

FCC Test Report for epop 500 & eFlex 500

Report Number 07-361/4010/3/09 Report Produced by: -

R.N. Electronics Ltd.

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2. Summary of Test Results

The epop 500 & eFlex 500 were tested to the following standards: -

FCC Part 15C (effective date October 1, 2008); Class DXT Intentional Radiator

Any compliance statements are made reliant on the modes of operation as instructed to us by the Manufacturer based on their specific knowledge of the application and functionality of the equipment tested. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard, particularly under different conditions to those during testing.

Title		Reference	Results
1.	Conducted Emissions	FCC Part 15C §15.207	NOT
		, and the second	APPLICABLE ²
2.	Radiated Emissions	FCC Part 15C §15.205, §15.209 & §15.249	PASSED
3.	Modulation Bandwidth	FCC Part 15C §15.215(c), §15.249	PASSED
4.	Intentional Radiator Field Strength	FCC Part 15C §15.249	PASSED
5.	Frequency Tolerance	FCC Part 15C §15.225, §15.229, §15.233, §15.249(b)	NOT APPLICABLE ¹
6.	Duty Cycle	FCC Part 15C §15.231, §15.240	NOT APPLICABLE ¹
7.	Power Spectral Density	FCC Part 15C §15.247	NOT APPLICABLE ¹
8.	Frequency separation	FCC Part 15C §15.247	NOT APPLICABLE ¹
9.	No.of hopping channels	FCC Part 15C §15.247	NOT APPLICABLE ¹

¹ No specification requirement for this type of equipment.

This report relates to the equipment tested as identified by a unique serial number and at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed.

Date of Test:	3rd to 6th July 2009		
Test Engineer:			
A 15			
Approved By:			
Customer Representative:			

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² EUT is a battery powered product

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3. Information about Equipment Under Test

3.1 Equipment Specification

Applicant ZBD Displays Ltd

Longford Business Centre

Orchard Lea Winkfield Lane Windsor SL4 4RU

Manufacturer/Brand Name ZBD Displays Ltd

Full name of EUT epop 500 & eFlex 500

Model Number of EUT epop 500 & eFlex 500

Serial Number of EUT EP00000212B

FCC ID (if applicable): Not specified.

Date when equipment was received

By RN Electronics Limited 2nd July 2009

Date of test: 3rd to 6th July 2009

Customer order number: 4600

A visual description of the EUT is as follows: Small plastic enclosure with LCD display

covering almost one whole side of unit.

The main function of the EUT is: Electronic signage for retail and office

labelling

Antenna: Integral

Equipment Under Test Information specification:

Height	90mm
Width	110mm
Depth	16mm
Weight	0.1kg
Voltage	3V DC battery
Current required from above voltage	<0.1A
source	
Highest Frequencies used / generated	902.5 – 927.5MHz

Purpose of Test: To demonstrate compliance with FCC OET

regulations for intentional radiators.

Modes of operation:

Mode	Description of mode	Used for Testing
Unmodulated carrier TX 902.5MHz	constant CW transmission	YES
Unmodulated carrier TX 915MHz	constant CW transmission	YES
Unmodulated carrier TX 927.5MHz	constant CW transmission	YES
Standby /RX mode 902.5MHz	Receive mode	YES
Standby /RX mode 915MHz	Receive mode	YES
Standby /RX mode 927.5MHz	Receive mode	YES
Constant Transmit data 902.5MHz	constant system modulated transmission	YES
Constant Transmit data 915MHz	constant system modulated transmission	YES
Constant Transmit data 927.5MHz	constant system modulated transmission	YES

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Other channels between the frequencies selected above were available each at 500 kHz channel spacings, however only the top, middle & bottom channels (covering the entire range) were selected for tests.

Any modifications made to the **EUT**, whilst under test, can be found in Section 12.

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3.2 **Emissions configuration** Test area Outside test area EUT in test jig only for programming Sniffer Aerial EUT *Only connected to program channels Spectrum Analyser Laptop Pc

The epop 500 unit is housed in a completely plastic enclosure. The eFlex 500 unit is marginally bigger & housed in a plastic enclosure with a metal plate around the front of the LCD display side. E.R.P emissions measurements were performed with the same PCB housed in each enclosure in turn to determine the worst case for full tests. The worst case was found to be the epop 500 (full plastic enclosure) and therefore full tests were performed with this unit configuration.

New batteries were fitted into the unit before tests began and monitored to ensure supply parameters were maintained.

*The unit was only connected via the laptop for programming of channels and modes and once programmed the EUT was removed from the programming jig and placed back into its enclosure.

The spectrum analyser was only used to ensure the correct operating channel was programmed by detecting the RF carrier signal.

Bottom, middle & top channels were selected for tests were appropriate in combination with the above mentioned modes. These were:-

Bottom = 902.5 MHz Middle = 915 MHz Top = 927.5 MHz

Power level setting for tests was P7 which was the equivalent of 0dBm.

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 11.

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4. Specifications

The tests were performed by RN Electronics Engineer Daniel Sims who set up the tests, the test equipment, and operated it in accordance with the *R.N. Electronics Ltd* procedures manual, FCC Part 15 and those specifications incorporated by reference into 47CFR15 (e.g. ANSI C63.4-2003).

