12.5	10.8
	7170	H	66.4	59.3	-11.76	66.4	47.5	74	54	7.6	6.5
18	2440	H	104.8								
	4880	H	58.8	52.0	-11.76	58.8	40.2	74	54	15.2	13.8
	7320	H	63.0	55.8	-11.76	63.0	44.0	74	54	11.0	10.0
26	2480	H	106.8								
	2483	H	70.0	62.5	-11.76	70.0	50.8	74	54	4.0	3.2
	4960	H	61.4	54.8	-11.76	61.4	43.0	74	54	12.6	11.0
	7440	H	66.6	59.5	-11.76	66.6	47.7	74	54	7.4	6.3

[1] h (horizontal) antenna orientation produced largest levels

[2] measured Duty Cycle = $20 \times \log_{10}(4 \times (6.455 \text{ms}) / 100 \text{ms}) = -11.76$ (see Section 3.11 below for source data)

[3] maximum PK value registered while the table rotates through 360 degrees

Sample Calculation of the Electric Field Magnitude

The magnitude of the Electric field, E is calculated in $dB\mu V/m$ in terms of the measured antenna output voltage and three transducer factors as follows:

$$E (dB\mu V/m) = AOV(dB\mu V) + AF(dB/m) + CL(dB) - AG(dB)$$

where,

$$AOV(dB\mu V) = \text{Antenna Output Voltage in dB}(\mu V),$$



$AF(dB/m)$ = Antenna Factor in dB(1/m),

$CL(dB)$ = Cable Loss in dB,

$AG(dB)$ = Amplifier Gain in dB

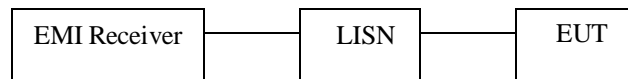
The three transducer factors AF , CL and AG are stored in the EMI Receiver, as functions of frequency, over corresponding frequency ranges.

3.8 Transmitter AC Power line Conducted Emissions

Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.207 and Table 4 of IC RSS-Gen.

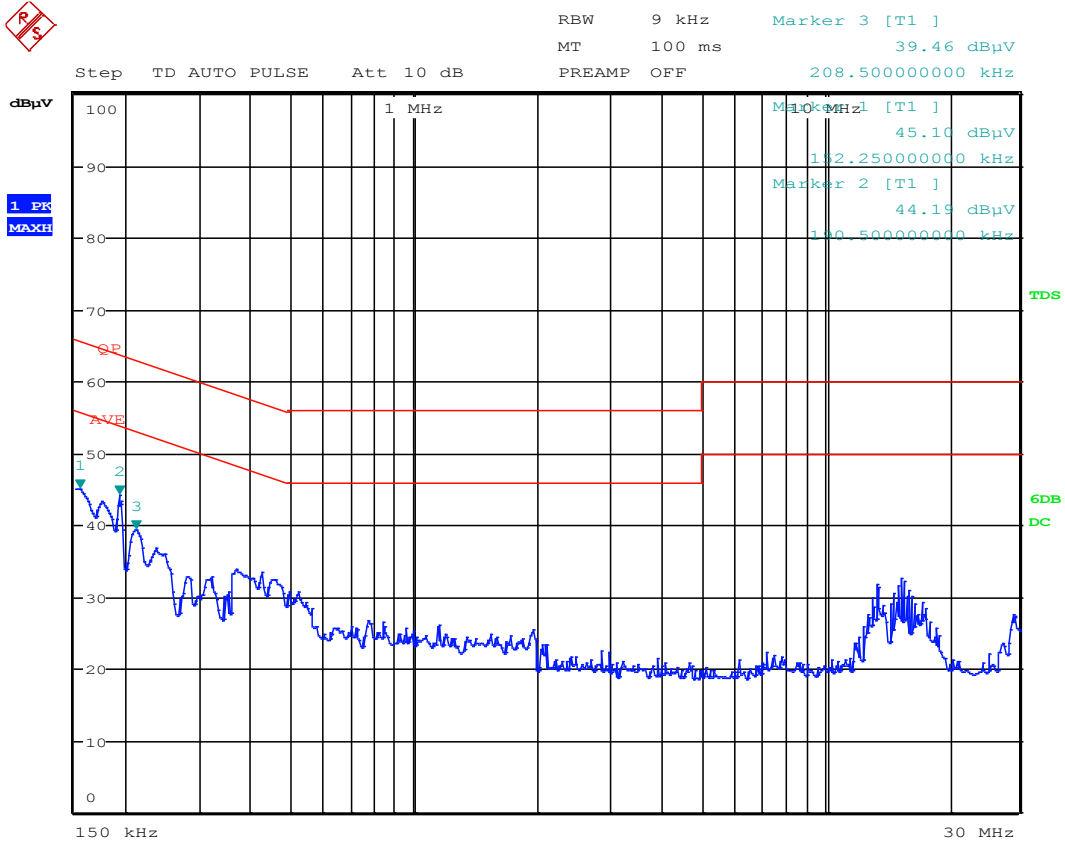
Test Details: AC power line conducted emissions were performed from 150 kHz to 30 MHz and measured with a resolution bandwidth of 9 kHz. EUT was set in the receiving mode. Refers to the following screen captures (using a peak detector) and block diagram

