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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

ZHC Systems Ltd

ScanMonkey

dated

28th January 2014

Document History

Issue	Date	Affected page(s)	Description of modifications	Revised by	Approved by
1	28/01/14		Initial release		
2	05/02/14	All	Manufacturer name change	DS	DB

Based on report template:
v090319

Equipment Under Test (EUT):	ScanMonkey
Test Commissioned by:	ZHC Systems Ltd 20 Panton Street Cambridge Cambridgeshire CB2 1HP
Representative:	Alun Jones
Test Started:	21st October 2013
Test Completed:	20th December 2013
Test Engineer:	Stephen Browning
Date of Report:	28th January 2014

Written by:	Stephen Browning	Checked by:	Dave Smith
Signature:		Signature:	
Date:	28th January 2014	Date:	28th January 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 **Class B**	*Code of Federal Regulations: Pt 15 Subpart B- Radio Frequency Devices - Unintentional Radiators*

Emissions Test Results Summary

CFR 47 **PASS**

Test	Port	Method	Limit	PASS/FAIL	*Notes*
Conducted Emissions	ac power	ANSI C63.4:2003	FCC_B	PASS	
Radiated Emissions		ANSI C63.4:2003	FCC_B	PASS	

specs_fccv100412

Contents

1 EUT Details

1.1 General

The EUT was an adaptor for single key or sensor data entry in place of a keyboard. The EUT had a metal enclosure and was designed to be powered from the pc via USB.

It is designed mainly to be used in office or domestic environments and it included microprocessor circuitry with a maximum frequency of 48MHz.

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	ZHC	Scan_Monkey	EUT	-	
2	Toby Churchill		Push button control.	-	#1
3	Toshiba	T130-11H	Laptop pc.	X9110012W	DoC
4	Toshiba	PA3714E-1AC3	PSU for Laptop	-	#2
5	D-Link	DES-1005D	Ethernet Switch	7000980	DoC
6	D-Link	AD-071AD	ac adaptor	-	#2

#1 This was a mechanical switch assembly only.
#2 PSU so FCC ID or DoC not required.

The manufacturer has a number of variants based on this unit which use the same hardware but turn off/on the LEDs to suit the product:

- ScanMonkey: for Computer
- KeyboardMonkey: for Computer
- ScanMonkey: for Android
- KeyboardMonkey: for Android
- ScanMonkey: for Mac
- KeyboardMonkey: for Mac

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.

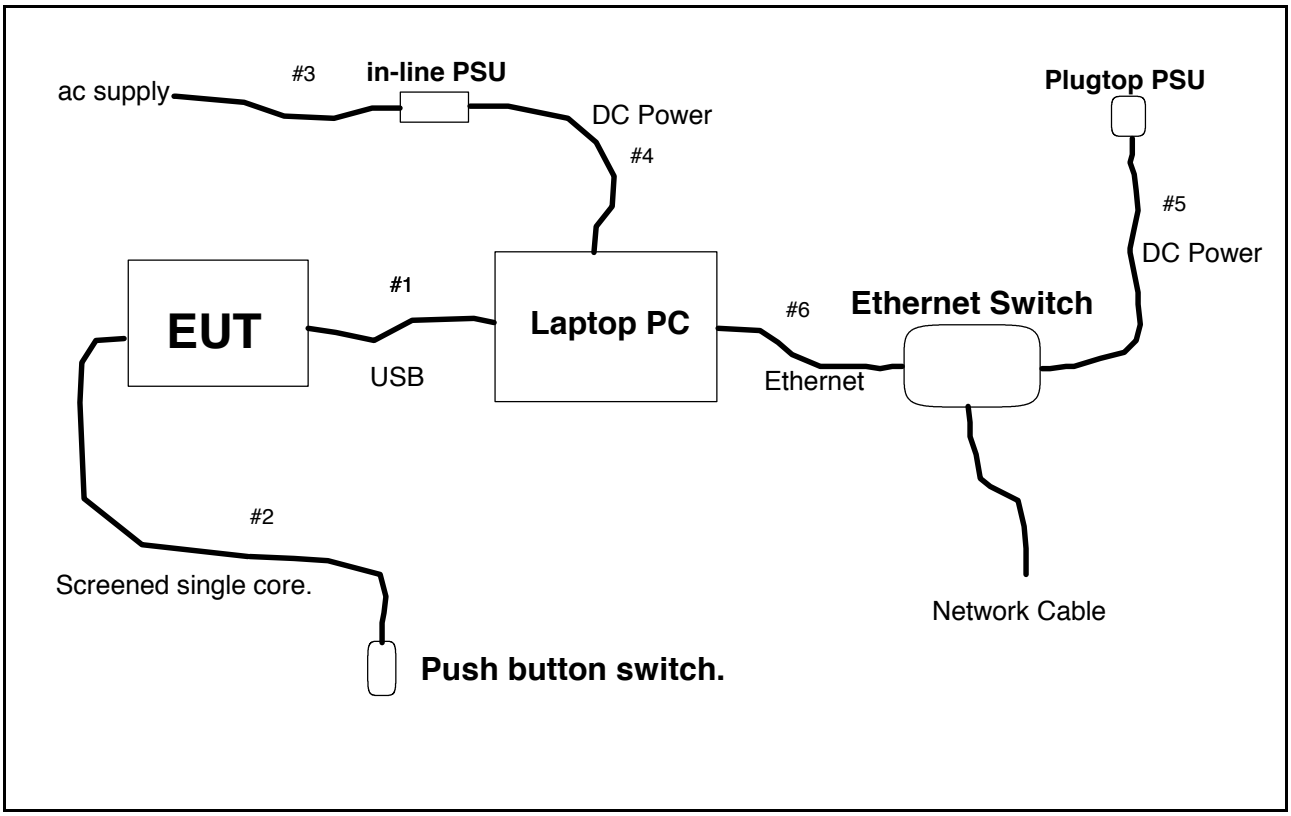
Mod No:	Details	Implemented for
0	As received on 19th December 2013 with metalised end panels plus copper tape applied to aperture for USB connector.	

