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Report On

FCC Testing of the
Crane Electronics Ltd RF-m
In accordance with FCC CFR 47 Part 15C

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FCC ID: TA6RFMT1

Document 75928950 Report 04 Issue 1

March 2015



Product Service

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REPORT ON

FCC Testing of the
Crane Electronics Ltd RF-m
In accordance with FCC CFR 47 Part 15C

Document 75928950 Report 04 Issue 1

March 2015

PREPARED FOR

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Authorised Signatory

DATED

26 March 2015

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 15C. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);



T Guy



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SECTION 1

1 REPORT SUMMARY

FCC Testing of the
Crane Electronics Ltd RF-m
In accordance with FCC CFR 47 Part 15C



1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC Testing of the Crane Electronics Ltd RF-m to the requirements of FCC CFR 47 Part 15C.

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	Crane Electronics Ltd
Model Number(s)	RF-m
Serial Number(s)	95336
Number of Samples Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 15C (2014)
Incoming Release Date	Declaration of Build Status 04 February 2015
Disposal Reference Number	Held Pending Disposal
Date	Not Applicable
Order Number	046003
Date	08 January 2015
Start of Test	21 February 2015
Finish of Test	21 February 2015
Name of Engineer(s)	T Guy
Related Document(s)	ANSI C63.10: 2009



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 15C is shown below.

Section	Spec Clause	Test Description	Result	Comments/Base Standard
Transmit				
2.1	15.249 (a) and 15.35 (b)	Field Strength of Fundamental	Pass	
2.2	15.249 (a)(d)	Field Strength of Spurious Emissions	Pass	



Product Service

1.3 DECLARATION OF BUILD STATUS

MAIN EUT			
MANUFACTURING DESCRIPTION	RF Module		
MANUFACTURER	Crane Electronics Ltd.		
TYPE	RF-m		
PART NUMBER	CDWD1-0001-CRXXRX		
SERIAL NUMBER	Not supplied		
HARDWARE VERSION	101464 101465 iss.b		
SOFTWARE VERSION	Test version supplied		
TRANSMITTER OPERATING RANGE	2400 MHz – 2480 MHz		
RECEIVER OPERATING RANGE	2400 MHz – 2480 MHz		
COUNTRY OF ORIGIN	UK		
INTERMEDIATE FREQUENCIES	None		
EMISSION DESIGNATOR(S): (i.e. G1D, GXW)	1M00F1D		
MODULATION TYPES: (i.e. GMSK, QPSK)	GFSK		
HIGHEST INTERNALLY GENERATED FREQUENCY	16MHz		
OUTPUT POWER (W or dBm)	0dBm		
FCC ID	TA6RFMT1		
INDUSTRY CANADA ID	Not supplied		
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	The RF-m takes torque and angle signals from a transducer and transmits the reading to a datacollector.		
BATTERY/POWER SUPPLY			
MANUFACTURING DESCRIPTION	Li-Ion battery		
MANUFACTURER	INOV8		
TYPE	Li-Ion		
PART NUMBER	LI42B		
VOLTAGE	3.7V		
COUNTRY OF ORIGIN	CHINA		
MODULES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
POWER			
FCC ID			
COUNTRY OF ORIGIN			
INDUSTRY CANADA ID			
EMISSION DESIGNATOR			
DHSS/FHSS/COMBINED OR OTHER			
ANCILLARIES (if applicable)			
MANUFACTURING DESCRIPTION	Rotary transducer	Torque module	Laptop pc
MANUFACTURER	Crane Electronics Ltd.	Crane Electronics Ltd.	
TYPE	25Nm with angle	Torque Module	
PART NUMBER		IQVT1-0001-CRXXRX	
SERIAL NUMBER	94495	94509	
COUNTRY OF ORIGIN	UK	UK	

Signature

Date 4/2/15
Declaration of Build Status Serial Number



1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Crane Electronics Ltd RF-m. 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 3.7 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 standard were made during testing.

1.7 MODIFICATION RECORD

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



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SECTION 2

2TEST DETAILS

FCC Testing of the
Crane Electronics Ltd RF-m
In accordance with FCC CFR 47 Part 15C



2.1 FIELD STRENGTH OF FUNDAMENTAL

2.1.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.249 (a) and 15.35 (b)

2.1.2 Equipment Under Test and Modification State

RF-m S/N: 95336 - Modification State 0

2.1.3 Date of Test

21 February 2015

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 performed in accordance with ANSI C63.10, Clause 6.3 and the guidelines in Clause 6.10.2.

Remarks

The duty cycle of the transmission was measured as follows:

On Time = 4.198 ms
 Off Time = 35.769 ms

Duty Cycle Correction = $20 \log (4.198 / 4.198 + 35.769) = 19.57 \text{ dB}$

The duty cycle correction was applied to the peak result to determine the average result.