R.N. Electronics Ltd sites M and OATS are listed with the FCC. Registration Number 293246

4.1 Deviations

None.

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- 5. Tests, Methods and Results
- 5.1 Conducted Emissions

Test not applicable, EUT is battery powered only.

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5.2 Radiated Emissions

5.2.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.209, 15.249)

Test Method: FCC Part 15C, Reference (15.209, 15.249)

5.2.1.1 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a new battery.

5.2.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Below 30MHz, measurements were made in a semi-anechoic chamber (pre-scan) with final measurements on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment and the antenna were rotated 360° to record the worst case emissions.

30MHz - 1GHz, measurements were made on a site listed with the FCC. The equipment was rotated 360° and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.

Above 1GHz, measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. The antenna was placed 1m above the ground in line with the EUT, which was rotated through 360° to record the worst case emissions.

At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.

5.2.2 Test results

Tests were performed using Test Site M.

Test Environment: M

Temperature: 20-24°C Humidity: 40-54%

Analyser plots for the Quasi-Peak / Average values as applicable and any table of signals within 20dB of the limit line can be found in Section 6.2 of this report.

These show that the EUT has PASSED this test.

5.2.2.1 Test Equipment used

E412, E001, E252, E268, E342, TMS82, TMS81

See Section 10 for more details

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5.3 Intentional Radiator Field Strength

5.3.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.249)

Test Method: FCC Part 15C, Reference (15.249)

5.3.1.1 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The antenna was scanned 1-4m in height in both Horizontal and Vertical polarisations. The EUT was rotated in all three orthogonal planes.

5.3.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Measurements were made in a semi-anechoic chamber.

Both the equipment and the antenna were rotated 360 $^{\circ}\,$ to record the maximised emission.

5.3.2 Test results

Tests were performed using Test Site M.

Test Environment: M

Temperature: 21°C Humidity: 54 %

Any Analyser plots can be found in Section 6.3 of this report.

The maximised field strength measured was 93.9dBuV/m @ 3metres, measured on the top channel with a horizontal measuring antenna with the EUT in a horizontal plane.

These results show that the EUT has PASSED this test.

5.3.2.1 Test Equipment used

E412, E001, TMS933

See Section 10 for more details

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5.4 Frequency Tolerance

Test not applicable. No requirement for this type of device and frequency range.

5.5 Duty Cycle

Test not applicable. No requirement for this type of device and frequency range.

5.6 Maximum Spectral Power Density

Test not applicable. No requirement for this type of device and frequency range.

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20dB Bandwidth

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5.7

5.7.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.215)

Test Method: FCC Part 15C, Reference (15.215)

5.7.1.1 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres.

5.7.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Measurements were made in a semi-anechoic chamber.

Test site 'M' has been listed with the FCC.

5.7.2 Test results

Tests were performed using Test Site M.

Temperature of test Environment: 21°C

Analyser plots for the 20dB bandwidth can be found in Section 6.6 of this report.

Channel frequency	20 dB bandwidth
902.5MHz	88.125kHz
927.5MHz	88.125kHz

These results show that the EUT has PASSED this test.

5.7.2.1 Test Equipment used

E001, E412, TMS933

See Section 10 for more details.

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- 6. Plots and Results
- 6.1 Conducted Emissions

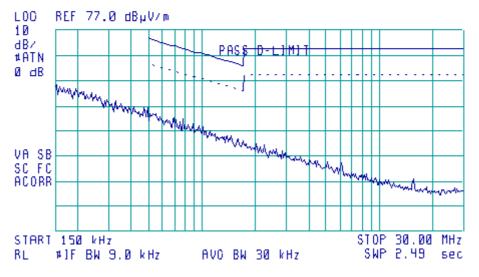
Not applicable, EUT battery powered only.

6.2 Radiated Emissions

Parallel.



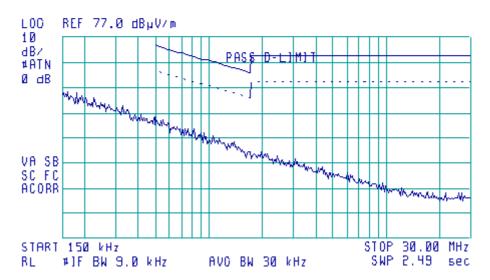
11:45:03 JUL 25, 2003 12:28:17 SEP 11, 2003 ACTV DET: PEAK MEAS DET: PEAK OP



Perpendicular.



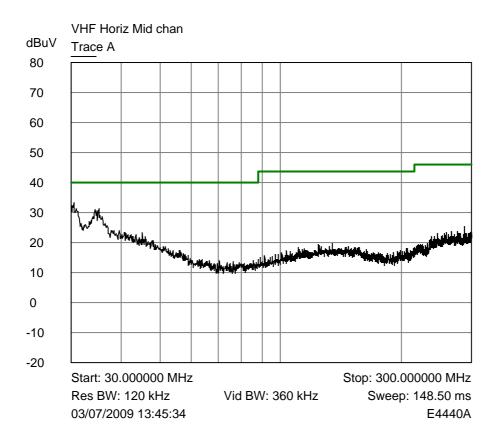
11:45:03 JUL 25, 2003 12:28:17 SEP 11, 2003 ACTV DET: PEAK MEAS DET: PEAK OP



Quasi-Peak Values 150kHz to 30MHz.