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	Scanning switch and displaying alphabetical sequence of letters continuously. Powered by USB.

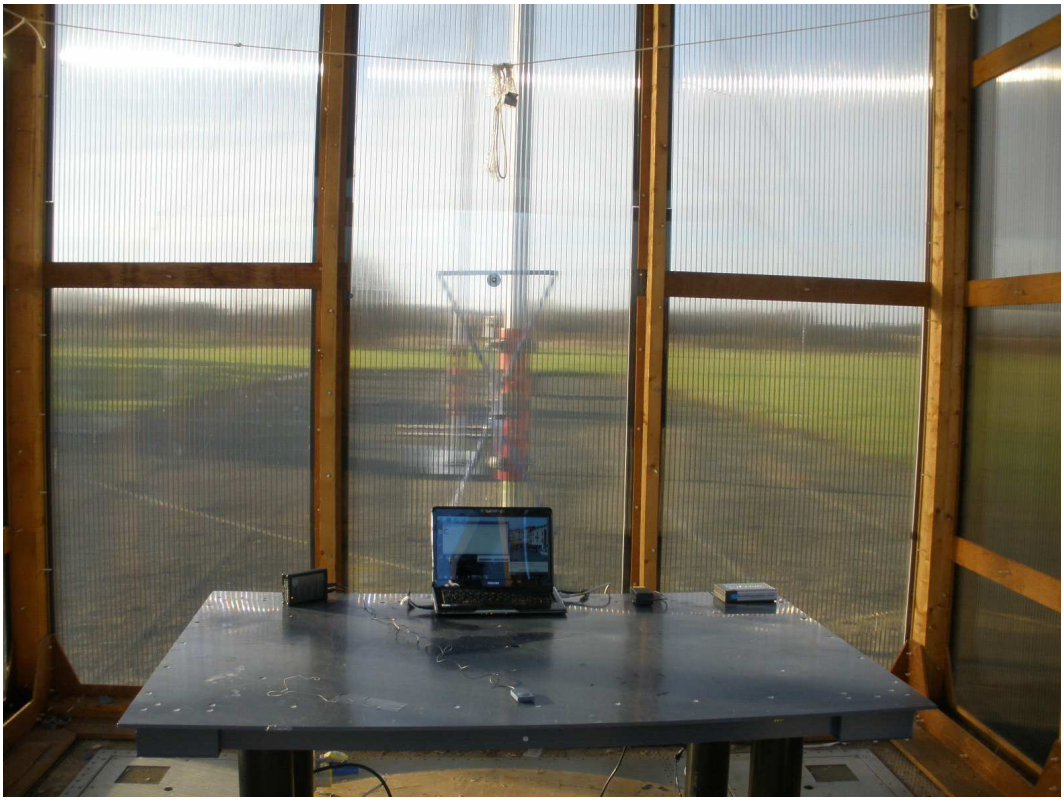
Figure 1 General Arrangement of EUT and Peripherals