2.1.6 Environmental Conditions

Ambient Temperature	20.0°C
Relative Humidity	28.0%

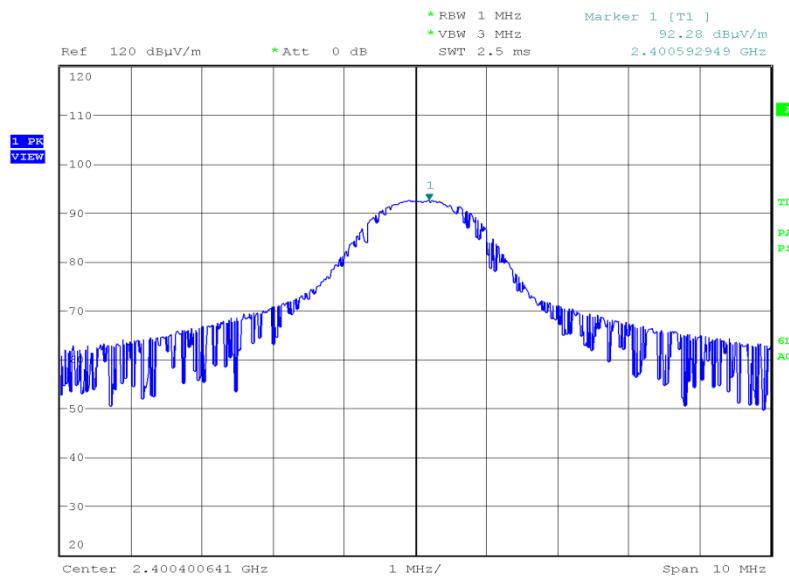


2.1.7 Test Results

Frequency (MHz)	Peak (dB μ V/m)	Average (dB μ V/m)
2400.5	92.28	72.71

2400.5 MHz

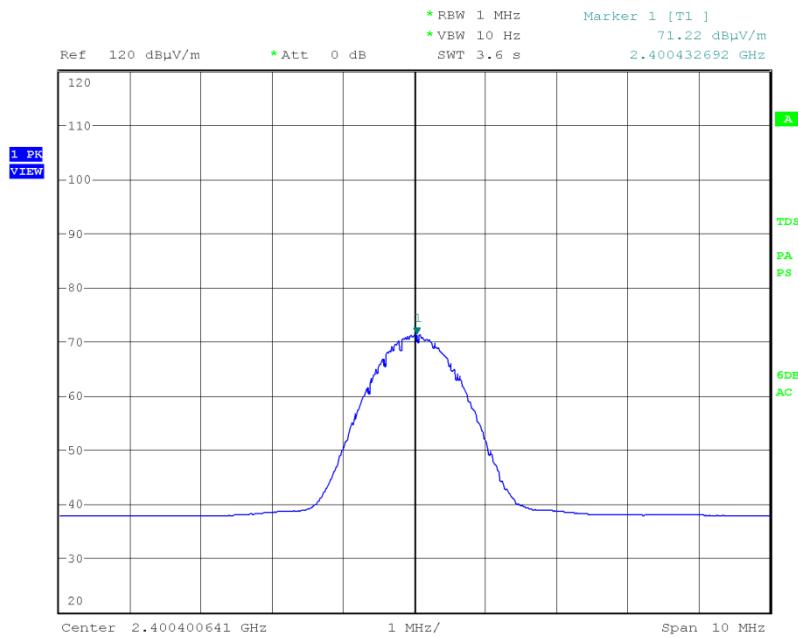
Fundamental Peak



Date: 21.FEB.2015 03:02:37



Product Service

Fundamental Average

Date: 21.FEB.2015 03:07:11



Product Service

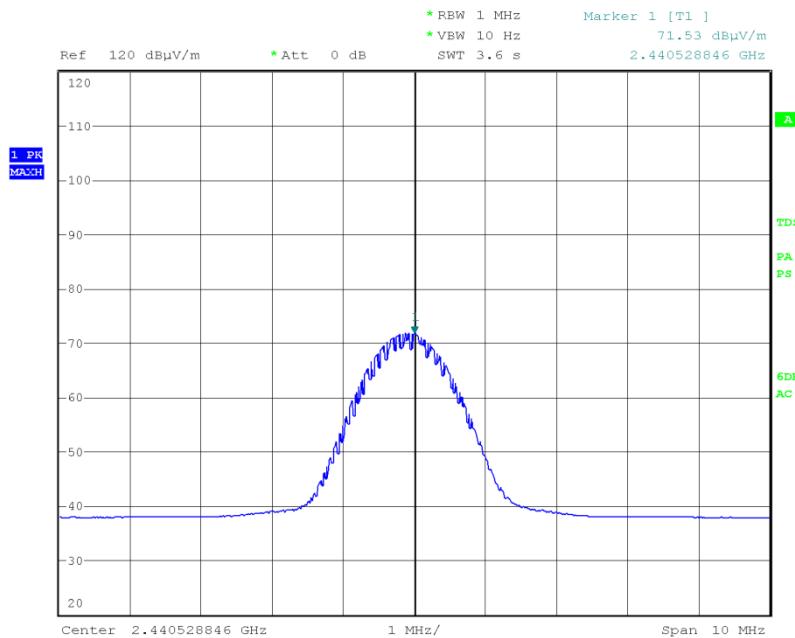
Frequency (MHz)	Peak (dB μ V/m)	Average (dB μ V/m)
2440.5	93.23	73.66

2440.5 MHzFundamental Peak

Date: 21.FEB.2015 03:09:57



Product Service

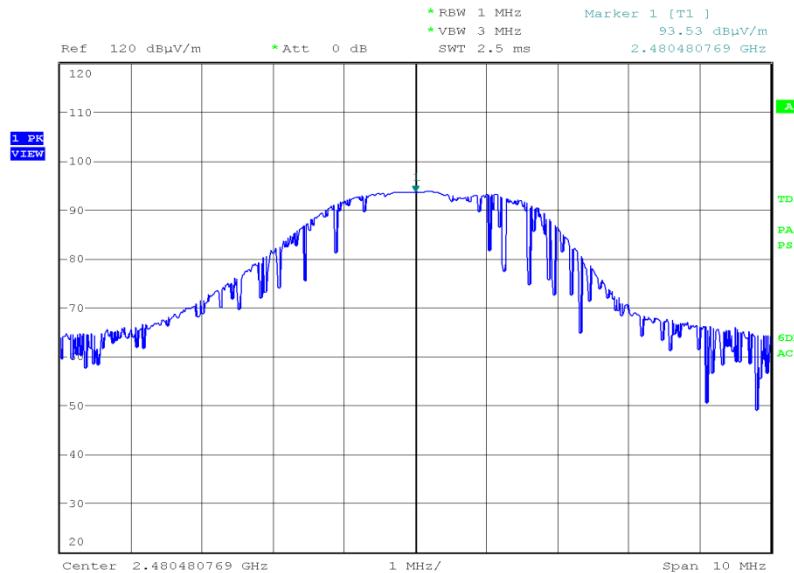
Fundamental Average

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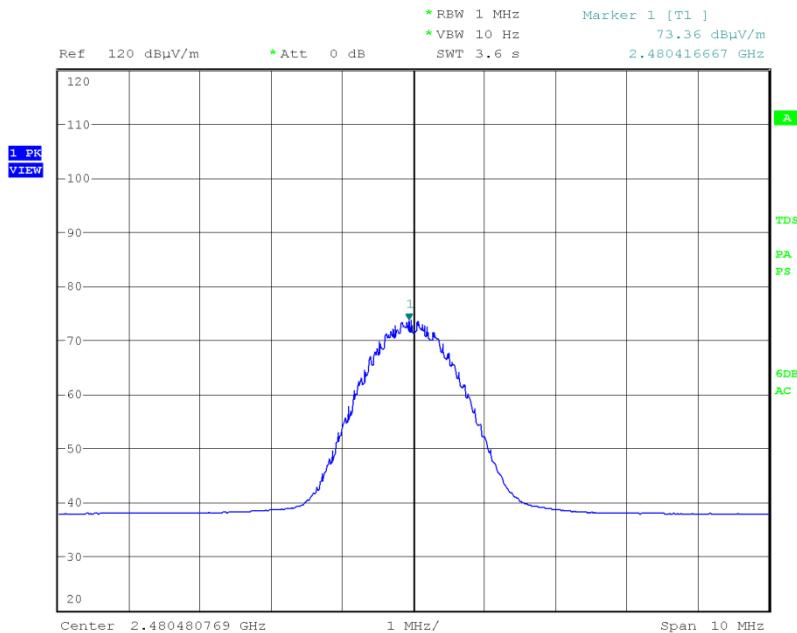


Product Service

Frequency (MHz)	Peak (dB μ V/m)	Average (dB μ V/m)
2480.5	93.53	73.96

2480.5 MHzFundamental Peak

Date: 21.FEB.2015 02:56:32

Fundamental Average

Date: 21.FEB.2015 02:59:31

Limit Clause15.249 (a)

Fundamental Frequency (MHz)	Average Field Strength of Fundamental (millivolts/meter)
2400 to 2483.5	50

15.35 (b)

The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.



