REPORT ON THE RADIO TESTING

FOR

DRUCK LTD T/A GE MEASUREMENT & CONTROL

ON

ADTS TOUCH-ER (ENHANCED RANGE)

DOCUMENT NO. TRA-028272-03-47-00A

0026

Report Number: TRA-028272-03-47-00A
Issue: A

REPORT ON THE RADIO TESTING OF A
Druck Ltd t/a GE Measurement & Control
ADTS TOUCH-ER (Enhanced Range)
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247 Issue 1
(Selected parts)

TEST DATE: 6th August 2015 – 21st August 2015

Tested by: A Tosif

A Tosif
Radio Test Engineer

Approved by: John Charters

Digitally signed by John Charters
DN: cn=John Charters, o=Element Materials Technology, ou, email=john.charters@element.com, c=GB
Date: 2015.11.20 15:10:11 Z

John Charters
Radio Product Manager

Date: 7th September 2015

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	7/9/2015	Original

2 Summary

TEST REPORT NUMBER:	TRA-028272-03-47-00A
WORKS ORDER NUMBER:	TRA-028272-03
PURPOSE OF TEST:	Class II Change
TEST SPECIFICATION(S):	47CFR15.247 & RSS-247 Issue 1 (Selected parts)
EQUIPMENT UNDER TEST (EUT):	ADTS TOUCH-ER (Enhanced Range)
FCC IDENTIFIER:	*2AAVWADTSTOUCH-02*
IC IDENTIFIER:	12097A-ADTSTOUCH02
EUT SERIAL NUMBER:	5216387
MANUFACTURER/AGENT:	Druck Ltd t/a GE Measurement & Control
ADDRESS:	Fir Tree Lane Groby LEICESTER Leicestershire LE6 0FH United Kingdom
CLIENT CONTACT:	Tom Piggin ☎ 0116 231 7100 ✉ tom.piggin@ge.com
ORDER NUMBER:	1010117420
TEST DATE:	6th August 2015 – 21st August 2015
TESTED BY:	A Tosif TRaC Global Ltd.

2.1 Test Summary

Test Method and Description	*Requirement Clause*		*Applicable to this equipment*	*Result / Note*
	RSS	*47CFR15*		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)	RSS – 247 issue 1 Section 3.3	15.247 (d)	☒	*Pass*
Unintentional radiated spurious emissions	RSS – Gen Section 7.1	15.109	☒	*Pass*

Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

3 Contents

4 Introduction

This report TRA-028272-03-47-00A presents the results of the Radio testing on a Druck Ltd t/a GE Measurement & Control, ADTS TOUCH-ER (Enhanced Range) to specification 47CFR15 Radio Frequency Devices and RSS-247, Issue 1, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices.

The testing was carried out for Druck Ltd t/a GE Measurement & Control by TRaC Global Ltd, at the address(es) detailed below.

☐ TRaC Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ TRaC North West
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

FCC Site Listing:
TRaC Global is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):
TRaC North West 3930B-2 & 3930B-4

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.
The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- Industry Canada RSS-247, Issue 1, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus

5.2 Deviations from Test Standards

- There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen Before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment under Test

7.1 EUT Identification

- Name: ADTS TOUCH-ER (Enhanced Range)
- Serial Number: 5216387
- Model Number: ADTS TOUCH-ER
- Software Revision:
    - o ADTS TOUCH Main Code DK428 – V02.00.16
    - o ADTS TOUCH OS Build DK442 – V01.03.00
    - o ADTS TOUCH Boot ROM DK441 – V01.00.00
- Build Level / Revision Number: Not Applicable

- Name: Stick Antenna – Pulse W1030
- Model Number: W1030

Incorporating the following external cable / test port:

Type	***Description of cable attached***	***Length***	***Equipment Connected***
RF port	co-axial	2m	Antenna

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Not Applicable – No support/monitoring equipment required.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follow.

Test	Description of Operating Mode: Transmit
All transmitter tests detailed in this report	EUT actively transmitting at standard data rate (DH5) on highest, middle and lowest operating frequencies and in hopping mode.

7.3.2 Reception

The mode of operation for Rx tests was as follows.

Test	Description of Operating Mode: Receive
Receiver radiated spurious emissions	EUT in receive mode on top, middle and bottom channels.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	2402 – 2480 MHz
Occupied channel bandwidth(s):	1 MHz
Channel spacing:	1 MHz
Nominal Supply Voltage:	Internal battery

7.4.2 Antennas

Type:	External
Frequency range:	2.4 – 2.5 GHz
Impedance:	50 Ω
SWR:	≤2.0
Gain:	2.0 dBi
Polarisation:	Vertical
Connector type:	Reverse SMA
Electrical Length:	1/4, dipole
Weight:	6.3 grams

7.5 EUT Description

The EUT is device containing a FHSS Bluetooth module operating with standard data rate.

