
**FCC Part 15C & Industry Canada
Verification Report**

for the

Avonwood

Plus Reader (FCC)

ZSR6663-FCC



Project Engineer: R. Pennell



Approval Signatory

Approved signatories: J. A. Jones ☐ R. P. St John James ☒ A. V. Jones ☐

The above named are authorised Hursley EMC Services signatories.

Contents

1.0	DECLARATION.....	3
1.1	FCC PART 15C AND INDUSTRY CANADA STATEMENT.....	3
1.2	RELATED SUBMITTAL(S) GRANTS.....	3
1.3	EUT MANUFACTURER.....	3
2.0	EUT DESCRIPTION.....	4
2.1	IDENTITY.....	4
2.2	PRODUCT OPERATION.....	4
2.3	SUPPORT EQUIPMENT.....	4
2.4	EXERCISER PROGRAM.....	4
3.0	MEASUREMENT PROCEDURE AND INSTRUMENTATION.....	5
3.1	EMI SITE ADDRESS & TEST DATE.....	5
3.2	GENERAL OPERATING CONDITIONS.....	5
3.3	ENVIRONMENTAL AMBIENT.....	5
3.4	RADIATED EMISSIONS.....	6
3.5	CONDUCTED EMISSIONS.....	7
3.5.1	<i>Data; EUT powered at 110V/60Hz.....</i>	<i>7</i>
3.6	FCC – RADIATED EMISSIONS.....	8
4.0	RESULTS.....	8
4.1	EXTRAPOLATION.....	8
4.2	CARRIER POWER.....	9
4.3	RESULTS - 9 kHz TO 30 MHz.....	9
4.4	RESULTS (TRANSMITTING) - 30 MHz TO 1000 MHz.....	9
4.5	RESULTS (TRANSMITTING) - 1 GHz TO 10 GHz.....	10
4.6	OCCUPIED BANDWIDTH TEST EQUIPMENT.....	10
4.7	99% OCCUPIED BANDWIDTH (IC).....	10
4.8	20dB OCCUPIED BANDWIDTH (FCC).....	10
4.9	PROFILES.....	11
4.9.1	<i>Conducted Emissions.....</i>	<i>11</i>
4.10	<30MHz TESTED AT 3M,.....	12
4.11	30MHz TO 1GHz.....	12
4.12	> 1GHz.....	13
4.13	99% BANDWIDTH PLOT (IC).....	13
4.14	20dB BANDWIDTH PLOT (FCC).....	14
5.0	FCC DETAILS.....	15
6.0	INDUSTRY CANADA LETTER.....	16

Document History:

Issue#1: 4th December 2017 was withdrawn and replaced by Issue#2: updated with editorial corrections.

1.0 DECLARATION

1.1 FCC Part 15C and Industry Canada Statement

The Equipment Under Test (EUT), as described and reported within this document, complies with the parts 15.207 and 15.209 of the CFR 47:2015 FCC rules in accordance with ANSI C63.4. The EUT operates at a transmit frequency of 125 kHz and complies with part 15C emission requirements. The EUT also complies with Industry Canada RSS-210 Issue 9.

Note: The EUT works in conjunction with other Avonwood products.

1.2 Related Submittal(s) Grants

ZoneSafe Standard Antenna Unit (FCC)

Standard Tag - Pedestrian (FCC)

TufTag (FCC)

VibraTag - Pedestrian (FCC)

Plus Reader (FCC)

1.3 EUT Manufacturer

Trade name:	Avonwood Developments Ltd
Company name:	Avonwood Developments Ltd
Company address:	Knoll Technology Centre Stapehill Road Hampreston Wimborne Dorset BH21 7ND United Kingdom
Manufacturing address:	As above.
Company representative:	Mr Adrian Nash Tel: +44 (0) 1202 868000

2.0 EUT DESCRIPTION

2.1 Identity

EUT:	Plus Reader (FCC)
Model:	ZSR6663-FCC
Serial numbers:	28972
Sample build:	Production

2.2 Product Operation

The Plus Reader (FCC) has been designed for reading microchips that are housed in tags. The Plus Reader transmits a 125kHz signal which is detected by the tags when nearby, the detector which in turn respond by transmitting at 902.4MHz which is received by the Plus Reader.