2.2 FIELD STRENGTH OF SPURIOUS EMISSIONS

2.2.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.249 (a)(d)

2.2.2 Equipment Under Test and Modification State

RF-m S/N: 95336 - Modification State 0

2.2.3 Date of Test

21 February 2015

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 test was performed in accordance with ANSI C63.10, Clause 6.3 and 6.9.2.

Remarks

The duty cycle of the transmission was measured as follows:

On Time = 4.198 ms

Off Time = 35.769 ms

Duty Cycle Correction = $20 \log (4.198 / 4.198 + 35.769) = 19.57 \text{ dB}$

The duty cycle correction was applied to the peak result to determine the average result of harmonics.

2.2.6 Environmental Conditions

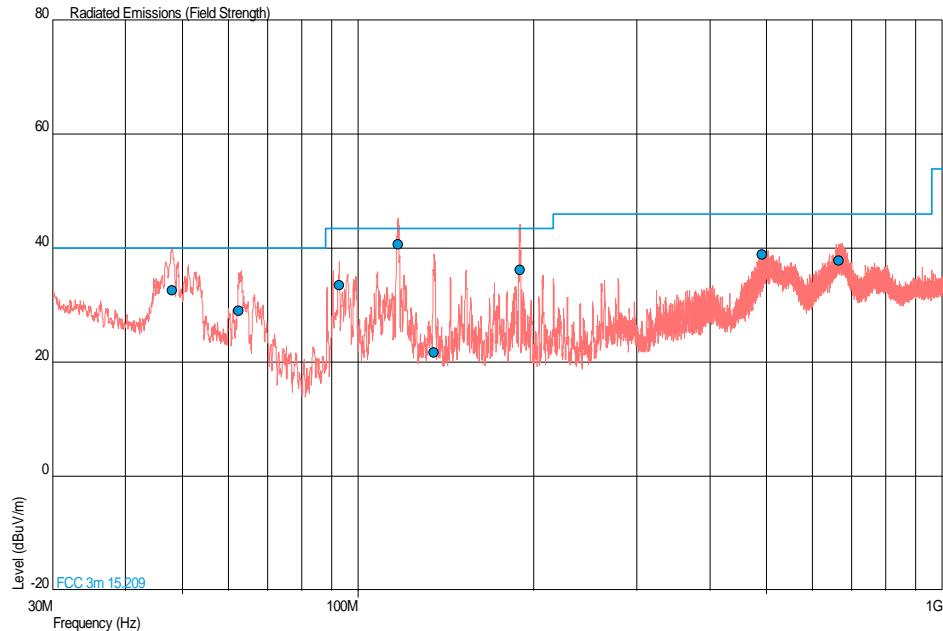
Ambient Temperature	19.8 - 20.1°C
Relative Humidity	28.0 - 30.1%



2.2.7 Test Results

2400.5 MHz

30 MHz to 1 GHz



Frequency (MHz)	QP Level (dBuV/m)	QP Margin (dBuV/m)	QP Level (uV/m)	QP Margin (uV/m)	Angle(Deg)	Height(m)	Polarity
48.040	32.6	-7.4	42.7	-57.3	360	1.00	Vertical
62.471	29.1	-10.9	28.5	-71.5	216	1.00	Vertical
92.866	33.5	-10.0	47.3	-102.7	198	1.00	Vertical
117.158	40.7	-2.8	108.4	-41.6	30	1.00	Vertical
135.003	21.7	-21.8	12.2	-137.8	83	1.00	Vertical
189.256	36.2	-7.3	64.6	-85.4	268	1.00	Vertical
491.568	38.8	-7.2	87.1	-112.9	192	1.00	Vertical
665.273	37.8	-8.2	77.6	-122.4	322	1.00	Vertical

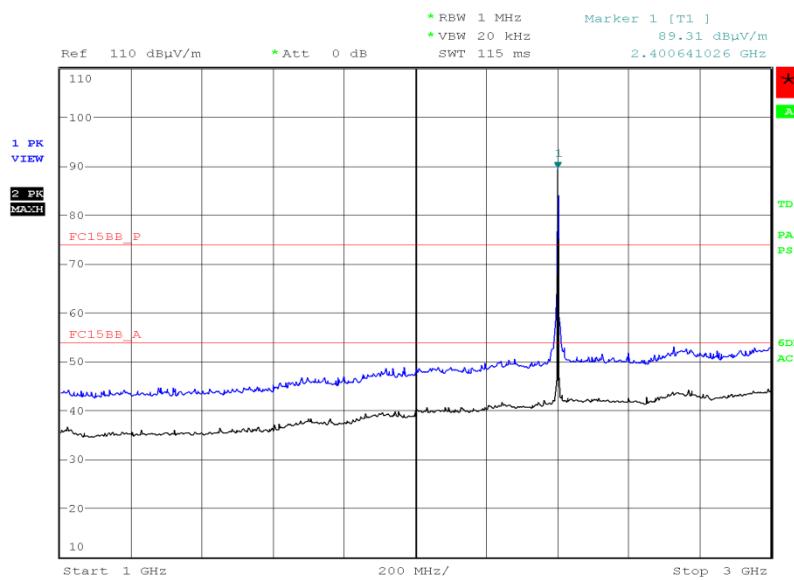


Product Service

1 GHz to 25 GHz

Frequency (GHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Final Peak (dB μ V/m)	Final Average (dB μ V/m)
4.801	Vertical	144	20	59.24	39.67*

* The average result is obtained by subtracting the duty cycle correcton factor from the peak result.