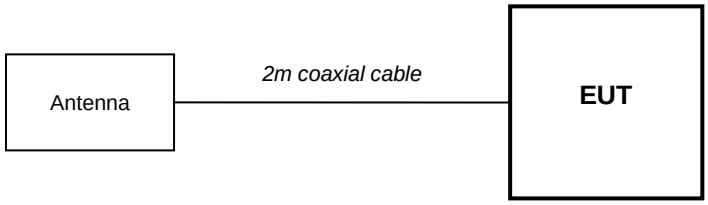
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT interconnections with cable type and cable lengths identified:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:

10 General Technical Parameters

10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was from internal battery.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing, the following variations were made:

	Category	***Nominal***	***Variation***
☐	Mains	110V ac +/-2%	85% and 115%
☒	Battery	Internal battery	N/A

11 Radiated emissions

11.1 Definitions

Spurious emissions
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

11.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	UH387 / REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	2402 MHz / 2441 MHz / 2480 MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC
Humidity: 37%RH	20%RH to 75%RH
Supply: Internal battery	As declared

Test Limits
Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

General Field Strength Limits for License-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (µV/m at 3m)
30-88	100
88-216	150
216-960	200
Above 960	500

11.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. For both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

Testing was performed with the EUT orientated in three orthogonal planes. For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

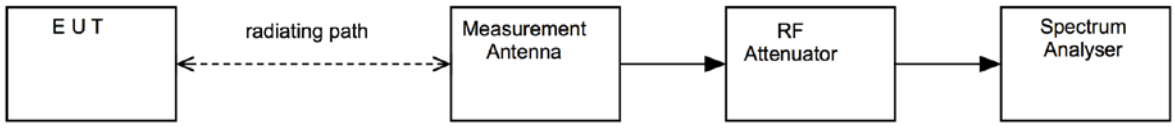
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

Figure i Test Setup



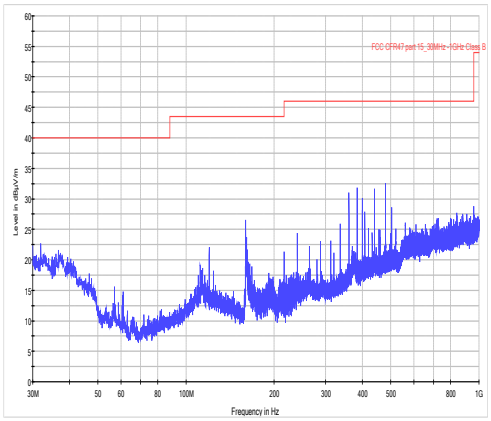
Test Setup Photograph(s)

11.4 Test Equipment

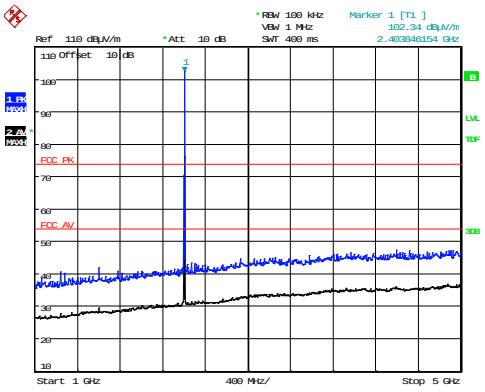
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Bilog	Chase	CBL6112	UH420	25/07/2014	24	25/07/2016
1-18GHz Horn	EMCO	3115	L138	17/10/2013	24	17/10/2015
Horn 18-26GHz (&UH330)	Flann	20240-20	L300	10/02/2014	24	10/02/2016
Pre Amp	Agilent	8449B	L572	10/02/2015	12	10/02/2016
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2014	24	08/09/2016
Chamber 1	Rainford EMC	ATS	UH387	06/09/2014	24	06/09/2016

11.5 Test Results

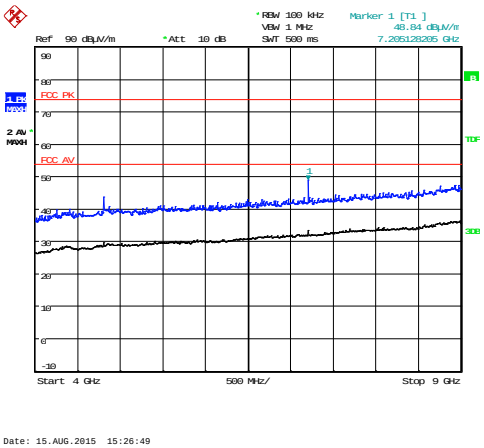
Radiated Transmitter Emissions – 2402 MHz