2.3 Support Equipment

None.

2.4 Exerciser Program

None.

3.0 MEASUREMENT PROCEDURE AND INSTRUMENTATION

3.1 EMI Site Address & Test Date

EMI Company Offices	Hursley EMC Services Ltd Trafalgar House, Trafalgar Close, Chandlers Ford, Hampshire
EMI Measurement Site	Hursley EMC Services Ltd Hursley Park, Winchester; FCC Registered UK Designation number: UK0006
Test Dates	15 th November 2017 to 29 th November 2017
HEMCS References:	17R616

3.2 General Operating Conditions

Testing was performed according to the procedures in ANSI C63.4-2014 and ANSI C63.10- 2013. Final radiated testing was performed at a EUT to antenna distance of three metres (above 30 MHz).

Below 30 MHz the EUT was measured at an antenna distance of three and ten metres and the extrapolation factor calculated.

Instrumentation, including receiver and spectrum analyser bandwidth, comply with the requirements of ANSI C63.2:1996.

3.3 Environmental Ambient

Test Type	Temperature	Humidity	Atmospheric Pressure
Radiated	21.4 - 22 degrees Celsius	56 - 59% relative	1016.8 – 1023.5 millibars

3.4 Radiated Emissions

Initial Scan

A radiated profile scan was taken at a three metre distance on eight azimuths of the system under test in both vertical and horizontal polarities of the antenna in a semi-anechoic chamber. Instrumentation used in the chamber as below:

#ID	CP	Manufacturer	Type	Serial No	Description	Calibration due date
762	3	Schwarzbeck	VULB9162	129	30-7000MHz	07/04/2019
762a	3	Schwarzbeck	DGA 9552N	0	6dB attenuator for #762	07/04/2019
050	1	HP	8447D	1937A02341	Pre-amplifier (30-1000MHz)	06/10/2019
033	1	HP	8593EM	3726U00203	Spectrum analyser (9kHz-26.5GHz)	29/11/2017
289	1	Rohde & Schwarz	ESCI 7	100765	CISPR 7GHz Receiver	24/08/2018
674	1	Rohde & Schwarz	ESH3-Z5	838576-018	1 phase LISN	26/05/2018
158	1	Rohde & Schwarz	ESH3-Z2	357881052	Pulse limiter	07/10/2018
698	1	Gauss	TDEMI30M	1510002	Time Domain Conducted Receiver	09/01/2018
047	3	Rohde & Schwarz	HFH2-Z2	879021/22	Loop antenna (9kHz-30MHz)	01/06/2019

The data obtained from the profile scan was used as a guide for the final Open Area Test Site (OATS) measurements.

Final Measurements

The system under test was transferred to the OATS from the semi-anechoic chamber. The data obtained from the chamber profile-scan was used to guide the test engineer. Above 30 MHz, each emission from the transmitter was maximised by revolving the system on the turntable and moving the antennae in height and azimuth. Below 30 MHz the loop antenna was set at a height of 1m, the EUT was measured with the antenna in the vertical and horizontal polarity and each emission was maximised by revolving the system on the turntable. The worst-case data is presented in this report. Test instrumentation used in the OAT's measurements was as follows:

#ID	CP	Manufacturer	Type	Serial No	Description	Calibration due date
762	3	Schwarzbeck	VULB9162	129	30-7000MHz	07/04/2019
762a	3	Schwarzbeck	DGA 9552N	0	6dB attenuator for #762	07/04/2019
050	1	HP	8447D	1937A02341	Pre-amplifier (30-1000MHz)	06/10/2019
033	1	HP	8593EM	3726U00203	Spectrum analyser (9kHz-26.5GHz)	29/11/2017
289	1	Rohde & Schwarz	ESCI 7	100765	CISPR 7GHz Receiver	24/08/2018
047	3	Rohde & Schwarz	HFH2-Z2	879021/22	Loop antenna (9kHz-30MHz)	01/06/2019

CP = Interval period [year] prescribed for external calibrations

Note: 'Calibration due date' means that the instrument is certified with a UKAS or traceable calibration certificate.
 '**' denotes that the calibration, as defined by Hursley EMC Services quality system, remains valid whilst within four calendar months of the due date.