	Description	Type	Length	Notes
#1	USB	Screened	1.8m	
#2	Switch	Screened	1.5m	
#3	AC power	Unscreened	1.6m	
#4	DC power	Screened	1.7m	
#5	DC power	Unscreened	2.0m	
#6	Ethernet	Cat 5 STP	1.0m	

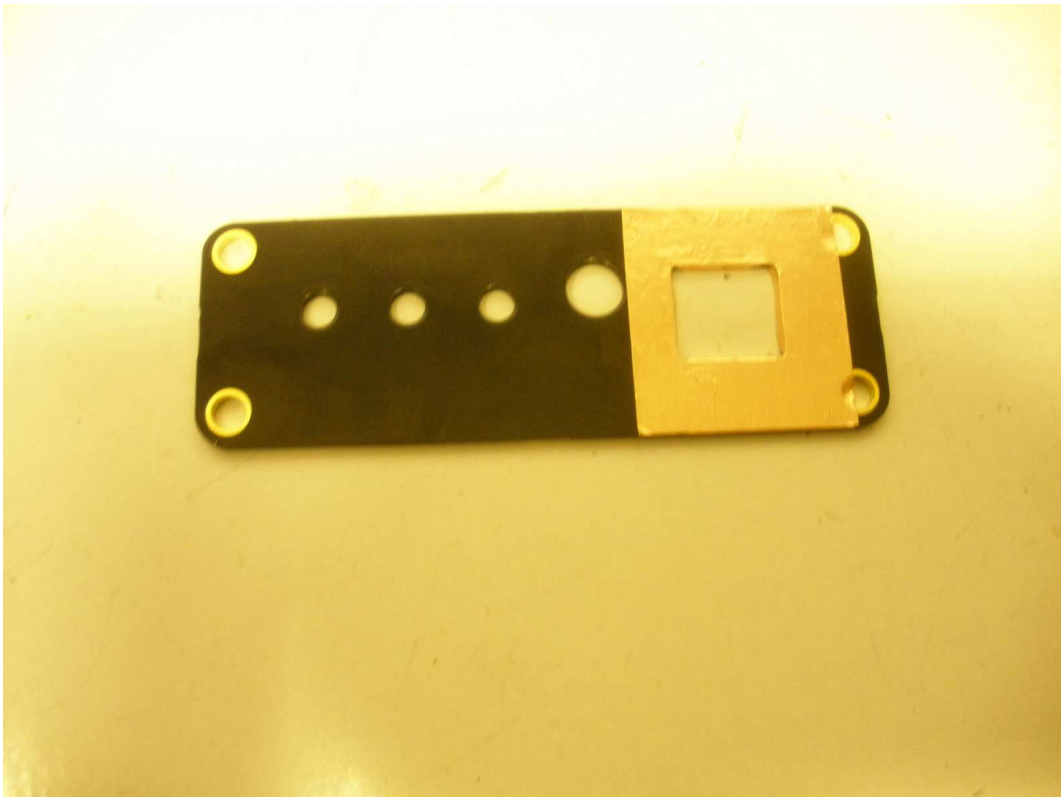
Photograph 1 Conducted Emissions : Front

Photograph 2 Conducted Emissions : Back



Photograph 3 Radiated Emissions : Front

Photograph 4 Radiated Emissions : Back



Photograph 5 Copper Tape applied to End Plate.

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
A12	Chase Bilog CBL6111A	1012	30/01/2013	1 Year
A24	Chase X-wing Bilog CBL6144 26MHz-3GHz	27590	28/10/2013	1 Year
L1	EMCO 3825/2 LISN	1358	12/03/2013	1 Year
L2	R&S ESH3-Z5 LISN	843862/009	12/03/2013	1 Year
R10	Narda PMM 9010 Receiver (10Hz-30MHz)	595WX11003	30/01/2013	1 Year
R7	R&S ESVD	841729/003	10/12/2013	1 Year
R9	Agilent E7405A Spectrum Analyser	MY45110758	19/11/2013	1 Year

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.

Final Level (dBuV)	=	Receiver Reading (dBuV)	+	Combined Cable and Attenuation Correction Factor (dB)

Example: if, @191kHz, receiver reading was 35.8dBuV

Final level = 35.8 + 10.0 = 45.8 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:

Field Strength (dBuV) = receiver reading (dBuV) + 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).

Total field strength = 17.9 + 13.1 = 31.0 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.

