

Report on the Radio Testing

For

SmarDTV (UK) Ltd.

On

S55

Report no. TRA-031431-00-45-02A

31st March 2017

Report Number: TRA-031431-00-45-02A
Issue: A

REPORT ON THE RADIO TESTING OF A

SmarDTV (UK) Ltd

S55

WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: From 22-2-2017 to 23-3-2017

Written by: A Wong

Alan Wong
Radio Test Engineer

Approved by:

Date: 31st March 2017

John Charters
Department Manager (Radio)

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
[2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	31 st March 2017	Original

2 Summary

TEST REPORT NUMBER:	TRA-031431-00-45-02A
WORKS ORDER NUMBER	TRA-0314310-00
PURPOSE OF TEST:	USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J. Canada: Testing of radio apparatus for TAC (technical acceptance certificate) per subsections 4(2) of the Radiocommunication Act and 21(1) of the Radiocommunication Regulations.
TEST SPECIFICATION(S):	47CFR15.247 & RSS-247
EQUIPMENT UNDER TEST (EUT):	S55
FCC IDENTIFIER:	DKN-AVAD1
ISED:	1707A-AVAD1
EUT SERIAL NUMBER:	Sample S7
MANUFACTURER:	SmarDTV (UK) Limited
ADDRESS:	Beckside Design Centre Millennium Business Park Station Road, Steeton Keighley, West Yorkshire BD20 6QW, United Kingdom
CLIENT CONTACT:	Chris Wordley ☎ 01535 659000 ✉ chris.wordley@smardtv.com
ORDER NUMBER:	POR01505
TEST DATE:	From 22-2-2017 to 23-3-2017
TESTED BY:	Alan Wong Element Hull

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)		Gen, 8.10	15.205	☒	PASS
AC power line conducted emissions		Gen, 8.8	15.207	☐	NOTE1
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	☐	NOTE2
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	☐	NOTE2
	Max.			☐	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	☐	NOTE2
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	☐	NOTE2
Calculation of duty correction		-	15.35(c)	☐	NOTE2

Notes:

NOTE1: Battery power operation only, with an internal fully charged Lithium-ion battery.

NOTE2: Only radiated emission results are included in this test report. The conducted measurements for the BTLE module are contained within report TRA-029575-02-45-02A.

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).

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4 Introduction

This report TRA-031431-00-45-01A presents the results of the Radio testing on a SmarDTV (UK) Ltd., S55 to specification 47CFR15 Radio Frequency Devices and RSS-247 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for a SmarDTV (UK) Ltd. by Element, at the address(es) detailed below.

☒	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	☐	Element Skelmersdale Unit 1 Pendle Place Skelmersdale West Lancashire WN8 9PN UK
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This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:

Element is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):

Element Hull	3483A
Element North West	3930B

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, May 2015 – 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

Only radiated emission results are included in this test report. The conducted measurements for the BTLE module are contained within report TRA-029575-02-45-02A. The manufacturer declared that no changes to the module were made.

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: S55
- Serial Number: Sample S7
- Model Number: S55
- Software Revision: RF Test Software
- Build Level: Pre-production S55 sample S7

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.

HD 1080p video source with HDMI output and power supply unit
RNDIS USB Hub device and power supply unit
Laptop computer and power supply

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for transmitter tests was as follows...

The EUT was connected via an RNDIS USB hub, to a laptop computer. The computer executed a Bluetooth EUT control software, named Bluetool for setting operating frequencies or hopping modes, modulation schemes, data rates and power levels. The same USB connection was also charging the EUT battery at the same time.

7.3.2 Reception

No receiver tests were carried out.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	From 2402 MHz to 2480 MHz
Modulation type(s):	Bluetooth LE
Occupied channel bandwidth(s):	1 MHz
Channel spacing:	1 MHz
Declared output power(s):	Maximum power setting at 0 dBm
Warning against use of alternative antennas in user manual (yes/no):	N/A: The antennae are internal and completely inaccessible to the user
Nominal Supply Voltage:	Lithium-ion Battery at 3.7 V d.c.
Frequency stability:	+/- 20ppm
Location of notice for license exempt use:	The FCC part 15.19(a) statement is in the online user manual
Method of prevention of use on non-US frequencies:	Firmware country code is factory set and it cannot be changed in user interface