3.5 Conducted Emissions

A filtered supply was fed to the EUT via a 50Ω/50μH Artificial Mains Network (AMN). The AMN was bonded to a conductive ground plane. Line and neutral phases were measured separately.

A spectrum analyser was set to measure between 0.15 MHz and 30.0 MHz to record the CISPR peak and CISPR average emission profiles. The worst-case peaks were compared to the CISPR 11 Class B limits. Measurements made according to the CISPR 11 test standard and Hursley EMC Services test procedure CON-02.

#ID	CP	Manufacturer	Type	Serial No	Description	Calibration due date
674	1	Rohde & Schwarz	ESH3-Z5	838576-018	1 phase LISN	26/05/2018
158	1	Rohde & Schwarz	ESH3-Z2	357881052	Pulse limiter	07/10/2018
698	2	Gauss	TDEMI30M	1510002	Time Domain Conducted Receiver	24/01/2019

3.5.1 Data; EUT powered at 110V/60Hz

MAINS – NEUTRAL

Frequency	Quasi-peak value (dBμV)			Average value (dBμV)			Status
	Measured	Class B Limit	Pass Margin	Measured	Class B Limit	Pass Margin	
150.000 kHz	46.25	66.00	19.75	28.30	56.00	27.70	Pass
8.256 MHz	19.48	60.00	40.52	14.01	50.00	35.99	Pass
14.503 MHz	19.06	60.00	40.94	13.75	50.00	36.25	Pass
18.752 MHz	19.43	60.00	40.57	14.14	50.00	35.86	Pass
24.998 MHz	20.40	60.00	39.60	15.18	50.00	34.82	Pass
29.480 MHz	22.15	60.00	37.85	17.11	50.00	32.89	Pass

MAINS – LINE

Frequency	Quasi-peak value (dBμV)			Average value (dBμV)			Status
	Measured	Class B Limit	Pass Margin	Measured	Class B Limit	Pass Margin	
159.740 kHz	45.36	65.48	20.11	28.27	56.00	27.73	Pass
8.237 MHz	19.57	60.00	40.43	14.10	50.00	35.90	Pass
12.500 MHz	19.20	60.00	40.80	13.88	50.00	36.12	Pass
18.747 MHz	19.36	60.00	40.64	14.14	50.00	35.86	Pass
24.998 MHz	20.42	60.00	39.58	15.16	50.00	34.84	Pass
29.485 MHz	21.75	60.00	38.25	16.62	50.00	33.38	Pass

3.6 FCC – Radiated Emissions

A search was made of the frequency spectrum from 9 kHz to 10 GHz and the measurements reported are the highest emissions relative to the 'FCC CFR 47 Section 15.209 Limits' at a measuring distance of three metres. Below 30 MHz the results have been extrapolated from measurements made at a distance of three and ten metres to the limit distance set at 300m.

To calculate the extrapolation factor (see FCC Part 15.31) measurements were made at three metres and ten metres from the EUT. The extrapolation factor (x) was then calculated as shown in 4.1:

Between 110 and 490 kHz measurements were made using an average detector with a 200 Hz bandwidth.

4.0 RESULTS

4.1 Extrapolation

To calculate the extrapolation factor (see FCC Part 15.31 (2)) measurements were made at three metres and ten metres from the EUT. The extrapolation factor (x) was then calculated as follows:

The figures below were measured using Peak detector

Limit at 125kHz is calculated from FCC 15.209 as $\frac{2400}{125} = 19.2\text{V/m} \Rightarrow 25.66\text{dBuV/m}$

$$\text{Extraoplotion factor } x = 20 \frac{\log\left(\frac{E_1}{E_2}\right)}{\log\left(\frac{D_1}{D_2}\right)}$$

Where: E1 field strength uV/m at D1 (closest distance)