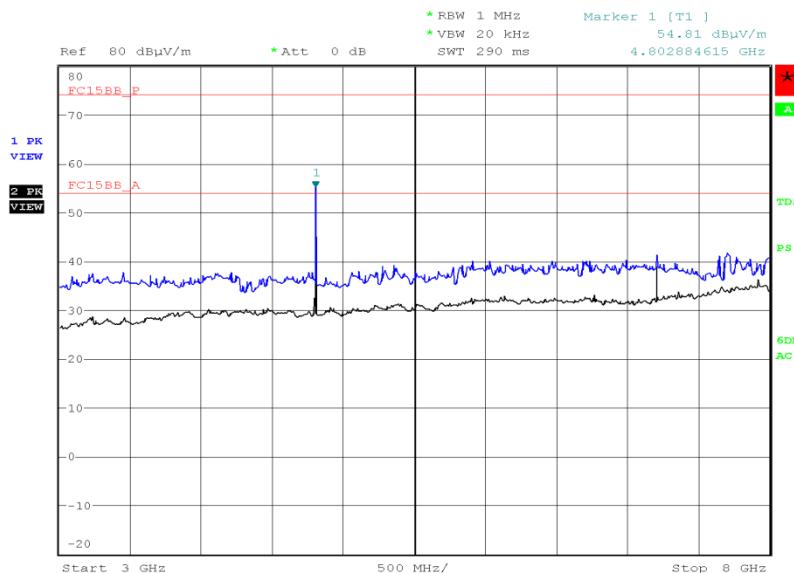
1 GHz to 3 GHz

Date: 20.FEB.2015 04:08:45

3 GHz to 8 GHz



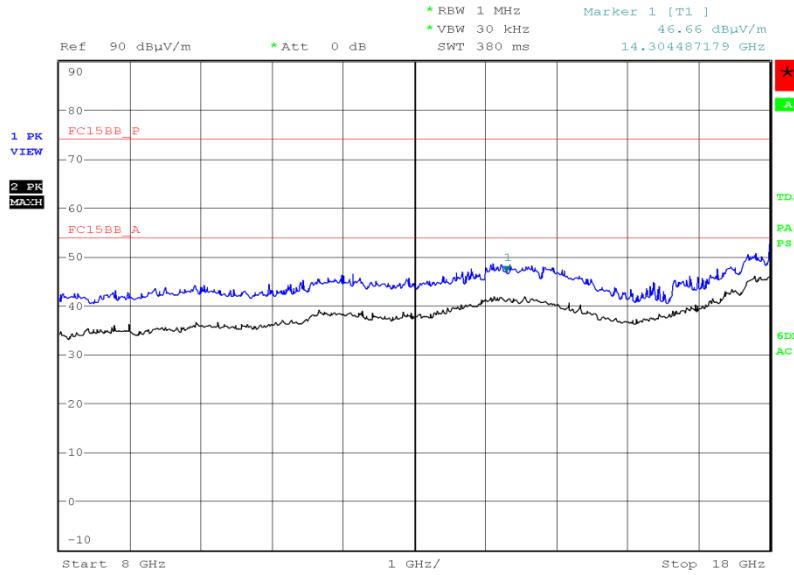
Product Service



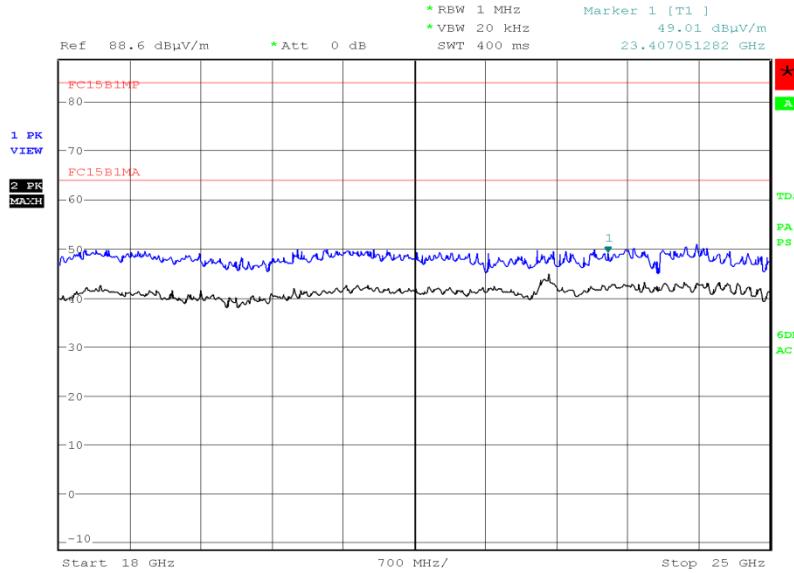
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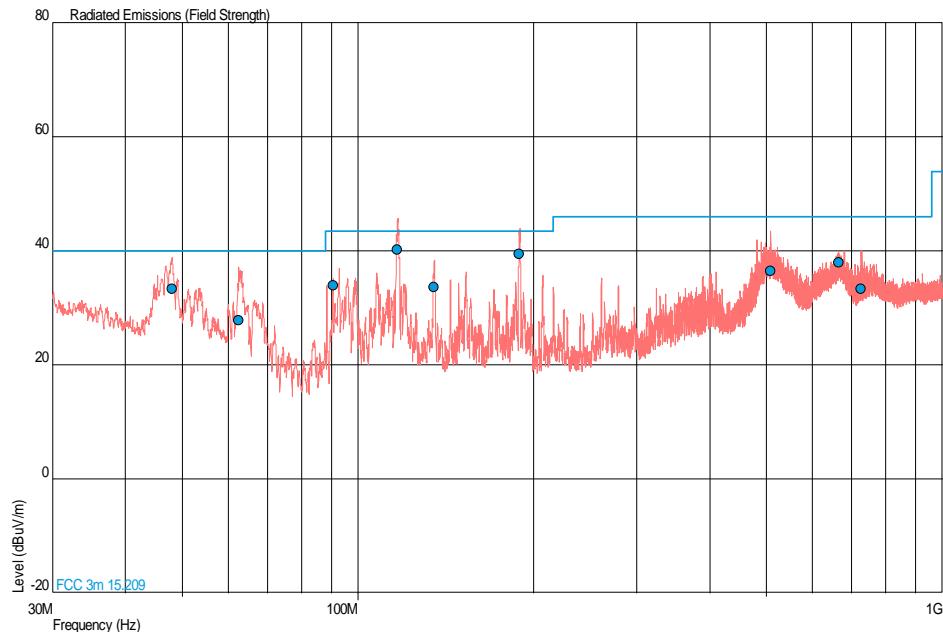
Product Service

8 GHz to 18 GHz

Date: 21.FEB.2015 21:43:07

18 GHz to 25 GHz

Date: 21.FEB.2015 23:24:38

2440.5 MHz30 MHz to 1 GHz

Frequency (MHz)	QP Level (dBuV/m)	QP Margin (dBuV/m)	QP Level (uV/m)	QP Margin (uV/m)	Angle(Deg)	Height(m)	Polarity
48.037	33.4	-6.6	46.8	-53.2	90	1.00	Vertical
62.475	27.8	-12.2	24.5	-75.5	360	1.00	Vertical
90.713	34.0	-9.5	50.1	-99.9	195	1.25	Vertical
116.679	40.2	-3.3	102.3	-47.7	23	1.00	Vertical
134.910	33.6	-9.9	47.9	-102.1	119	1.00	Vertical
188.710	39.4	-4.1	93.3	-56.7	232	1.02	Vertical
508.428	36.5	-9.5	66.8	-133.2	191	1.00	Vertical
665.273	38.0	-8.0	79.4	-120.6	323	1.00	Vertical
726.148	33.3	-12.7	46.2	-153.8	306	1.57	Horizontal