7.4.2 Antennas

Type:	Airgain N2410CSM Embedded
Frequency range:	Single 2.4 GHz Band Operation 2.4 – 2.49 GHz
Impedance:	50 ohms
VSWR:	< 2:1
Gain:	2.3 dBi Peak Gain at 2.44 GHz
Polarisation:	Non-polarised
Beam width:	N/A: Not directional
Connector type:	U. FL-compatible cable connection
Length:	21.35 x 19.5 x 0.8 mm
Weight:	0.78 g (0.026 oz)
Environmental limits:	Operating: -40° C to +75° C (-40° F to +167° F) Storage: -40° C to +85° C (-40° F to +185° F) 0% to 95% non-condensing
Mounting:	PCB

7.4.3 Product specific declarations

Multiple antenna configuration(s), e.g. MIMO:	No multiple antenna configuration
Fixed pt-pt operations (yes/no):	No
Installation manual advice on pt-pt operational restrictions (yes/no):	No
Fixed pt-mpt operations (yes/no):	No
Simultaneous tx (yes/no):	No

7.5 EUT Description

The EUT is a converter for HDMI video streams and then transmits then data over a WiFi network.

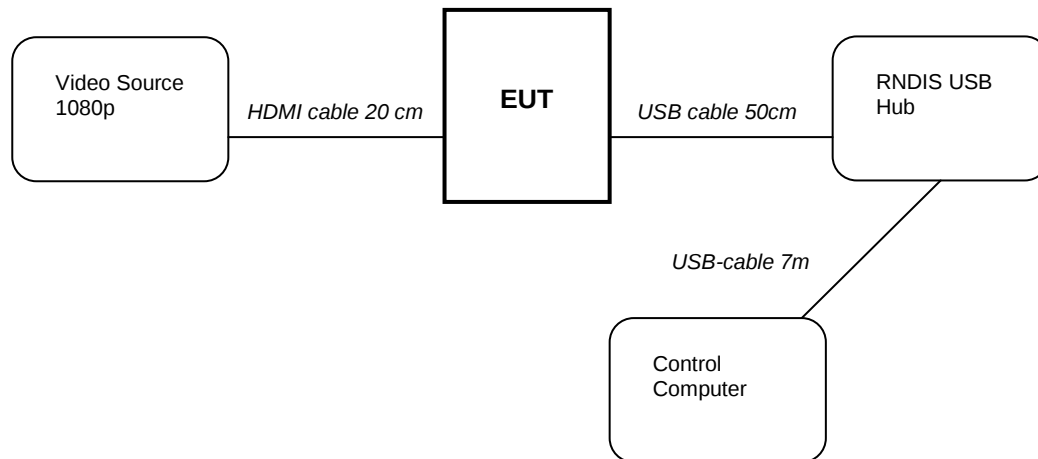
8 Modifications

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

Please refer to document number TRA-031431-PHOTOS as the client has requested photographs are held short term confidential.

10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source was a built-in Lithium-ion battery with nominal output voltage at 3.7 V d.c.

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		85 % and 115 %
☒	Battery	3.7 V d.c.	3.0 – 4.2 V d.c.

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:	Element Hull
Test Chamber:	Wireless Laboratory 2 (Lab16)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	2402 / 2440 / 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: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 37 %RH	20%RH to 75%RH (as declared)
Supply: 3.7 V dc	Fully charged Li-ion battery

11.3 Test Limit

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 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

11.4 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 100 kHz 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.

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;

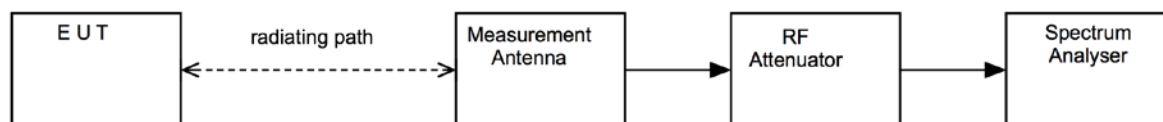
PA is the pre-amplifier gain in dB (where used);

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



11.5 Test Set-up Photograph

Please refer to document number TRA-031431-PHOTOS as the client has requested photographs are held short term confidential.