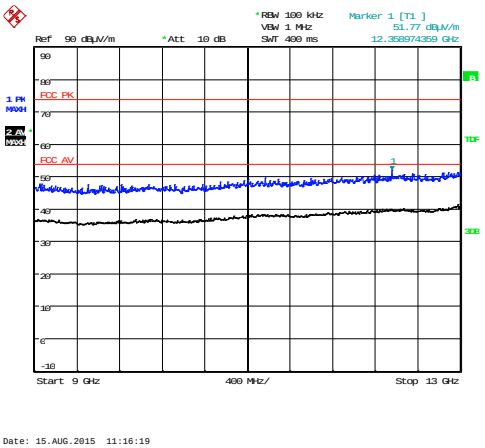
30MHz – 1GHz



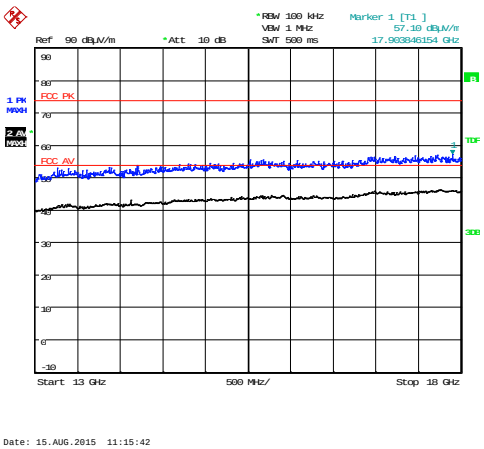
1GHz – 4GHz



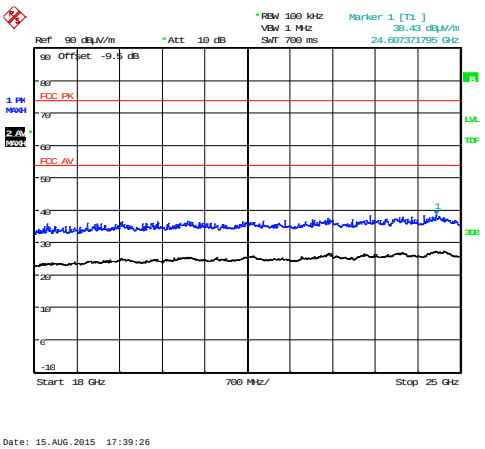
4GHz – 9GHz



9GHz – 13GHz

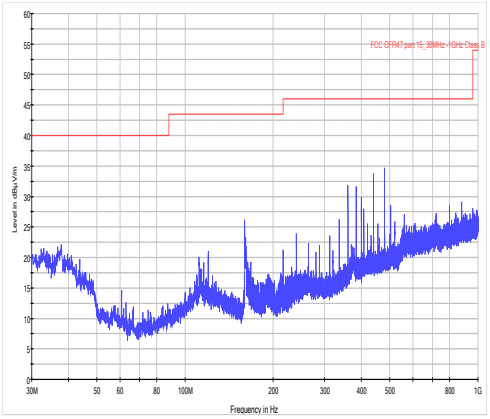


13GHz – 18GHz

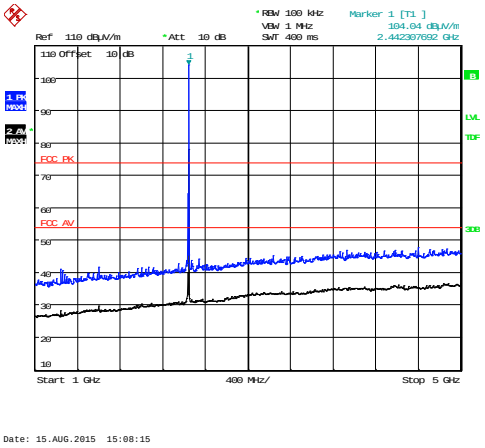


18GHz – 25GHz

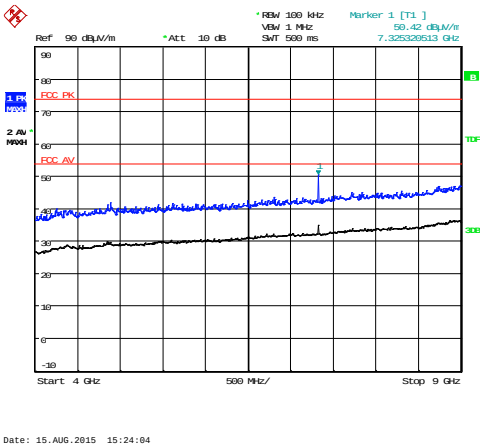
Radiated Transmitter Emissions – 2441 MHz



