

EMC TEST REPORT

**Report No.: TS13080013-EME** 

Model No.: T416

**Issued Date: Sep. 04, 2013** 

Applicant: Kobo Inc

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Canada

Test Method/Standard: FCC Part 15 Subpart C Section §15.205, §15.207, §15.209,

§15.247, KDB558074 and ANSI C63.4/2003

**Registration No.:** 93910

Test By: Intertek Testing Services Taiwan Ltd.

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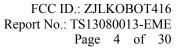
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# **Summary of Tests**

Test Item	Reference	Results
Maximum 6 dB Bandwidth	15.247 (a)(2)	Pass
Power Spectral Density	15.247(e)	Pass
Maximum Output Power Test	15.247(b)	Pass
RF Antenna Conducted Spurious Test	15.247(d)	Pass
Radiated Spurious Emission Test	15.205, 15.209	Pass
Emission on the Band Edge Test	15.247(d)	Pass
AC Power Line Conducted Emission Test	15.207	Pass



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#### 1. General Information

#### 1.1 Identification of the EUT

Product: Tablet Model No.: T416

FCC ID.: ZJLKOBOT416

Frequency Range: 2402MHz~2480MHz

Total Hopping Channel No: 40 channels

Frequency of Each Channel: 2402+2k MHz, k=0~39

Type of Modulation: GFSK

Rated Power: 1. DC 5.35 V from adapter

2. DC 3.7 V from battery

Power Cord: N/A

Data Cable: USB shielded cable 1 meter × 1

Sample Received: Jul. 19, 2013

Test Date(s): Jul. 19, 2013~Aug. 19, 2013

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been under an Intertek certification program.

Note 2: When determining the test conclusion, the Measurement

Uncertainty of test has been considered.

#### 1.2 Additional Information about the EUT

The EUT is Tablet, and was defined as information technology equipment.

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



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# 1.3 Antenna Description

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 0.36dBi

Antenna Type : PIFA Antenna

Connector Type : I-PEX

## 1.4 Adapter Information

The EUT will be supplied with a power supply from below list:

No.	Brand	Model no.	Specification
Adapter	kobo	PSAI10R-050Q	I/P: 100-240V~, 0.3A, 50-60Hz O/P: 5.35V, 2.0A

#### 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, KDB558074 and ANSI C63.4/2003.

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

#### 2.2 Operation Mode

The EUT is supplied with DC 3.7 V from battery for all test items except for conducted emission test.

The EUT is supplied with DC 5.35 V from adapter (Test voltage: 120VAC, 60Hz) for conducted emission test.

The EUT executes test by "MS-DOS" and enters the relevant commands provided by Wistron.

The signal is maximized through rotation and placement in the three orthogonal axes (The EUT configuration refers to the "Spurious set-up photo.pdf").

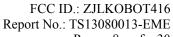
After verifying three axes, we found the maximum electromagnetic field was occurred at X axis. The final test data was executed under this configuration.

### 2.3 Measurement Uncertainty

Measurement uncertainty was calculated in accordance with TR 100 028-1

Parameter	Uncertainty				
	Below 1 GHz	Vertical	3.90 dB		
Radiated Emission	Delow I GHZ	Horizontal	3.86 dB		
Radiated Emission	Above 1 CII-	Vertical	5.74 dB		
	Above 1 GHz	Horizontal	5.55 dB		
Conducted Emission	2.08 dB				

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2.



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# 2.4 Test Equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2012/11/30	2013/11/29
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2013/06/21	2014/06/20
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2013/01/23	2014/01/22
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2012/09/03	2013/09/02
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2012/09/05	2013/09/04
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2013/08/08	2014/08/07
Loop Antenna	RolfHeine	LA-285	02/10033	2013/03/20	2014/03/19
Pre-Amplifier	MITEQ	AFS44-0010265 042-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000 27-8A	828825	2012/9/18	2014/9/17
Power Meter	Anritsu	ML2495A	0844001	2012/10/09	2013/10/08
Power Senor	Anritsu	MA2411B	0738452	2012/10/09	2013/10/08
Temperature& Humidity Test Chamber	TERCHY	MHU-225LRU (SA)	950838	2013/06/14	2014/06/13
Two-Line V-Network	Rohde&schwarz	ESH3-Z5	838979/014	2012/10/29	2013/10/28

Note: The above equipments are within the valid calibration period.