11.6 Test Equipment

<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Due For Calibration</i>
For 30-200 MHz	EMCO	Biconical Antenna	RFG095	17/05/2019
For 200-1000MHz	EMCO	Log Periodic Antenna	RFG191	17/05/2019
For 1-18 GHz	EMCO	Horn Antenna	RFG129	09/02/2018
Spectrum Analyser	R&S	FSU46	REF910	05/07/2017
N-Type RF coaxial cable	Unknown	Cable	REF884	04/12/2017
Pre-Amp (9kHz – 1GHz)	Sonoma	310	REF927	30/06/2018
Short SMA RF Cable	AtlanTec	Cable	REF2165	09/12/2017
Cable	Teledyne	5m 2.92mm	REF919	05/10/2017
Pre-Amp (1 – 26.5GHz)	Agilent	8449B	REF913	02/02/2018
EMI / SA	R&S	ESU	RFG701	29/12/2017
For 18-26.5 GHz	Q-Par	Horn Antenna	RFG629	30/09/2017
For 26.5-40 GHz	FM	Horn Antenna	REF820	19/07/18
Ferrite Lined Chamber	Rainford	SARS	REF886	21/07/17

11.7 Test Results

Emissions not related to transmitter in the frequency range from 30 MHz to 1000 MHz

<i>Frequency (MHz)</i>	<i>Quasi-Peak (dBμV/m)</i>	<i>Limit (dBμV/m)</i>	<i>Quasi-Peak (μV/m)</i>	<i>Limit (μV/m)</i>	<i>Result</i>
32.596	22.2	40.0	12.9	100	PASS
41.293	30.4	40.0	33.1	100	PASS
43.741	31.5	40.0	37.6	100	PASS
43.913	31.5	40.0	37.6	100	PASS
71.333	31.7	40.0	38.5	100	PASS
113.517	30.5	43.5	33.5	150	PASS
119.995	22.9	43.5	14.0	150	PASS
122.153	31.0	43.5	35.5	150	PASS
120.017	41.9	43.5	124.5	150	PASS
133.349	33.5	43.5	47.3	150	PASS
148.347	35.0	43.5	56.2	150	PASS
236.403	31.6	46.0	38.0	200	PASS
237.044	32.1	46.0	40.3	200	PASS
266.531	33.1	46.0	45.2	200	PASS
445.051	39.0	46.0	89.1	200	PASS
480.054	38.0	46.0	79.4	200	PASS
532.961	44.8	46.0	173.8	200	PASS
593.390	44.6	46.0	169.8	200	PASS
741.754	44.2	46.0	162.2	200	PASS
799.439	42.0	46.0	125.9	200	PASS
799.503	44.5	46.0	167.9	200	PASS
798.460	26.4	46.0	20.9	200	PASS
799.487	39.9	46.0	98.9	200	PASS
890.107	45.2	46.0	182.0	200	PASS
906.718	23.7	46.0	15.3	200	PASS
949.391	28.2	46.0	25.7	200	PASS
959.967	33.5	46.0	47.3	200	PASS
960.110	36.2	46.0	64.6	200	PASS

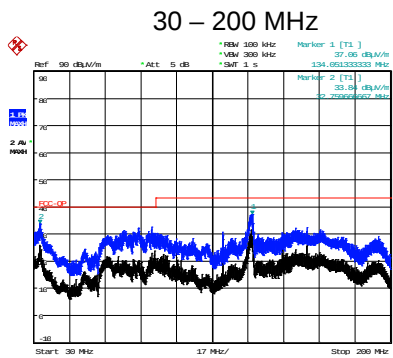
Emissions not related to transmitter in the frequency range from 1000 MHz to 5000 MHz