E2 field strength uV/m at D2 (farthest distance)

⇒ E1 = 89.63 dBuV/m @ 3m => 30304uV/m

⇒ E2 = 61.42 dBuV/m @ 10m => 1177.6uV/m

$$\Rightarrow X = 20 \frac{\log\left(\frac{30304}{1177.6}\right)}{\log\left(\frac{3}{10}\right)}$$

$$\Rightarrow X = -53.95$$

4.2 Carrier Power

	Measured amplitude (E ₁)	Extrapolation	Calculated amplitude @ 300m		Specified limit @ 300m	
MHz	dBμV/m @3m (d ₁)	Factor (x)	dBμV/m	μV/m	dBμV/m	μV/m
0.124639	88.33	-53.95	-19.5726	0.105043	25.66	19.2

4.3 RESULTS - 9 kHz to 30 MHz

	Measured amplitude (E ₁)	Extrapolation	Calculated amplitude @ 30m		Specified limit @ 30m	
MHz	dBμV/m @3m (d ₁)	Factor (x)	dBμV/m	μV/m	dBμV/m	μV/m
1.288974	50.88	-53.95	-57.02	0.001409	25.39	18.6
27.662566	54.6	-53.95	-53.30	0.002162	29.54	30

4.4 RESULTS (Transmitting) - 30 MHz to 1000 MHz

Frequency MHz	Receiver amplitude dBμV	Antenna factor dB	Cable loss dB	Actual quasi-peak value @ 3m	Specified limit @ 3m	
				dBμV/m	dBμV/m	μV/m
68.33	7.5	9.1	1.0	17.6	40.0	100
190	14.3	11.6	1.8	27.7	43.5	150
253.48	25.2	11.8	2.2	39.2	46.0	200
376.84	26.3	14.9	2.8	44.0	46.0	200
440.03	21.7	16.3	3.1	41.1	46.0	200
562	12.6	17.9	3.6	34.1	46.0	200

Uncertainty of measurement: ± 4.2 dBμV/m for a 95% confidence level.

4.5 RESULTS (Transmitting) - 1 GHz to 10 GHz

Frequency	AVERAGE @ 3m			PEAK @ 3m			Antenna polarity	Antenna height	Turntable azimuth	STATUS
	Measured	Specified CLASS B Limit	Pass Margin	Measured	Specified CLASS B Limit	Pass Margin				
GHz	dB μ V/m	dB μ V/m	dB	dB μ V/m	dB μ V/m	dB	H/V	m	deg	
No emissions within 12dB of limit										

V = Vertical / H = Horizontal

4.6 Occupied Bandwidth test equipment

#ID	CP	Manufacturer	Type	Serial No	Description	Calibration due date
289	1	Rohde & Schwarz	ESCI7	100765	7GHz Receiver	24/08/2018
--	1	EMCO	7045	1048	Near filed probe	Internal

4.7 99% Occupied Bandwidth (IC)

Section 4.6 of RSS-GEN

The output from the measuring antenna was fed into the input of the ESCI spectrum analyser/receiver. The bandwidth of the transmitter was measured with an ESCI receiver set to 99% Occupied Bandwidth with a sampling detector on max hold. The resolution bandwidth, span and video bandwidth are indicated on the occupied bandwidth plot (modulated) included with this report.

The bandwidth of the Transmitter was measured as 41.6 kHz.

4.8 20dB Occupied Bandwidth (FCC)

