EMC
TEST REPORT

Report No. : EME-030198
Model No. : EL-235
Issued Date : Mar. 27, 2003

Applicant : E-LEAD ELECTRONIC CO., LTD.
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Test By : Intertek Testing Services Taiwan Ltd.
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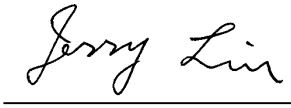
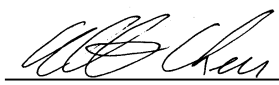
Project Engineer



Jerry Liu

Reviewed By



Elton Chen

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Summary of Tests

Necklace Bluetooth Wireless Earphone-Model: EL-235
FCC ID: QYKELBTHS235

Test	Reference	Results
Maximum Output Power test	15.247(b)	Complies
Carrier Frequency Separation test	15.247(a)(1)	Complies
Number of hopping frequencies test	15.247(a)(1)	Complies
Time of Occupancy (dwell time) test	15.247(a)(1)	Complies
20dB Bandwidth test	15.247(a)(1)	Complies
Radiated Spurious Emission test	15.205, 15.209	Complies
Power Line Conducted Emission test	15.207	Complies

1. General information

1.1 Identification of the EUT

Applicant	: E-LEAD ELECTRONIC CO., LTD.
Product	: Necklace Bluetooth Wireless Earphone
Model No.	: EL-235
FCC ID.	: QYKELBTHS235
Frequency Range	: 2402MHz to 2480MHz
Channel Number	: 79
Frequency of Each Channel	: 2402 + k (MHz), k: 0 ~78
Type of Modulation	: FHSS
Power Supply	: 3.6Vdc battery
Power Cord	: N/A
Sample Received	: Feb. 13, 2003
Test Date(s)	: Feb. 14, 2003 to Feb. 25, 2003

1.2 Additional information about the EUT

The EUT is a Necklace Bluetooth Wireless Earphone.

For more detail features, please refer to User's manual as file name “Installation guide.pdf”

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain : 2.5dBi
Antenna Type : Ceramic
Connector Type : N/A

1.4 Peripherals equipment

Peripherals	Manufacturer	Product No.	Serial No.
PC	HP	P5661AV	SG20400774
Key Board	IBM	37L2548	0095996
Monitor	IBM	6331-0LN	23-NW855
Mouse	Logitech	850693-0001	LAZ82706831
Printer	HP	C2642A	TH86K1N2ZB
Modem	Dynalink	V1456VQE	00V230A00051494
Simulator	Will’tek	4170	0812418
Balance Dipole antenna	INDEX SAR	IXD-180	N/A
Cell Phone	Nokia	6310	0507226

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Section §15.205、§15.207、§15.209、§15.247 and ANSI C63.4/1992.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

The EUT setup configurations please refer to the photo of test configuration in item.

2.2 Operation mode

The EUT was placed in three orthogonal axes, during Radiated emission test:

During Conducted Emission & Radiated Emission (up to 1GHz) test:
The EUT was test in normal operation mode with a cell phone that communicated with a simulating base station.

During other test:
The EUT connect to PC via RS232 cable. Run the test program “Bluetest” under Windows OS, provided by manufacturer.

This setup manner only for test purpose.

The EUT was transmitted continuously during the test.

2.3 Test equipment

Equipment	Brand	Frequency range	Model No.	Series No.	Last Cal.Date
EMI Test Receiver	Rohde & Schwarz	9kHz~2.75GHz	ESCS 30	825788/014	May 24, 2002
EMI Test Receiver	Rohde & Schwarz	20Hz~26.5GHz	ESMI	825428/005	June 10, 2002
Spectrum Analyzer	Rohde & Schwarz	9kHz~30GHz	FSP 30	100137	July 10, 2002
Spectrum Analyzer	Rohde & Schwarz	20Hz~40GHz	FSEK 30	100186	Oct. 9, 2002
Horn Antenna	EMCO	1GHz~18GHz	3115	9906-5890	Sep. 19, 2002
Horn Antenna	SCHWARZBECK	14GHz~40GHz	BBHA 9170	159	June 20, 2002
Bilog Antenna	SCHWARZBECK	25MHz~1.7GHz	VULB 9160	3111	June 20, 2002
Turn Table	HDGmbH	N/A	DS 420S	420/669/01	N/A
Antenna Tower	HDGmbH	N/A	MA 240	240/573	N/A
Microwave Amplifier	Agilent	2GHz~26.5GHz	8348A	3111A00567	Dec. 20, 2002
RF Power Meter	Boonton	10kHz~100GHz	4231A	79401	May 22, 2002
Power Sensor	Boonton	30MHz~8GHz	51011-EMC	32482	May 25, 2002