Frequency (MHz)	Peak (dBμV/m)	Limit (dBμV/m)	Peak (μV/m)	Limit (μV/m)	Result
1319.000	42.2	74	129.2	5000	PASS
1332.538	58.1	74	803.5	5000	PASS
1332.670	61.0	74	1122.0	5000	PASS
1563.642	46.1	74	201.8	5000	PASS
1598.770	66.8	74	2187.8	5000	PASS
1598.798	64.5	74	1678.8	5000	PASS
1599.967	49.7	74	305.4	5000	PASS
1865.316	53.5	74	473.2	5000	PASS
2225.378	50.5	74	335.0	5000	PASS
2332.440	47.2	74	229.1	5000	PASS
2373.692	62.9	74	1391.2	5000	PASS
2393.498	48.9	74	278.6	5000	PASS
2398.367	62.9	74	1391.2	5000	PASS
2398.416	58.6	74	851.1	5000	PASS
2398.964	52.3	74	412.1	5000	PASS
2464.300	52.8	74	438.4	5000	PASS
2931.250	50.7	74	342.8	5000	PASS
3464.300	59.8	74	978.1	5000	PASS
3464.738	53.8	74	489.8	5000	PASS
3506.644	51.4	74	371.5	5000	PASS
3729.867	54.2	74	510.4	5000	PASS
3730.867	69.4	74	2940.2	5000	PASS
4984.765	51.5	74	374.4	5000	PASS
4985.582	54.8	74	548.1	5000	PASS

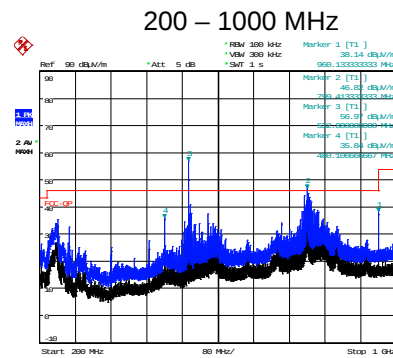
Emissions not related to transmitter in the frequency range from 1000 MHz to 5000 MHz

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Average (μV/m)	Limit (μV/m)	Result
1319.000	36.6	54	67.7	500	PASS
1332.538	37.9	54	78.5	500	PASS
1332.670	39.3	54	92.3	500	PASS
1563.642	30.5	54	33.5	500	PASS
1598.770	37.3	54	73.3	500	PASS
1598.798	33.7	54	48.4	500	PASS
1599.967	47.9	54	249.7	500	PASS
1865.316	36.0	54	63.1	500	PASS
2225.378	49.4	54	295.1	500	PASS
2332.440	33.1	54	45.2	500	PASS
2373.692	47.1	54	226.1	500	PASS
2393.498	37.4	54	74.1	500	PASS
2398.367	38.1	54	80.6	500	PASS
2398.416	40.0	54	100.0	500	PASS
2398.964	37.9	54	78.5	500	PASS
2464.300	50.6	54	338.0	500	PASS
2931.250	36.8	54	69.2	500	PASS
3464.300	33.8	54	48.9	500	PASS
3464.738	38.7	54	86.1	500	PASS
3506.644	57.6	54	758.6	500	PASS
3729.867	47.4	54	234.4	500	PASS
3730.867	38.1	54	80.0	500	PASS
4984.765	41.0	54	112.2	500	PASS
4985.582	44.4	54	165.7	500	PASS

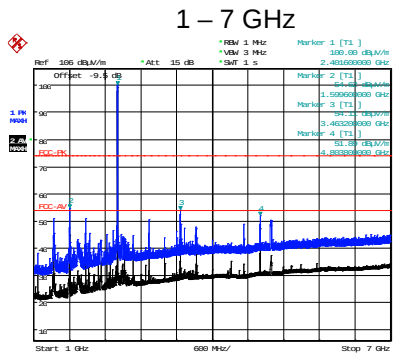
BTLE Center Frequency: 2402 MHz Full power at 0 dBm Setting



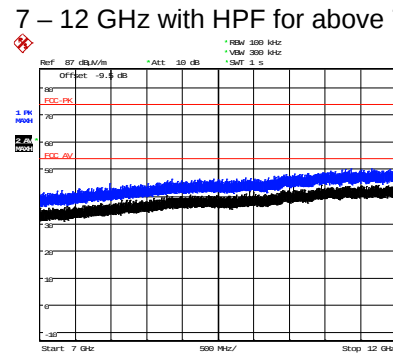
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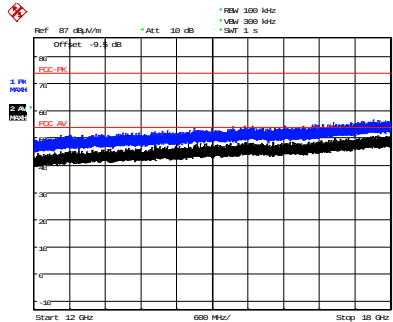