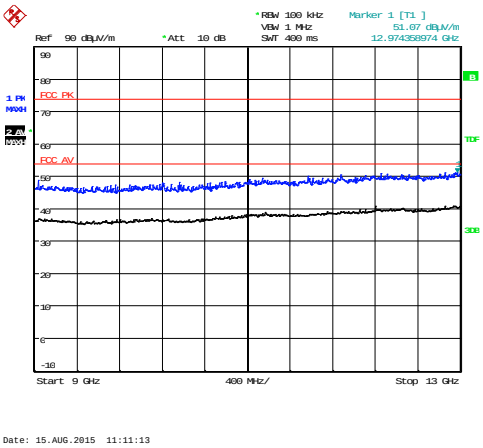
30MHz – 1GHz



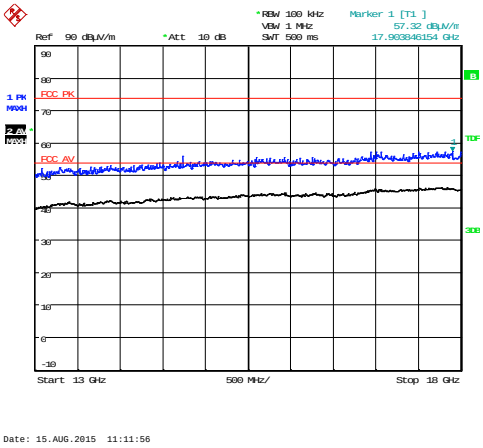
1GHz – 4GHz



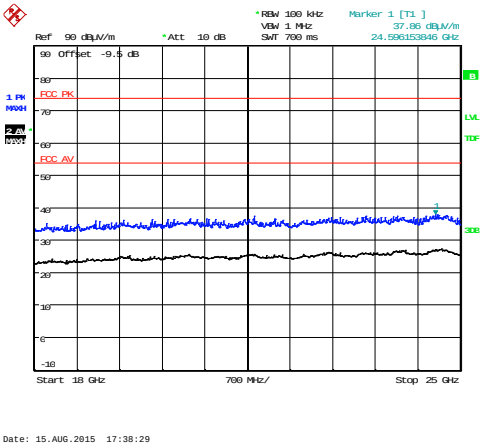
4GHz – 9GHz



9GHz – 13GHz

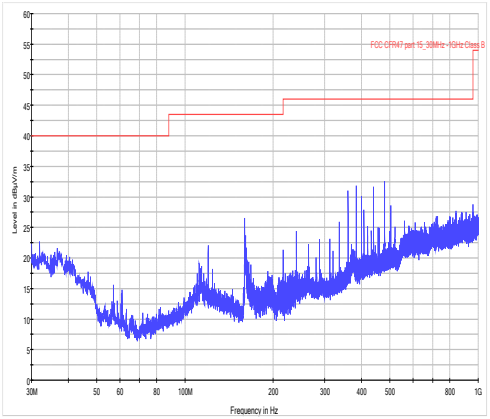


13GHz – 18GHz

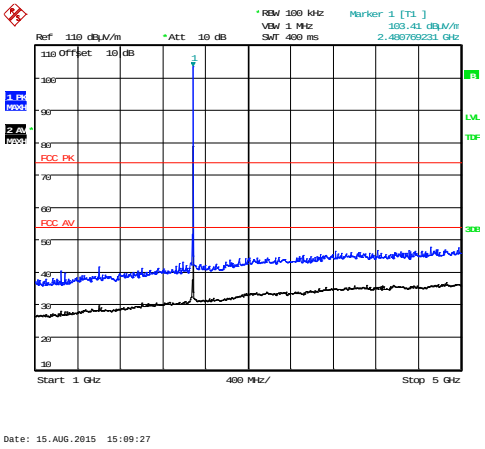


18GHz – 25GHz

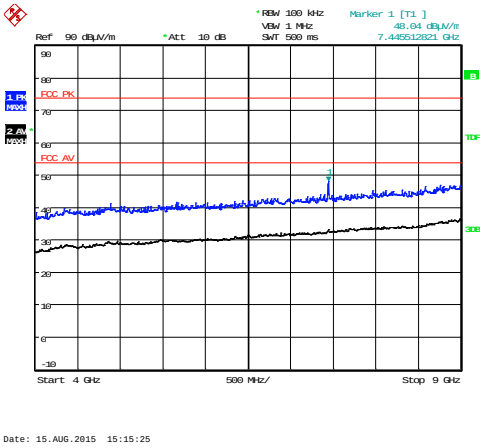
Radiated Transmitter Emissions – 2480 MHz



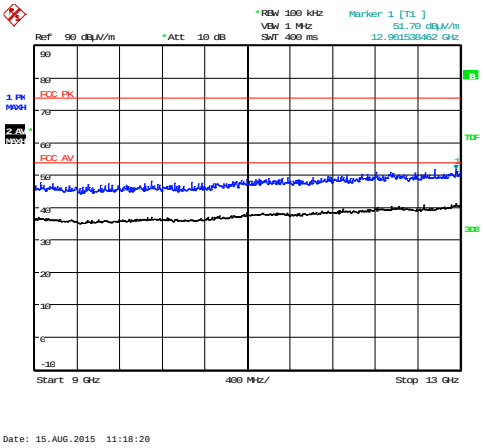
30MHz – 1GHz



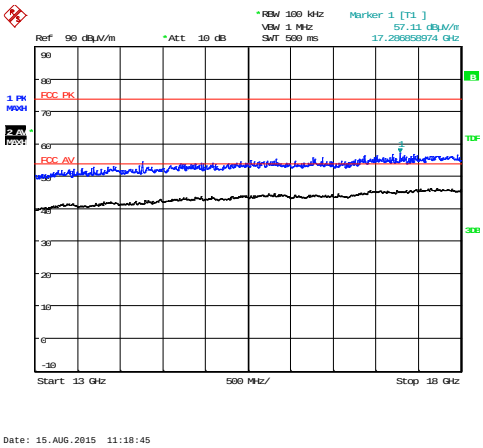
1GHz – 4GHz



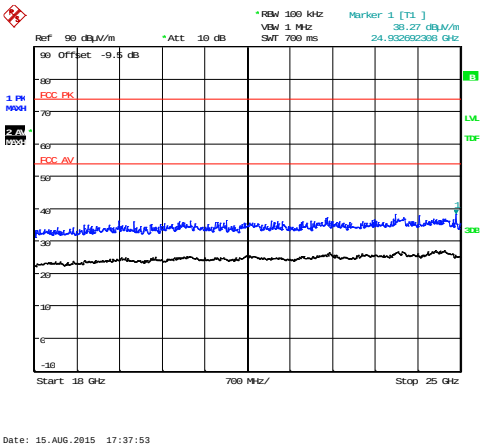
4GHz – 9GHz



9GHz – 13GHz



13GHz – 18GHz



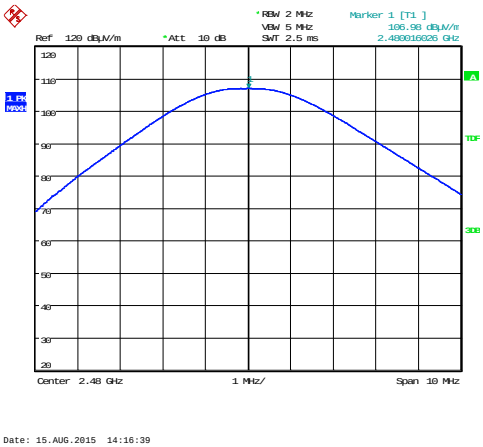
18GHz – 25GHz

Channel: 2402 MHz									
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	High pass filter loss (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
Peak	4803.9	50.7	5.2	32.7	35.9	0.3	53.0	445.1	5000.0
Average	4803.9	41.6	5.2	32.7	35.9	0.3	43.8	155.6	500.0
Peak	7205.9	51.6	6.2	36.2	36.6	0.2	57.7	763.0	5000.0
Average	7205.9	43.1	6.2	36.2	36.6	0.2	49.1	285.4	500.0