4.1 Conducted Emissions (Power) - Results

Factor Set 1: L1_13A AB002_CBL005_CBL039_12A - -
Factor Set 2: - - - -
Factor Set 3: - - - -
Test Equipment: R10 L1 L2

Conducted Emissions (Power)

Company: ZHC Systems Ltd *Product:* ScanMonkey
Date: 20/12/2013 *Test Eng:* Stephen Browning
Ports: ac power
Test: ANSI C63.4:2003 using limits of FCC B
Ports:
Test: using limits of

Plot	Op Mode	Mod State	Line (L/N)	Fact Set	Freq. MHz	Det qp/ av	Rec. Level dBuV	Corr'n Factor dB	Total Level dBuV	Limit CISPR22(B) dBuV	Margin CISPR22(B) dB	Notes
1	1	0	L	1	0.155	qp	43.7	10.0	53.7	65.7	12.1	
1	1	0	L	1	0.155	av	23.5	10.0	33.5	55.7	22.2	
1	1	0	L	1	0.165	qp	39.8	10.0	49.7	65.2	15.5	
1	1	0	L	1	0.165	av	22.7	10.0	32.7	55.2	22.5	
1	1	0	L	1	0.194	qp	37.4	9.9	47.3	63.9	16.5	
1	1	0	L	1	0.194	av	20.5	9.9	30.4	53.9	23.4	
1	1	0	L	1	0.231	qp	28.8	10.0	38.8	62.4	23.6	
1	1	0	L	1	0.231	av	9.5	10.0	19.5	52.4	32.9	
1	1	0	L	1	0.247	qp	28.0	10.0	37.9	61.9	23.9	
1	1	0	L	1	0.247	av	9.1	10.0	19.1	51.9	32.8	
1	1	0	L	1	18.915	qp	23.4	10.2	33.6	60.0	26.4	
1	1	0	L	1	18.915	av	22.3	10.2	32.4	50.0	17.6	
2	1	0	N	1	0.154	qp	43.3	10.0	53.3	65.8	12.5	
2	1	0	N	1	0.154	av	29.6	10.0	39.5	55.8	16.2	
2	1	0	N	1	0.183	qp	34.2	10.0	44.2	64.3	20.2	
2	1	0	N	1	0.183	av	12.4	10.0	22.4	54.3	32.0	
2	1	0	N	1	0.195	qp	35.1	9.9	45.0	63.8	18.8	
2	1	0	N	1	0.195	av	19.0	9.9	29.0	53.8	24.8	
2	1	0	N	1	0.221	qp	31.6	10.0	41.5	62.8	21.3	
2	1	0	N	1	0.221	av	14.0	10.0	23.9	52.8	28.8	
2	1	0	N	1	0.242	qp	27.9	10.0	37.9	62.0	24.1	
2	1	0	N	1	0.242	av	2.6	10.0	12.5	52.0	39.5	
2	1	0	N	1	18.916	qp	23.0	10.2	33.2	60.0	26.8	
2	1	0	N	1	18.916	av	21.9	10.2	32.1	50.0	17.9	

Results	**Minimum Margin**	**12.1 dB**	
	PASS/FAIL	**PASS**	

Notes	Comments and Observations
	Results of scans are shown in plots 1 and 2. Measured with 9kHz bandwidth QP and linear average detectors.

4.2 Radiated Emissions Results : Vertical

Factor Set 1: A12_FS_13B CBL015_11A - -
Factor Set 2: - - - -
Factor Set 3: - - - -
Test Equipment: R7 A12 CSET005 R9 A24

Radiated Emissions

Company: ZHC Systems Ltd *Product:* ScanMonkey
Date: 19/12/2013 *Test Eng:* Stephen Browning
Ports:
Test: ANSI C63.4:2003 using limits of FCC 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 FCC_B dBuV/m	Margin FCC_B dB	Notes
3	1	0	3	1	31.781	V	11.5	18.8		30.3	40.0	9.7	
3	1	0	3	1	39.070	V	15.2	13.9		29.1	40.0	10.9	
3	1	0	3	1	96.032	V	17.1	9.9	3.1	30.1	43.5	13.4	#2
3	1	0	3	1	107.300	V	15.1	12.4		27.5	43.5	16.0	
3	1	0	3	1	143.970	V	12.6	12.8		25.4	43.5	18.1	
3	1	0	3	1	168.314	V	11.8	11.7		23.5	43.5	20.0	
3	1	0	3	1	200.045	V	17.6	11.4		29.0	43.5	14.5	
4	1	0	3	1	266.341	V	9.3	15.7		25.0	46.0	21.0	
4	1	0	3	1	400.030	V	21.9	19.6		41.5	46.0	4.5	
4	1	0	3	1	700.060	V	10.7	26.4		37.1	46.0	8.9	
4	1	0	3	1	897.000	V	1.7	28.6		30.3	46.0	15.7	
4	1	0	3	1	934.045	V	11.5	30.1		41.6	46.0	4.4	#1

