



RADIO TEST REPORT

47 CFR FCC PART 15.247
RSS-GEN ISSUE 4
RSS-210 ISSUE 8

Report Number:	CFR-CSMQMTDC-071015
Test Dates:	

EWO:	2044
-------------	------

Model:	CSM-QMTDC-163-1-EX
---------------	--------------------

FCC ID:	EROQMTDC163
IC:	5683C-QMTDC163

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

Report Date: 07/10/2015

Test Result:	Pass
---------------------	------

Prepared by:

C.N. Patel

Chirag Patel, Compliance Engineer

Date: 07/10/15

Reviewed by:

Mairaj Hussain

Mairaj Hussain, Global Compliance Manager

Date: 07/14/15



Table of Contents

1. REFERENCE STANDARDS.....	3
1.1 TEST FACILITY.....	3
2. SYSTEM TEST CONFIGURATION.....	4
2.1 PRODUCT DESCRIPTION	4
2.2 BLOCK DIAGRAM.....	4
2.3 EUT SETUP JUSTIFICATION	5
2.4 EUT EXERCISE SOFTWARE AND MODE(S) OF OPERATION	5
2.5 CABLES	5
2.6 SPECIAL ACCESSORIES.....	5
2.7 SUPPORT EQUIPMENT	6
2.8 EQUIPMENT MODIFICATION	6
2.9 TEST EQUIPMENT.....	7
3. TEST RESULTS	8
3.1 COMPLIANCE STATEMENT	8
3.2 ANTENNA REQUIREMENTS	9
3.3 6 DB BANDWIDTH	10
3.4 99% BANDWIDTH	13
3.5 POWER OUTPUT.....	15
3.6 BAND EDGE CONDUCTED.....	18
3.7 CONDUCTED SPURIOUS EMISSIONS	20
3.8 POWER SPECTRAL DENSITY	22
3.9 RADIATED SPURIOUS EMISSIONS	25
3.10 TRANSMITTER AC POWER LINE CONDUCTED EMISSIONS	30
3.11 DUTY CYCLE CORRECTION FACTOR (DCCF)	33

This document shall not be reproduced, except in full, without written approval from Crestron Electronics, Inc.

Revision History

Revision	Description	Date
00	Initial release	07/14/2015



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-210 Issue 8
- 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.

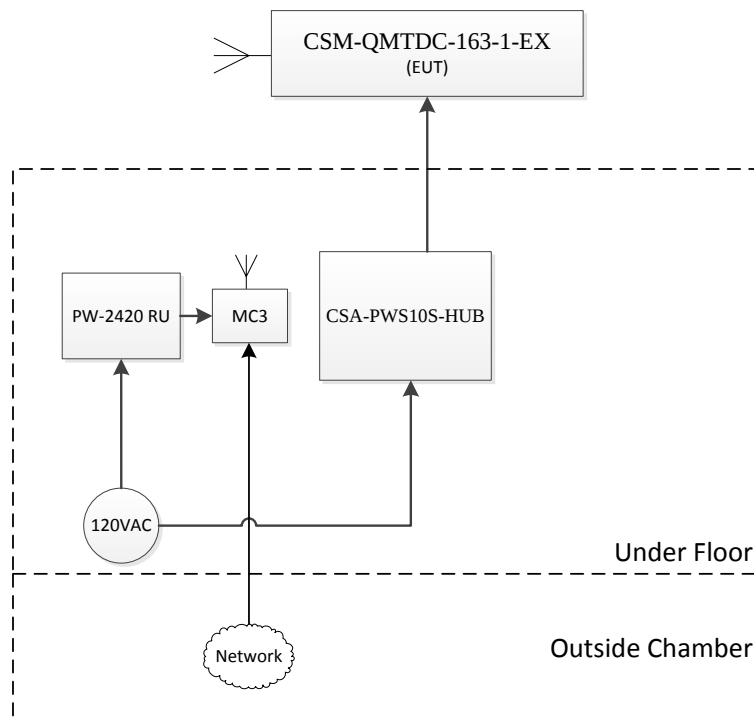
2. System Test Configuration

2.1 Product Description

The equipment under test (EUT) is a Digital QMT® Shade Motor for QMT3 Series, infiNET EX®, model: CSM-QMTDC-163-1-EX, manufactured by Crestron Electronics, Inc.

Model Number: CSM-QMTDC-163-1-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. Date	Cal. Due Date
R&S EMI Receiver	20 Hz – 40 GHz	ROHDE & SCHWARZ	ESU40	100076	10/23/2014	10/23/2016
Teseq Bilog Antenna	30 MHz – 2 GHz	Teseq	CBL 6112D	25231	12/16/2014	12/16/2016
ETS-Lindgren Double Ridge Horn Antenna	1 GHz – 18 GHz	ETS	3117	00047560	12/1/2014	12/1/2016
R&S Preamplifier	1GHz – 18 GHz	ROHDE & SCHWARZ	TS-PR18	100044	12/18/2013	12/18/2015
ETS-Lindgren Standard Gain Horn Antenna	18 GHz – 26.5 GHz	ETS	3160-09	00078911	12/3/2014	12/3/2016
R&S Preamplifier	18 GHz – 26.5 GHz	ROHDE & SCHWARZ	TS-PR26	100030	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)	§A8.2(a) of RSS-210	6 dB Bandwidth, 500 kHz	5/4/15	HK	Complies
N/A	§6.6 of RSS-Gen	99% Occupied Bandwidth	5/4/15	HK	(for reporting purpose)
§15.247(b)(3)	§A8.4(4) of RSS-210	Power Output, conducted, 1 Watt (30dBm)	5/4 & 5/12	HK	Complies
§15.247(d)	§A8.5 of RSS-210	Band Edge	5/8/15	HK	Complies
§15.247(d)	§A8.5 of RSS-210	Conducted Spurious Emissions, -20 dBc	5/5/15	HK	Complies
§15.247(e)	§A8.2(b) of RSS-210	Power Spectral Density (PSD), 8 dBm in any 3 kHz band.	5/5/15	HK	Complies
§15.205, §15.209, §15.247(d)	§A8.5 of RSS-210; §8.9 of RSS-Gen	Radiated Spurious Emissions	5/7,11,12/15	HK	Complies
§15.207	§8.8 of RSS-Gen	Transmitter AC Power Line Conducted Emissions	5/15/15	HK	Complies

Note:

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



3.2 Antenna Requirements

The product uses a trace antenna embedded into the PCB. The gain of the antenna is 1.95dBi. 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