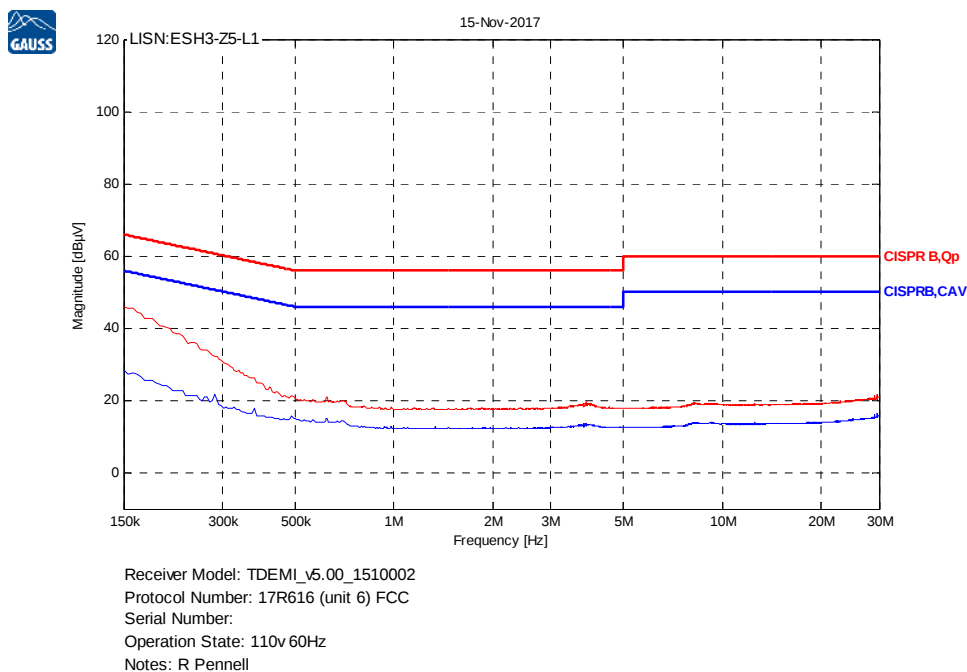
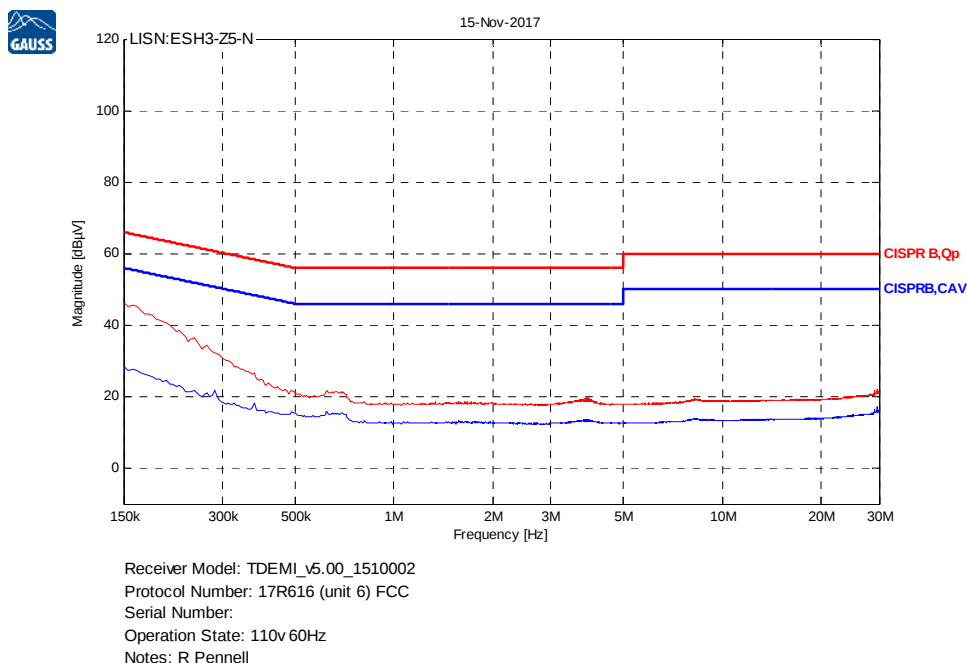
ANSI 63.10 6.9.3

The output from the measuring antenna was fed into the input of the ESCI spectrum analyser/receiver. The bandwidth of the transmitter was measured 20dB down either side of the peak. The ESCI analyser resolution bandwidth, span and video bandwidth are indicated on the occupied bandwidth plot (modulated) included with this report.

The bandwidth of the Transmitter signal was measured as 6.26 kHz.