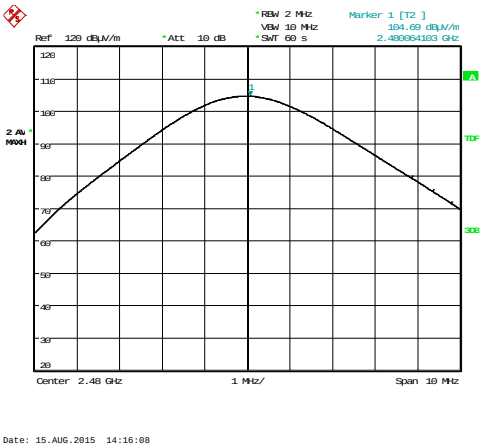
Channel: 2441 MHz									
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	High pass filter loss (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
Peak	4882.0	49.9	5.1	33.0	35.9	0.3	52.4	417.3	5000.0
Average	4882.0	40.1	5.1	33.0	35.9	0.3	42.6	134.1	500.0
Peak	7322.9	51.8	6.4	36.6	36.6	0.3	58.5	842.4	5000.0
Average	7322.9	43.8	6.4	36.6	36.6	0.3	50.5	335.7	500.0

Channel: 2480 MHz									
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	High pass filter loss (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
Peak	4960.0	48.8	5.1	33.2	35.9	0.2	51.4	371.5	5000.0
Average	4960.0	36.9	5.1	33.2	35.9	0.2	39.5	94.6	500.0
Peak	7439.9	51.6	6.3	36.7	36.6	0.4	58.4	829.9	5000.0
Average	7439.9	42.7	6.3	36.7	36.6	0.4	49.4	295.5	500.0

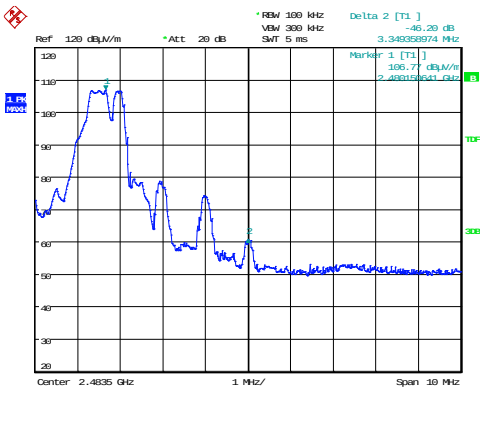
Radiated Upper Bandedge Compliance



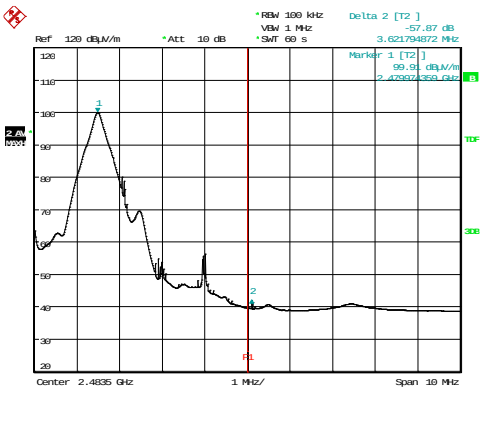
Peak Carrier Power in 2MHz RBW



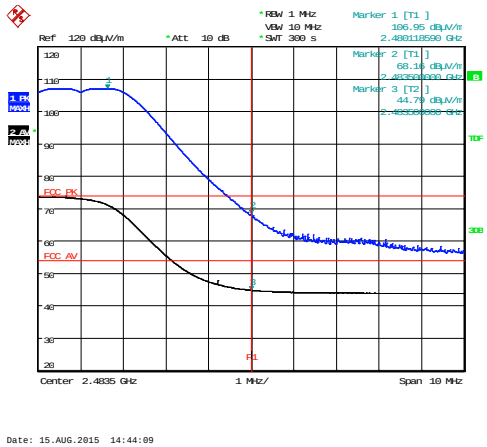
Average Carrier Power in 2MHz RBW



Peak Delta in 100 kHz RBW



Average Delta in 100 kHz RBW



Bandedge compliance – Hopping

12 Radiated emissions – unintentional radiation / receiver emissions

12.1 Definitions

Receiver spurious emissions
The radio frequency signals generated within the receiver, which may cause interference to other equipment. This includes the period during which the equipment is scanning or switching channels.

Unintentional radiator
A device that generates RF energy which is not intended to be radiated for reception by a radio receiver.

12.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	UH387 / REF940
Test Standard and Clause:	ANSI C63.4-2014, Clause 8
EUT Channels / Frequencies Measured:	2402 MHz / 2441 MHz / 2480MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC
Humidity: 37%RH	20%RH to 75%RH
Supply: Internal Battery	As declared

Test Limits
Note:

Only radiocommunication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to requirements, as described above. All other receivers are exempted from any certification, testing, labelling and reporting requirements.

However, all receivers in all frequency bands shall comply with the limits set forth in FCC 47CFR15B / IC RSS-Gen even in cases where testing, reporting and/or certification are not required.