Block Diagram:



Note: AC side of AC-DC (support power supply) conducted emissions were measured.

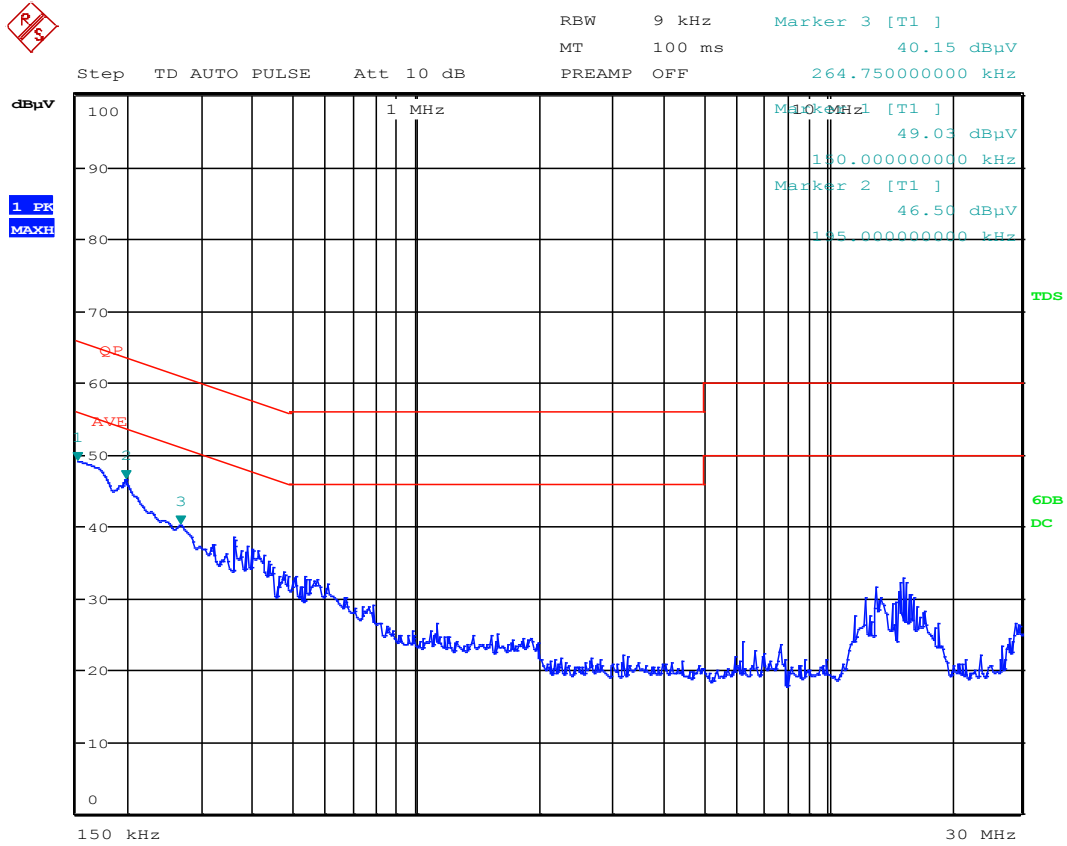
Line 1:



Date: 17.AUG.2015 10:08:49

Frequency (MHz)	Measured Level (dBuV)		Limits (dBuV)		Margins (dB)	
	QP	AV	QP	AV	QP	AV
120V/L1						
0.15225	42.5	23.5	65.9	55.9	23.4	32.4
0.1905	43.5	38.4	64.0	54.0	20.5	15.6
0.2085	34.1	18	64.0	54.0	29.9	36.0

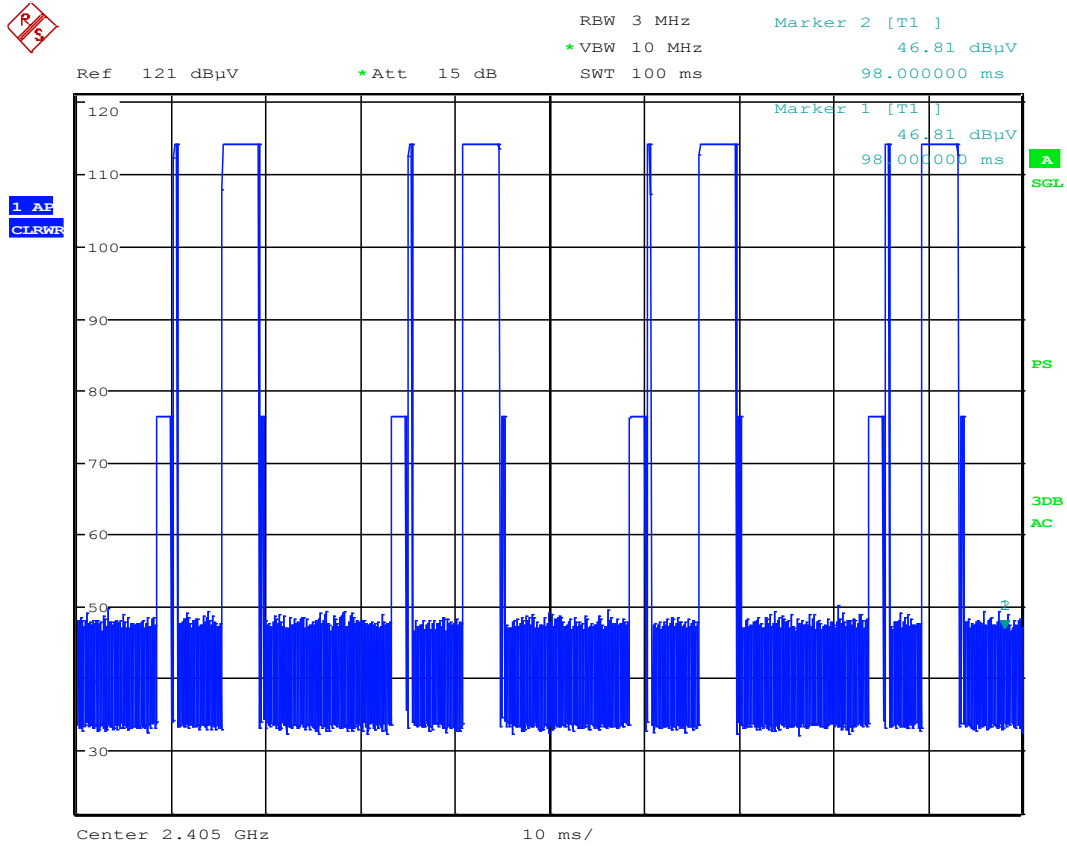
Line 2:



Date: 17.AUG.2015 10:22:09

Frequency (MHz)	Measured Level (dBuV)		Limits (dBuV)		Margins (dB)	
	QP	AV	QP	AV	QP	AV
120V/L1						
.15	42.5	23.3	66	56	23.5	32.7
.195	39.8	32.7	63.8	53.8	24	21.1
.26475	31.5	16.7	61.3	51.3	29.8	34.6