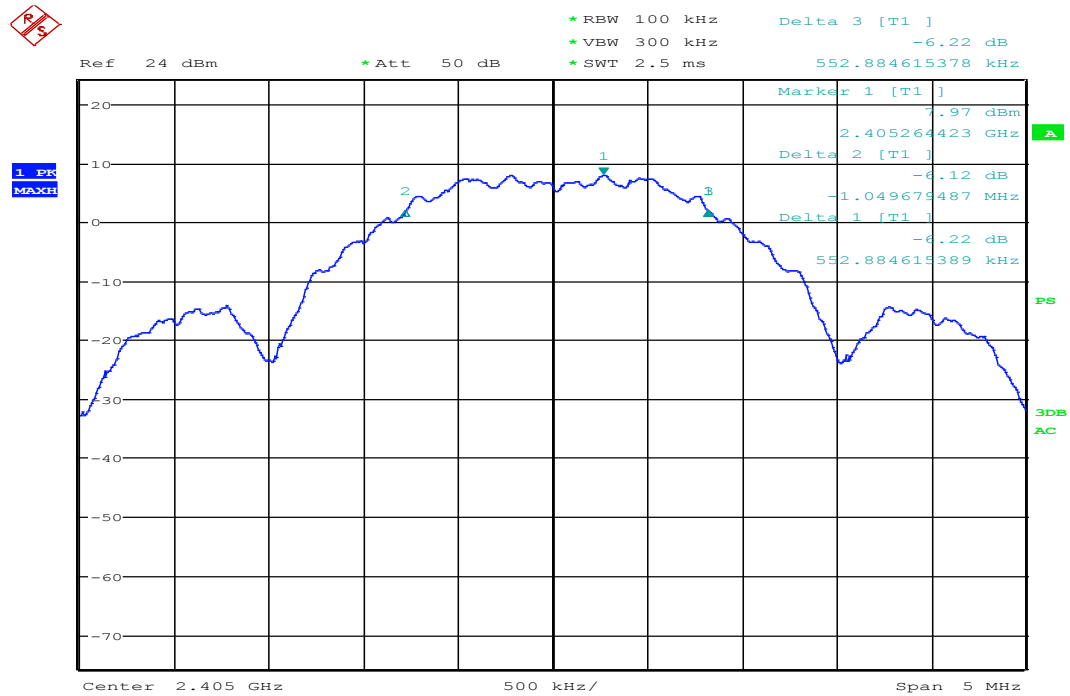
Criterion: The minimum 6 dB bandwidth shall be at least 500 kHz.

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	1602.4
18	2440	1602.4
26	2480	1650.5

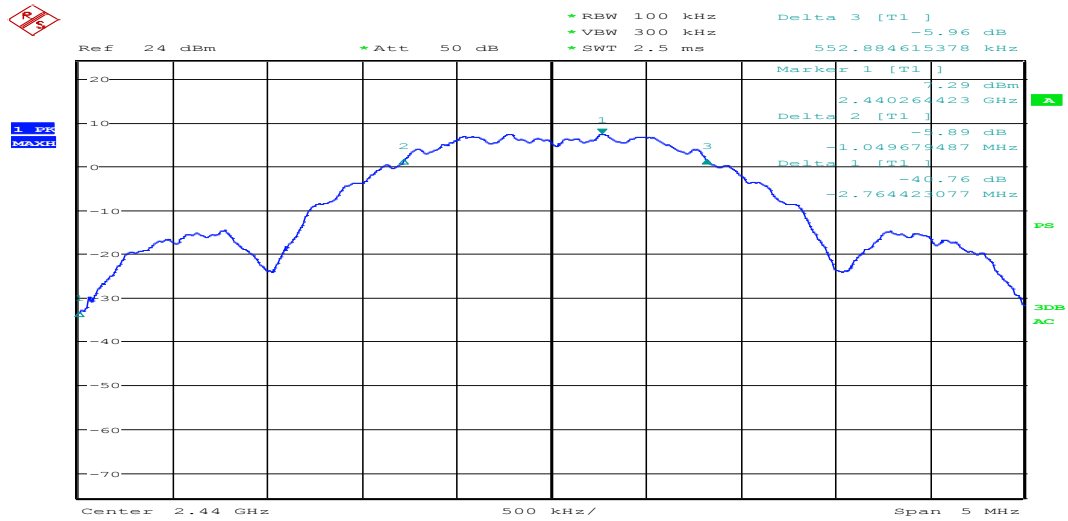
6 dB Bandwidth, Channel 11:



Date: 4.MAY.2015 15:39:56

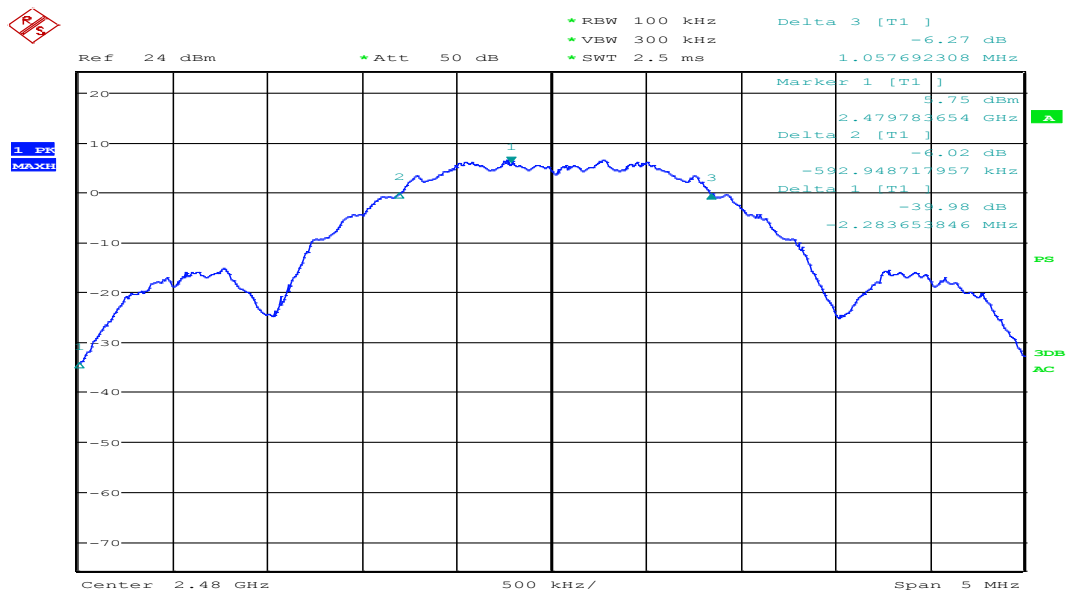


6 dB Bandwidth, Channel 18:



Date: 4.MAY.2015 15:46:37

6 dB Bandwidth, Channel 26:



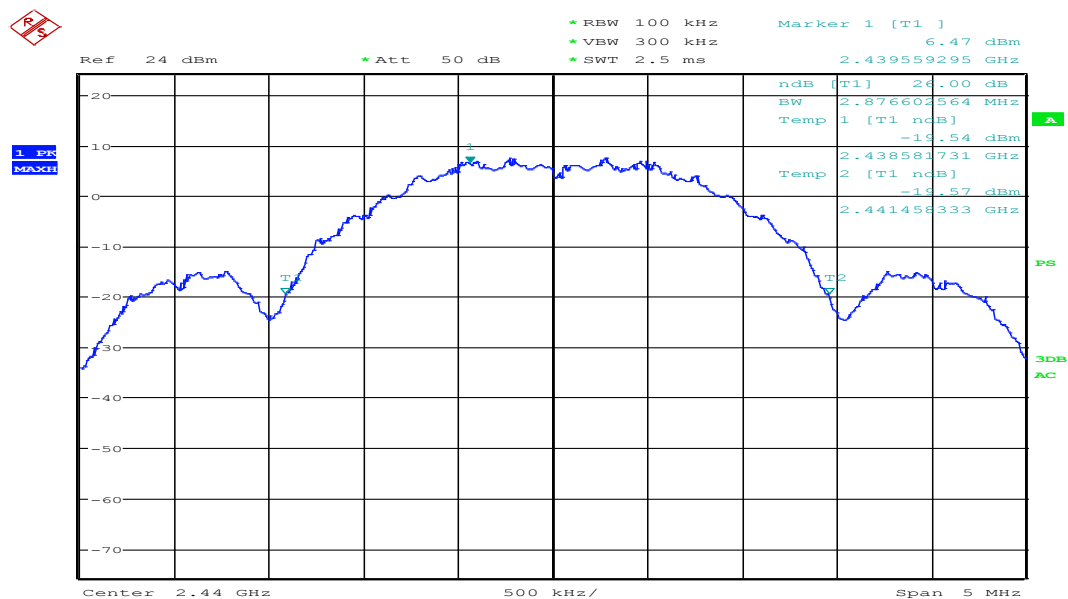
Date: 4.MAY.2015 15:50:00

3.4 99% Bandwidth

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

Channel	Frequency(MHz)	99% dB Bandwidth(kHz)
18	2440	2.876
26	2480	2.884

99% dB Bandwidth, Channel 18:



Date: 4.MAY.2015 16:07:14



3.5 Power Output

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

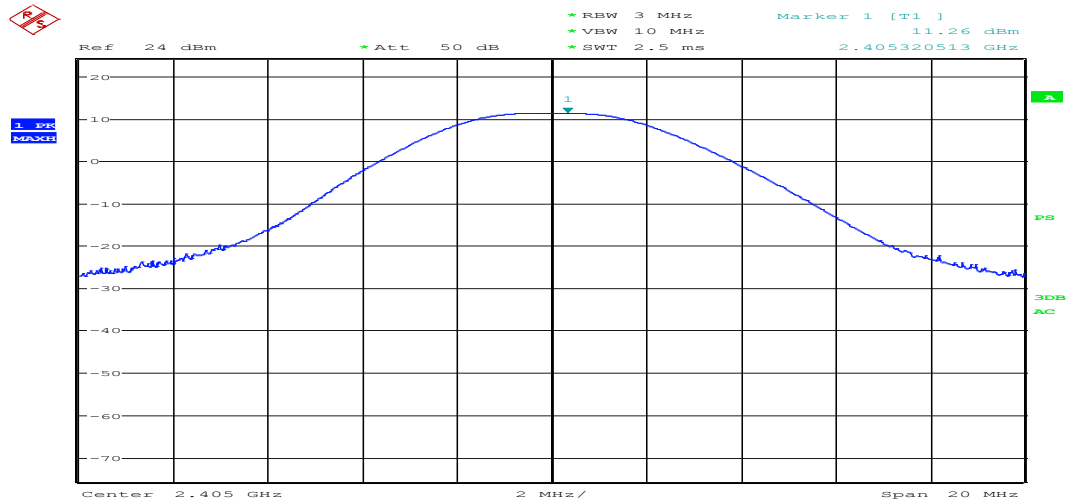
Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 9.1.1

- 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)	Power Level	Power	
			dBm	mW
11	2405	0	11.26	13.36
18	2440	0	10.73	11.83
26	2480	-26	-8.08	0.15

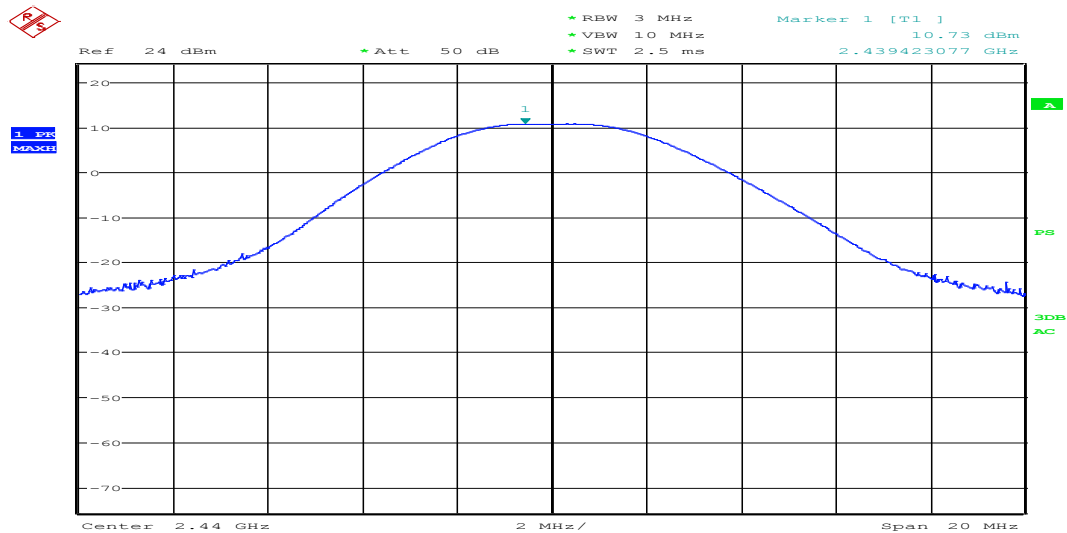


Power Output, Channel 11:



Date: 4.MAY.2015 16:13:47

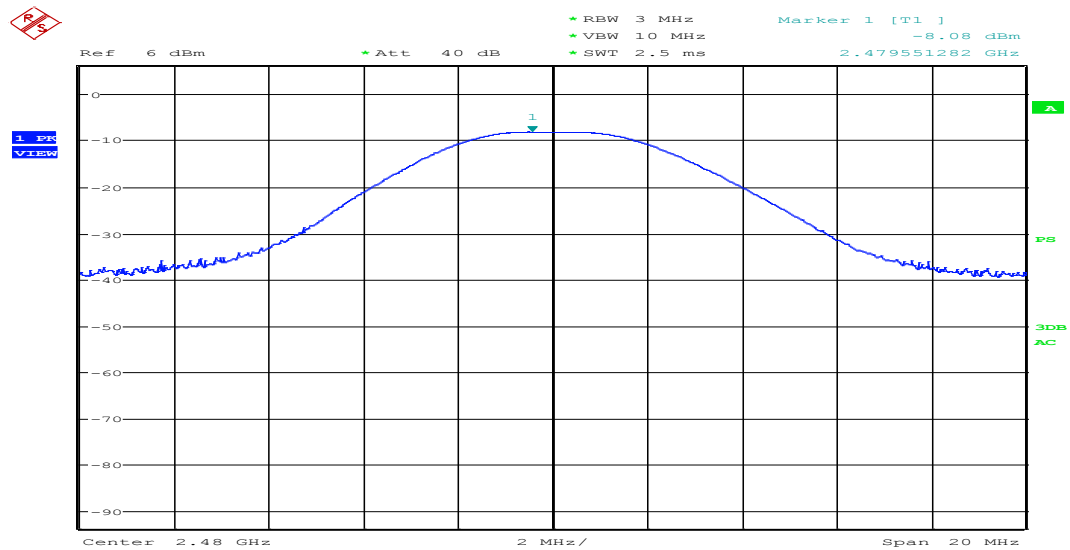
Power Output, Channel 18:



Date: 4.MAY.2015 16:16:04



Power Output, Channel 26:



Date: 4.MAY.2015 16:27:58

3.6 Band Edge Conducted

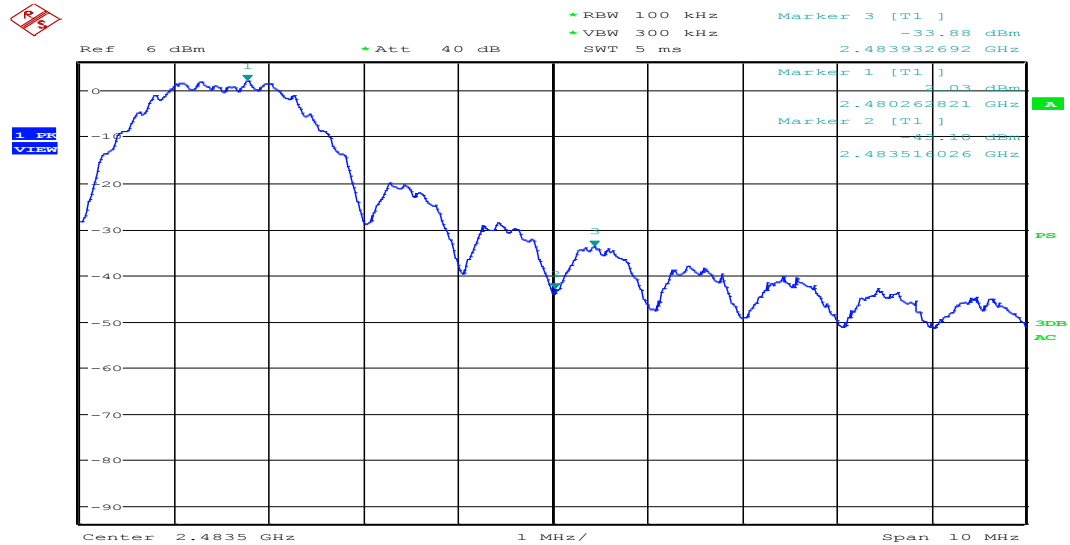
Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

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:

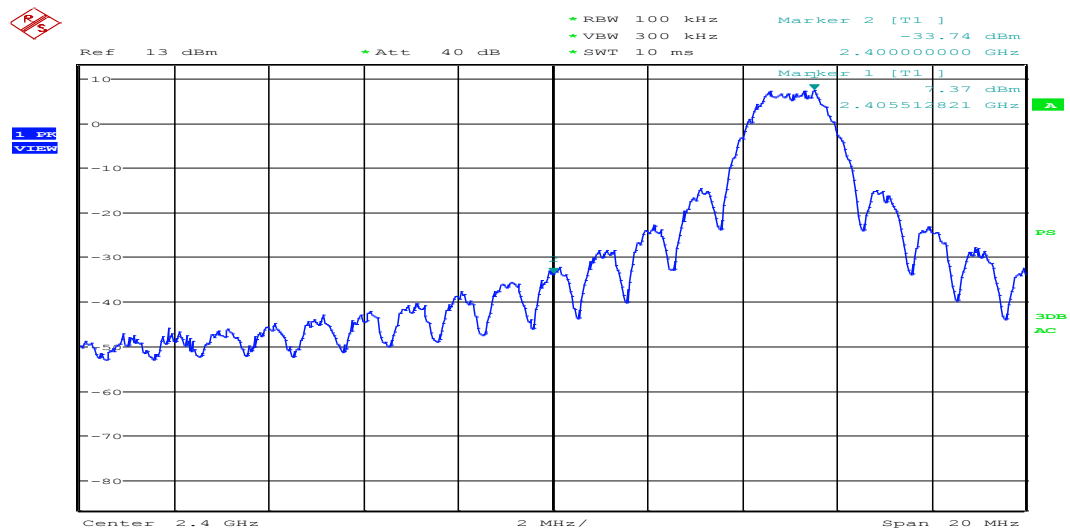
- a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level 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: 5.MAY.2015 09:58:54

Band Edge, Channel 26:



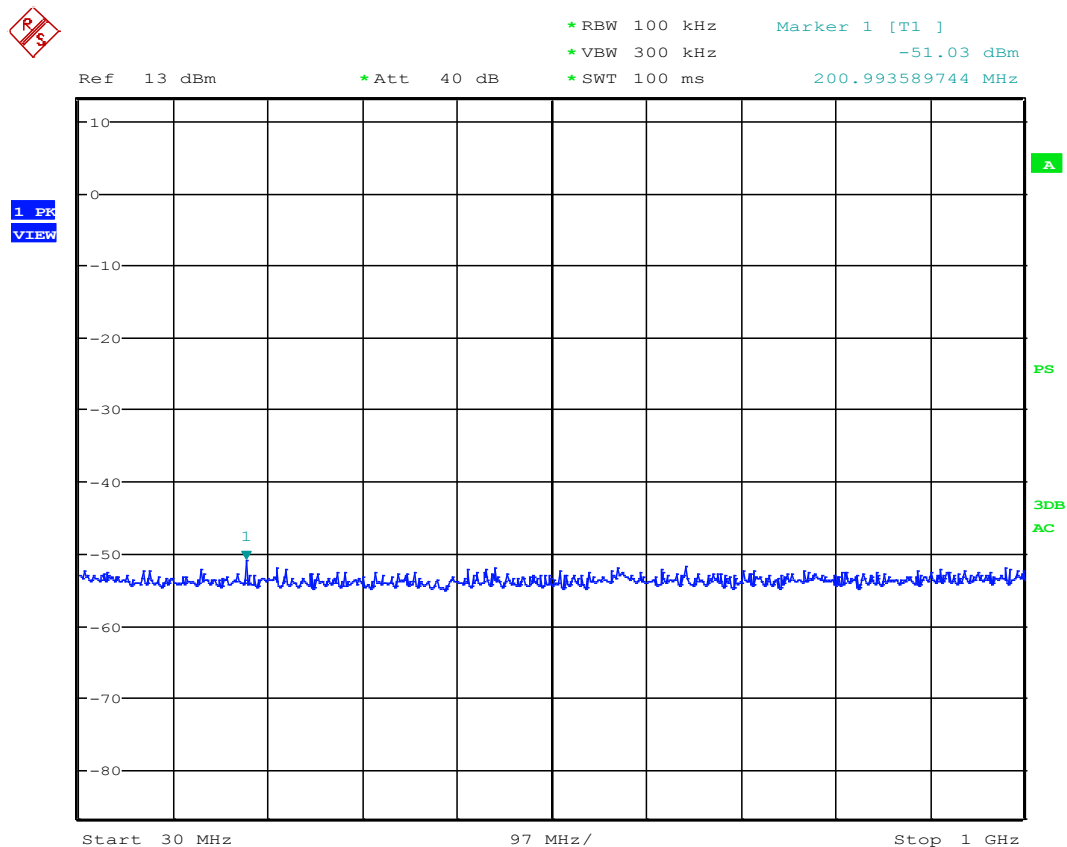
Date: 5.MAY.2015 10:08:48

3.7 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.