Results **Minimum Margin** **4.4 dB**
PASS/FAIL **PASS**

Notes	Comments and Observations
	Results of scans shown in plots 3 to 4. Maximised readings using 120kHz QP detector.
#1	High ambient: level remained the same when the system was turned off.
#2	Because of a high ambient, measurements were made with a 10Hz RBW / 3Hz VBW peak detector. Measurements in screened room showed a 3.1 dB difference between measurement with this detector and a measurement with a 120kH QP detector. This 3.1 dB difference was added as a second correction factor in the table above.

4.3 Radiated Emissions Results : Horizontal

Factor Set 1: A12_FS_13B CBL015_11A - -
Factor Set 2: - - - -
Factor Set 3: - - - -
Test Equipment: R7 A12 CSET005 R9 A24

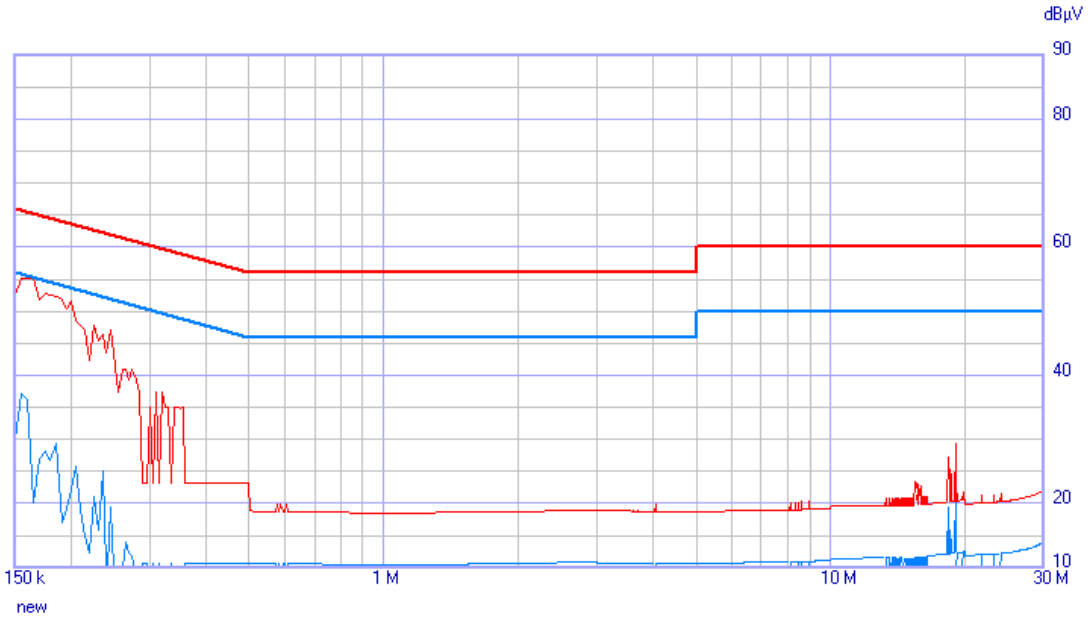
Radiated Emissions

Company: ZHC Systems Ltd *Product:* ScanMonkey
Date: 19/12/2013 *Test Eng:* Stephen Browning
Ports:
Test: ANSI C63.4:2003 using limits of FCC 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 FCC_B dBuV/m	Margin FCC_B dB	Notes
3	1	0	3	1	31.781	H	4.5	18.8		23.3	40.0	16.7	
3	1	0	3	1	39.070	H	8.2	13.9		22.1	40.0	17.9	
3	1	0	3	1	96.032	H	21.6	9.9	3.1	34.5	43.5	9.0	#2
3	1	0	3	1	107.300	H	11.6	12.4		24.0	43.5	19.5	
3	1	0	3	1	143.970	H	11.4	12.8		24.2	43.5	19.3	
3	1	0	3	1	168.314	H	12.7	11.7		24.4	43.5	19.1	
3	1	0	3	1	200.045	H	22.5	11.4		33.9	43.5	9.6	
4	1	0	3	1	266.341	H	11.2	15.7		26.9	46.0	19.1	
4	1	0	3	1	400.030	H	17.4	19.6		37.0	46.0	9.0	
4	1	0	3	1	700.060	H	10.9	26.4		37.3	46.0	8.7	
4	1	0	3	1	897.000	H	-0.5	28.6		28.1	46.0	17.9	
4	1	0	3	1	934.045	H	13.4	30.1		43.5	46.0	2.5	#1

Results	**Minimum Margin**	**2.5 dB**	
	PASS/FAIL	**PASS**	

Notes	Comments and Observations
	Results of scans shown in plots 3 to 4. Maximised readings using 120kHz QP detector.
#1	High ambient: level remained the same when the system was turned off.
#2	Because of a high ambient, measurements were made with a 10Hz RBW / 3Hz VBW peak detector. Measurements in screened room showed a 3.1 dB difference between measurement with this detector and a measurement with a 120kH QP detector. This 3.1 dB difference was added as a second correction factor in the table above.



