

Report on the Radio Testing

For

SmarDTV (UK) Limited

on

S55

Report no. TRA-031431-0045-07A

20th April 2017







Report Number: TRA-031431-0045-07A

Tested by: A Wong

Issue: A

REPORT ON THE RADIO TESTING OF A SmarDTV (UK) Limited \$55 WITH RESPECT TO SPECIFICATION FCC 47CFR 15.207 & IC RSS-207

TEST DATE: 21st April 2017

A Wong

Radio Test Engineers

A Wong

Written by: A Wong Senior Radio Test Engineer

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Approved by: 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

ilac mra



# 1 Revision Record

Issue Number	Issue Date	Revision History
Α	20th April 2017	Original

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### Summary

**TESTED BY:** 

**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 IDENTIFER: 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 **2** 01535 659000 □ chris.wordley@smardtv.com ORDER NUMBER: POR01251 TEST DATE: 25th Apr - 26th Sep 2016

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A Longley – A Wong

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Element

### 2.1 Test Summary

		Requireme	nt Clause	Applicable		
Test Method and Descr	ription	RSS	47CFR15	to this equipment	Result / Note	
Radiated spurious emissio (restricted bands of operat 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	
Conducted carrier power	Max.	247, 5.4 (4)				
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 correcti	on	-	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).

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#### 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.

 $\boxtimes$ Element Hull Element Skelmersdale Unit E Unit 1 South Orbital Trading Park Pendle Place Hedon Road Skemersdale Hull West Lancashire HU9 1NJ WN8 9PN UK 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.

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## 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.

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## 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
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-mptPoint-to-multipointPt-ptPoint-to-pointRFRadio FrequencyRHRelative HumidityRMSRoot Mean Square

Rx receiver s second

**SVSWR** Site Voltage Standing Wave Ratio

Tx transmitter

**UKAS** United Kingdom Accreditation Service

 $\begin{array}{ll} \textbf{V} & \text{volt} \\ \textbf{W} & \text{watt} \\ \textbf{\Omega} & \text{ohm} \end{array}$ 

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# 7 Equipment Under Test

### 7.1 EUT Identification

• Name: S55

Serial Number: Sample S7Model 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.

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## 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	The FCC part 15.19(a) statement is in the
use:	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

Туре:	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

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# 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

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# 7.4 EUT Description

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

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# 8 Modifications

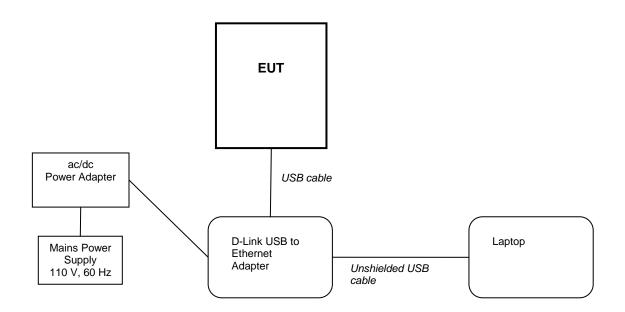
No modifications were performed during this assessment.

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# 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

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### 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.	

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### 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 (dΒμV)			
(WITZ)	Quasi-Peak	Average		
0.15 – 0.5	66 to 56 <sup>*</sup>	56 to 46 <sup>*</sup>		
0.5 - 5.0	56	46		
5.0 – 30.0	60	50		

<sup>\*</sup> The level decreases linearly with the logarithm of the frequency.

#### 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.

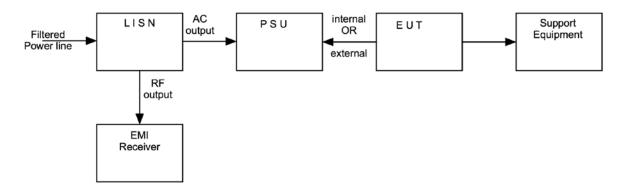
AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

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.

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<sup>\*\*</sup> A linear average detector is required.

# Figure ii Test Setup



# Test Setup Photograph(s)



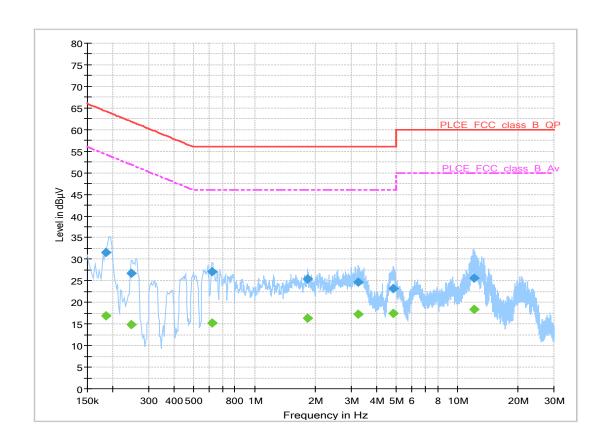
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# 11.4 Test Equipment

Equipment		Equipment	Element	Last Cal	Calibration	Due For
Description	Manufacturer	Туре	No	Calibration	Period	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

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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

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### 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

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