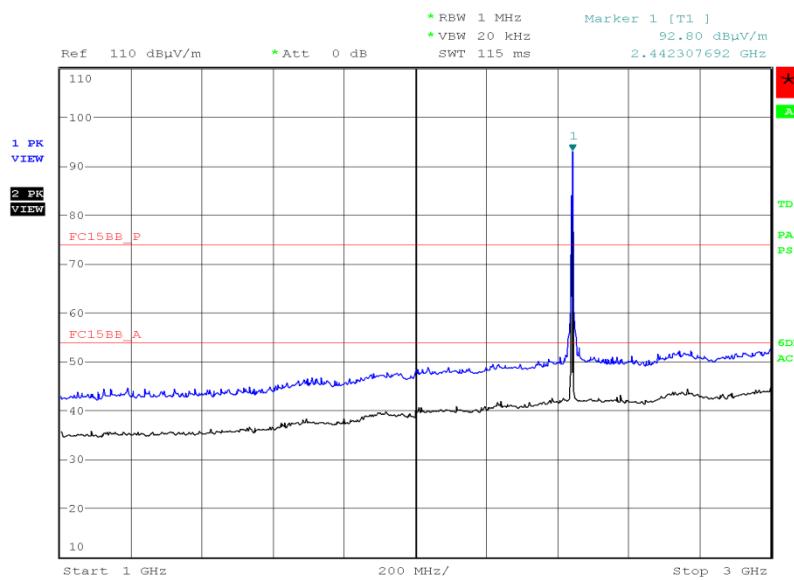


Product Service

1 GHz to 25 GHz

Frequency (GHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Final Peak (dB μ V/m)	Final Average (dB μ V/m)
4.880	Vdertical	155	30	61.36	41.79*

* The avergae result is obtained by subtracting the duty cycle correcton factor from the peak result.

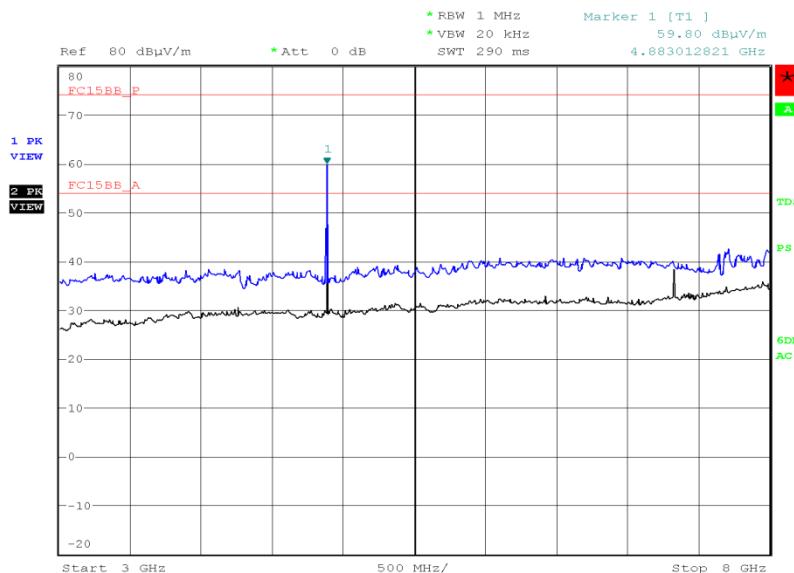
1 GHz to 3 GHz

Date: 20.FEB.2015 04:13:54

3 GHz to 8 GHz



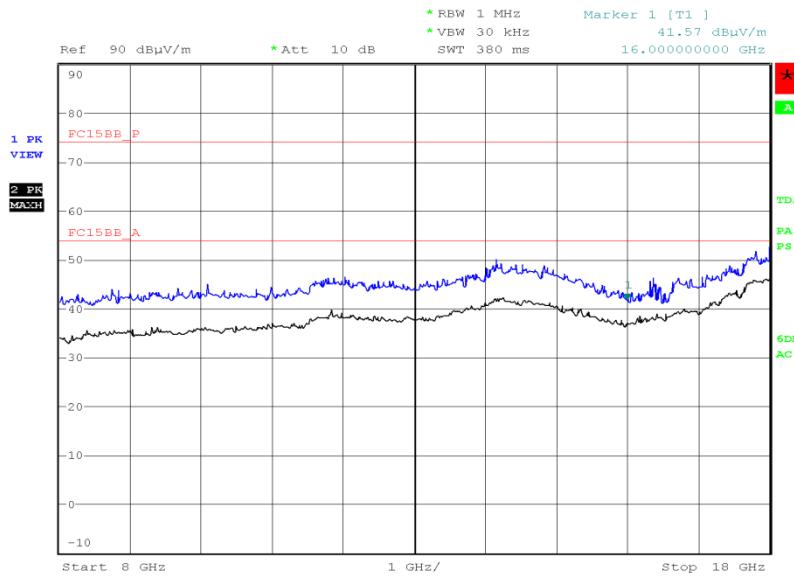
Product Service



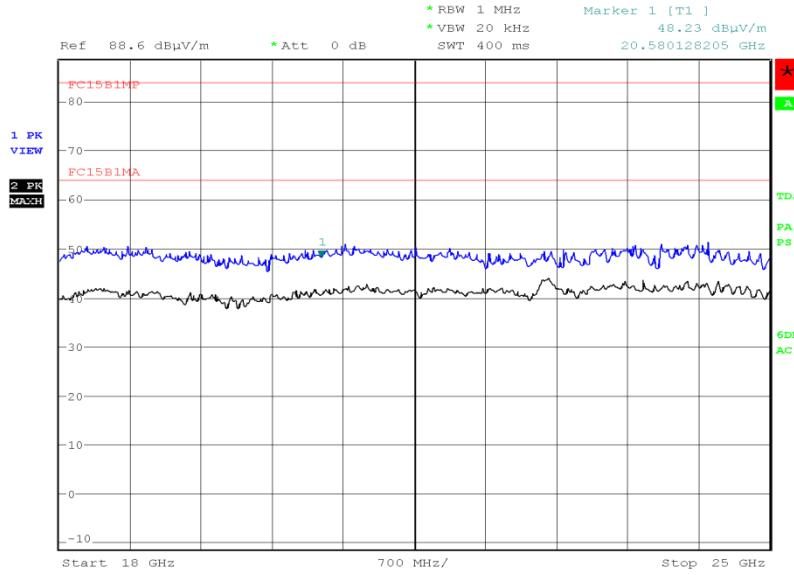
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Product Service