Receiver Radiated Limits

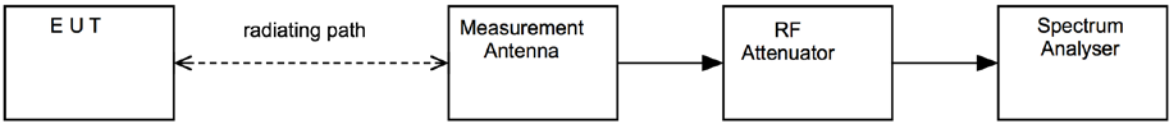
Frequency (MHz)	Field Strength (µV/m at 3m)
30-88	100
88-216	150
216-960	200
Above 960	500

12.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure viii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver. The EUT was rotated in three orthogonal planes and the measurement antenna height scanned (below 1GHz, from 1 to 4 m; above 1GHz as necessary) in order to maximise emissions.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration at each frequency. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

Figure viii Test Setup



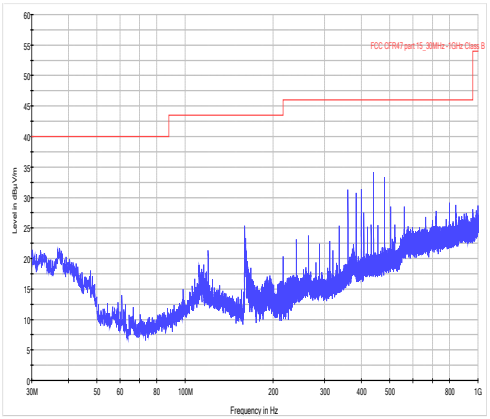
Test Setup Photograph(s)

12.4 Test Equipment

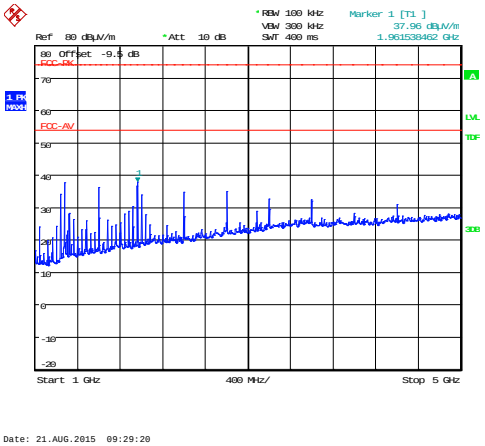
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Bilog	Chase	CBL6112	UH420	25/07/2014	24	25/07/2016
1-18GHz Horn	EMCO	3115	L138	17/10/2013	24	17/10/2015
Horn 18-26GHz (&UH330)	Flann	20240-20	L300	10/02/2014	24	10/02/2016
Pre Amp	Agilent	8449B	L572	10/02/2015	12	10/02/2016
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2014	24	08/09/2016
Chamber 1	Rainford EMC	ATS	UH387	06/09/2014	24	06/09/2016

