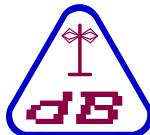


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REPORT ON ELECTROMAGNETIC COMPATIBILITY TESTS

**Performed at:
TWENTY PENCE TEST SITE**

**Twenty Pence Road,
Cottenham,
Cambridge
U.K.
CB24 8PS**

on

Dentaku London

Ototo

dated

17th July 2014

Document History

Issue	Date	Affected page(s)	Description of modifications	Revised by	Approved by
1	23/07/14		Initial release		

Based on report template:
v090319

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	Report No: R3370 Issue No: 1	FCC ID: 2ACKT-OTOTO1	
Test No: T5219		Test Report	Page: 2 of 15

Equipment Under Test (EUT): **Ototo**

Test Commissioned by: **Dentaku London
Unit 11
Dalston Studios
230 Dalston Lane
London
E8 1LA**

Representative: **Mark McKeague**

Test Started: **20th June 2014**

Test Completed: **1st July 2014**

Test Engineer: **Russell McDonnell**

Date of Report: **17th July 2014**

Written by: Russell McDonnell

Signature: 

Date: 17th July 2014

Checked by: Derek Barlow

Signature: 

Date: 23rd July 2014

dB Technology can only report on the specific unit(s) tested at its site. The responsibility for extrapolating this data to a product line lies solely with the manufacturer.

Test Standards Applied

CFR 47	<i>Code of Federal Regulations: Pt 15 Subpart B- Radio Frequency Devices - Unintentional Radiators</i>
---------------	--

Measurements performed at dB Technology FCC Listed test facility, registration No: 90528

Emissions Test Results Summary

CFR 47						PASS
Test	Port	Method	Limit	PASS/FAIL	Notes	
Conducted Emissions	ac power	ANSI C63.4:2003	FCC(B) = CISPR22(B)	PASS		
Radiated Emissions		ANSI C63.4:2003	CISPR22(B)	PASS		

specs_fccv100412

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1 EUT Details

1.1 General

The EUT was “Ototo”, a circuit board synthesizer. It was an unenclosed PCB, designed to be used in a domestic environment. It was powered over USB, and included microprocessor circuitry with a maximum frequency of 16 MHz.

Details of the EUT and associated peripherals used during the tests are listed below. Figure 1 shows the interconnections between the EUT and peripherals.

Item	Manufacturer	Model	Description	Serial No:	Notes
1	Dentaku Ltd	Ototo	Circuit board synth	001	EUT
2	Dentaku Ltd	Light sensor	Light sensor	001	#1
3	Dentaku Ltd	Force sensor	Force sensor	001	#1
4	Dentaku Ltd	Rotation sensor	Rotation sensor	001	#1
5	Dentaku Ltd	Joystick	Joystick	001	#1
6	Apple	MacBook Air	Laptop	C02GM20PDJWR	DoC
7	Apple	A1374	PSU 14.5V 3.1A	none	Verif
8	Apple	A1433	Ethernet adapter	none	DoC
9	AIAIAI	TMA-1	Headphones	1236	#1

#1 Passive devices not requiring FCC authorisation.

1.2 Modifications to EUT and Peripherals

Details of any modifications that were required to achieve compliance are listed below. The modification numbers are referred to in the results sections as appropriate.

Mod No:	Details	Implemented for
0	As supplied 21st May 2014.	