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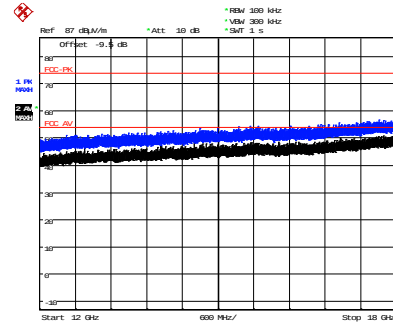
Date: 29.MAR.2017 12:22:19

12 – 18 GHz with HPF for above 7 GHz



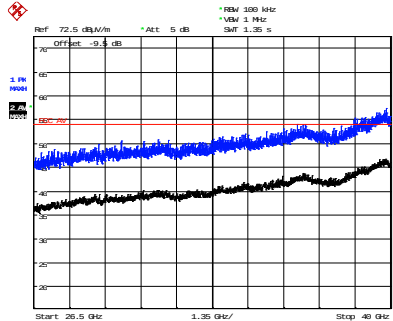
Date: 29.MAR.2017 12:23:55

18 – 26.5 GHz with HPF for above 7 GHz



Date: 29.MAR.2017 12:23:55

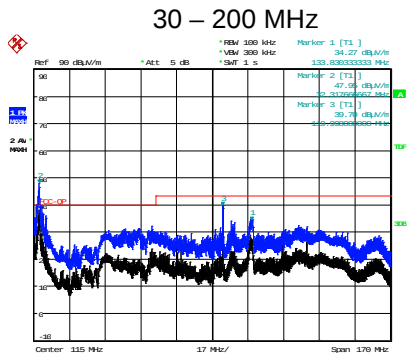
26.5 – 40 GHz with HPF for above 7 GHz



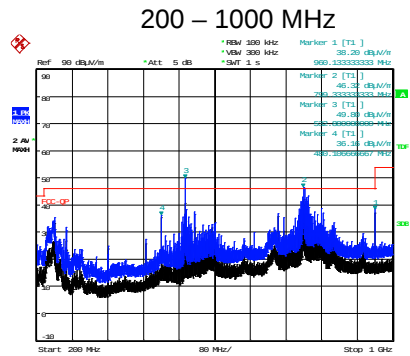
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Note: HPF means High Pass Filter

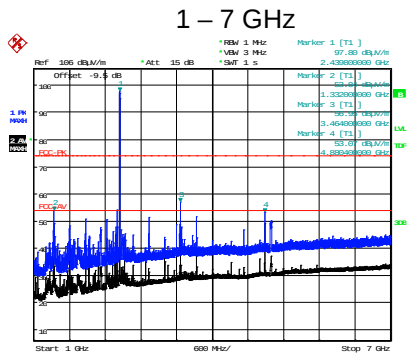
BTLE Center Frequency: 2440 MHz Full power at 0 dBm Setting