Note:
1. The calibration interval of the above instruments is 12 months.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature:	20	℃
Relative Humidity:	60	%
Atmospheric Pressure	1023	hPa

3.2 Test setup & procedure

The 20dB bandwidth per FCC §15.247(a)(1)(i) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 100 kHz, the video bandwidth ≧RBW, and the SPAN may equal to approximately 2 to 3 times the 20dB bandwidth. The test was performed at 3 channels (lowest, middle and highest channel). The maximum 20dB modulation bandwidth is in the following Table.

See 20dB Bbandwidth plot as file name “20dB Bandwidth plot.pdf”

3.3 Measured data of modulated bandwidth test results

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit
Low	2402.004	800	1MHz
Middle	2441.004	800	1MHz
High	2480.008	804	1MHz

＊ The EUT has its hopping function disable.

4. Carrier Frequency Separation test

4.1 Operating environment

Temperature:	20	℃
Relative Humidity:	60	%
Atmospheric Pressure	1023	hPa

4.2 Test setup & procedure

The carrier frequency separation per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at ≧1% of the span, the video bandwidth≧RBW, and the SPAN was wide enough to capture the peaks of two adjacent channels. The carrier frequency separation result is in the following Table.

See Carrier Frequency Separation plot as file name "Carrier Frequency Separation plot.pdf"

4.3 Measured data of Carrier Frequency Separation test result

Channel	Frequency (MHz)	Measurement Frequency separation (MHz)
1	2402	0.984
2	2403	

＊ The EUT has its hopping function enable.

5. Number of hopping frequencies test

5.1 Operating environment

Temperature:	20	℃
Relative Humidity:	60	%
Atmospheric Pressure	1023	hPa

5.2 Test setup & procedure

The number of hopping frequencies per FCC § 15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at ≧1% of the span, the video bandwidth≧RBW, and the SPAN was the frequency band of operation. The carrier frequency separation result is in the following Table.

See number of hopping frequencies plot as file name “number of hopping frequencies plot.pdf”

5.3 Measured data of number of hopping frequencies test result

Frequency Range (MHz)	Number of hopping frequencies	Total hopping channels
2400 ~ 2428.5	27	79
2429 ~ 2454.5	26	
2455 ~ 2483.5	26	

∗ The EUT has its hopping function enable.

6. Time of Occupancy (dwell time) test

6.1 Operating environment

Temperature:	20	℃
Relative Humidity:	60	%
Atmospheric Pressure	1023	hPa

6.2 Test setup & procedure

The time of occupancy (dwell time) per FCC § 15.247(a)(1)(iii) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 10MHz, the video bandwidth≧RBW, and the zero span function of spectrum analyzer was enable. The EUT has its hopping function enable.

The system makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels.

Time of occupancy (dwell time) for DH1

Dwell time = 420.84 μs * 1600 * 1/2 * 1/s / 79 *31.6s
= 134.69 ms (in a 31.6s period)

Time of occupancy (dwell time) for DH3

Dwell time = 1.683 ms * 1600 * 1/4 * 1/s / 79 *31.6s
= 269.28 ms (in a 31.6s period)

Time of occupancy (dwell time) for DH5

Dwell time = 1.754 ms * 1600 * 1/6 * 1/s / 79 *31.6s
= 187.093 ms (in a 31.6s period)

See time of occupancy (dwell time) plot as file name “Time of Occupancy (dwell time).pdf”

7. Maximum Output Power test

7.1 Operating environment

Temperature:	22	℃
Relative Humidity:	60	%
Atmospheric Pressure	1023	hPa

7.2 Test setup & procedure

The power output per FCC §15.247(b) was measured on the EUT using a 50 ohm SMA cable connected to power meter via power sensor. Power was read directly and cable loss correction (0.5dB) was added to the reading to obtain power at the EUT antenna terminals. The test was performed at 3 channels (lowest, middle and highest channel).