	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	...	...

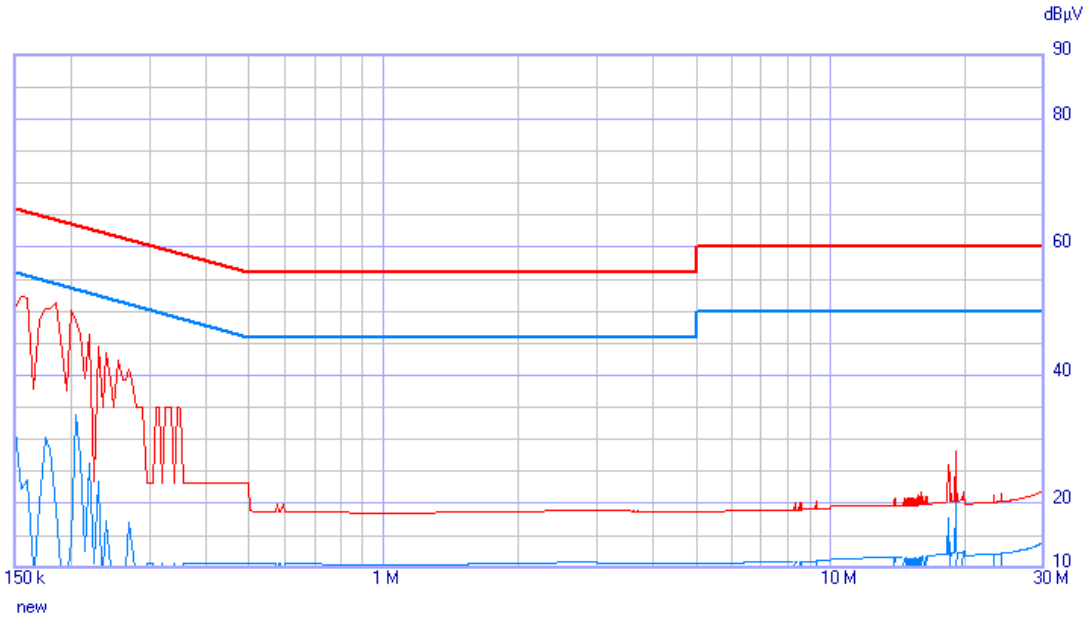
Ancillary = General
Limits:
pwr_B_QP
pwr_B_Avg
Factors:
L1
AB002_CBL005_CBL039
QPeak
Avg

PLOT 1 Conducted Emissions : Live

Company:	ZHC Systems Ltd	Product:	Scan Monkey
Date:	20 Dec 13	Test Engineer:	S Browning
Test:	FCC pt 15	Limit:	FCC (B) QP + AV

Notes:
EUT running continuous scan. Laptop powered via primary LISN.
Ethernet Switch connected to secondary LISN
115V
Equipment : R10, L1, L2, AB002, CBL005, CBL039.

Line:	Live	Attenuator:	10dB PAD	Operating Mode:	1
Detector:	QP + Av			Mod. State:	0
LISN:	EMCO	Filename:	C3C20478.png		



	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	...	...