The plot shows a swept response of peak values using the quasi-peak limit line

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Quasi-Peak Values of 30 MHz. to 300 MHz. Horizontal Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the table on following page of this report)

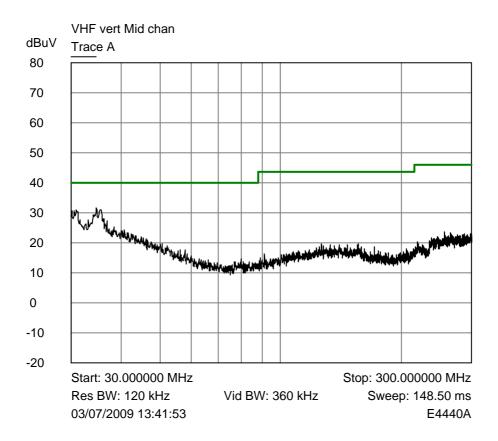
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None.

Table of signals within 20dB of the limit line for Quasi-Peak Horizontal

Measurement Uncertainty of \pm 5.2dB Applies

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Quasi-Peak Values of 30 MHz. to 300 MHz. Vertical Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the table on following page of this report)

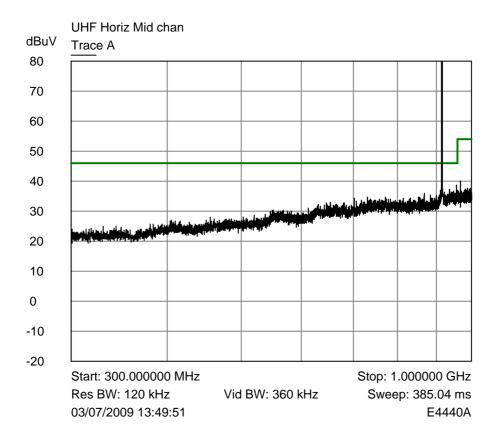
File name ZBD.361 PAGE 16 OF 46

None.

Table of signals within 20dB of the limit line for Quasi-peak Vertical

Measurement Uncertainty of \pm 5.2dB Applies

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Quasi-Peak Values of 300 MHz. to 1 GHz. Horizontal Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the table on following page of this report)

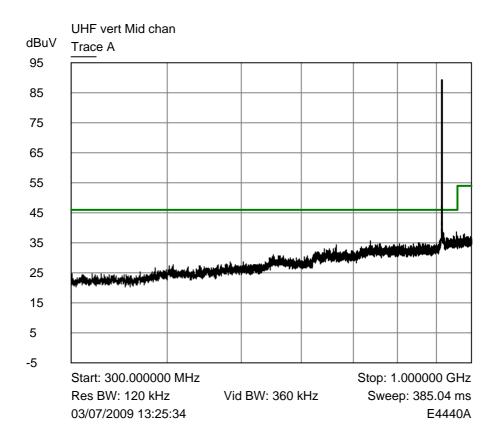
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None.

Table of signals within 20dB of the limit line for Quasi-Peak Horizontal

Measurement Uncertainty of \pm 5.2dB Applies

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Quasi-Peak Values of 300 MHz. to 1 GHz. Vertical Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the table on following page of this report)

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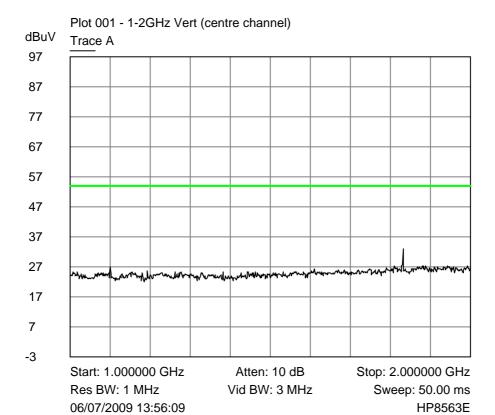
None.

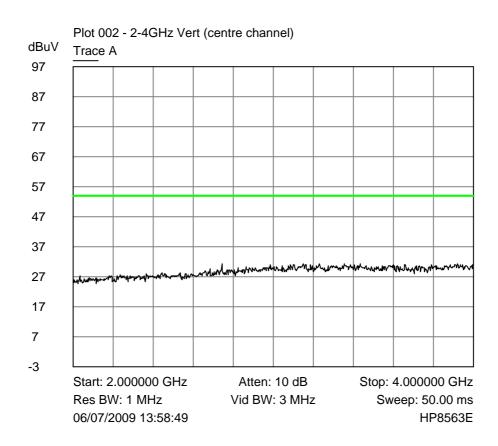
Table of signals within 20dB of the limit line for Quasi-peak Vertical