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#### 3. - 6dB Bandwidth

### 3.1 Operating Environment

 $^{\circ}$ C Temperature: 23 Relative Humidity: % 55 Atmospheric Pressure: 1008 hPa Test Date: Aug. 19, 2013

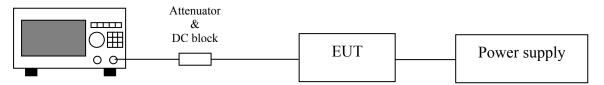
# 3.2 Test Setup & Procedure

#### **Method of Measurement:**

### Reference FCC document: KDB558074

A portion of the transmitted signal is coupled to a Spectrum Analyzer with a resolution bandwidth of 1~5 % of the bandwidth of the transmitted signal. The resolution bandwidth is chosen so as not to reduce the peak level of the measured waveform. The appropriate bandwidth mask is applied to the output waveform to verify compliance.

#### **Test Diagram:**



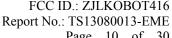
Spectrum Analyzer

**Note:** The EUT was tested while in a continuous transmit mode and the data rates are 1 Mbps for GFSK. The EUT was tuned to a low, middle and high channel.

#### 3.3 Measured Data of - 6dB Bandwidth Test Results

1TX Mode	Channel Frequence (MHz)		- 6dB Bandwidth (MHz)	Min. Limit (MHz)	Pass/Fail
	0	2402	0.7338	0.5	Pass
LE-1Mbps	20	2442	0.7228	0.5	Pass
	39	2480	0.7316	0.5	Pass

Please see the plots below.

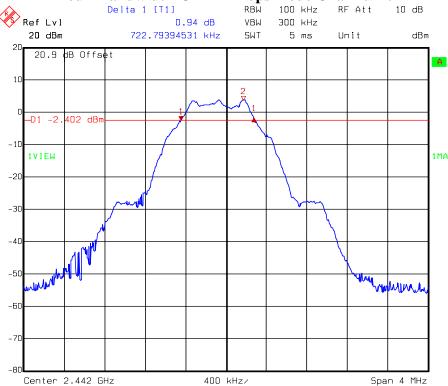


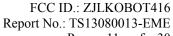
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### - 6dB Bandwidth @ LE-1Mbps mode Channel 0



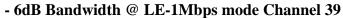
## - 6dB Bandwidth @ LE-1Mbps mode Channel 20

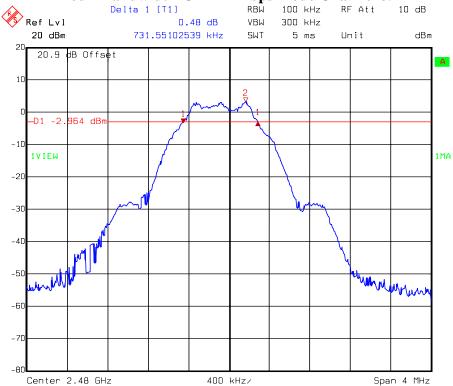




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### 4. Power Spectral Density

#### **4.1 Operating Environment**

 $^{\circ}$ C Temperature: 23 Relative Humidity: % 55 Atmospheric Pressure: 1008 hPa Test Date: Aug. 19, 2013

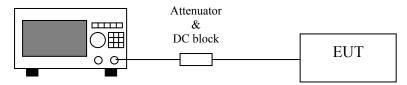
# 4.2 Test Setup & Procedure

#### **Method of Measurement:**

#### Reference FCC document: KDB558074

The power spectrum density was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer. Locate and zoom in on emission peak(s) within the pass band. Set RBW  $\geq$ 3 kHz, VBW  $\geq$  3×RBW, sweep time = auto couple. The peak level measured must be no greater than + 8 dBm. Power spectrum density was read directly and cable loss (1 dB)/external attenuator (20 dB) correction was added to the reading to obtain power at the EUT antenna terminals.