12.5 Test Results

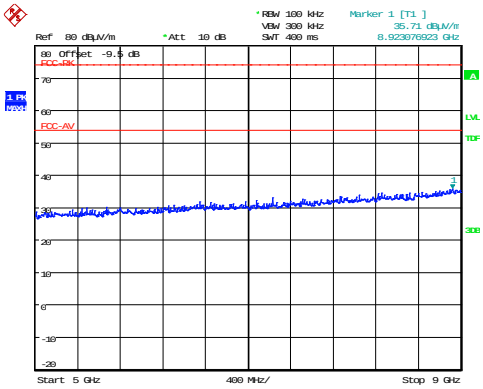
Radiated Receiver Emissions – 2402 MHz



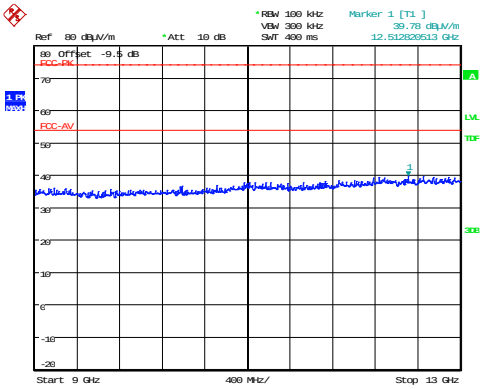
30MHz – 1GHz



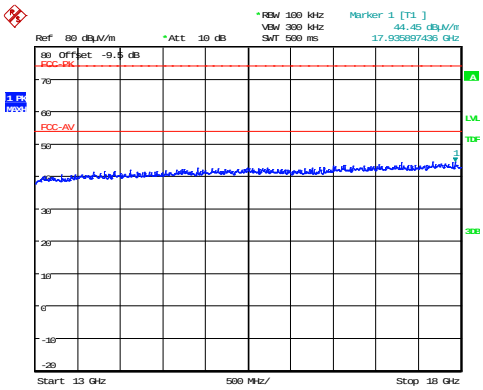
1GHz – 5GHz



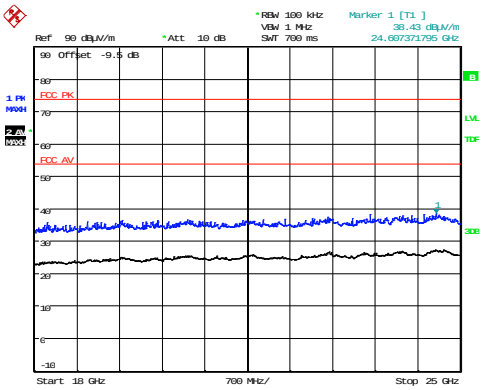
5GHz – 9GHz



9GHz – 13GHz

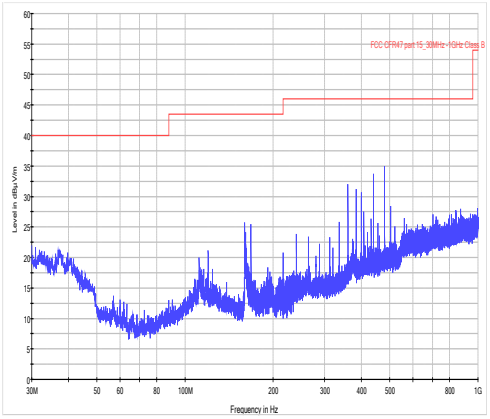


13GHz – 18GHz

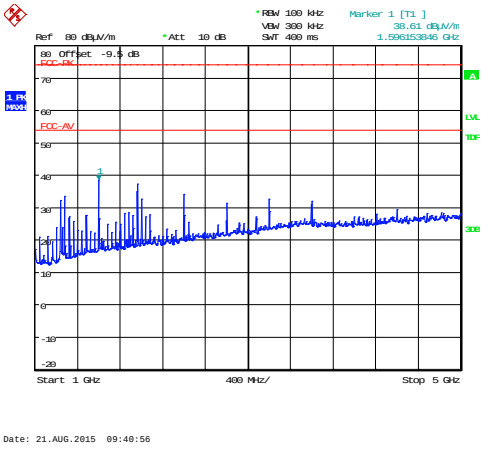


18GHz – 25GHz

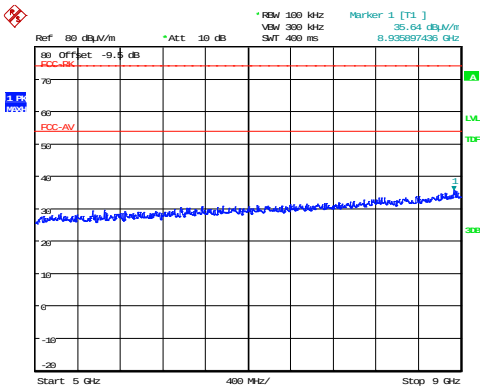
Radiated Receiver Emissions – 2441 MHz



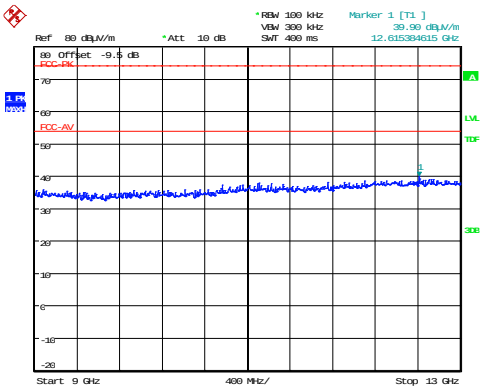
30MHz – 1GHz



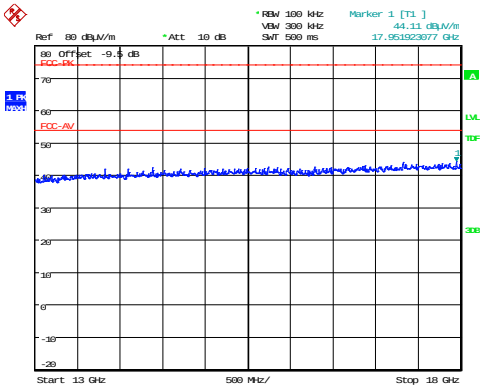
1GHz – 5GHz



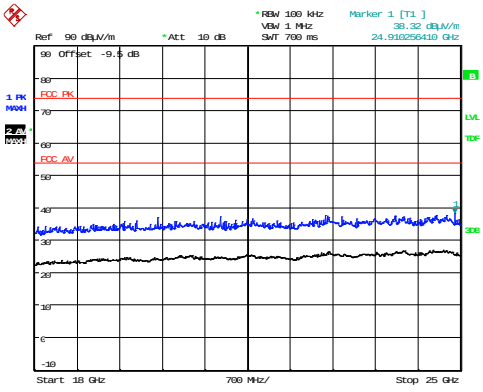
5GHz – 9GHz



9GHz – 13GHz

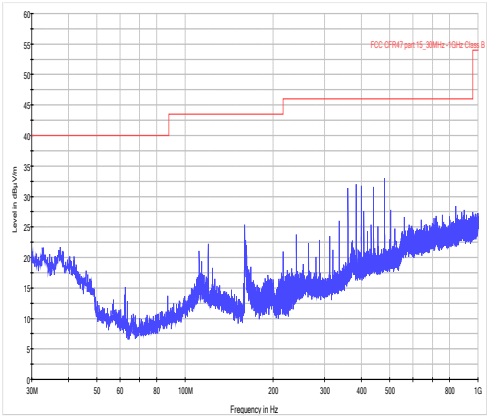


13GHz – 18GHz

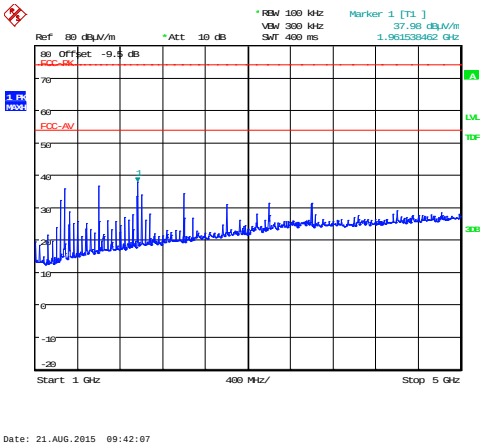


18GHz – 25GHz

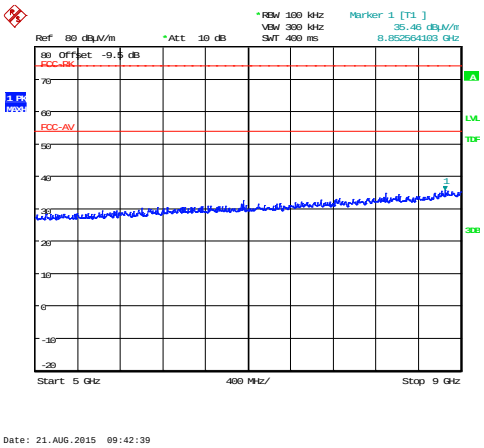
Radiated Receiver Emissions – 2480 MHz



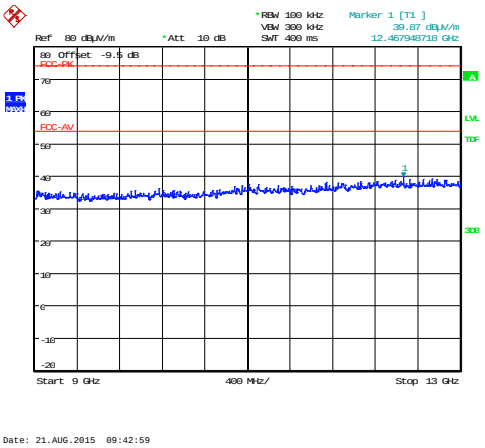
30MHz – 1GHz



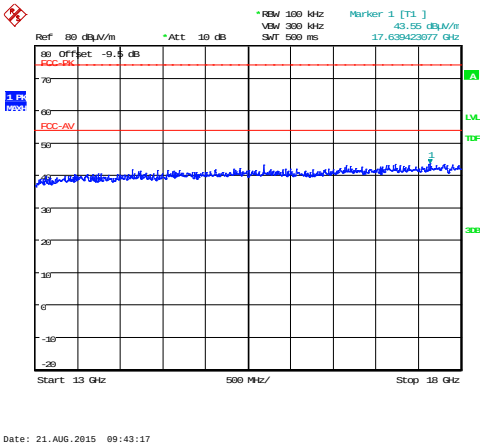
1GHz – 5GHz



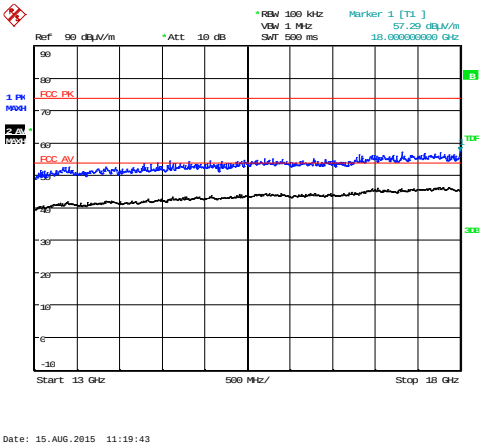
5GHz – 9GHz



9GHz – 13GHz



13GHz – 18GHz



18GHz – 25GHz

Detector	Freq. (MHz)	Measured Emission (dBµV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Extrap'n Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
Qp	119.9	9.8	1.6	12.2	N/A	N/A	23.6	15.2	150.0
Qp	200.0	14.8	1.9	8.3	N/A	N/A	25.0	17.8	150.0
Qp	216.0	19.4	2.0	9.2	N/A	N/A	30.6	33.8	150.0
Qp	288.0	11.7	2.3	12.8	N/A	N/A	26.8	21.9	200.0
Qp	336.0	11.0	2.5	13.9	N/A	N/A	27.4	23.3	200.0
Qp	360.0	18.2	2.6	14.0	N/A	N/A	34.8	55.2	200.0