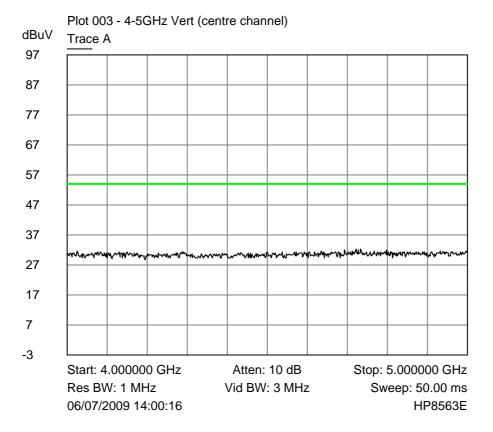
Measurement Uncertainty of \pm 5.2dB Applies

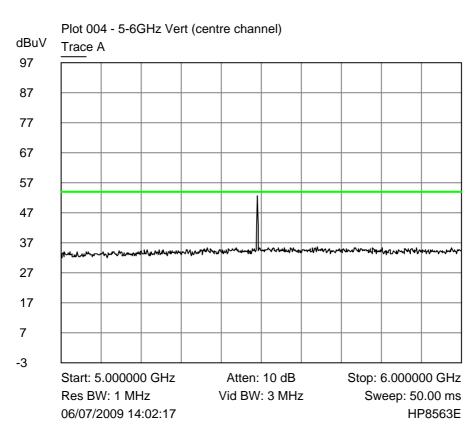
File name ZBD.361 PAGE 21 OF 46

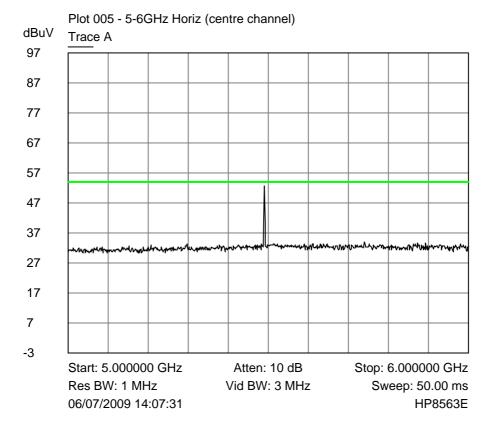
Above 1GHz radiated emissions plots.