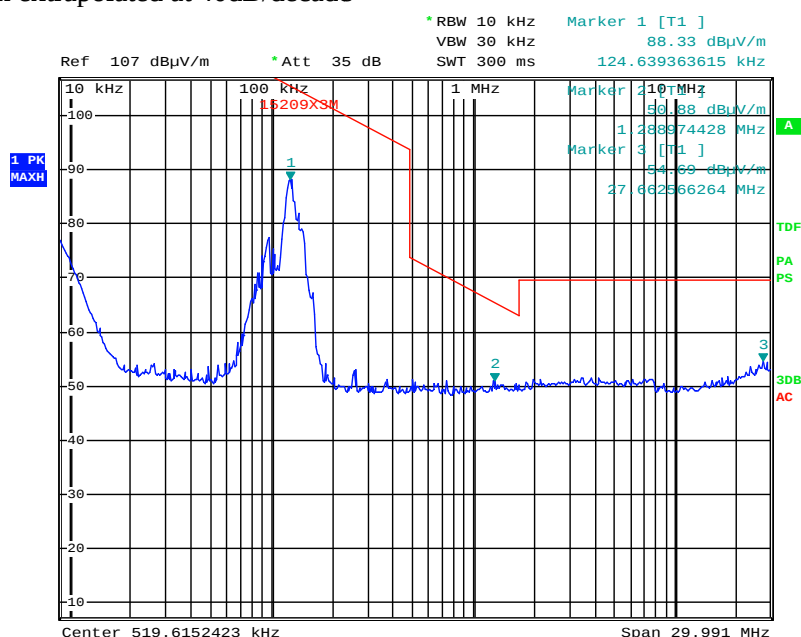
4.9 Profiles

4.9.1 Conducted Emissions



4.10 <30MHz tested at 3m,

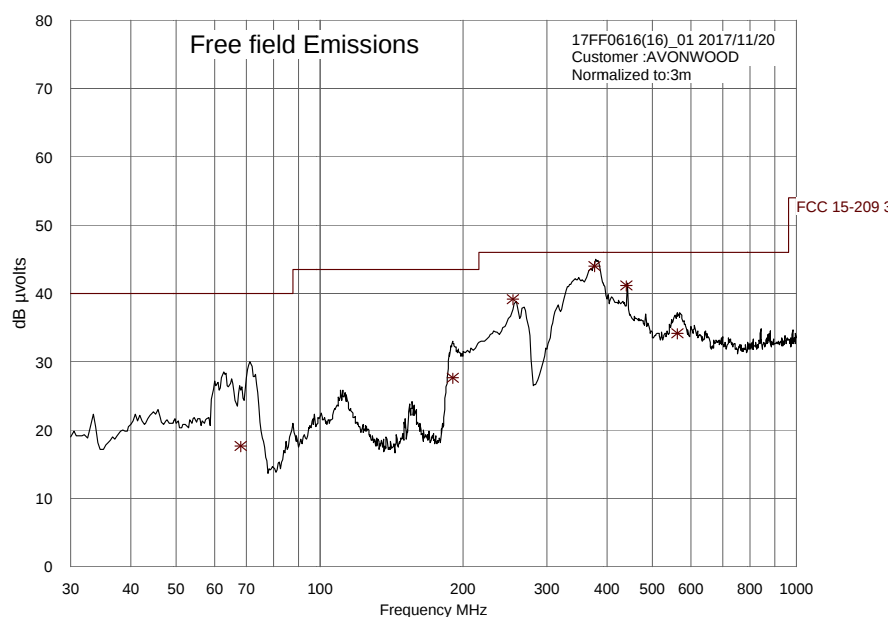
limit line shown extrapolated at 40dB/decade