7.3 Measured data of Maximum Output Power test results

Channel	Frequency (MHz)	C.B.L. (dB)	Reading (dBm)	Power Output		Limit (W)
				(dBm)	(mW)	
Lowest	2402.00	0.5	-0.38	0.12	1.028	1
Middle	2441.00	0.5	0.23	0.73	1.183	1
Highest	2480.00	0.5	-0.16	0.34	1.081	1

＊ The EUT has its hopping function disable.

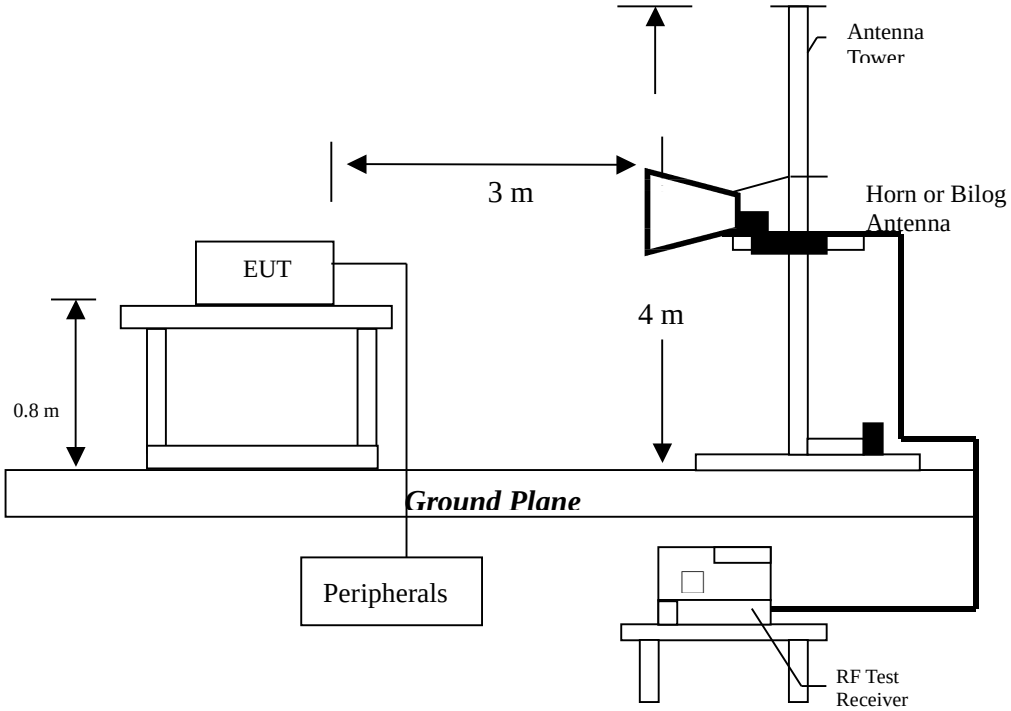
8. Radiated Emission test

8.1 Operating environment

Temperature:	20	℃
Relative Humidity:	60	%
Atmospheric Pressure	1023	hPa

8.2 Test setup & procedure

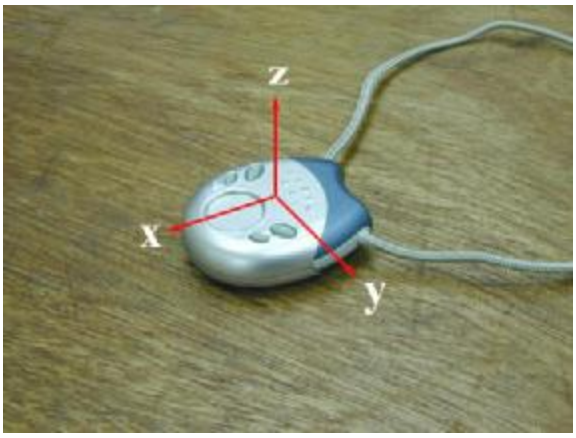
The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emissions were invested cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading recorded also on the report
The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

The signal is maximized through rotation and placement in the three orthogonal axes.