8 GHz to 18 GHz

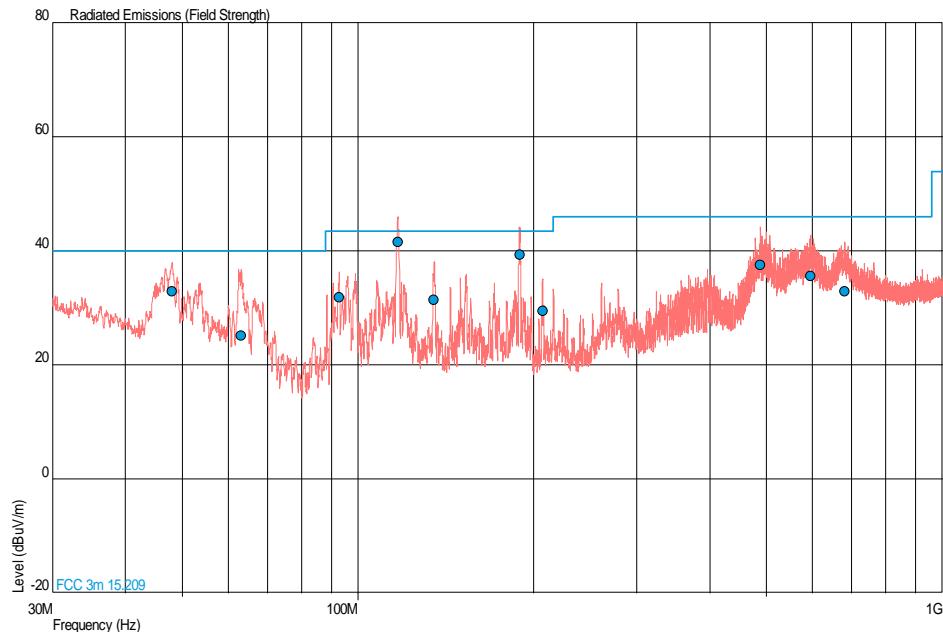
Date: 21.FEB.2015 21:27:08

18 GHz to 25 GHz

Date: 21.FEB.2015 23:07:08



Product Service

2480.5 MHz30 MHz to 1 GHz

Frequency (MHz)	QP Level (dBuV/m)	QP Margin (dBuV/m)	QP Level (uV/m)	QP Margin (uV/m)	Angle(Deg)	Height(m)	Polarity
48.034	32.9	-7.1	44.2	-55.8	70	1.00	Vertical
63.091	25.2	-14.8	18.2	-81.8	360	1.06	Vertical
92.843	31.9	-11.6	39.4	-110.6	123	1.00	Vertical
116.970	41.6	-1.9	120.2	-29.8	96	1.02	Vertical
134.957	31.4	-12.1	37.2	-112.8	101	1.06	Vertical
189.280	39.3	-4.2	92.3	-57.7	216	1.00	Vertical
206.996	29.5	-14.0	29.9	-120.1	217	1.00	Vertical
488.377	37.5	-8.5	75.0	-125.0	181	1.06	Vertical
594.278	35.6	-10.4	60.3	-139.7	13	1.00	Vertical
679.987	32.9	-13.1	44.2	-55.8	323	1.00	Vertical

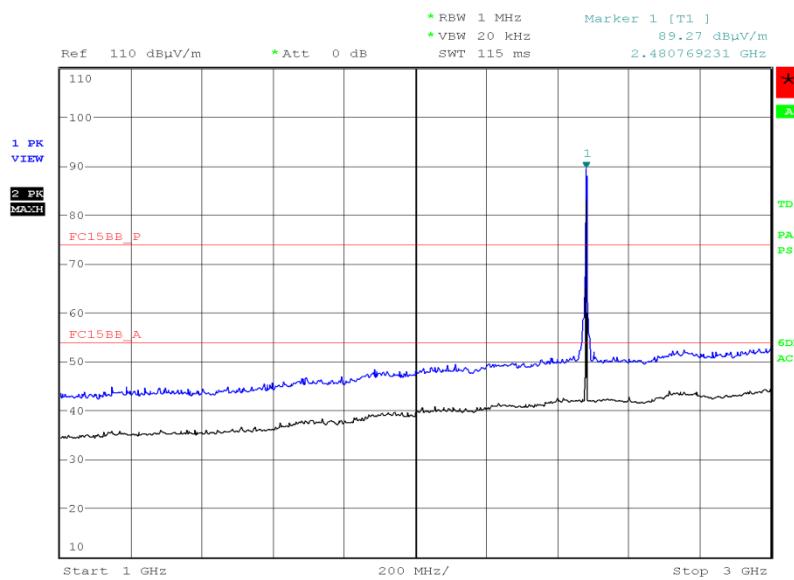


Product Service

1 GHz to 25 GHz

Frequency (GHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Final Peak (dB μ V/m)	Final Average (dB μ V/m)
4.960	Vertical	152	237	62.97	43.40*

* The average result is obtained by subtracting the duty cycle correcton factor from the peak result.