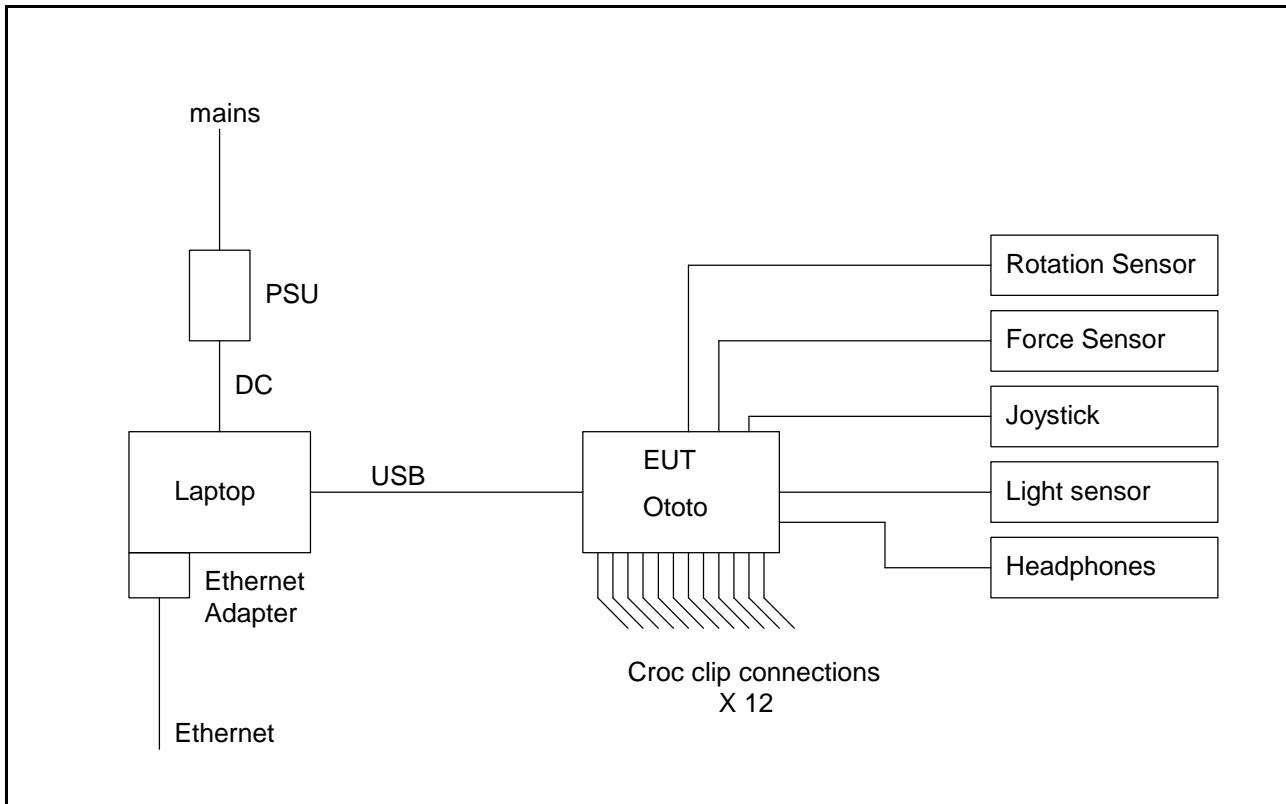
1.3 EUT Operating Modes

The EUT was tested in the following operating mode or modes. Generally, operating modes are chosen that will exercise the functions of the EUT as fully as possible and in a manner likely to produce maximum emission levels or susceptibility. Individual test result sheets reference the operating mode of the EUT.

Operating Mode	Details
1	Ototo board playing test sequence from flash memory, USB (12Mbps) comms to Macbook air. H pattern on display. Ethernet internet connection active.

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Figure 1 General Arrangement of EUT and Peripherals



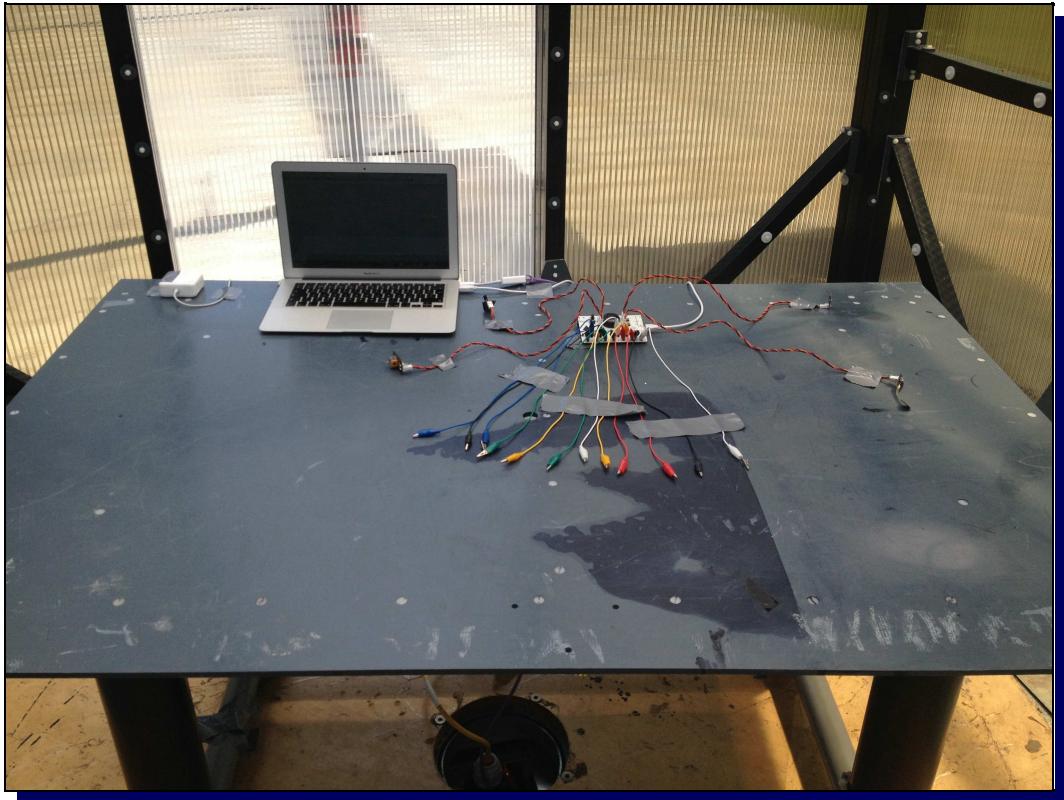
1.4 Details of Interconnecting Cables

The following table lists details of the cables connected to the EUT.