### **Test Diagram:**

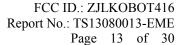


Spectrum Analyzer

### 4.3 Measured Data of Power Spectral Density Test Results

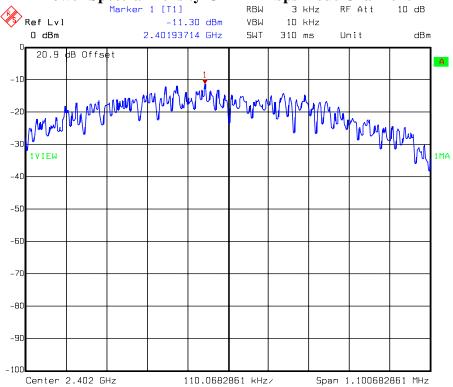
1TX	Channel	Frequency	PSD	PSD	Limit	Margin
Mode	Chamiei	(MHz)	(dBm)	(mW)	(dBm)	(dB)
LE-1Mbps	0	2402	-11.30	0.07	8	-19.30
	20	2442	-11.01	0.08	8	-19.01
	39	2480	-11.78	0.07	8	-19.78

Please see the plot below.

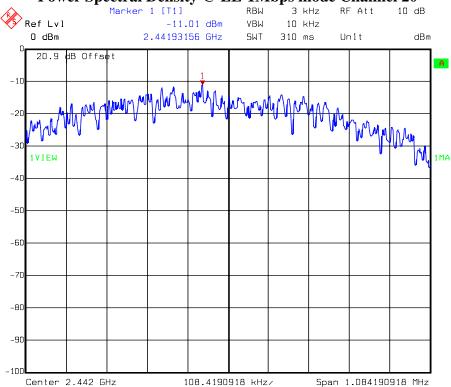


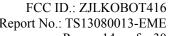


Power Spectral Density @ LE-1Mbps mode Channel 0



## **Power Spectral Density @ LE-1Mbps mode Channel 20**

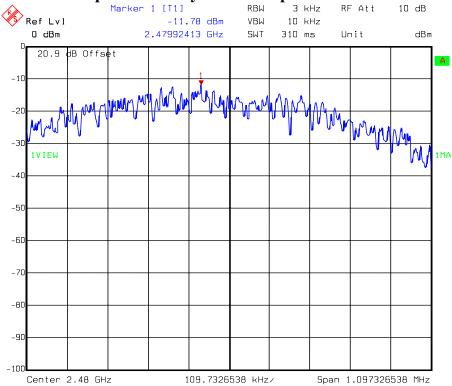




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## Power Spectral Density @ LE-1Mbps mode Channel 39



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#### **5. Maximum Output Power Test**

#### **5.1 Operating Environment**

 $^{\circ}$ C Temperature: 23 % Relative Humidity: 55 Atmospheric Pressure: 1008 hPa Test Date: Aug. 15, 2013

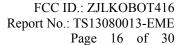
### 5.2 Test Setup & Procedure

### The test procedure was according to FCC measurement guidelines KDB558074.

The power output per FCC §15.247(b) was measured on the EUT using a 50 ohm SMA cable connected to peak power meter via power sensor. Power was read directly and cable loss correction (1 dB) 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).