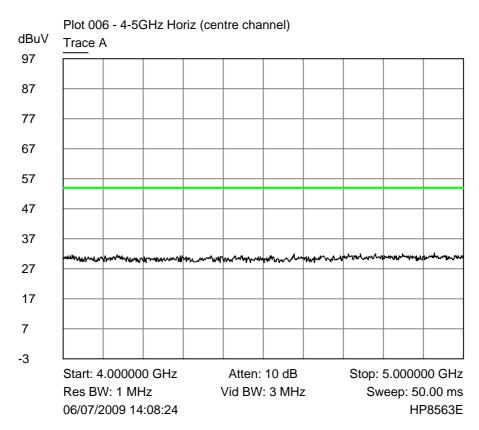


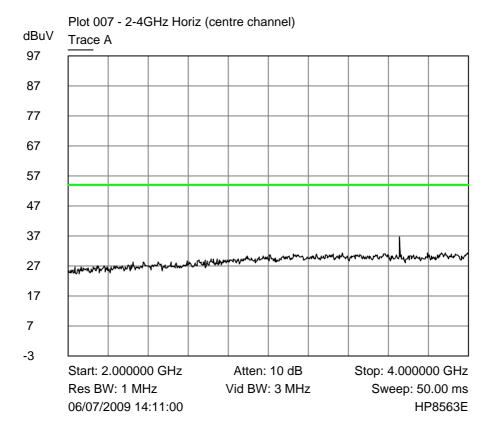


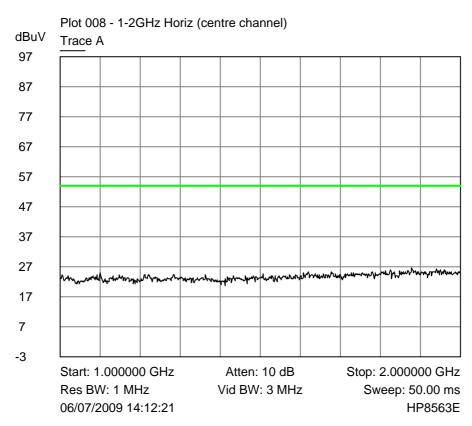


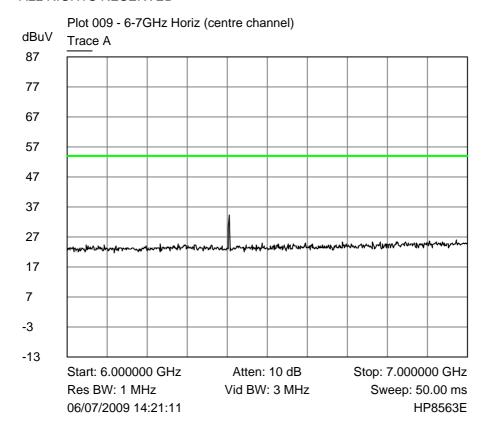


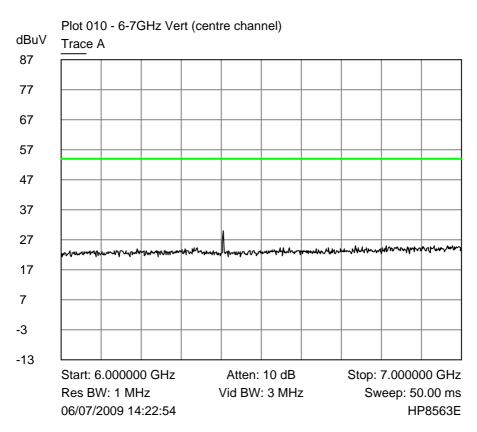


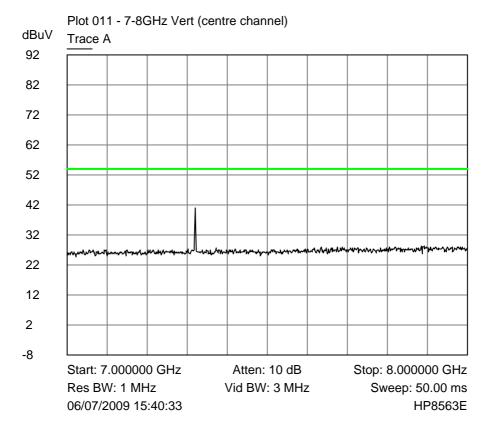


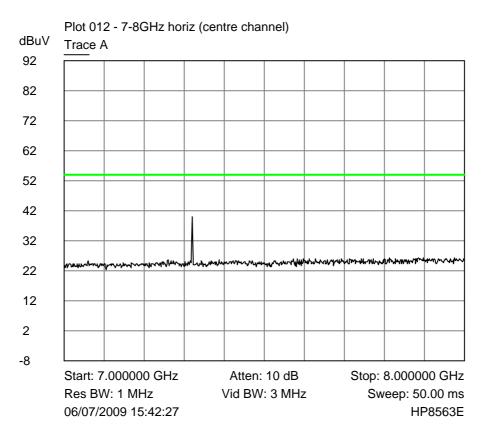






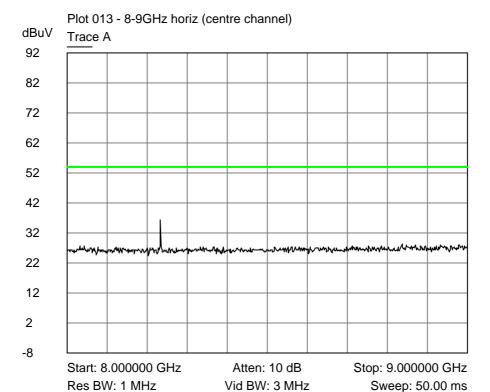


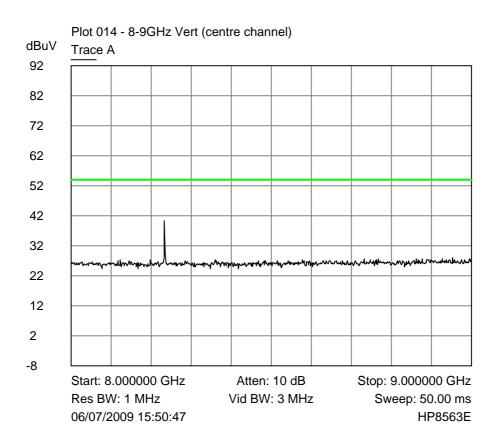


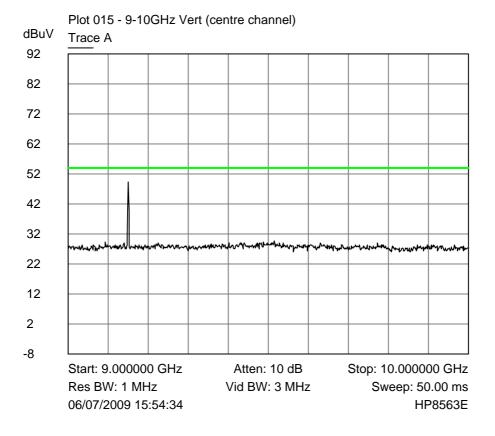


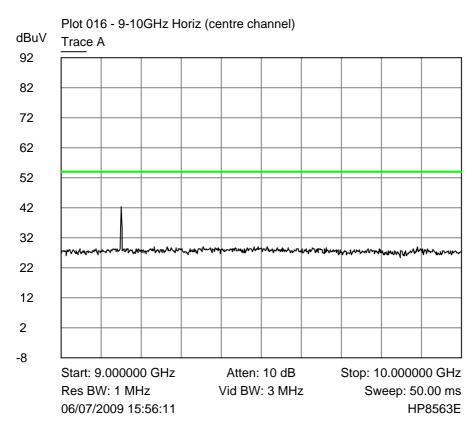
06/07/2009 15:47:06

HP8563E









Above 1GHz radiated emissions signal lists.