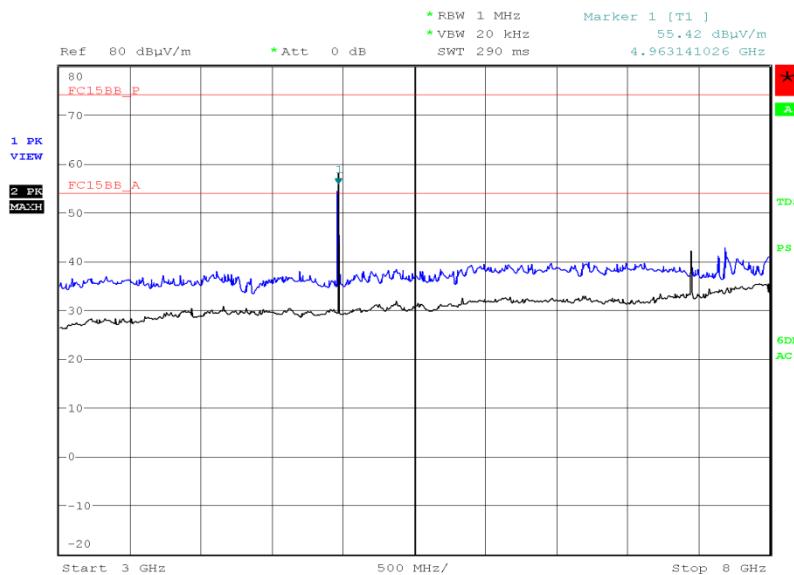
1 GHz to 3 GHz

Date: 20.FEB.2015 04:01:58

3 GHz to 8 GHz



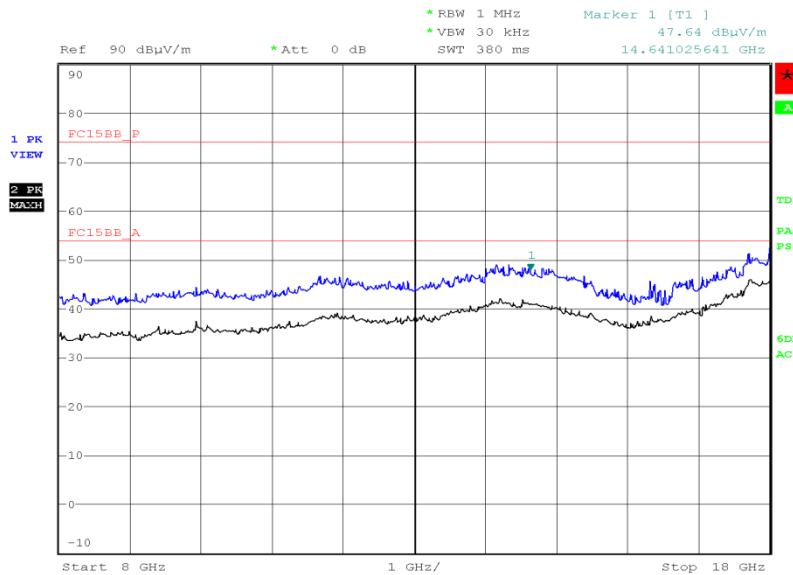
Product Service



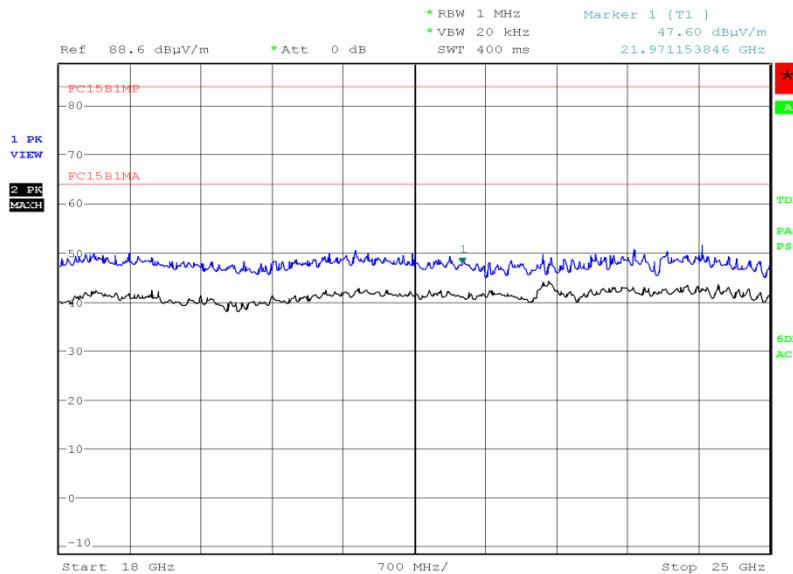
Date: 21.FEB.2015 03:54:18



Product Service

8 GHz to 18 GHz

Date: 21.FEB.2015 21:49:29

18 GHz to 25 GHz

Date: 21.FEB.2015 23:18:37



Product Service

Limit Clause15.249 (a)

Fundamental Frequency (MHz)	Field Strength of Harmonics (microvolts/meter)
2400 to 2483.5	500

15.249 (d), 15.209

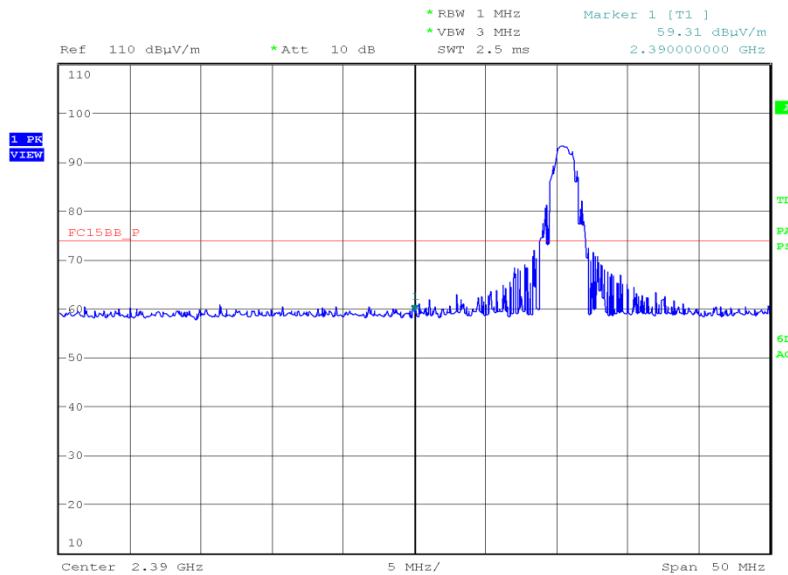
Frequency (MHz)	Field Strength (microvolts/meter)
0.009 to 0.490	2400/F (kHz)
0.490 to 1.705	24000/F (kHz)
1.705 to 30.0	30
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500



Product Service

Band Edge Emissions

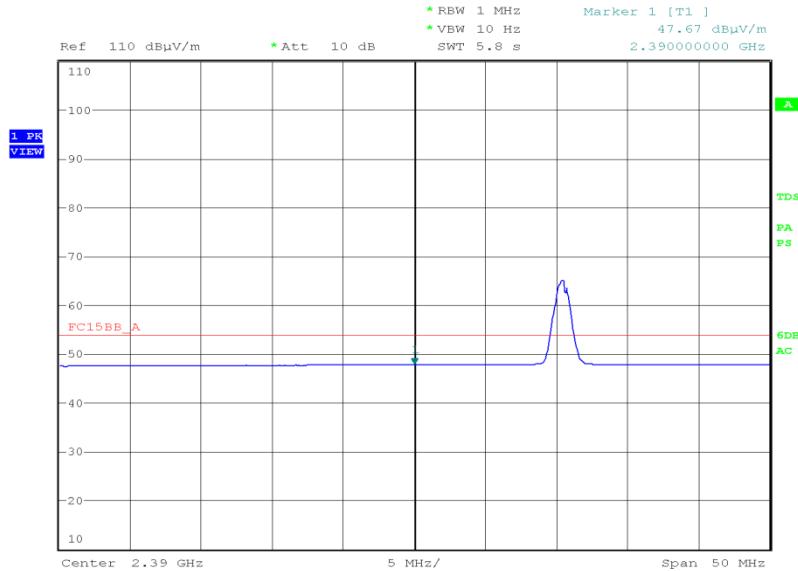
Restricted Bands of Operation		
Frequency (MHz)	Final Peak (dB μ V/m)	Final Average (dB μ V/m)
2390.00	59.31	47.67
2483.50	67.73	47.53