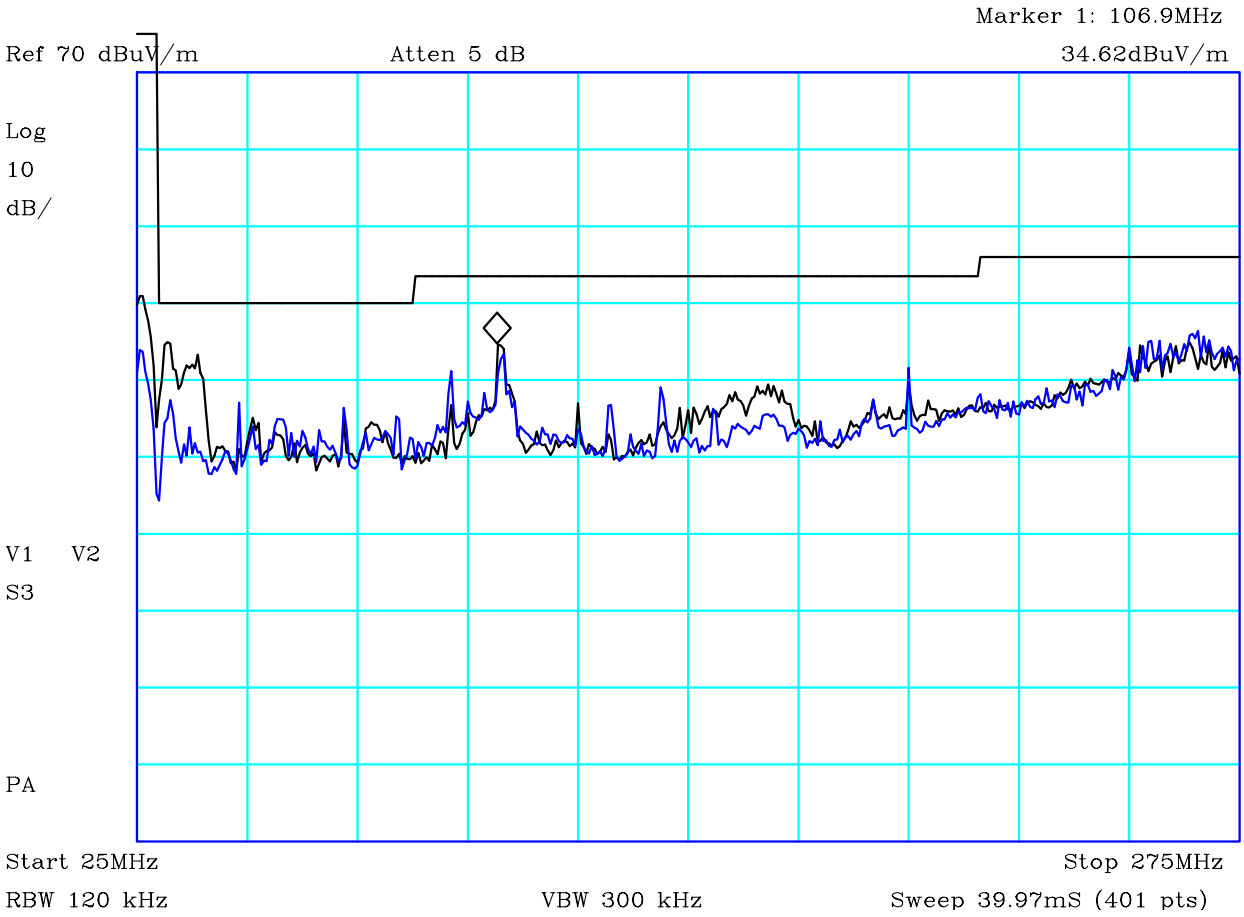
Ancillary = General
Limits:
pwr_B_QP
pwr_B_Avg
Factors:
L1
AB002_CBL005_CBL039
QPeak
Avg

PLOT 2 Conducted Emissions : Neutral

Company:	ZHC Systems Ltd	Product:	Scan Monkey
Date:	20 Dec 13	Test Engineer:	S Browning
Test:	FCC pt 15	Limit:	FCC (B) QP + AV

Notes:
EUT running continuous scan mode. Laptop powered via primary LISN.
Ethernet Switch connected to secondary LISN
115V
Equipment : R10, L1, L2, AB002, CBL005, CBL039.

Line:	Neutral	Attenuator:	10dB PAD	Operating Mode:	1
Detector:	QP + Av			Mod. State:	0
LISN:	EMCO	Filename:	C3C204AB.png		