### 5.3 Measured Data of Maximum Output Power Test Results

Mode	Channel			Limit	Margin	
		(MHz)	PK	PK	(dBm)	(dB)
	0	2402	3.05	2.02	30	-26.95
LE-1Mbps	20	2442	3.49	2.23	30	-26.51
	39	2480	3.31	2.14	30	-26.69





#### 6. RF Antenna Conducted Spurious Test

### **6.1 Operating Environment**

Temperature: 23 °C
Relative Humidity: 55 %
Atmospheric Pressure: 1008 hPa
Test Date: Aug. 19, 2013

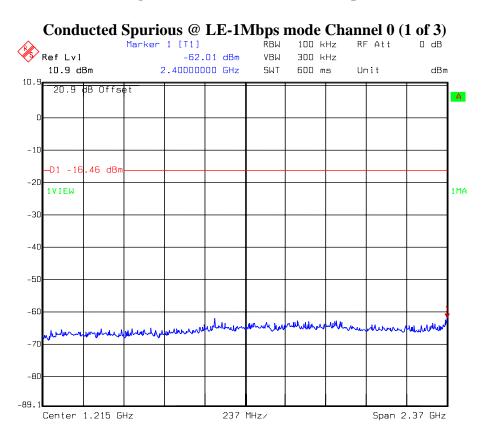
#### **6.2 Test Setup & Procedure**

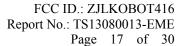
#### The test procedure was according to FCC measurement guidelines KDB558074.

The measurements were performed from lowest generated frequency to 10th fundamental frequency RF antenna conducted per FCC 15.247 (c) was measured from the EUT antenna port using a 50ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz.

Harmonics and spurious noise must be at least 20dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

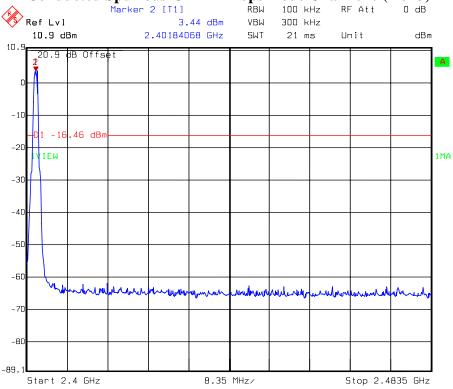
## 6.3 Measured Data of the Highest RF Antenna Conducted Spurious Test Result



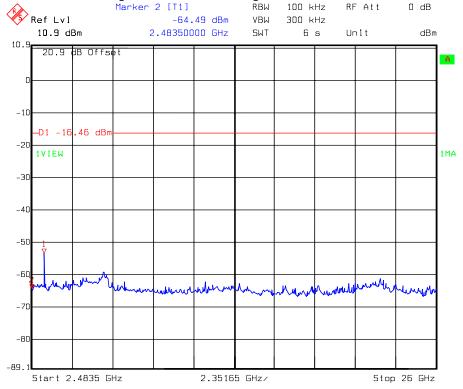


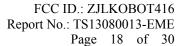


Conducted Spurious @ LE-1Mbps mode Channel 0 (2 of 3)



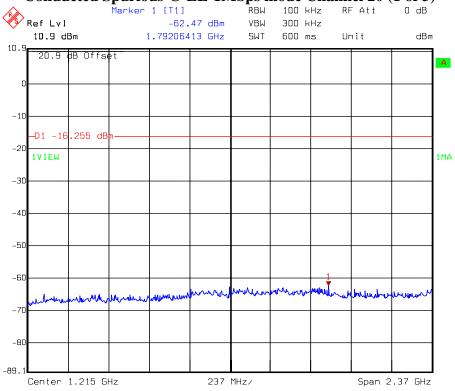




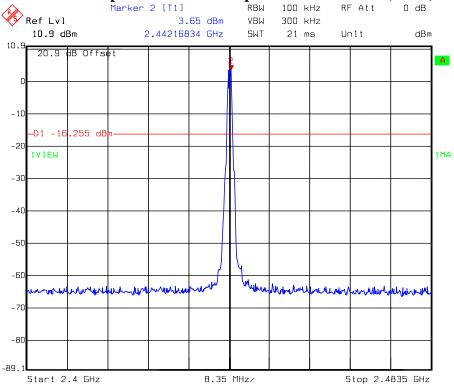




Conducted Spurious @ LE-1Mbps mode Channel 20 (1 of 3)

