

Report on the Radio Testing

For

SmarDTV (UK) Limited

on

S55

Report no. TRA-031431-0045-07A

20th April 2017

RF915 4.0



Report Number: TRA-031431-0045-07A
Issue: A

REPORT ON THE RADIO TESTING OF A
SmarDTV (UK) Limited
S55
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.207 & IC RSS-207

TEST DATE: 21st April 2017

Tested by: A Wong

A Wong
Radio Test Engineers

Written by: A Wong

A Wong
Senior Radio Test Engineer

Approved by:

J Charters
Department Manager- Radio

Date: 20th April 2017

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

RF915 4.0

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	20th April 2017	Original

2 Summary

TEST REPORT NUMBER:	TRA-031431-00-45-07A
WORKS ORDER NUMBER	TRA-0931431-00
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 Radio communication Act and 21(1) of the Radio communication Regulations
TEST SPECIFICATION(S):	47CFR15.207 & RSS-247
EQUIPMENT UNDER TEST (EUT):	S55
FCC IDENTIFIER:	DKN-AVAD1
ISED IDENTIFIER:	1707A-AVAD1
MANUFACTURER/AGENT:	SmarDTV (UK) Limited
ADDRESS:	Beckside Design Centre Millennium Business Park Station Rd Steeton Keighley West Yorkshire BD20 6QW United Kingdom
CLIENT CONTACT:	Chris Wordley  01535 659000  chris.wordley@smardtv.com
ORDER NUMBER:	POR01251
TEST DATE:	25th Apr - 26th Sep 2016
TESTED BY:	A Longley – A Wong Element

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

Notes:

1. This test report covers the AC power line conducted emission on all modes.

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

1	Revision Record	3
2	Summary	4
2.1	Test Summary	5
3	Contents	6
4	Introduction	7
5	Test Specifications	8
5.1	Normative References	8
5.2	Deviations from Test Standards	8
6	Glossary of Terms	9
7	Equipment Under Test	10
7.1	EUT Identification	10
7.2	EUT Mode of Operation	10
7.2.1	Transmission	10
7.3	EUT Radio Parameters	11
7.3.1	General	11
7.3.2	Antennas	11
7.3.3	Product specific declarations	12
7.4	EUT Description	13
8	Modifications	14
9	EUT Test Setup	15
9.1	Block Diagram	15
10	General Technical Parameters	16
10.1	Normal Conditions	16
10.2	Varying Test Conditions	16
11	AC power-line conducted emissions	17
11.1	Definition	17
11.2	Test Parameters	17
11.3	Test Method	17
11.4	Test Equipment	19
11.5	Test Results	19
12	Measurement Uncertainty	21

4 Introduction

This report TRA-031431-00-45-07A presents the results of the Radio testing on a SmarDTV (UK) Limited, 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 SmarDTV (UK) Limited 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
-------------------------------------	---	--------------------------	--

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

This test report only covers the AC power line conducted emissions.

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 EUT Mode of Operation

7.2.1 Transmission

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

The EUT was set to transmit in the 5 GHz WiFi band, with multiple antennae, at the highest power, MCS0NSS1 data rate and 40 MHz channel width available to produce worst case test mode.

7.3 EUT Radio Parameters

7.3.1 General

Frequency of operation:	From 5150 MHz to 5850 MHz
Modulation type(s):	IEEE802.11a/n/ac
Occupied channel bandwidth(s):	20 / 40 / 80 MHz
Channel spacing:	IEEE802.11a/n/ac
Declared output power(s):	Power table included for all modes/channels
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:	+/- 25ppm in OFDM, +/- 20ppm in all other modes
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

7.3.2 Antennas

Type:	Embedded
Frequency range:	4.9 – 5.9 GHz
Impedance:	50 ohms
VSWR:	< 2:1
Gain:	2.7 dBi peak gain at 5.2 GHz and 2.7 dBi peak gain at 5.8 GHz
Polarisation:	Non polar
Beam width:	N/A: Not directional.
Connector type:	50 ohm, 1.13mm diameter, micro coax cable, U.FL compatible cable connector (optional), cable mounted EMI ferrites (optional)
Dimensions:	17.2 x 17.2 x 0.8 mm
Weight:	0.51 g (0.018 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:	U. FL compatible cable connector

7.3.3 Product specific declarations

Multiple antenna configuration(s), e.g. MIMO:	It uses the following operating schemes (without beamforming): • SISO (single antenna transmission) • SM-MIMO (multiple antenna transmission, uncorrelated) • STBC (multiple antenna transmission, uncorrelated) • CDD (multiple antenna transmission, correlated)
Fixed pt-pt operations (yes/no):	No
Software security description:	Signed and AES-128 Encrypted Firmware with RSA-2048 & SHA256 Authentication (User not accessible to configuration part)
TDWR interference information in users manual (yes/no):	No