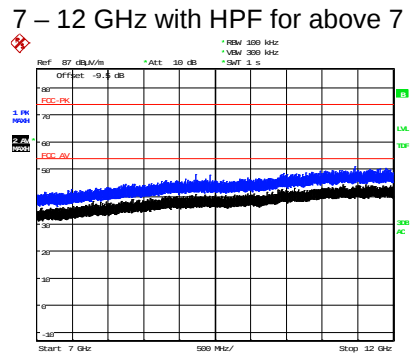
Date: 12.MAR.2017 11:21:31



Date: 12.MAR.2017 09:32:31

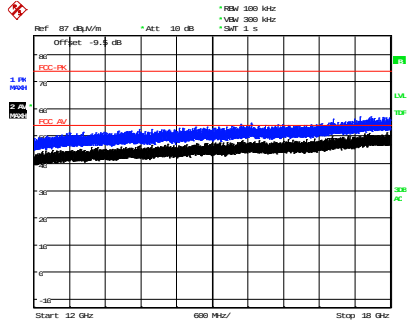


Date: 13.MAR.2017 17:59:04



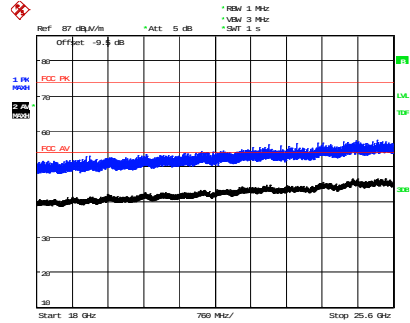
Date: 29.MAR.2017 12:29:37

12 – 18 GHz with HPF for above 7 GHz



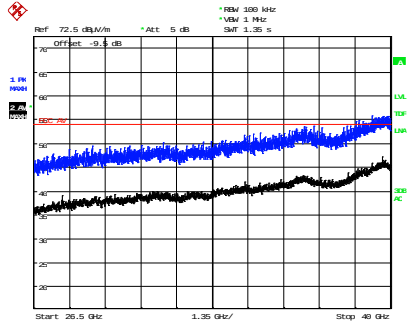
Date: 29.MAR.2017 12:27:58

18 – 26.5 GHz with HPF for above 7 GHz



Date: 23.MAR.2017 08:17:46

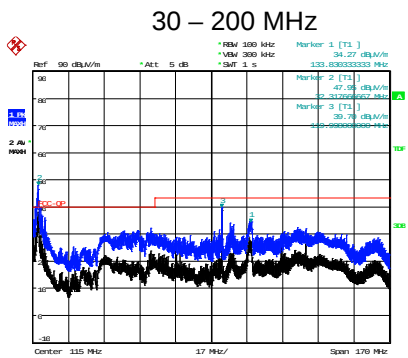
26.5 – 40 GHz with HPF for above 7 GHz



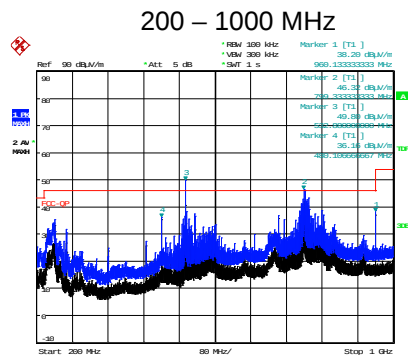
Date: 23.MAR.2017 13:06:15

Note: HPF means High Pass Filter

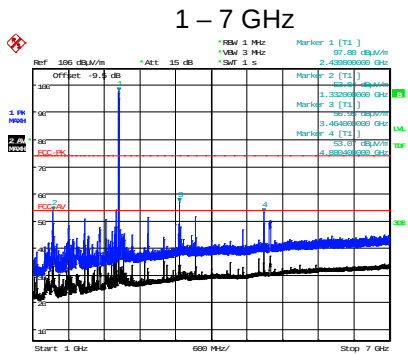
BTLE Center Frequency: 2480 MHz Full power at 0 dBm Setting