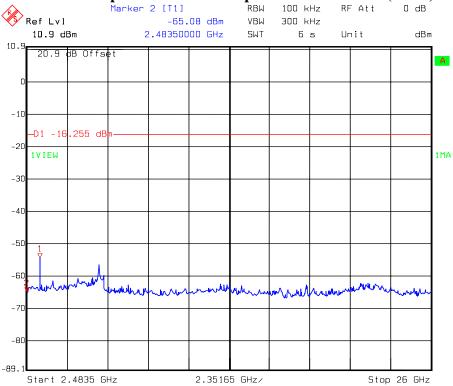




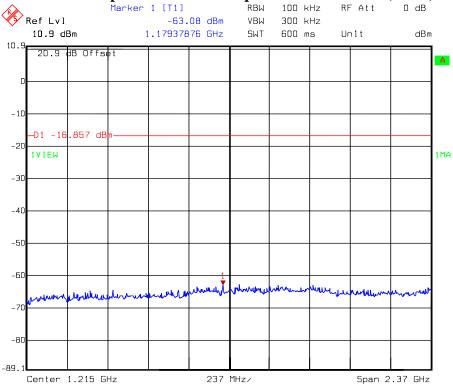




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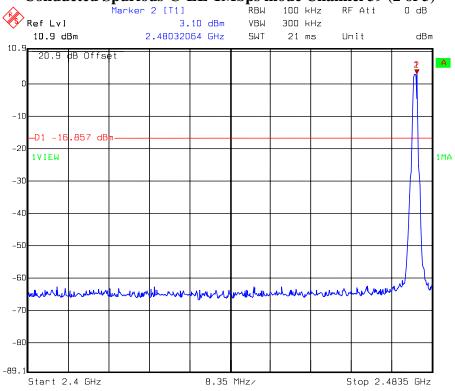


### **Conducted Spurious @ LE-1Mbps mode Channel 39 (1 of 3)**

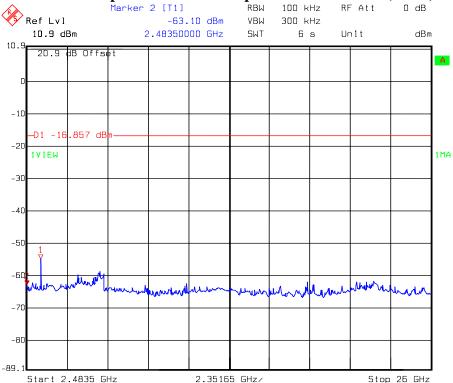




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### **Conducted Spurious @ LE-1Mbps mode Channel 39 (3 of 3)**





#### 7. Radiated Emission Test

### 7.1 Operating Environment

Temperature: 24 °C Relative Humidity: 55 % Atmospheric Pressure: 1008 hPa

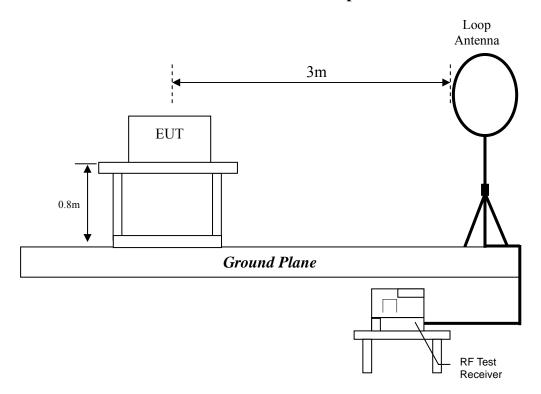
Test Date: Aug. 16, 2013~Aug. 19, 2013

## 7.2 Test Setup & Procedure

The test procedure was according to FCC measurement guidelines KDB558074 and ANSI C63.4/2003.