Bottom channel TX

Number	Frequency	Measured	Measured – Limit	Measuring Antenna
	(MHz)	Average	(54dBuV/m)	Polarisation
1	3610	42.0	-12.0	Horizontal
2	5415	51.5	-2.5	Vertical
3	5415	51.0	-3.0	Horizontal
4	6317.5	43.5	-10.5	Vertical
5	6317.5	44.0	-10.0	Horizontal
6	7220	45.1	-8.9	Vertical
7	7220	46.0	-8.0	Horizontal
8	8122.5	40.0	-14.0	Vertical
9	8122.5	41.0	-13.0	Horizontal
10	9025	50.0	-4.0	Vertical
11	9025	49.0	-5.0	

Middle channel TX

Wildale offatili	0. 171			
Number	Frequency (MHz)	Measured Average	Measured – Limit (54dBuV/m)	Measuring Antenna Polarisation
1	1830	36.5	-17.5	Vertical
2	1830	34.0	-20.0	Horizontal
3	3660	41.0	-13.0	Horizontal
4	5490	54.1	-0.1	Vertical
5	5490	51.2	-2.8	Horizontal
6	6405	41.0	-13.0	Vertical
7	6405	39.3	-14.7	Horizontal
8	7320	46.0	-8.0	Vertical
9	7320	44.0	-10.0	Horizontal
10	8235	34.0	-20.0	Vertical
11	8235	40.0	-14.0	Horizontal
12	9150	49.0	-5.0	Vertical
13	9150	42.5	-11.5	Horizontal

Top channel TX

TOP CHAINE	17			
Number	Frequency (MHz)	Measured Average	Measured – Limit (54dBuV/m)	Measuring Antenna Polarisation
1	1855	44.5	-9.5	Vertical
2	1855	36.0	-18.0	Horizontal
3	2782.5	39.5	-14.5	Horizontal
4	3710	34.0	-20.0	Vertical
5	3710	40.0	-14.0	Horizontal
6	4637.5	34.0	-20.0	Vertical
7	4637.5	38.0	-16.0	Horizontal
8	5565	53.8	-0.2	Vertical
9	5565	54.1	-0.1	Horizontal
10	6492.5	42.0	-12.0	Vertical
11	6492.5	47.0	-7.0	Horizontal
12	7420	47.2	-6.8	Vertical
13	7420	43.5	-10.5	Horizontal
14	8347.5	40.0	-14.0	Vertical
15	8347.5	38.0	-16.0	Horizontal
16	9275	52.1	-1.9	Vertical

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17	9275	44.5	-9.5	Horizontal

Receive modes.

Bottom channel RX

Number	Frequency (MHz)	Measured Average	Measured – Limit (54dBuV/m)	Measuring Antenna Polarisation
1	5415	54.1	-0.1	Vertical
2	5415	50.0	-4.0	Horizontal

Middle channel RX

inidalo olianiloi 177					
Number	Frequency (MHz)	Measured Average	Measured – Limit (54dBuV/m)	Measuring Antenna Polarisation	
1	5490	53.5	-0.5	Vertical	
2	5490	52.8	-1.2	Horizontal	

Top channel RX

TOP Chamile IVX				
Number	Frequency (MHz)	Measured Average	Measured – Limit (54dBuV/m)	Measuring Antenna Polarisation
1	5565	53.8	-0.2	Vertical
2	5565	53.2	-0.8	Horizontal

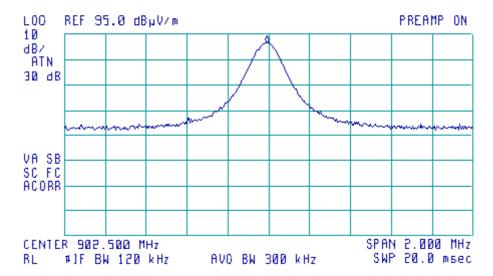
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6.3 Fundamental Emissions

ERP bottom channel vertical.

(B)

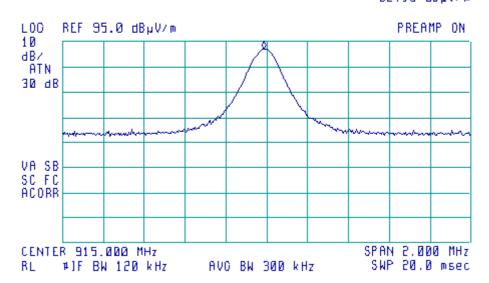
11:45:03 JUL 25, 2003 12:35:11 JAN 29, 2004 ACTV DET: PEAK MEAS DET: PEAK OP MKR 902.490 MHz 91.63 dΒμV/m



ERP middle channel horizontal.

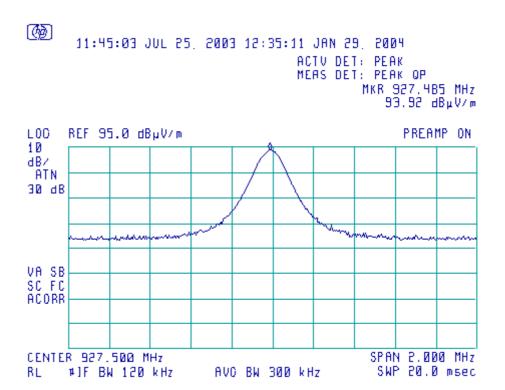
(B)

11:45:03 JUL 25, 2003 12:35:11 JAN 29, 2004 ACTV DET: PEAK MEAS DET: PEAK OP MKR 914.985 MHz 92.16 dBuV/m



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ERP top channel horizontal.