7.4 EUT Description

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

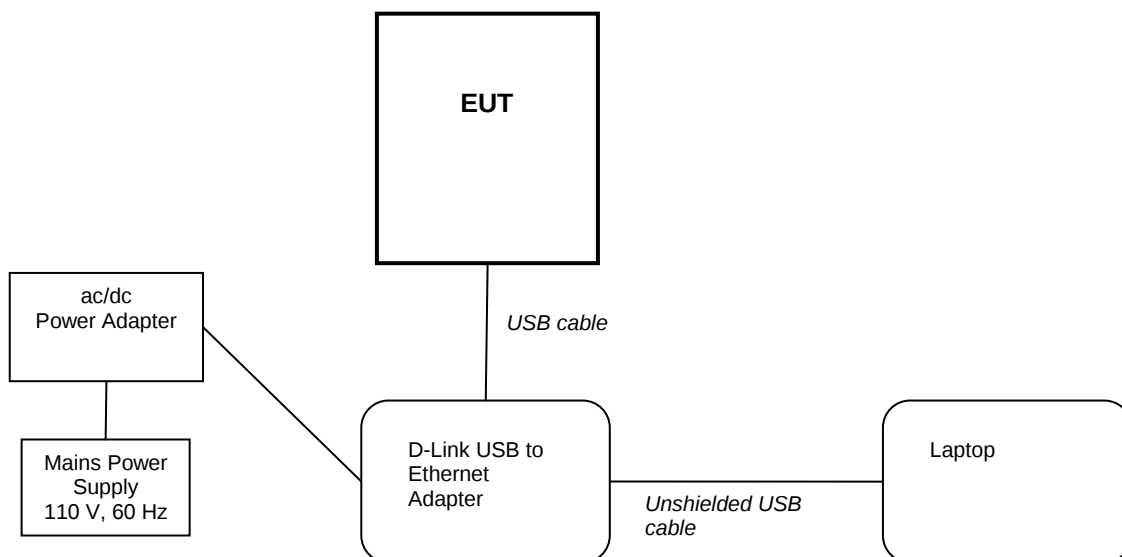
8 Modifications

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:



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.

Sample No.	Description	Model No.	Serial No.
TRA-031431 - S03	EUT 12 Vdc Power Adapter	EADP-40MB A	HBBD45F00A7
TRA-029575 - S11	Lenovo ThinkPad	E560	34546
TRA-031431 – S02	D-Link NDIS USB Hub	DUB H4	DL3H1G5000853

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 applied to the N63 Host device was approx. 110 V ac, 60 Hz, from the mains.

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	110 V ac +/-2 %	85 % and 115 %
☐	Battery	3.7 V d.c	3.4 – 3.75 V d.c.

11 AC power-line conducted emissions

11.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

11.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Screen Room 2 (Lab5)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Channels / Frequencies Measured:	Channel 54 / 5270 MHz
EUT Channel Bandwidths:	40 MHz
EUT Modulation:	CDD MCS0NSS1
Deviations From Standard:	None
Measurement BW:	9 kHz
Measurement Detectors:	Quasi-Peak and Average

Environmental Conditions (Normal Environment)

Temperature: 32 °C	+15 °C to +35 °C (as declared)
Humidity: 37 %RH	20%RH to 75%RH (as declared)
Supply: 110 Vac	110Vac +/-10% (as declared)

Test Limits

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-Peak	Average**
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5.0	56	46
5.0 – 30.0	60	50

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

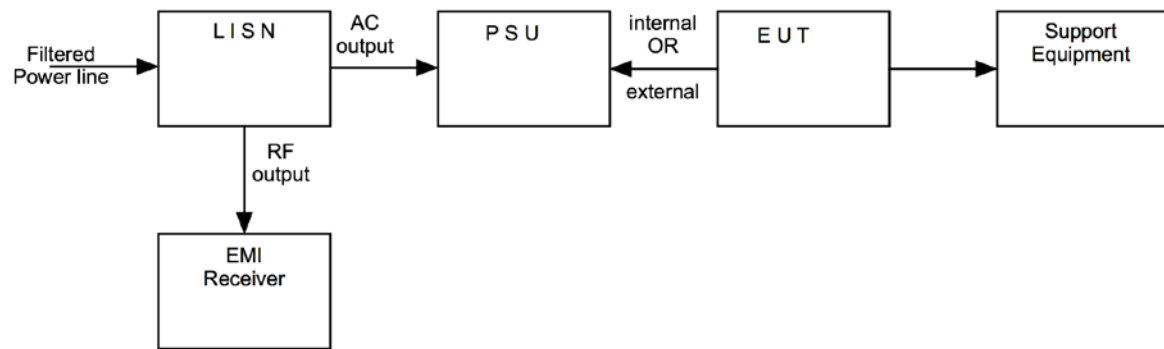
11.3 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure ii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