Qp	384.0	9.1	2.9	15.0	N/A	N/A	27.0	22.4	200.0
Qp	400.0	9.4	2.7	15.6	N/A	N/A	27.7	24.2	200.0
Qp	408.0	11.7	2.7	16.1	N/A	N/A	30.5	33.7	200.0
Qp	432.0	7.9	2.9	16.0	N/A	N/A	26.8	21.8	200.0
Qp	440.0	11.8	3.0	16.0	N/A	N/A	30.7	34.4	200.0
Qp	456.0	6.4	3.1	16.6	N/A	N/A	26.1	20.1	200.0
Qp	479.9	11.0	3.1	17.0	N/A	N/A	31.1	36.0	200.0
Qp	504.0	12.3	3.1	17.5	N/A	N/A	32.9	44.0	200.0
Qp	520.0	8.7	3.1	17.8	N/A	N/A	29.7	30.4	200.0
Qp	560.0	9.9	3.4	19.3	N/A	N/A	32.6	42.7	200.0
Qp	639.7	5.9	3.6	19.6	N/A	N/A	29.0	28.3	200.0
Qp	695.7	12.4	3.7	20.1	N/A	N/A	36.2	64.5	200.0
Qp	719.9	11.5	3.8	21.1	N/A	N/A	36.4	66.2	200.0
Qp	800.0	5.5	4.0	21.7	N/A	N/A	31.2	36.3	200.0
Qp	959.9	7.4	4.3	24.0	N/A	N/A	35.8	61.3	200.0
Av	1280.0	54.8	2.2	25.9	33.8	-9.5	39.5	94.8	500.0
Av	1600.0	56.7	2.5	25.9	33.4	-9.5	42.2	128.5	500.0
Av	1960.0	52.1	2.5	27.6	33.2	-9.5	39.5	93.9	500.0
Av	2397.4	50.5	2.4	28.2	33.3	-9.5	38.3	82.6	500.0
Av	2800.0	47.0	2.6	29.2	33.4	-9.5	35.8	61.5	500.0

13 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence:

[1] Radiated spurious emissions

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.4dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.5%**

[4] Conducted carrier power

Uncertainty in test result (Power Meter) = **1.08dB**

[5] Conducted / radiated RF power out-of-band

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[6] Frequency separation

Uncertainty in test result (Spectrum Analyser) = **3.6kHz**

[7] Accumulated channel occupancy time

Uncertainty in test result = **7.98%**