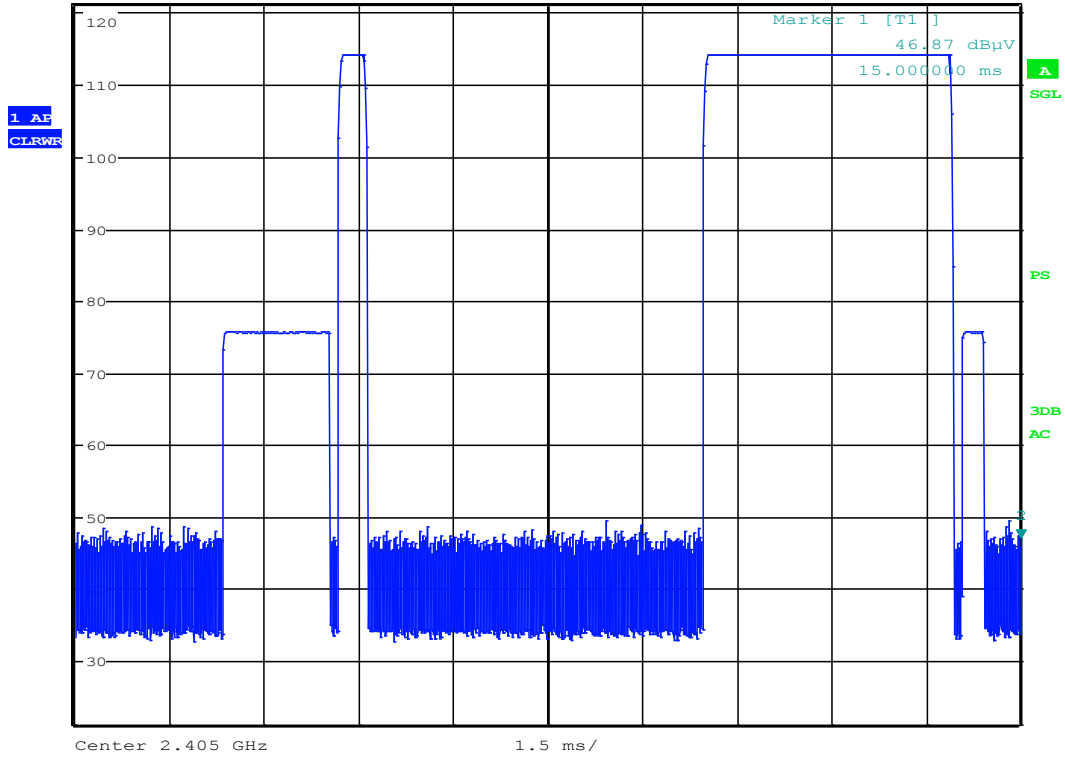
3.9 Duty Cycle Correction Factor (DCCF) Measurement