From	To	Cable Type	Length	Notes
mains	laptop PSU	3 core	2m	
laptop PSU	laptop	DC co-ax	2m	
laptop Ethernet adapter	local network	Ethernet Cat5 SFTP	5m	
EUT	laptop	USB shielded	1m	
EUT	Rotation sensor	3 core twisted	50cm	
EUT	Force sensor	3 core twisted	50cm	
EUT	Joystick	3 core twisted	50cm	
EUT	Light sensor	3 core twisted	50cm	
EUT	Croc clips X 12	Single core	40cm	
EUT	Headphones	Audio co-ax	1.5m	

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Photograph 1 Radiated Emissions: Front view

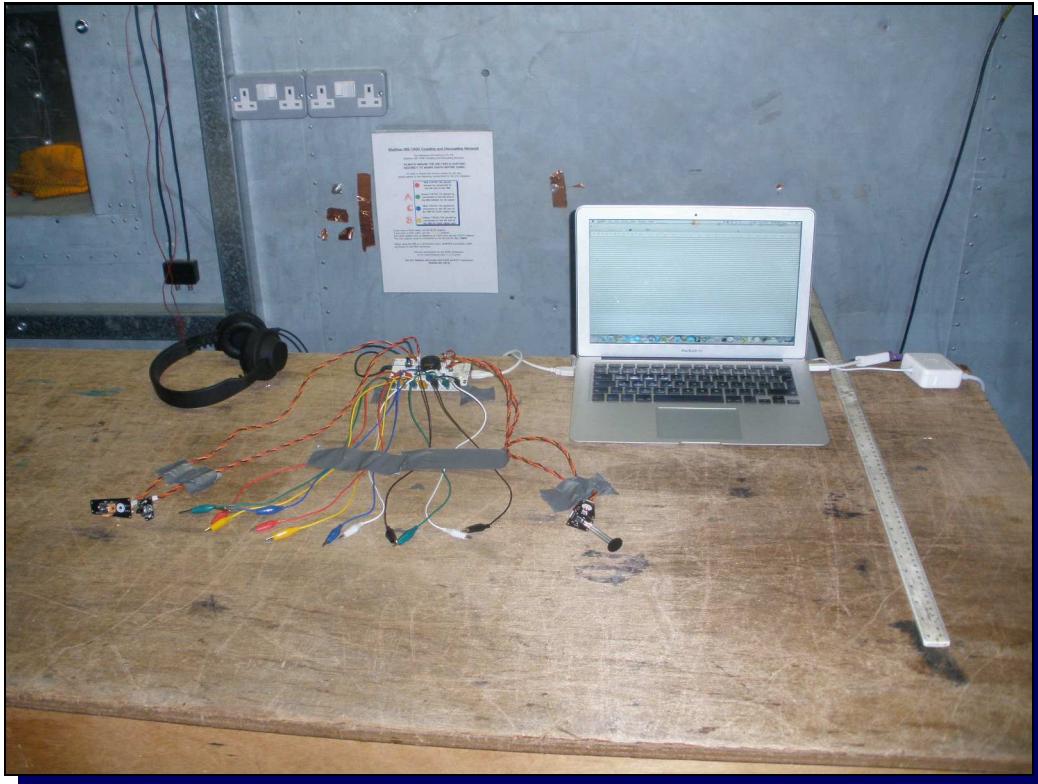


Photograph 2 Radiated Emissions: Front view

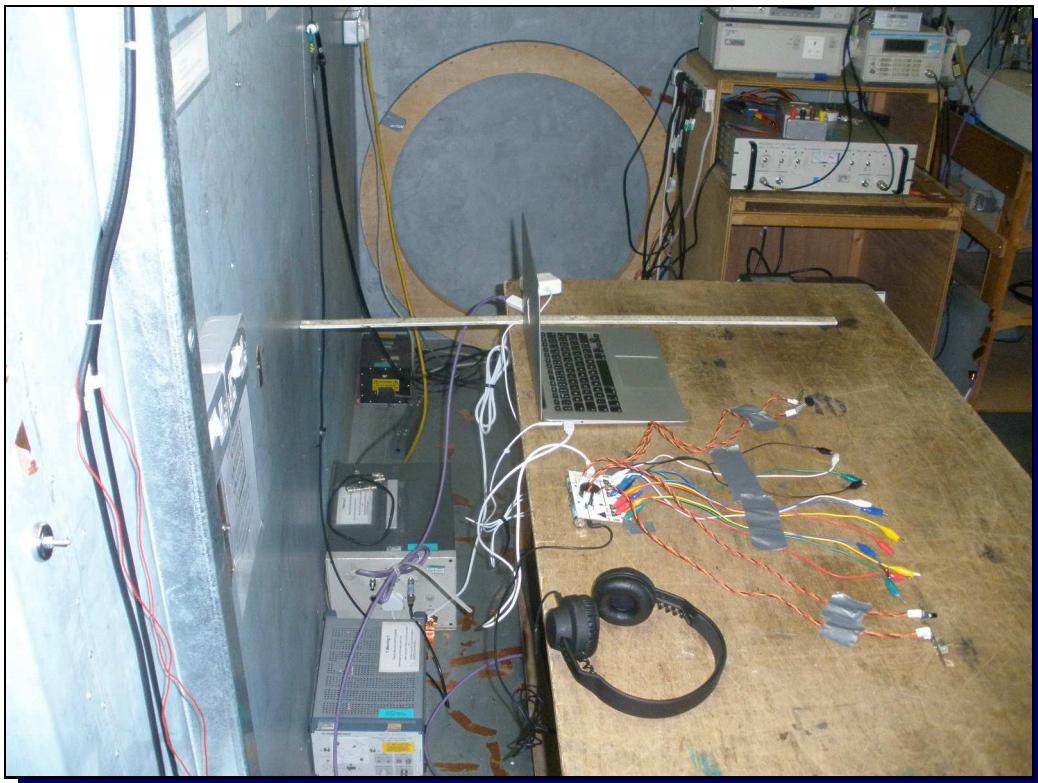


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Photograph 3 Conducted Emissions setup



Photograph 4 Conducted Emissions: LISN connection



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2 Test Equipment

The test equipment used during the tests was one or more of the items listed below. Individual test result sheets indicate which items were used.

Ref No:	Details	Serial Number	Cal Date	Cal Interval
A24	Chase X-wing Bilog CBL6144 26MHz-3GHz	27590	28/10/2013	1 year
A5	Chase Bilog CBL6111A	1760	03/03/2014	1 year
L1	EMCO 3825/2 LISN	1358	21/02/2014	1 year
L2	R&S ESH3-Z5 LISN	843862/009	21/02/2014	1 year
R10	Narda PMM 9010 Receiver (10Hz-30MHz)	595WX11003	12/02/2014	1 year
R4	R&S ESVS10	843744/002	13/12/2013	1 year
R9	Agilent E7405A Spectrum Analyser	MY45110758	19/11/2013	1 year

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	Issue No: 1		
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3 Test Methods

3.1 Conducted Emissions - ac power

Bench top EUTs and peripheral equipment are normally placed on a 0.8m high non-conducting bench, positioned 0.4m from one of the metallic walls of a screened room. Floor standing EUTs are normally placed 0.1m above the metallic floor of the screened room. Mains leads are bundled so as not to exceed 1m.

The EUT is powered using a 50ohm/50uH Line Impedance Stabilisation Network (LISN). Peripherals are powered using a second a 50ohm/50uH LISN. These LISNs are bonded to the screened room floor.

With the correct supply voltage applied to the EUT scans are performed on both the live and neutral line outputs of the LISN using quasi-peak detection over the specified frequency range. The results of these scans are shown in the plots section at the end of the report.