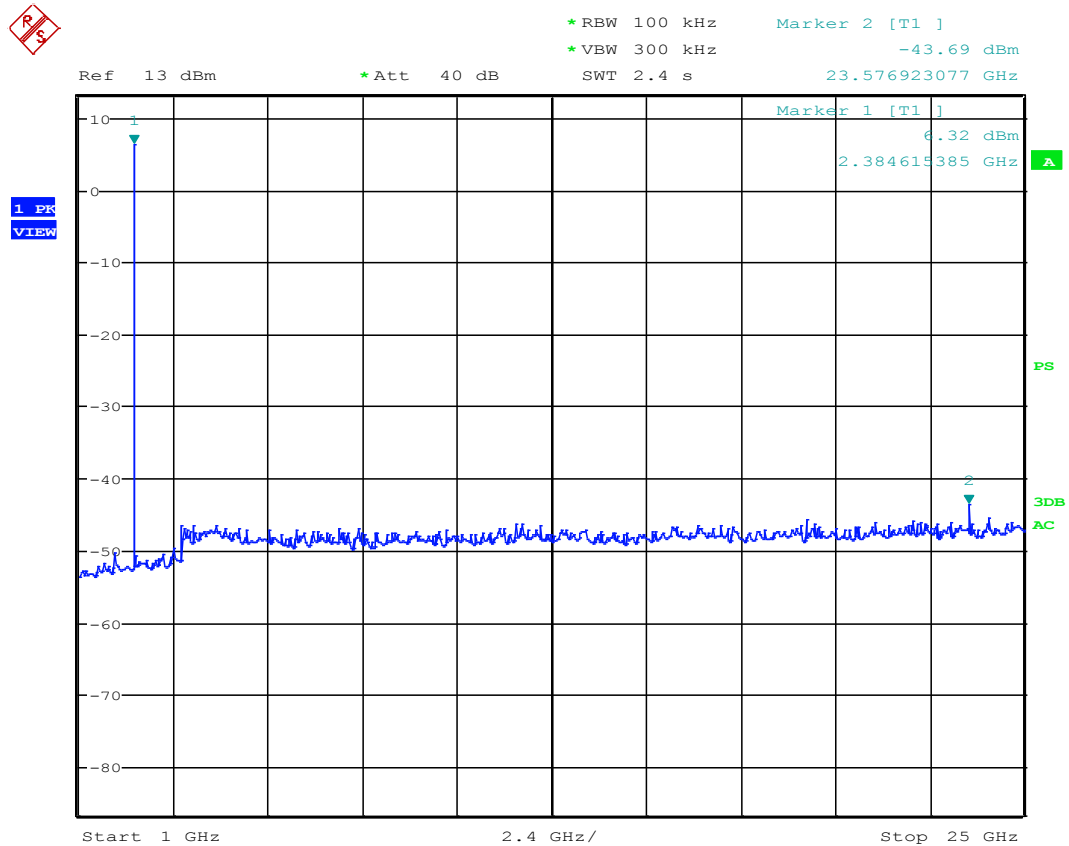
Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 11

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



Date: 5.MAY.2015 10:26:11

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



Date: 5.MAY.2015 10:29:16

3.8 Power Spectral Density

Criterion: PSD shall be less than 8dBm.

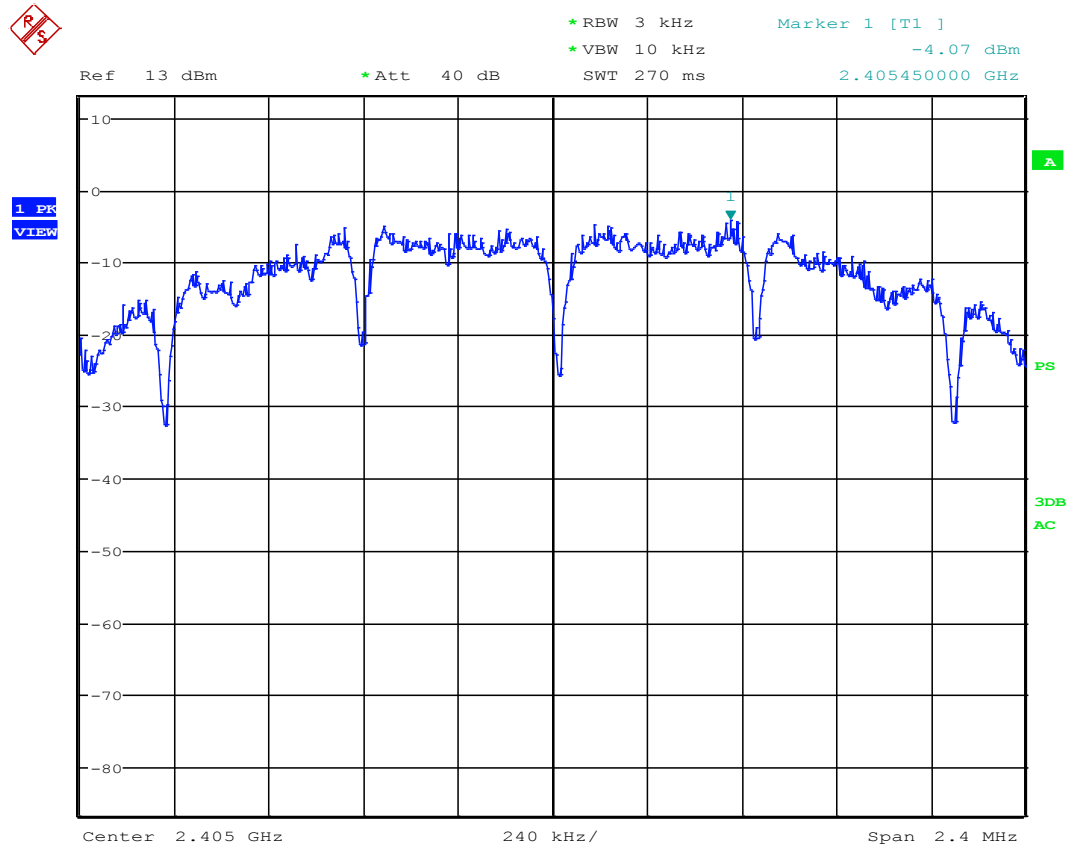
Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 10.2

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	-4.07
18	2440	-4.89
26	2480	-4.85

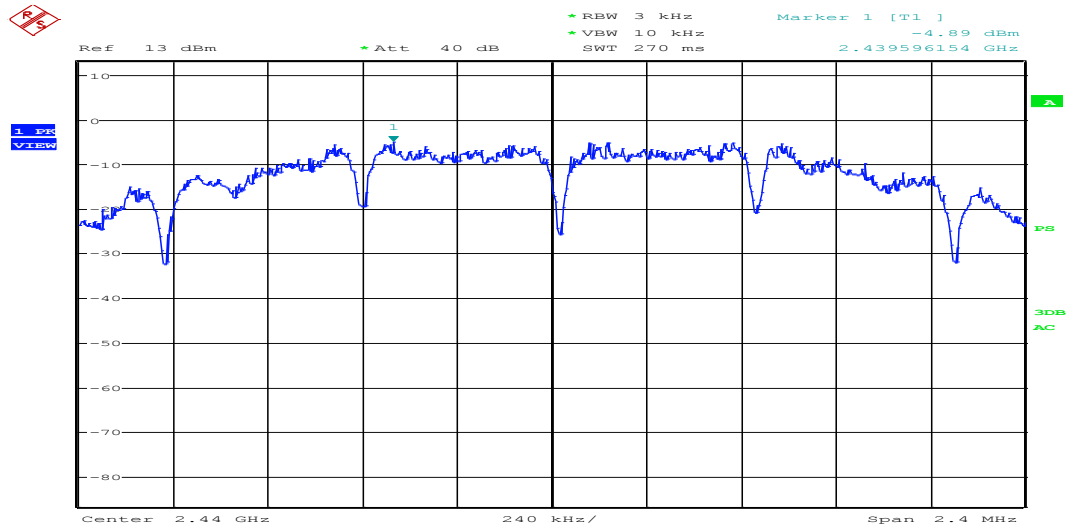
Power Spectral Density, Channel 11:



Date: 5.MAY.2015 10:33:10

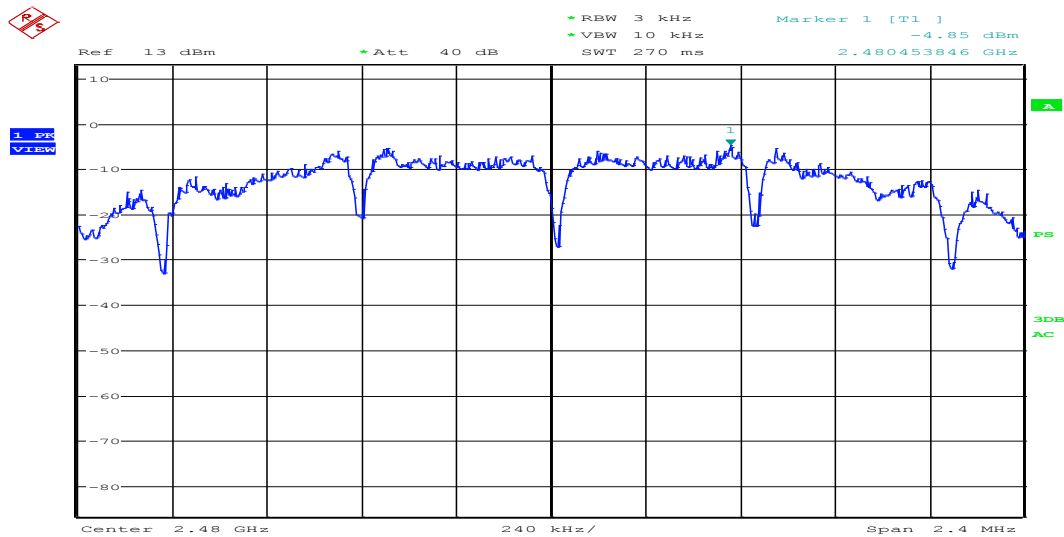


Power Spectral Density, Channel 18:



Date: 5.MAY.2015 10:35:23

Power Spectral Density, Channel 26:



Date: 5.MAY.2015 10:37:32

3.9 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.

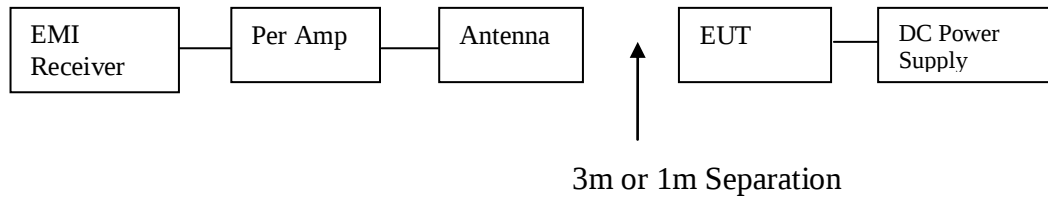
Test Procedure: Per 558074 D01 DTS Meas Guidance v03r02 § 11
Radiated spurious emission was performed from 30 MHz to the tenth harmonics of the carrier. For each scan of radiated emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1 m and 4 m in order to maximize the emission. 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 3-meter distance between an antenna and the EUT. All radiated emission measurements, above 18 GHz, were performed at 0.3-meter distance between an antenna and the EUT.

The peak level of radiated emissions above 1 GHz was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz. Average level was measured with VDW of 10Hz, duty cycle correction factor was applied to harmonics.

A factor of 20 dB/decade applies to measurements made at a closer distance than the limit distance before comparing to the limits.

EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes). EUT antenna can be maximized since it is a trace on the board.

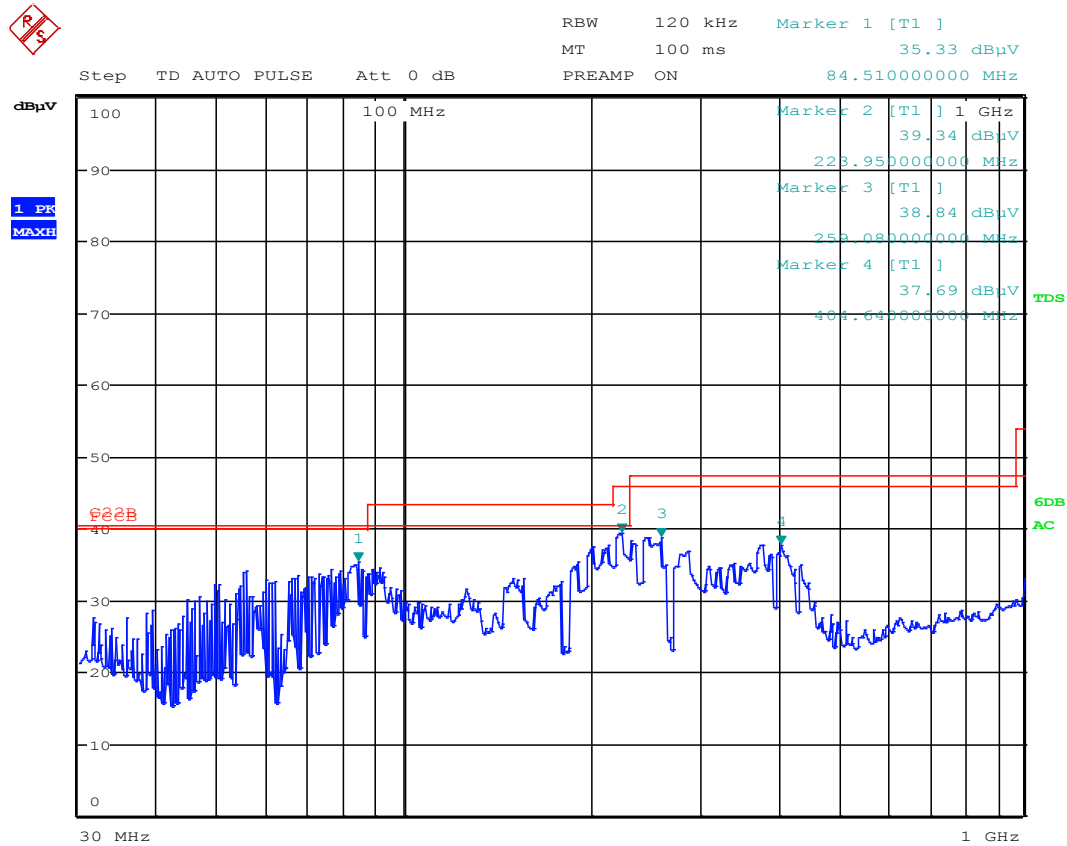
Block Diagram:





Radiated Emissions Data:

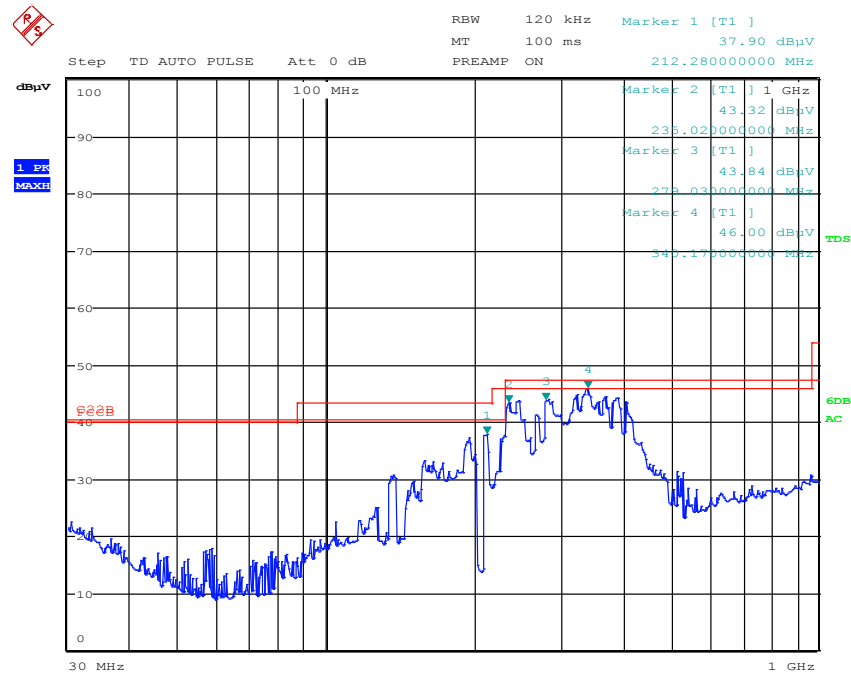
30MHz-1GHz VERTICAL:



Date: 7.MAY.2015 09:34:14



30MHz-1GHz HORIZONTAL:



Date: 7.MAY.2015 09:37:01

Antenna	Frequency (MHz)	Measured Level (dBuV/m)	FCC Class B		CISPR 22 Class B	
			Limit (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Margin (dB)
V	30.18	35.9	40	4.1	40.5	4.6
V	83.25	37.9	40	2.1	40.5	2.6
V	169.8	34.1	43.5	9.4	40.5	6.4
V	217.26	31.3	46	14.7	40.5	9.2
H	226.29	40	46	6	40.5	0.5
H	264.12	36.9	46	9.1	47.5	10.6
H	330.87	33.8	46	12.2	47.5	13.7

Sample Calculation:

$$QP_{\text{reading}} = \text{Reading(dBuV/m)} + \text{AF(dB/m)} + \text{Cable}_{\text{factor}}(\text{dB})$$

All factors are pre stored in the R & S receiver.

**1-18GHz:**

ANTENNA ORIENTATION	Frequency(MHz)	Field Strength Measured (PK) (dBuV/m)	Field Strength (AVG) (dBuV/m)	Limit (dBuV/m) (PK)	Limit (dBuV/m) (AVG)
V*	2483.5	78	62.76	83.54	63.54
V*	2390	66.9	54.36	83.54	63.54
V*	4960	82.1	60.3	83.54	63.54
V*	7215	78.9	52.5	83.54	63.54
V*	4810	78.9	52.5	83.54	63.54

Duty Cycle Correction Factor: -12.54dB

Sample Calculation:

PK (dBuV/m) = Reading(dBuV/m) – PA(dB) + Antenna Factor (dB/m) + Cable loss(dB)

Avg (dBuV/m) = PK_{reading} – Duty Cycle Correction Factor

All factors are pre stored in the R & S receiver.

***1 METER ANTENNA DISTANCE**

18-24GHz:

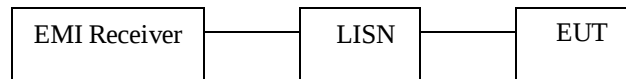
No Emissions Found.

3.10 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.

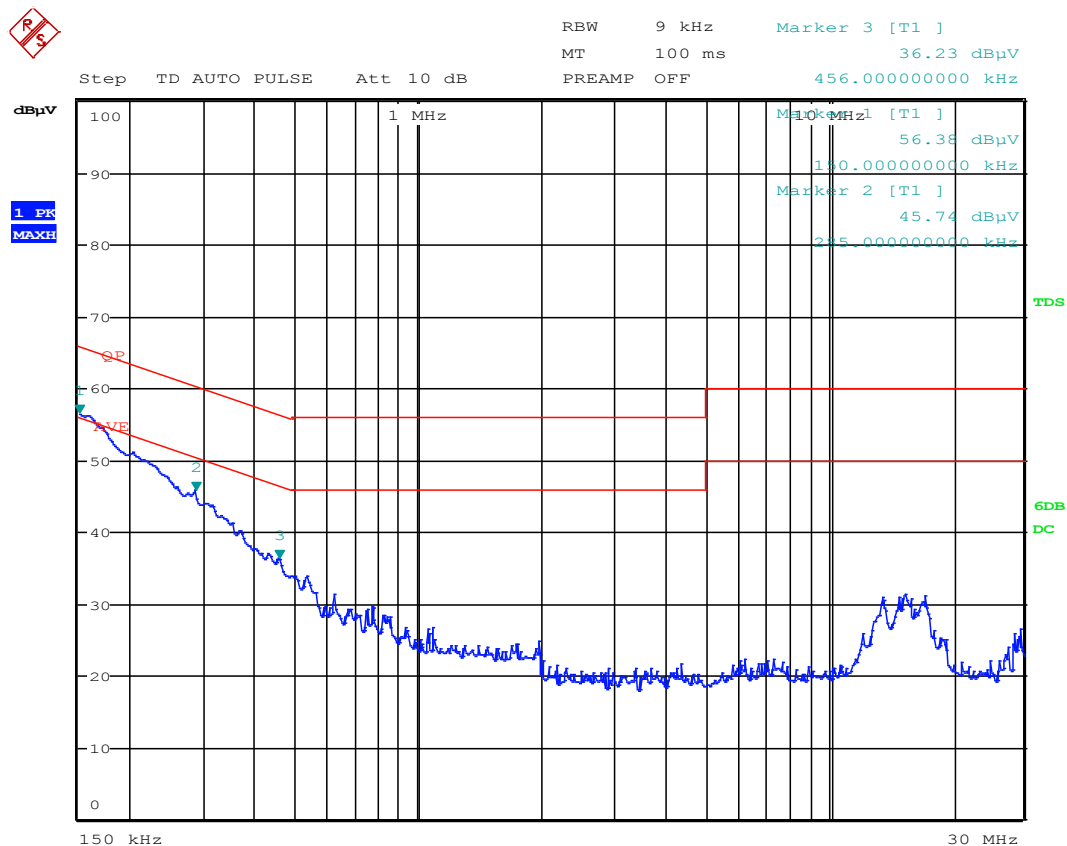
Test Details: AC power line conducted emissions were performed from 150 kHz to 30 MHz and measured with a resolution bandwidth of 9 kHz. EUT was set in the receiving mode. Refers to the following screen captures (using a peak detector) and block diagram

Block Diagram:



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

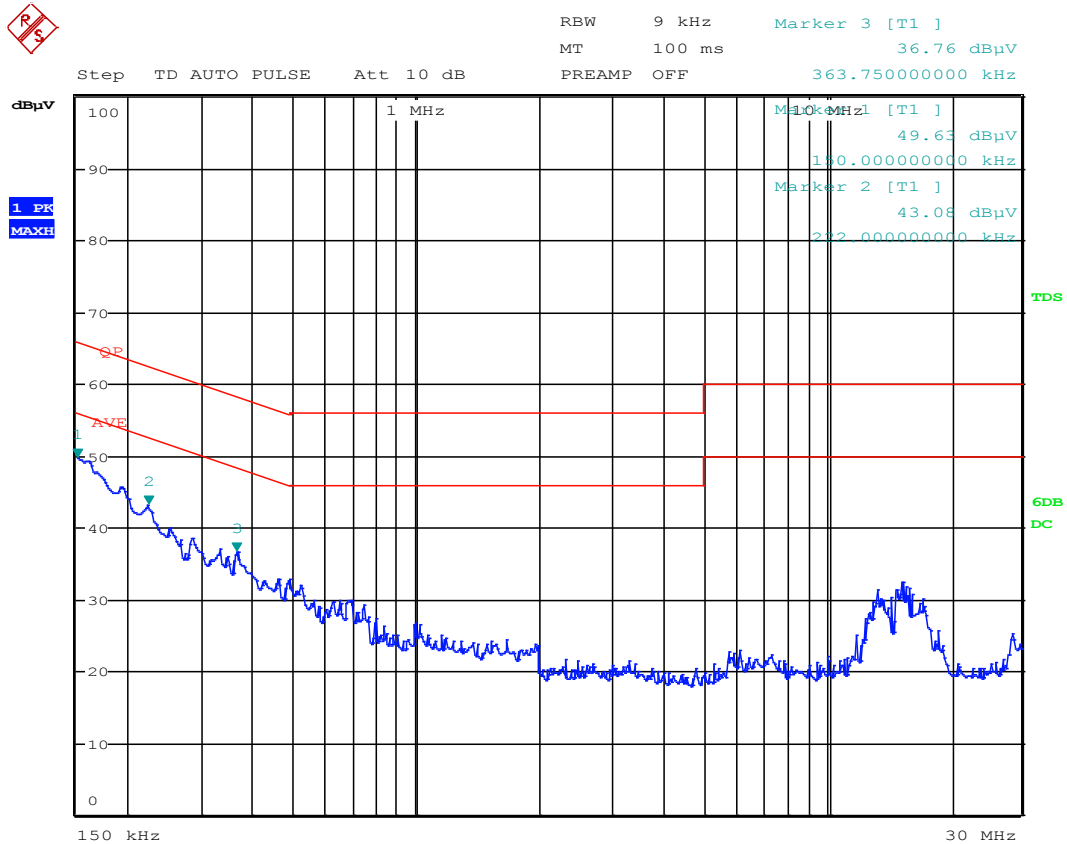
Line 1:



Date: 15.MAY.2015 16:55:41

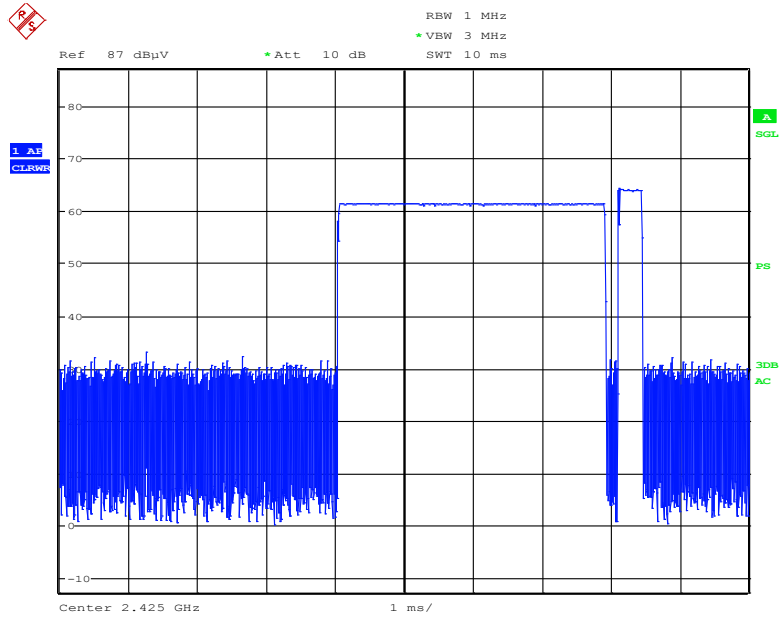
Frequency (MHz)	Measured Level (dBuV)		Limits (dBuV)		Margins (dB)	
	QP	AV	QP	AV	QP	AV
120V/L1						
0.15	46.3	28.8	66.0	56.0	19.7	27.2
0.285	36.4	25.4	60.7	50.7	24.3	25.3
0.456	27.5	15.9	56.8	46.8	29.3	30.9

Line 2:



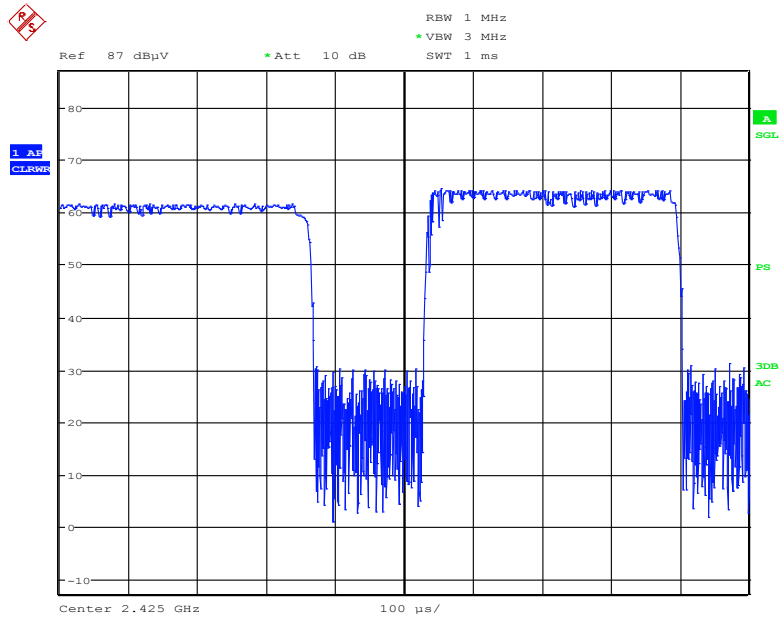
Date: 15.MAY.2015 17:04:26

Frequency (MHz)	Measured Level (dBuV)		Limits (dBuV)		Margins (dB)	
	QP	AV	QP	AV	QP	AV
120V/L2						
0.15	47.6	36.3	66.0	56.0	18.4	19.7
0.222	40	26	62.7	52.7	22.7	26.7
0.36375	30.8	18.3	58.6	48.6	27.8	30.3



Date: 7.MAY.2015 16:51:38

Fig 2



Date: 7.MAY.2015 16:54:11

Fig 3



From Fig (1) and Fig (2)

4 pulses measuring 4ms ON time per pulse $\Rightarrow 4 * 4.4\text{ms} = 17.6\text{ms}$

From Fig (1) and Fig (3)

4 pulses measuring 0.4ms ON time per pulse $\Rightarrow 4 * 1.5\text{ms} = 6\text{ms}$

Total ON time = $(17.6 + 6) \text{ ms} = 23.6 \text{ ms}$

Duty Cycle Correction Factor DCCF = $20 * \log (23.6/100) = -12.54\text{dB}$