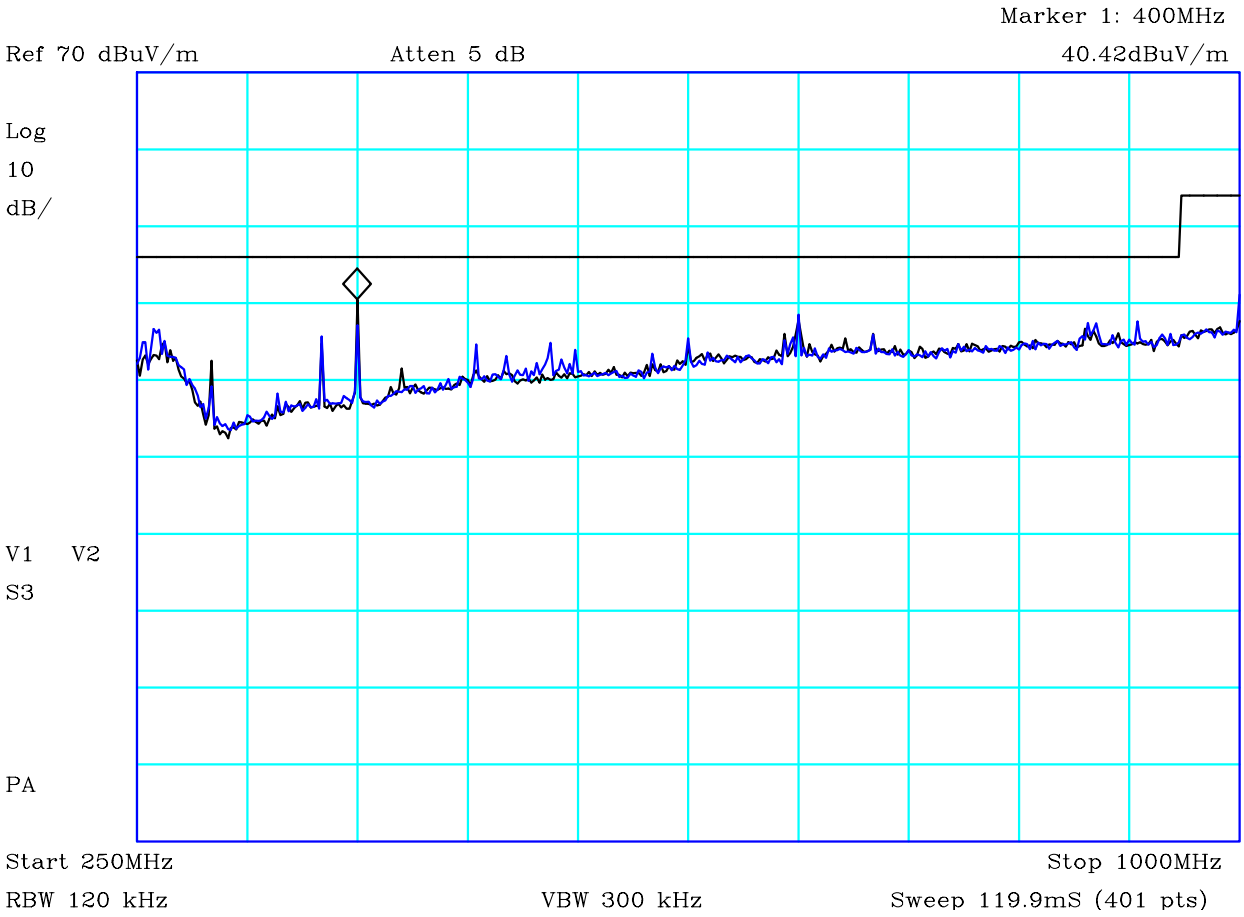
CF1:A24_3m_130215 CF2:CBL059_CBL018_CBL065_CBL060_100806

PLOT 3 Radiated Emissions : 25MHz - 275MHz

Company:	ZHC Systems Ltd	Product:	Scan Monkey
Date:	19th December 2013	Test Eng:	Stephen Browning
Method:	ANSI C63.4	Method:	
Limit1:(BLK)	FCC(B)@3m	Limit2:	
Limit3:		Limit4:	

Vertical Antenna Polarisation : Black Trace, Horizontal : Blue Trace.
EUT connected to laptop via USB. TCL switch connected to EUT input.
Laptop connected to D-Link 5 port switch.
EUT running continuous scan, characters being displayed on laptop.

Facility:	Anech_2	Height	1m,1.5m,2m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H3B19713	Analyser:	R9



CF1:A24_3m_130215 CF2:CBL059_CBL018_CBL065_CBL060_100806

PLOT 4 Radiated Emissions : 250MHz - 1GHz

Company:	ZHC Systems Ltd	Product:	Scan Monkey
Date:	19th December 2013	Test Eng:	Stephen Browning
Method:	ANSI C63.4	Method:	
Limit1:(BLK)	FCC(B)@3m	Limit2:	
Limit3:		Limit4:	

Vertical Antenna Polarisation : Black Trace, Horizontal : Blue Trace.
EUT connected to laptop via USB. TCL switch connected to EUT input.
Laptop connected to D-Link 5 port switch.
EUT running continuous scan, characters being displayed on laptop.

Facility:	Anech_2	Height	1m,1.5m,2m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H3B19721	Analyser:	R9