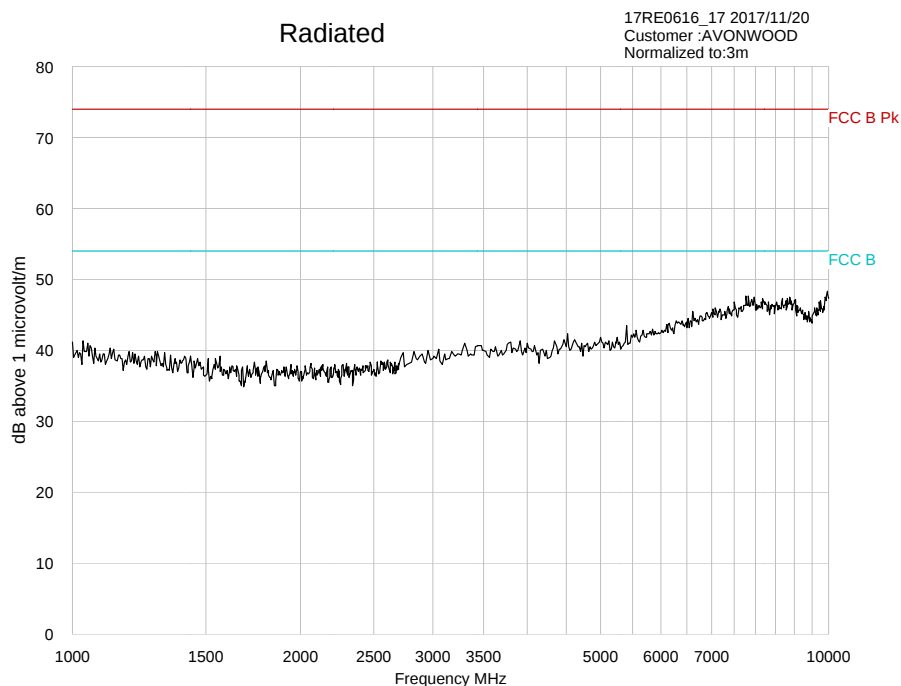
Date: 21.NOV.2017 17:39:32

4.11 30MHz to 1GHz

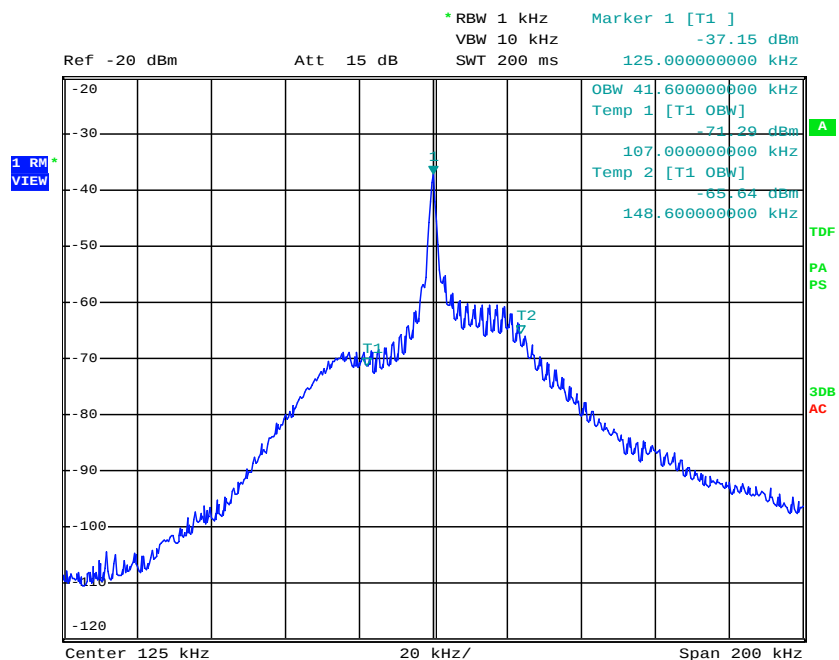
Emissions plots >30MHz (carried out at 3m, limits shown extrapolated using 20dB / Decade)