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6.4 Duty Cycle

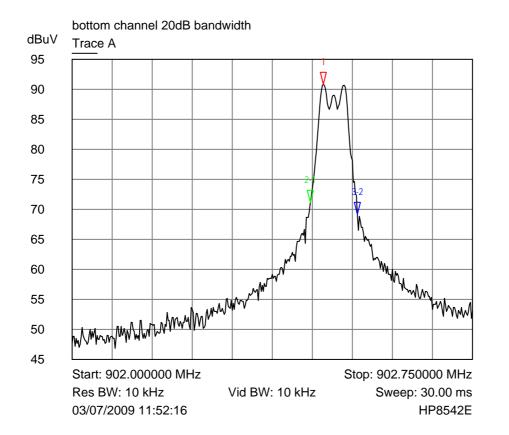
Not applicable.

6.5 Maximum Spectral Power Density

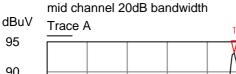
Not applicable.

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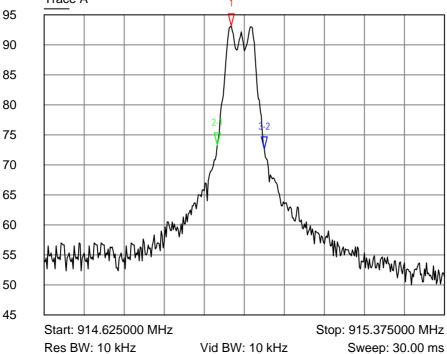
6.6 **Modulation Bandwidth**



- Trace A V 902.470625 MHz 90.7900 dBuV
- Trace A
- -24.375000 kHz -19.6800 dB
- 3-2 Trace A
- 88.125000 kHz -1.8700 dB



03/07/2009 12:10:32



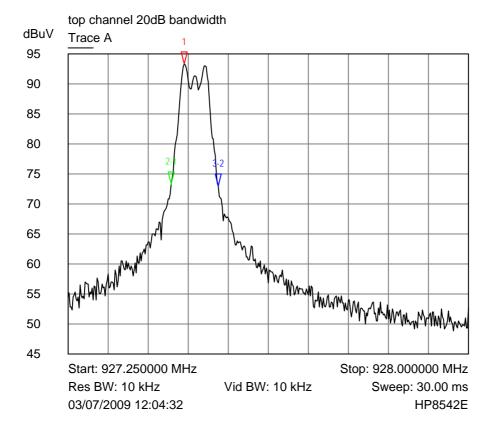
- Trace A 914.975625 MHz 93.1000 dBuV
- Trace A
- -26.250000 kHz -19.7500 dB
- 3-2 Trace A

HP8542E

88.125000 kHz -0.7000 dB

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- Trace A
- ▼ 927.467500 MHz 93.2700 dBuV
- 2-1 Trace A
- 7 -24.375000 kHz -19.9200 dB
- 3-2 Trace A
- 88.125000 kHz

7 Explanatory Notes

7.1 Explanation of FAIL LIMIT 1 Statement

The **FAIL MARGIN 1** statement(s) may appear on the graphical plots when the receiver used to measure your equipment detects a signal that exceeds the dashed line. This does not mean that the **EUT** has failed the test, only that the 10 dB calculation margin set, has been exceeded on a peak measurement.

Following the indication that the margin has been exceeded, measurements are made at the frequency (ies) of the peaks. These peaks have been calculated to either Quasi Peak or Average Peak dependant on the test. A table of results has been printed on the reverse of the page. This table looks similar to the one illustrated below: -

Signal	Frequency	Peak	PK Delta	Avg	Av Delta
Number	(MHz)	($dB\mu V$)	L1 (dB)	$(dB\mu V)$	L1 (dB)
1	12345.0000	12.9	-2.5	10.2	-5.2

The First column, labelled Signal Number, is a number that the receiver has given to each signal, which has been calculated.

Column Two, labelled Frequency (MHz), is the frequency of the signal received.

Column Three, labelled Peak (dB μ V), (can also be labelled, in the case of Quasi Peak, Peak dB μ V/m) is the Level that was received at peak amount in dB above 1 μ V.

Column Four, labelled PK Delta L1 (dB), is the same level as Column three but is given in a level relative to the limit line required.

Column Five, labelled AVG (dB μ V), (can also be labelled, in the case of Quasi Peak, QP dB μ V/m) when undertaking a Quasi peak test, This is the Average or Quasi peak calculation results given in dB μ V or dB μ V/m above 1 μ V.