Significant emissions identified by the scans are measured and the results tabulated. The table of results is shown in the conducted emissions results section. Corrections are applied as shown below:

$$\text{Final Level} = \text{Receiver Reading} + \text{Combined Cable and Attenuation Correction Factor} \\ (\text{dBuV}) \qquad \qquad \qquad (\text{dBuV}) \qquad \qquad \qquad (\text{dB})$$

Example: if, @191kHz, receiver reading was 35.8dBuV and the combined correction factor was 10dB

$$\text{Final level} = 35.8 + 10.0 = 45.8 \text{ dBuV}$$

3.2 Radiated Emissions

Initial scans are performed in a semi-anechoic screened room at a distance of 3m. Scans are performed over the frequency range specified in the test standard with the antenna both horizontally and vertically polarised. During these scans the EUT and peripherals are rotated through 360°. Bench top EUTs are placed on a non-conducting bench at a height of 0.8m above the ground plane. Floor standing EUTs are placed 0.1m above the ground plane. The EUT cables were manipulated in an attempt to produce maximum emissions. The results of the scans are shown in the plots included at the end of the report.

Significant emissions identified by the scans are measured on an open area test site at the appropriate test distance using a CISPR16 quasi-peak receiver. Maximised readings are obtained by rotating the EUT through 360° and adjusting the height of the antenna from 1m to 4m. Measurements are made with the antenna both horizontally and vertically polarised and the results tabulated.

Tabulated results show levels based on the following calculation:

$$\text{Field Strength (dBuV)} = \text{receiver reading (dBuV)} + \text{CF (dB/m)}.$$

CF is the correction factor for the antenna and the cable.

For example: if, at 114MHz, receiver reading was 17.9dBuV, combined correction factor = 13.1 (dB/m).

$$\text{Total field strength} = 17.9 + 13.1 = 31.0 \text{ dBuV/m}$$

Where a narrow band measurement has been taken an additional correction factor is included.

4 Test Results

The following sections contain tabulated test results. Plots of various scans are included at the back of this section.