Date: 12.MAR.2017 11:21:31

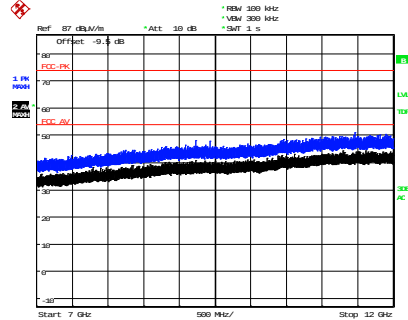


Date: 12.MAR.2017 09:32:31



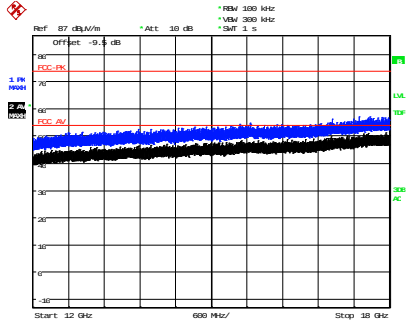
Date: 13.MAR.2017 17:59:04

7 – 12 GHz with HPF for above 7 GHz



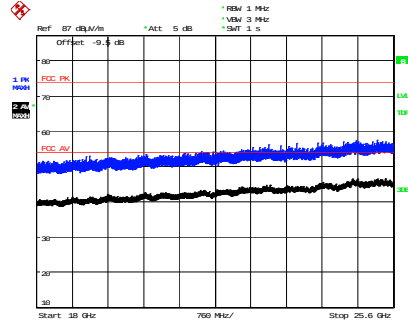
Date: 29.MAR.2017 12:29:37

12 – 18 GHz with HPF for above 7 GHz



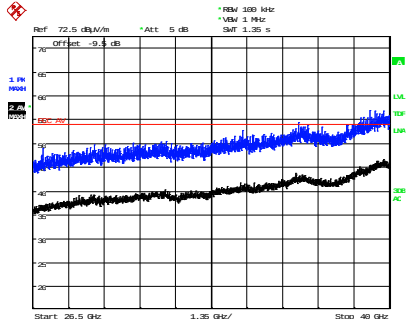
Date: 29.MAR.2017 12:27:58

18 – 26.5 GHz with HPF for above 7 GHz



Date: 23.MAR.2017 08:17:46

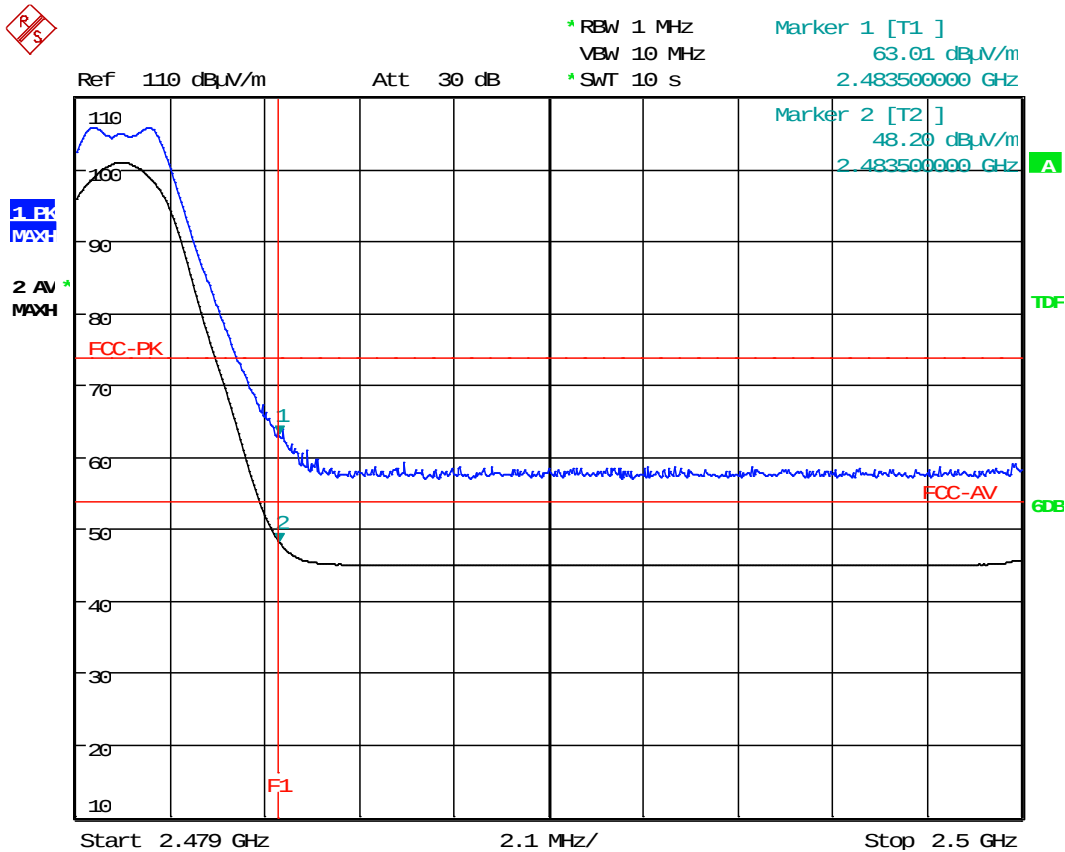
26.5 – 40 GHz with HPF for above 7 GHz



Date: 23.MAR.2017 13:03:49

Note: HPF means High Pass Filter

BTLE Upper Band Edge Channel Frequency 2480 MHz Maximum Power Setting at 0 dBm



Date: 17.MAY.2016 11:01:23

12 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 (30 MHz to 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[4] Conducted carrier power

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

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

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**

Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[6] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**