Date: 13.AUG.2015 17:21:04



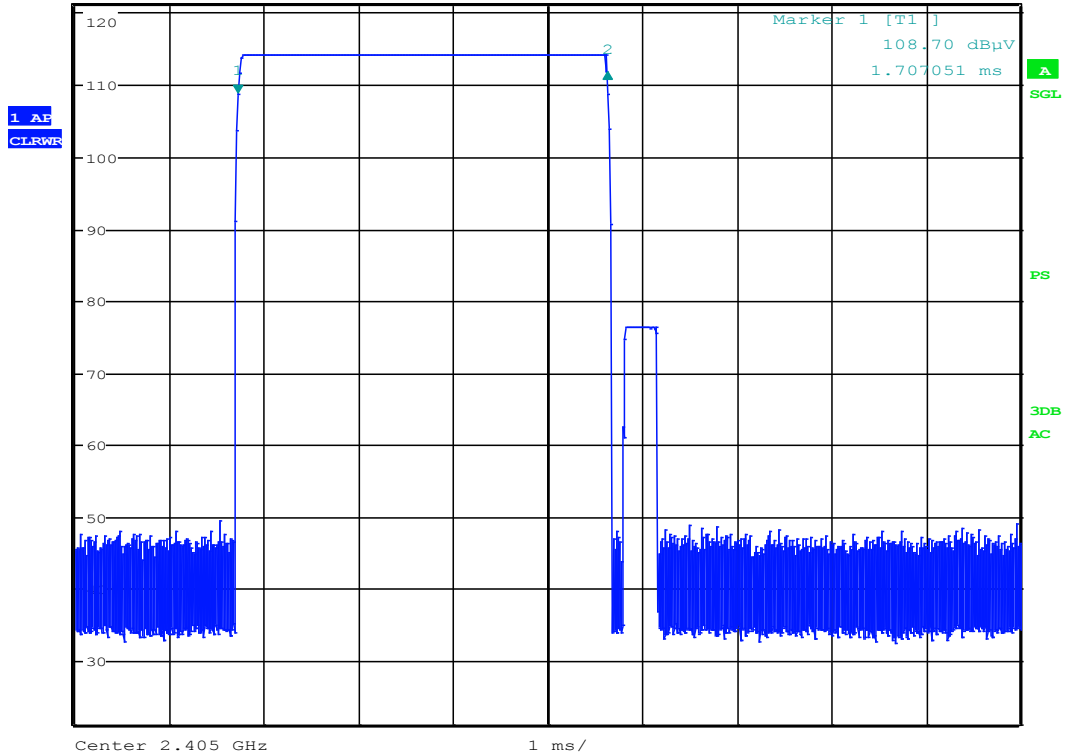
RBW 3 MHz Marker 2 [T1] 46.87 dBµV
* VBW 10 MHz 15.000000 ms
Ref 121 dBµV * Att 15 dB SWT 15 ms



Date: 13.AUG.2015 17:27:49



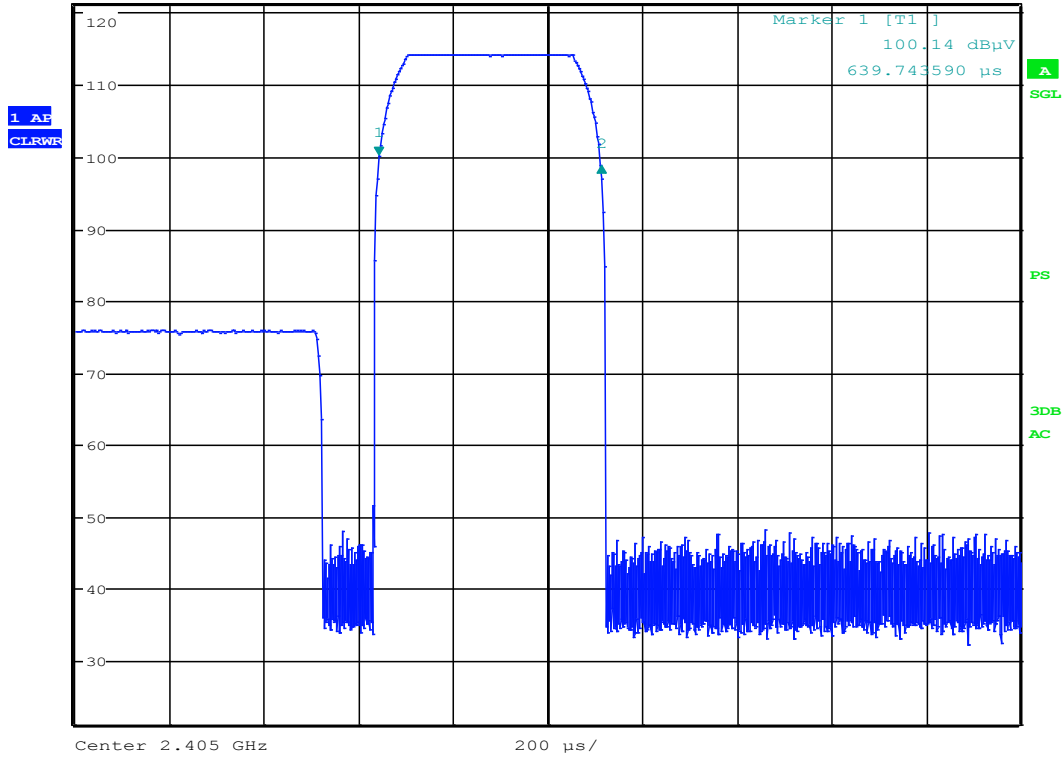
RBW 3 MHz Delta 2 [T1]
 * VBW 10 MHz 2.97 dB
 Ref 121 dBμV * Att 15 dB SWT 10 ms 3.910256 ms