Test Setup Photograph(s)

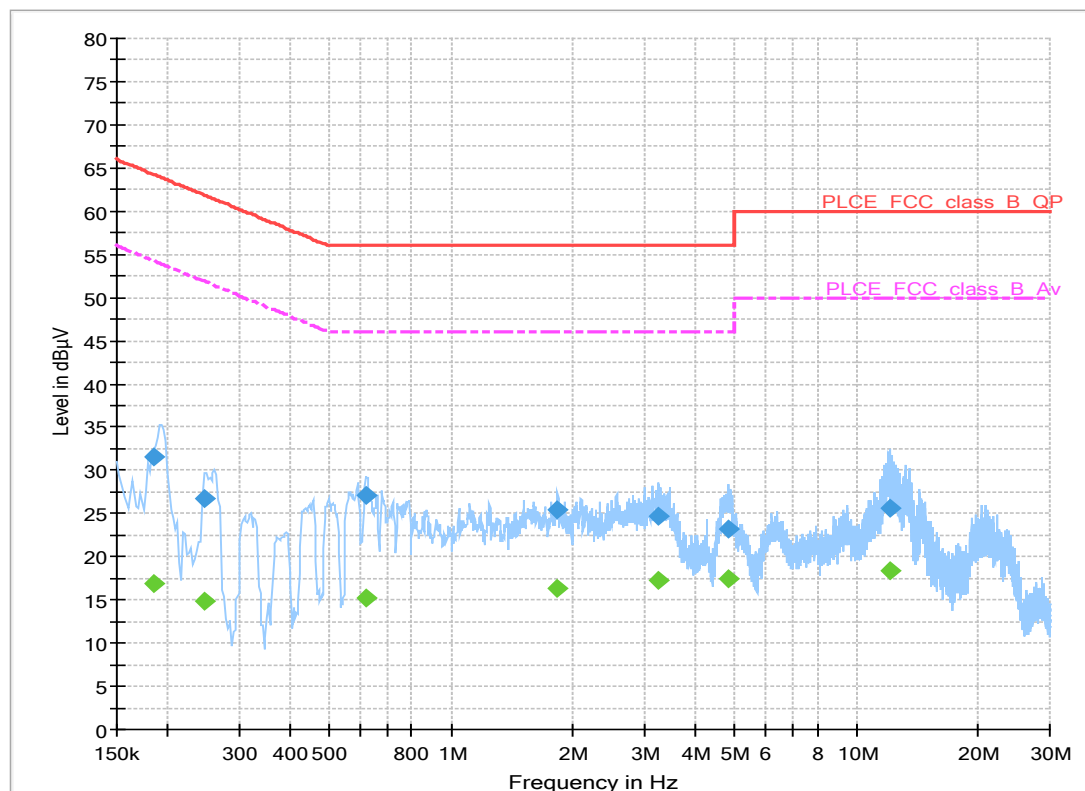


11.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	Element No	Last Cal Calibration	Calibration Period	Due For Calibration
LISN	R&S	2-Line V network	RFG189	2-8-2016	12-month	2-8-2017
9kHz-7GHz Receiver	R&S	EMI test receiver ESCI7	RFG715	11-10-2016	12-month	11-10-2017
Pulse Limiter	R&S	ESH3-Z2	RFG674	6-4-2017	12-month	6-4-2018
Frequency converter	8559 500VA	Voltage converter	RFG109	N / A	N / A	N / A

11.5 Test Results

Transmit mode: Channel: 5270 MHz; 40 MHz channel width; Power Setting: 62q dBm; Data rate: MCS0NSS1 CDD



Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.184725	31.6	15000.0	9.000	GND	N	0.2	32.7	64.3
0.247050	26.6	15000.0	9.000	GND	N	0.2	35.2	61.9
0.617100	27.1	15000.0	9.000	GND	N	0.2	28.9	56.0
1.836875	25.5	15000.0	9.000	GND	L1	0.4	30.5	56.0
3.231375	24.7	15000.0	9.000	GND	L1	0.5	31.3	56.0
4.837450	23.2	15000.0	9.000	GND	L1	0.6	32.8	56.0
12.165000	25.7	15000.0	9.000	GND	L1	1.2	34.3	60.0

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.184725	16.9	15000.0	9.000	GND	N	0.2	37.3	54.3
0.247050	14.9	15000.0	9.000	GND	N	0.2	37.0	51.9
0.617100	15.3	15000.0	9.000	GND	N	0.2	30.7	46.0
1.836875	16.3	15000.0	9.000	GND	L1	0.4	29.7	46.0
3.231375	17.3	15000.0	9.000	GND	L1	0.5	28.7	46.0
4.837450	17.4	15000.0	9.000	GND	L1	0.6	28.6	46.0
12.165000	18.4	15000.0	9.000	GND	L1	1.2	31.6	50.0

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**