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4.1 Conducted Emissions (Power) - Results

Factor Set 1: L1_14A AB002_CBL005_CBL039_14A - -

Factor Set 2: - - -

Factor Set 3: - - -

Test Equipment: R10 L1 CSET001 L2

Conducted Emissions (Power)

Company: Dentaku London

Product: Ototo

Date: 01/07/2014

Test Eng: Russell McDonnell

Ports: ac power

Test: ANSI C63.4:2003 using limits of

FCC(B) ≡ CISPR22(B)

Ports:

Test: using limits of

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	Issue No: 1	Test Report			
	Test No: T5219				

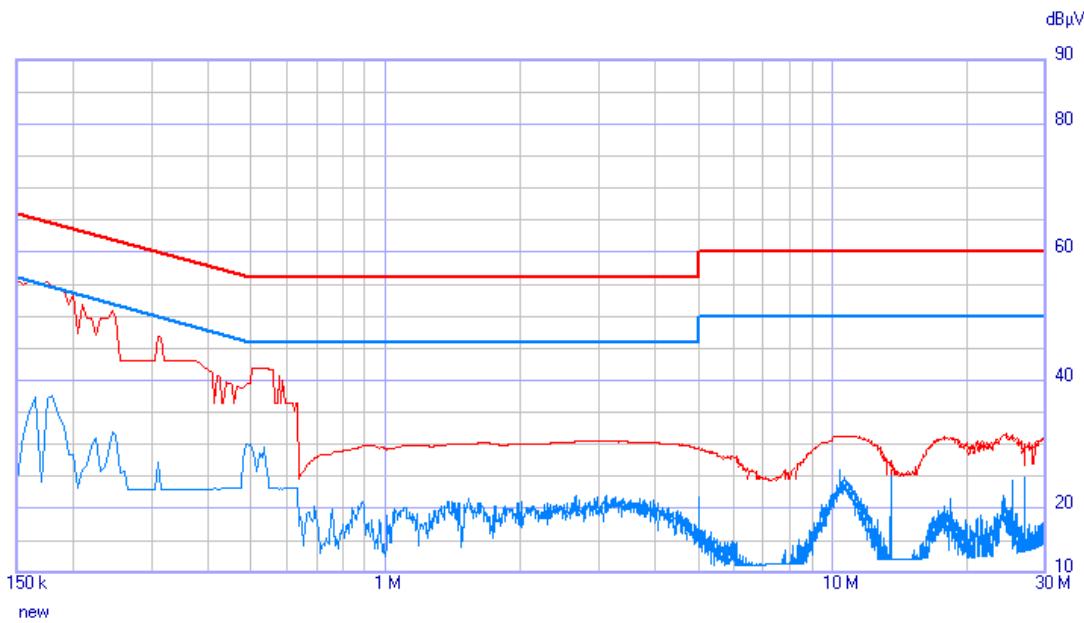
4.2 Radiated Emissions Results

Factor Set 1: A5_14A - - CBL015_14A	1 m cable
Factor Set 2: - - -	
Factor Set 3: - - -	
Test Equipment: R4 A5	

Radiated Emissions

Company: Dentaku London							Product: Ototo													
Date: 20/06/2014							Test Eng: Peter Barlow													
Ports:																				
Test: ANSI C63.4:2003 using limits of CISPR22(B)																				
Ports:																				
Test: using limits of																				
Plot	Op Mode	Mod State	Dist m	Fact Set	Freq. MHz	Ant Pol	Rec. Level dBuV	Corr'n Factor dB/m	Corr'n Factor dB	Total Level dBuV/m	Limit CISPR22(B) dBuV/m	Margin CISPR22(B) dB	Notes							
3	1	0	10	1	30.180	V	0.8	18.9		19.7	30.0	10.3								
3	1	0	10	1	30.180	H	-4.0	18.9		14.9	30.0	15.1								
3	1	0	10	1	36.088	V	7.5	15.8		23.3	30.0	6.7								
3	1	0	10	1	36.088	H	2.0	15.8		17.8	30.0	12.2								
3	1	0	10	1	41.006	V	8.1	13.2		21.3	30.0	8.7								
3	1	0	10	1	41.006	H	-1.9	13.2		11.3	30.0	18.7								
3	1	0	10	1	115.800	V	5.5	13.1		18.6	30.0	11.4								
3	1	0	10	1	115.800	H	2.5	13.1		15.6	30.0	14.4								
3	1	0	10	1	118.300	V	5.5	13.3		18.8	30.0	11.2								
3	1	0	10	1	118.300	H	3.8	13.3		17.1	30.0	12.9								
3	1	0	10	1	144.000	V	12.3	13.3		25.6	30.0	4.4								
3	1	0	10	1	144.000	H	14.5	13.3		27.8	30.0	2.2								
3	1	0	10	1	156.024	V	12.5	12.7		25.2	30.0	4.8								
3	1	0	10	1	156.024	H	6.3	12.7		19.0	30.0	11.0								
3	1	0	10	1	160.000	V	9.8	12.4		22.2	30.0	7.8								
3	1	0	10	1	160.000	H	3.2	12.4		15.6	30.0	14.4								
3	1	0	10	1	185.500	V	7.8	10.9		18.7	30.0	11.3								
3	1	0	10	1	185.500	H	-0.6	10.9		10.3	30.0	19.7								
4	1	0	10	1	384.016	V	3.1	19.1		22.2	37.0	14.8								
4	1	0	10	1	384.016	H	4.8	19.1		23.9	37.0	13.1								
Results							Minimum Margin PASS/FAIL				2.2 dB									
Notes		Comments and Observations																		
		Results of scans shown in plots 3 and 4. Unless otherwise noted measurements were made using a 120kHz bandwidth. Unless otherwise noted measurements were made using a quasi-peak detector. These measurements were made at 10m on an Open Area Test Site.																		
Key:		qp - quasi-peak, av - average, pk - peak																		