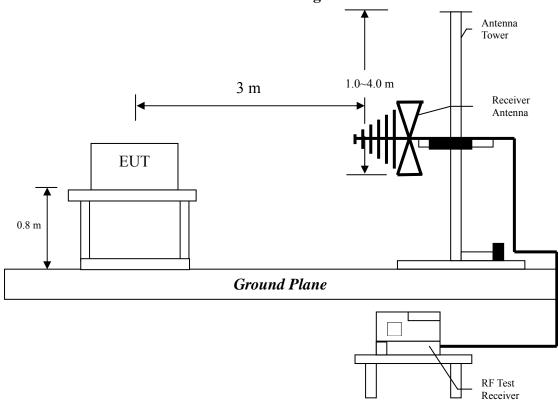
The Diagram below shows the test setup, which is utilized to make these measurements.

# Radiated emission from 9kHz to 30MHz uses Loop Antenna:

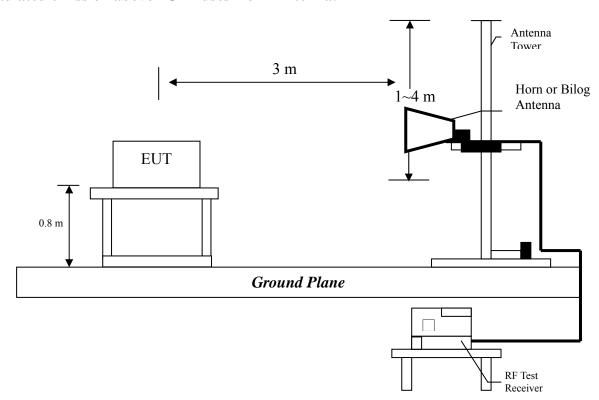


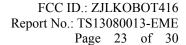
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Radiated emission from 30MHz to 1GHz uses Bilog Antenna:



## Radiated emission above 1GHz uses Horn Antenna:







The signal is maximized through rotation and placement in the three orthogonal axes. According to §15.33(a), the spectrum shall be investigated from the lowest radio frequency signal generated in the device, to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Spectrum Analyzer Resolution Bandwidth is 100kHz or greater for frequencies 30MHz to 1GHz, 1MHz – for frequencies above 1GHz.

The EUT for testing is arranged on a fiberglass 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 3 meter reading using inverse scaling with distance.

The EUT configuration refers to the "Spurious set-up photo.pdf".

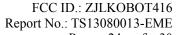
#### 7.3 Emission Limits

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)	Field Strength (microvolts/meter)
0.009~0.490	2400/F(kHz)
0.490~1.705	2400/F(kHz)
1.705~30	30
30-88	100
88-216	150
216-960	200
Above 960	500

#### 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



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## 7.4 Radiated Spurious Emission Test Data

### 7.4.1 Measurement Results: Frequencies Equal to or Less than 1 GHz

The test was performed on EUT under Channel 0, 20 and 39. The worst case occurred at Channel 20.

**EUT** : T416

: LE-1Mbps mode at Channel 20 Worst Case

Antenna	Freq.	Receiver	Corr.	Reading	Corrected	Limit	Margin
Polariz.			Factor		Level	@ 3 m	
(V/H)	(MHz)	Detector	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
V	90.14	QP	7.38	14.54	21.91	43.50	-21.59
V	169.68	QP	15.70	6.32	22.02	43.50	-21.48
V	474.26	QP	17.68	9.73	27.41	46.00	-18.59
V	619.76	QP	20.75	11.13	31.88	46.00	-14.12
V	852.56	QP	23.70	8.70	32.40	46.00	-13.60
V	897.18	QP	24.35	7.44	31.78	46.00	-14.22
Н	90.14	QP	7.93	23.59	31.51	43.50	-11.99
Н	175.50	QP	13.48	13.91	27.38	43.50	-16.12
Н	474.26	QP	18.16	14.27	32.43	46.00	-13.57
Н	619.76	QP	20.88	8.13	29.00	46.00	-17.00
Н	817.64	QP	23.62	8.03	31.65	46.00	-14.35
Н	951.50	QP	25.54	10.44	35.98	46.00	-10.02

Remark: 1. Corr. Factor = Antenna Factor + Cable Loss

2. Corrected Level = Reading + Corr. Factor

Note: The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.