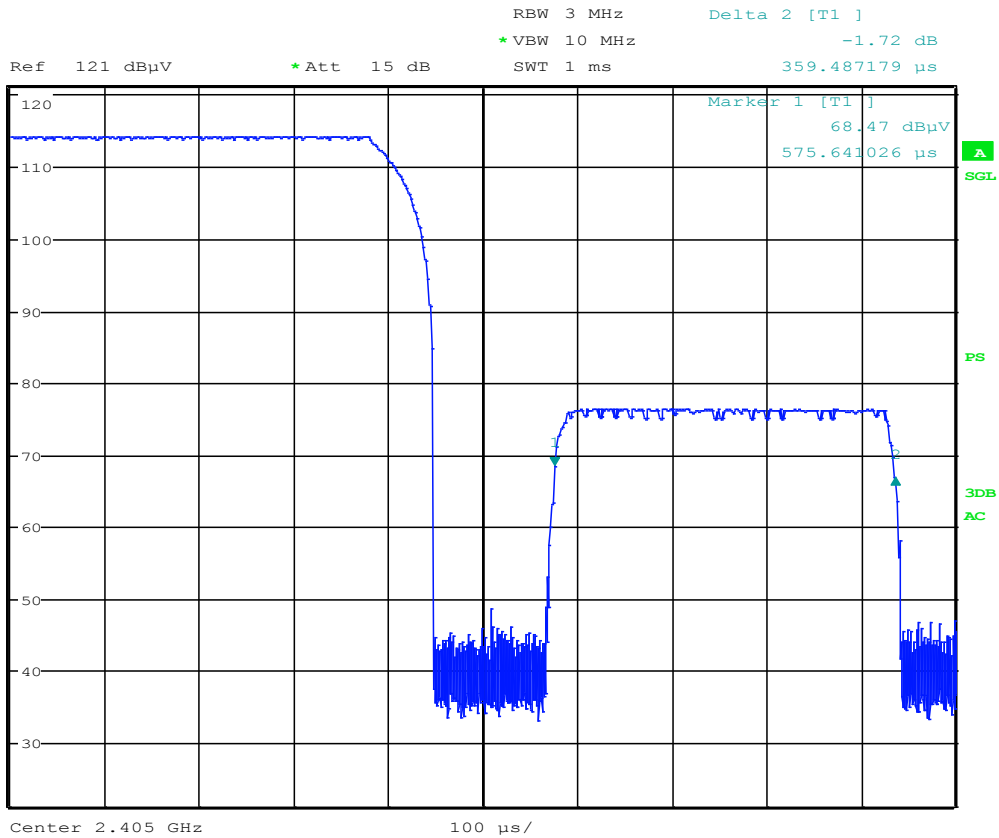
Date: 13.AUG.2015 17:31:50



RBW 3 MHz Delta 2 [T1]
 * VBW 10 MHz -1.53 dB
 Ref 121 dBμV * Att 15 dB SWT 2 ms 472.435897 μs



Date: 13.AUG.2015 17:36:44



Date: 13.AUG.2015 17:43:24

Calculation of the Duty Cycle Correction Factor (DCCF)

The DCCF is defined by the following relationship:

$$DCCF(dB) = 20 \log_{10}(\{\text{sum of durations of pulses over a } 100\text{ms interval}\}/100\text{ms})$$

four different pulses repeated four times over a 100 ms interval, as follows:

puls1 duration = 1712.82 us

puls2 duration = 472.44 us

puls3 duration = 3910.26 us

puls4 duration = 359.49 us

Sum of Puls Durations = 6455.00 us

4x Sum of Puls Durations = 25820.00 us

Hence,

$$DCCF = 20 \log_{10}(4x \text{ Sum of Puls Durations}/100000 \text{ us}) = -11.76 \text{ dB}$$