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new

	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (5 kHz)	P Q A pwr_B_QP Margin 5 dB	20 ms	9 kHz	10	OFF	ON
2	0.15	0.151	500 Hz	P pwr_B_Avg Margin 0 dB	1.9 ms	9 kHz	10	OFF	ON

Ancillary = General

Limits:

pwr_B_QP

pwr_B_Avg

Factors: **QPeak** — **Avg** —
L1
AB002_CBL005_CBL039

PLOT 1 Conducted Emissions 150 kHz to 30 MHz 115V AC Live

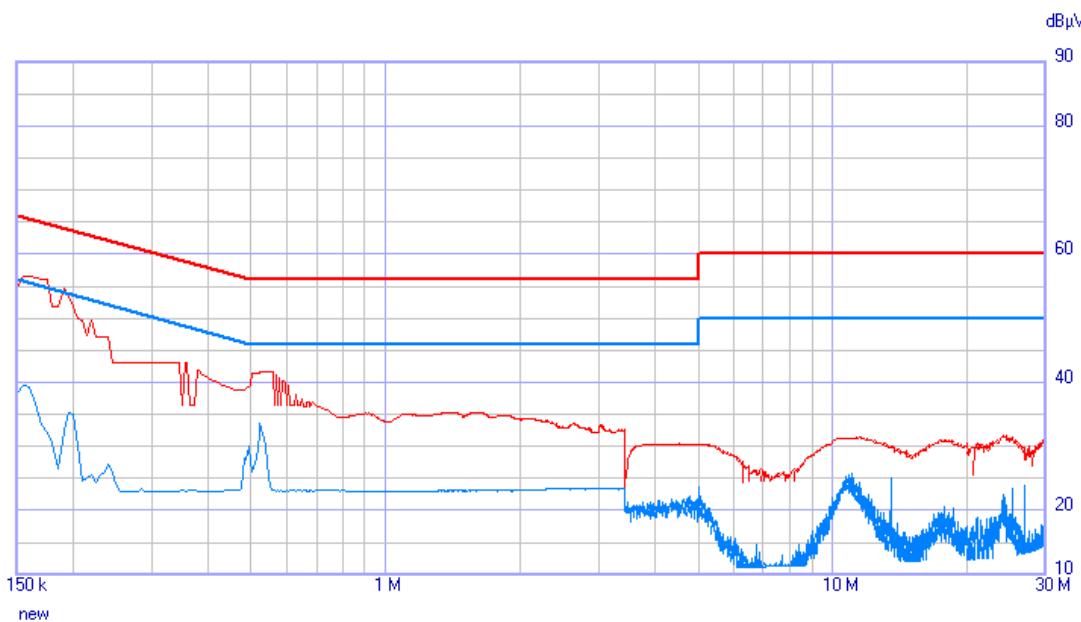
Company:	Dentaku Ltd	Product:	Ototo
Date:	01 Jul 14	Test Engineer:	R McDonnell
Test:	FCC pt 15	Limit:	EN (B) QP + AV
Notes:			
The EUT was powered via USB from a MacBook Air connected via a mains to DC adapter to 115V AC supplied via LISN L1. Ethernet STP lead from MacBook connected via ISN7 to network.			
Equipment: L1, R10, AB002, CBL 005, CBL 039, ISN7			
Line:	Live	Attenuator:	10dB PAD
Detector:	QuasiPeak		Operating Mode: 1 Mod. State: 0
LISN:	EMCO	Filename:	C4701483.png

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FCC ID: 2ACKT-OTOTO1

Test Report

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new

	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary
1	0.15	30	AUTO (5 kHz)	P Q A pwr_B_QP Margin 5 dB	20 ms	9 kHz	10	OFF	ON
2	0.15	0.151	500 Hz	P pwr_B_Avg Margin 0 dB	1.9 ms	9 kHz	10	OFF	ON

Ancillary = General

Limits:

pwr_B_QP

pwr_B_Avg

Factors:

L1

AB002_CBL005_CBL039

QPeak —

Avg —

PLOT 2 Conducted Emissions 150 kHz to 30 MHz 115V AC Neutral

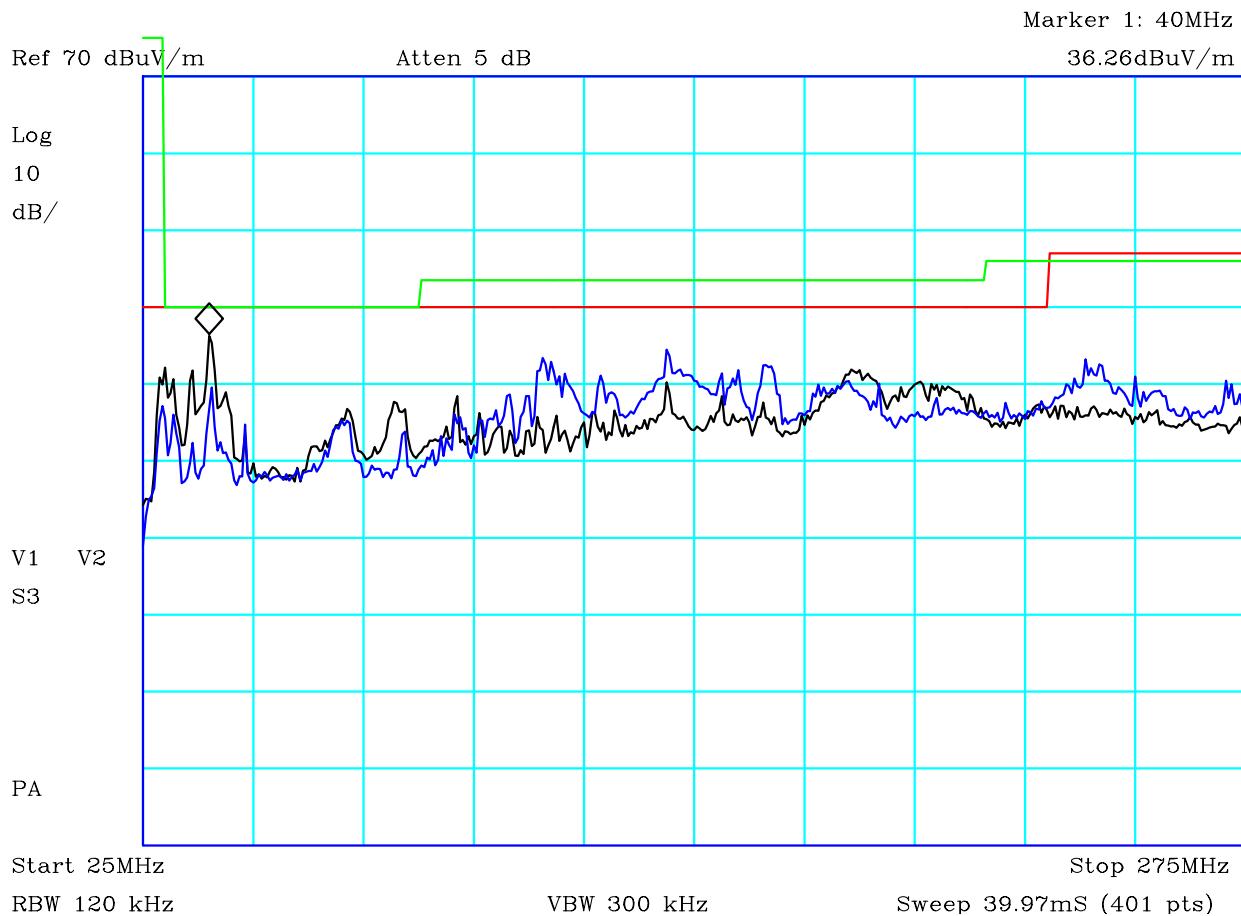
Company:	Dentaku Ltd	Product:	Ototo
Date:	01 Jul 14	Test Engineer:	R McDonnell
Test:	FCC pt 15	Limit:	EN (B) QP + AV
Notes:			
The EUT was powered via USB from a MacBook Air connected via a mains to DC adapter to 115V AC supplied via LISN L1. Ethernet STP lead from MacBook connected via ISN7 to network.			
Equipment: L1, R10, AB002, CBL 005, CBL 039, ISN7			
Line:	Neutral	Attenuator:	10dB PAD
Detector:	QuasiPeak		Operating Mode: 1 Mod. State: 0
LISN:	EMCO	Filename:	C4701499.png