8.3 Emission limits

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency (MHz)	Limits (dB μ V/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Uncertainty was calculated in accordance with NAMAS NIS 81.
Expanded uncertainty (k=2) of radiated emission measurement is ±4.98 dB.
Expanded uncertainty (k=2) of conducted emission measurement is ±2.02 dB.

8.4 Radiated spurious emission test data

8.4.1 Measurement results: frequencies equal to or less than 1 GHz

EUT : EL-235
Test Condition : Normal Operation (Hopping enable)
Worst Case Condition : X-Y plane

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)
31.9000	QP	V	15.52	17.18	32.70	40.00	-7.30
39.7000	QP	V	15.52	16.48	32.00	40.00	-8.00
57.2000	QP	V	12.37	20.33	32.70	40.00	-7.30
74.6000	QP	V	9.40	15.30	24.70	40.00	-15.30
115.6000	QP	V	9.76	19.14	28.90	43.50	-14.60
214.3000	QP	V	9.78	22.32	32.10	43.50	-11.40
55.2000	QP	H	12.91	10.59	23.50	40.00	-16.50
115.4000	QP	H	9.76	10.94	20.70	43.50	-22.80
130.9000	QP	H	9.27	7.83	17.10	43.50	-26.40
214.3000	QP	H	9.78	16.52	26.30	43.50	-17.20
352.0000	QP	H	10.60	9.10	19.70	46.00	-26.30
396.7000	QP	H	10.90	9.80	20.70	46.00	-25.30

Remark:
1.Corrected Level = Reading Level + Correction Factor
2.Correction Factor = Antenna Factor + Cable Loss
3. “-“ means the emission is below the noise floor.

8.4.2 Measurement results: frequency above 1GHz

EUT : EL-235
Test Condition : Tx at low channel (Hopping disable)
Worst Case Condition : X-Y plane

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Preamp (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)
4804	PK	V	32.496	35.47	-	-	74	-
4804	AV	V	32.496	35.47	-	-	54	-
7206	PK	V	34.32	38.42	-	-	74	-
7206	AV	V	34.32	38.42	-	-	54	-
4804	PK	H	32.496	35.47	-	-	74	-
4804	AV	H	32.496	35.47	-	-	54	-
7206	PK	H	34.32	38.42	-	-	74	-
7206	AV	H	34.32	38.42	-	-	54	-

Remark:
1.Corrected Level = Reading Level + Correction Factor－Preamp
2.Correction Factor = Antenna Factor + Cable Loss
3. “-“ means the emission is below the noise floor.

EUT : EL-235
Test Condition : Tx at middle channel (Hopping disable)
Worst Case Condition : X-Y plane

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Preamp (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)
4882	PK	V	32.496	35.47	-	-	74	-
4882	AV	V	32.496	35.47	-	-	54	-
7323	PK	V	34.32	38.42	-	-	74	-
7323	AV	V	34.32	38.42	-	-	54	-
4882	PK	H	32.496	35.47	-	-	74	-
4882	AV	H	32.496	35.47	-	-	54	-
7323	PK	H	34.32	38.42	-	-	74	-
7323	AV	H	34.32	38.42	-	-	54	-

Remark:
1.Corrected Level = Reading Level + Correction Factor－Preamp
2.Correction Factor = Antenna Factor + Cable Loss
3. “-“ means the emission is below the noise floor.