2390.00 MHzFinal Peak

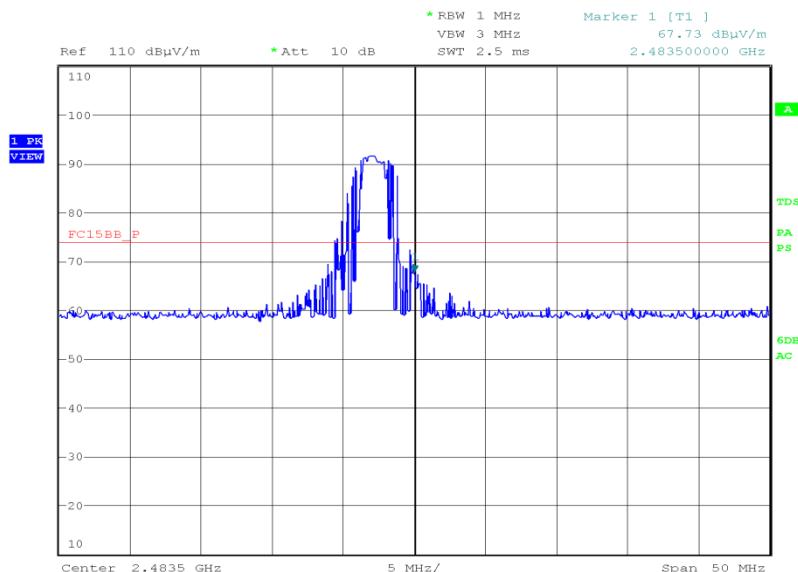
Date: 20.FEB.2015 03:07:22



Product Service

Final Average

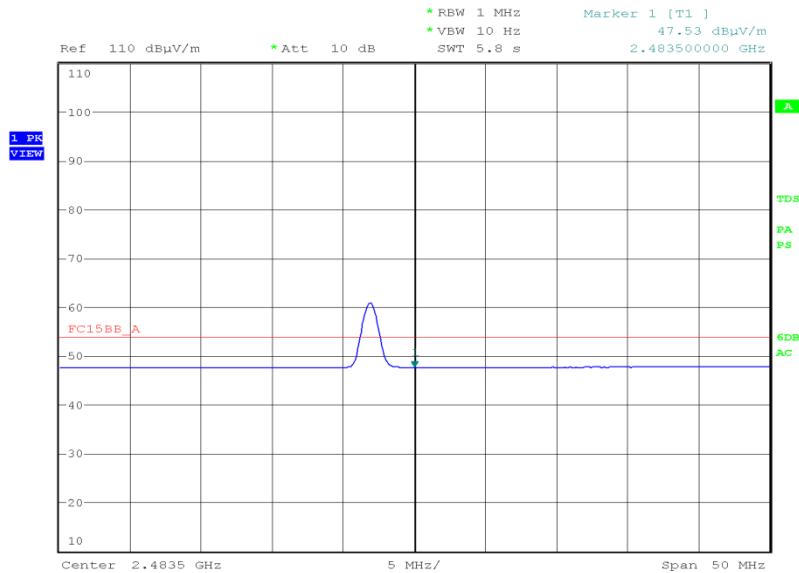
Date: 20.FEB.2015 03:09:11

2483.50 MHzFinal Peak

Date: 20.FEB.2015 03:42:33



Product Service

Final Average

Date: 20.FEB.2015 03:44:54



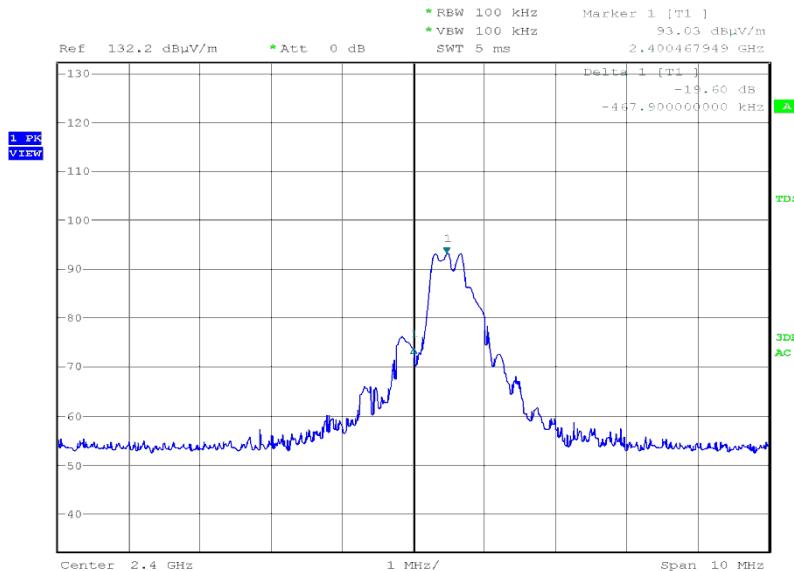
Product Service

Authorised Band Edge	
Frequency (MHz)	Final Average (dB μ V/m)
2400.00	53.71*
2483.50	47.53

*The marker delta method was used to determine the final average result at 2400.00 MHz. The final peak was level was measured at 92.88 dB μ V/m. The plot below shows the marker delta at 19.60 dB. Therefore, $92.88 \text{ dB}\mu\text{V/m} - 19.60 \text{ dB} = 73.28 \text{ dB}\mu\text{V/m}$.

The duty cycle correction of 19.57 dB was then applied to the final peak result to obtain the final average result. This is, $73.28 \text{ dB}\mu\text{V/m} - 19.57 \text{ dB} = 53.71 \text{ dB}\mu\text{V/m}$.

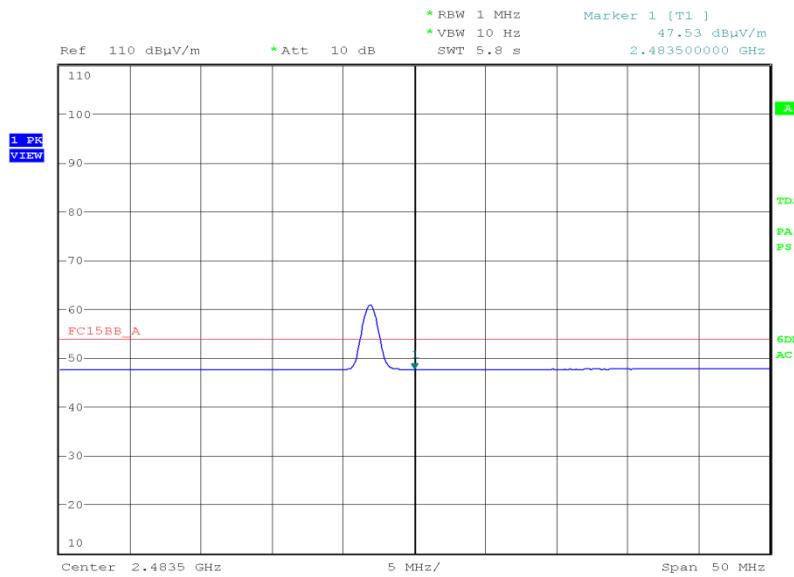
2400.00 MHz



Date: 1.MAR.2015 10:01:59



Product Service

2483.50 MHzFinal Average

Date: 20.FEB.2015 03:44:54

Limit

Peak (dB μ V/m)	Average (dB μ V/m)
74.0	54.0



Product Service

SECTION 3

3TEST EQUIPMENT USED



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 - Field Strength of Fundamental					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	2-May-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Signal Generator	Rohde & Schwarz	SMT03	1907	12	27-Jun-2015
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	16-Jul-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-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	3980	12	22-Sep-2015
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	22-Sep-2015
Section 2.2 - Field Strength of Spurious Emissions					
Antenna (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	26-Nov-2015
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	2-May-2015
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Pre-Amplifier	Phase One	PS04-0086	1533	12	23-Dec-2015
Pre-Amplifier	Phase One	PS04-0087	1534	12	23-Dec-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	1-Oct-2015

TU – Traceability Unscheduled



3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Field Strength of Fundamental	30MHz to 1GHz: ± 5.1 dB 1GHz to 40GHz: ± 6.3 dB
Field Strength of Spurious Emissions	30MHz to 1GHz: ± 5.1 dB 1GHz to 40GHz: ± 6.3 dB



Product Service

SECTION 4

4 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

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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