	Report No: R3370 Issue No: 1
Test No: T5219	

FCC ID: 2ACKT-OTOTO1

Test Report

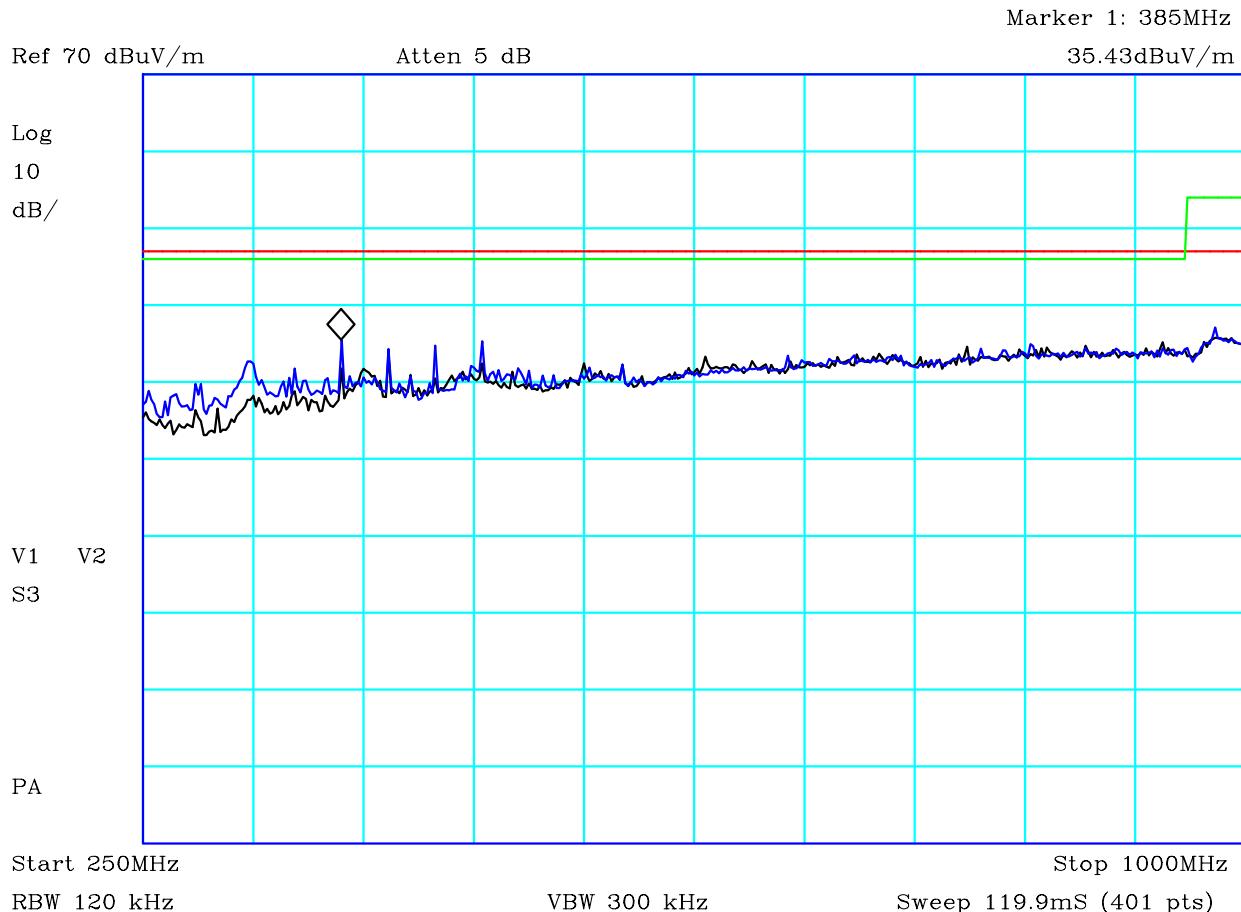
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PLOT 3 Radiated Emissions 25 MHz to 275 MHz

Company:	Dentaku London	Product:	Ototo
Date:	20/06/2014	Test Eng:	Peter Barlow
Method:		Method:	
Limit1:(RED)	EN55022(B)@3m	Limit2:(GRN)	FCC(B)@3m
Limit3:		Limit4:	
Op mode: Ototo board playing test sequence from flash memory, USB (12Mbps) comms to MacBook air. H pattern on display. Ethernet internet connection active. Setup: Ototo board with USB connection to MacBook air running from PSU. Ototo board with 4x sensors (joystick, pot, light, force) on 50 cm leads. 12x croc clips on 40 cm leads. MacBook with thunderbolt to ethernet adapter connected. CAT5 SFTP cable from Adapter to local network. Mod state: Version 4. Mod state 0.			
Vertical Antenna Polarisation = Black Trace. Horizontal = Blue Trace.			
Facility:	Anech_2	Height	1m,1.5m,2m
Distance	3m	Polarisation	V+H
Angle	0-360	File:	H4520570
		Mode:	1
		Modification State:	0
		Analyser:	R9

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Test No: T5219		Test Report	Page: 15 of 15



PLOT 4 Radiated Emissions 250 MHz to 1 GHz

Company:	Dentaku London	Product:	Ototo
Date:	20/06/2014	Test Eng:	Peter Barlow
Method:		Method:	
Limit1:(RED)	EN55022(B)@3m	Limit2:(GRN)	FCC(B)@3m
Limit3:		Limit4:	
<p>Op mode: Ototo board playing test sequence from flash memory, USB (12Mbps) comms to MacBook air. H pattern on display. Ethernet internet connection active.</p> <p>Setup: Ototo board with USB connection to MacBook air running from PSU. Ototo board with 4x sensors (joystick, pot, light, force) on 50 cm leads. 12x croc clips on 40 cm leads. MacBook with thunderbolt to ethernet adapter connected. CAT5 SFTP cable from Adapter to local network.</p> <p>Mod state: Version 4. Mod state 0.</p>			
<p>Vertical Antenna Polarisation = Black Trace. Horizontal = Blue Trace.</p>			
Facility:	Anech_2	Height	1m,1.5m,2m
Distance	3m	Polarisation	V+H
Angle	0-360	File:	H452058D
		Mode:	1
		Modification State:	0
		Analyser:	R9