EUT : EL-235
Test Condition : Tx at middle channel (Hopping disable)
Worst Case Condition : X-Y plane

Frequency (MHz)	Spectrum Analyzer Detector	Antenna Polariz. (H/V)	Preamp (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV)	Limit @ 3 m (dBuV)	Margin (dB)
4960	PK	V	32.496	35.47	-	-	74	-
4960	AV	V	32.496	35.47	-	-	54	-
7440	PK	V	34.47	38.38	-	-	74	-
7440	AV	V	34.47	38.38	-	-	54	-
4960	PK	H	32.496	35.47	-	-	74	-
4960	AV	H	32.496	35.47	-	-	54	-
7440	PK	H	34.47	38.38	-	-	74	-
7440	AV	H	34.47	38.38	-	-	54	-

Remark:
1.Corrected Level = Reading Level + Correction Factor－Preamp
2.Correction Factor = Antenna Factor + Cable Loss
3. “-“ means the emission is below the noise floor.

9. Emission on the band edge §FCC 15.247(C)

In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

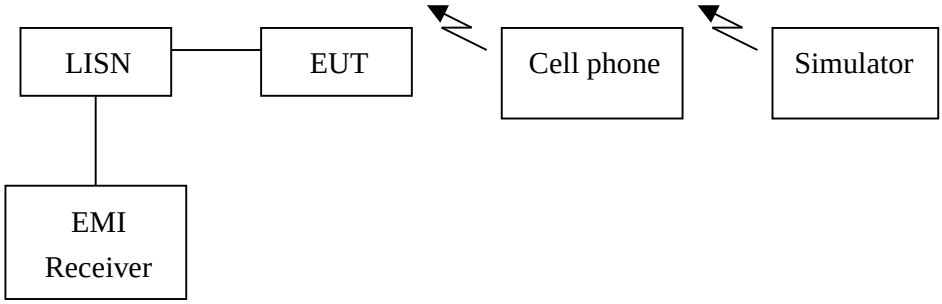
See band-edge plot as file name “Band-edge plot.pdf”.

10. Power Line Conducted Emission test §FCC 15.207

10.1 Operating environment

Temperature: 20 ℃
Relative Humidity: 60 %
Atmospheric Pressure 1023 hPa

10.2 Test setup & procedure



The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/1992 on conducted measurement. The AC power conducted emissions was invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz. (15.207 paragraph)

See Power Line Conducted Emission plot as file name “Power Line Conducted Emission plot.pdf”.

Emission Limit

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*
0.50~5.00	56	46
5.00~30.0	60	50

*Decreases with the logarithm of the frequency.

10.3 Power Line Conducted Emission test data

(1) Line
EUT : EL-235
Test Condition : Hopping enable

Freq. (MHz)	Reading (dB μ V) QP	Limit (dB μ V) QP	Reading (dB μ V) AV	Limit (dB μ V) AV	Margin (dB)	
					QP	AV
0.1800	13.10	64.49	5.60	54.49	-51.39	-48.89
0.3420	8.10	59.15	3.20	49.15	-51.05	-45.95
0.4540	11.60	56.80	3.10	46.80	-45.20	-43.70
1.3500	10.90	56.00	3.50	46.00	-45.10	-42.50
7.6940	10.60	60.00	5.70	50.00	-49.40	-44.30
12.2860	17.40	60.00	15.50	50.00	-42.60	-34.50

(2) Neutral
EUT : EL-235
Test Condition : Hopping enable

Freq. (MHz)	Reading (dB μ V) QP	Limit (dB μ V) QP	Reading (dB μ V) AV	Limit (dB μ V) AV	Margin (dB)	
					QP	AV
0.1740	15.50	64.77	10.20	54.77	-49.27	-44.57
0.2380	12.70	62.17	7.70	52.17	-49.47	-44.47
0.4860	9.10	56.24	3.00	46.24	-47.14	-43.24
0.5580	7.90	56.00	2.90	46.00	-48.10	-43.10
1.3100	9.60	56.00	3.60	46.00	-46.40	-42.40
5.7420	9.40	60.00	4.30	50.00	-50.60	-45.70

Remark:
1. 1. The reading value included cable loss and LISN factor.
2. Uncertainty was calculated in accordance with NAMAS NIS 81.
Expanded uncertainty (k=2) of conducted emission measurement is ±2.6 dB.