Column Six, labelled AV Delta L 1 (dB), (can also be labelled, in the case of Quasi Peak, QP Delta L 1 (dB)) is the Average or Quasi Peak calculation relevant to the limit line. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

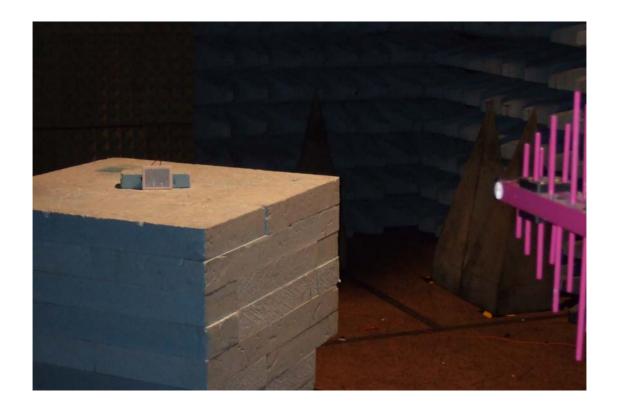
7.2 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in μ V/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dB μ V/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

- (a) limit of 500 μ V/m equates to 20.log (500) = 54 dB μ V/m.
- (b) limit of 300 μ V/m at 10m equates to 20.log (300 . 10/3) = 60 dB μ V/m at 3m

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8. Photographs



Photograph of the EUT as viewed from in front of the antenna, site M.

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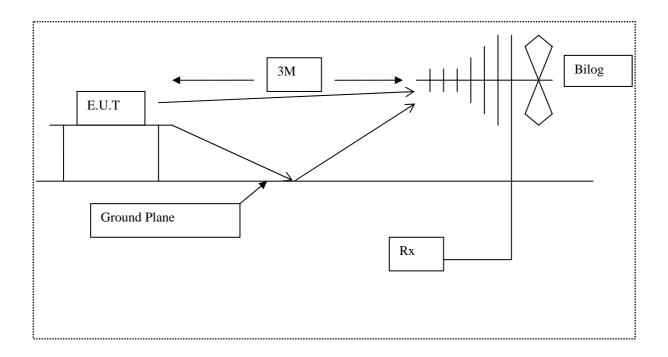


Diagram of the radiated emissions test setup.

Not applicable.

Photograph of the EUT as viewed from screened room (conducted emissions)

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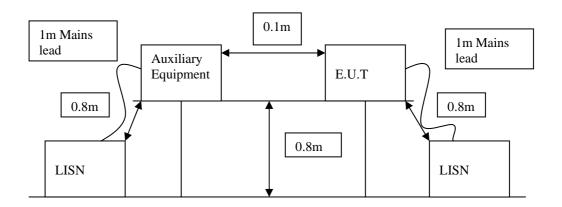


Diagram of the conducted emissions test setup.

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9. Signal Leads

The EUT is battery powered and has no signal leads.

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10. Test Equipment Calibration list

The following table lists the test equipment used, last calibration date and calibration interval. All test equipment used has been maintained within the calibration requirements of **R.N. Electronics Ltd.** test facility quality system. Calibration intervals are regularly reviewed dependent on equipment manufacturer's recommendations and actual usage of the equipment.

RNNo	Model	Description	Manufacturer	Date Calibrated	Period
E001	HP8542E	EMI Receiver & RF Filter	Hewlett Packard	13-Nov-07	21
E252	6810.19.A	10 dB Attenuator	Suhner	16-Oct-08	12
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	26-May-06	60
E342	8563E	Spectrum Analyser 26.5 GHz	HP	23-Feb-09	24
E412	E4440A	3 Hz - 26.5 GHz PSA Spectrum Analyzer	Agilent	01-Oct-08	12
TMS81	6502	Active Loop Antenna	EMCO	11-Dec-07	24
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent	28-Oct-08	12
TMS933	CBL6141A	Bilog Antenna 30MHz - 2GHz	York EMC	10-Sep-07	36

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11. Auxiliary equipment

11.1 Auxiliary equipment supplied by ZBD Displays Ltd

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

Manufacturer	Description	Model Number	Serial Number
ZBD Displays Ltd	EDK231 module test jig	EDk231	#1
ZBD Displays Ltd	Module USB interface	120-0050-01	1
Dell	Inspiron laptop PC	Inspiron 640M	CN0MG532-70166-6AH-08N5

11.2 Auxiliary equipment supplied by RN Electronics Limited

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

No auxiliary equipment was supplied by RN Electronics Ltd.

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12. Modifications

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

No modifications were required.

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13. Compliance information

Products subject to the Declaration of Conformity procedure are required to be supplied with a compliance information statement. A copy of this statement may be included here:

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Certificate of Test

The equipment noted below has been tested by R.N. Electronics **Limited** and conforms with the relevant subpart of FCC part 15, subject to deviations as detailed in this report.

This certificate relates to the equipment, as identified by unique serial number(s) and further detailed in the referenced report, in the condition(s) at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Furthermore, this is a certificate of test only and should not be confused with an equipment authorisation.

Equipment:	epop 500 & eFlex 500
Model Number(s):	epop500 & eFlex 500
Unique Serial Number(s):	EP00000212B
Manufacturer:	ZBD Displays Ltd
Customer Purchase Order Number:	4600
R.N. Electronics Limited Report Number:	07-361/4010/3/09
Test Standards:	FCC Part 15C (effective date October 1, 2008); Class DXT Intentional Radiator
Date:	3rd to 6th July 2009
For and on behalf of R.N. Electronics Limited	
Signature:	