4.12 > 1GHz

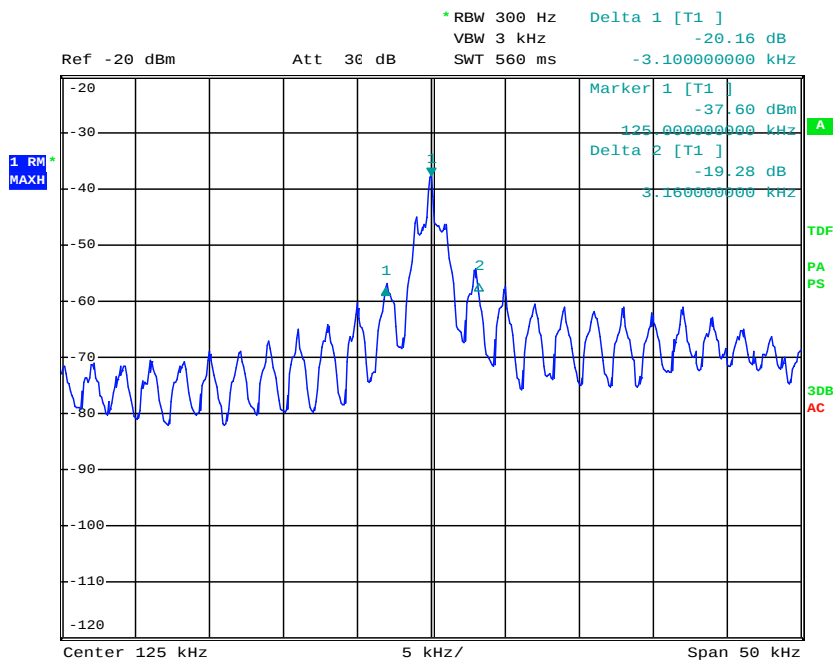


4.13 99% Bandwidth Plot (IC)



Date: 23.NOV.2017 14:30:07

4.14 20dB Bandwidth Plot (FCC)



Date: 23.NOV.2017 14:39:31

5.0 FCC DETAILS

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

February 13, 2006

Hursley EMC Services Ltd.
Unit 16
Brickfield Lane
Chandlers Ford - Hampshire, SO53 4DB
United Kingdom
Attention: R P St John James

Re: Accreditation of Hursley EMC Services Ltd.
Designation Number: UK0006

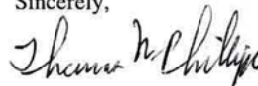
Dear Sir or Madam:

We have been notified by Department of Trade and Industry (DTI) that Hursley EMC Services Ltd. has been accredited as a Conformity Assessment Body (CAB).

At this time your organization is hereby designated to perform compliance testing on equipment subject to Declaration Of Conformity (DOC) and Certification under Parts 15 and 18 of the Commission's Rules.

This designation will expire upon expiration of the accreditation or notification of withdrawal of designation.

Sincerely,



Thomas Phillips
Electronics Engineer

6.0 INDUSTRY CANADA LETTER



September 24, 2010

OUR FILE: 46405-7104
Submission No: 142641

Hursley EMC Services Ltd.
Unit 16, Brickfield Lane, Eastleigh
Hampshire, SO53 4DP
Great Britain

Attention: Rob St. John James

Dear Sir/Madame:

The Bureau has received your application for the renewal of a 3/10m OATS. Be advised that the information received was satisfactory to Industry Canada. The following number(s) is now associated to the site(s) for which registration / renewal was sought (**7104A-1**). Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please keep for your records the following information;

- The company address code associated to the site(s) located at the above address is: **7104A**

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2003 or later shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 metre OATS or 3 metre chamber). If the test facility is not accredited to ANSI C63.4-2003 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

The frequency for re-validation of the test site and the information that is required to be filed or retained by the testing party shall comply with the requirements established by the accrediting organization. However, in all cases, test site re-validation shall occur on an interval not to exceed two years. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;

http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/h_tt00052e.html.

If you have any questions, you may contact the Bureau by e-mail at certification.bureau@ic.gc.ca Please reference our file and submission number above for all correspondence.

Yours sincerely,



Dalwinder Gill
For: Wireless Laboratory Manager
Certification and Engineering Bureau
3701 Carling Ave., Building 94
P.O. Box 11490, Station "H"
Ottawa, Ontario K2H 8S2
Email: dalwinder.gill@ic.gc.ca
Tel. No. (613) 998-8363
Fax. No. (613) 990-4752