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## 7.4.2 Measurement Results: Frequency above 1GHz

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Test Condition : LE-1Mbps mode at Channel 0

Frequency	Spectrum	Antenna	Preamp	Correction	Reading	Corrected	Limit	Margin
	Analyzer	Polariz.	Gain	Factor		Level	@ 3 m	
(MHz)	Detector	(H/V)	(dB)	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
4804	PK	V	35.1	38.54	36.9	40.34	54	-13.66
4804	PK	Н	35.1	38.54	36.29	39.73	54	-14.27

#### Remark:

1. Correction Factor = Antenna Factor + Cable Loss

2. Corrected Level = Reading + Correction Factor – Preamp. Gain

3. The frequency measured ranges from 1GHz to 25GHz. The data value listed above which is higher than the noise floor, the others please refer to noise floor level.

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Test Condition : LE-1Mbps mode at Channel 20

Frequency	Spectrum	Antenna	Preamp	Correction	Reading	Corrected	Limit	Margin
	Analyzer	Polariz.	Gain	Factor		Level	@ 3 m	
(MHz)	Detector	(H/V)	(dB)	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
3240	PK	V	33.8	36.24	42.93	45.37	54	-8.63
4884	PK	V	35.1	38.54	36.55	39.99	54	-14.01
3240	PK	Н	33.8	36.24	44.47	46.91	54	-7.09
4884	PK	Н	35.1	38.54	37.29	40.73	54	-13.27
4980	PK	Н	35.1	38.54	41.88	45.32	54	-8.68

#### Remark:

- 1. Correction Factor = Antenna Factor + Cable Loss
- 2. Corrected Level = Reading + Correction Factor Preamp. Gain
- 3. The frequency measured ranges from 1GHz to 25GHz. The data value listed above which is higher than the noise floor, the others please refer to noise floor level.



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EUT : T416

Test Condition : LE-1Mbps mode at Channel 39

Frequency	Spectrum	Antenna	Preamp	Correction	Reading	Corrected	Limit	Margin
	Analyzer	Polariz.	Gain	Factor		Level	@ 3 m	
(MHz)	Detector	(H/V)	(dB)	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
3300	PK	V	33.8	36.24	40.71	43.15	54	-10.85
4960	PK	V	35.1	38.54	36.02	39.46	54	-14.54
3300	PK	Н	33.8	36.24	38.52	40.96	54	-13.04
4960	PK	Н	35.1	38.54	36.91	40.35	54	-13.65

#### Remark:

- 1. Correction Factor = Antenna Factor + Cable Loss
- 2. Corrected Level = Reading + Correction Factor Preamp. Gain
- 3. The frequency measured ranges from 1GHz to 25GHz. The data value listed above which is higher than the noise floor, the others please refer to noise floor level.

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### 8. Emission on the Band Edge §FCC 15.247(d)

Radiated emissions were invested cover the frequency range from 30 MHz to 1000 MHz using a receiver RBW of 120 kHz record QP reading, and the frequency over 1 GHz using a spectrum analyzer RBW of 1 MHz and 10 Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1MHz / 3MHz; RBW / VBW) recorded also on the report.

### **8.1 Operating Environment**

 $^{\circ}$ C Temperature: 24 Relative Humidity: 55 % Atmospheric Pressure: 1008 hPa Test Date: Aug. 03, 2013

### 8.2 Test Setup & Procedure

Please refer to the section 7.2 of this report.

#### **8.3** Test Results

	Restricted	Freq.	Spectrum	Ant.	Preamp.	Correction	Reading	Corrected	Limit	Margin
Mode	Band		Analyzer	Pol.	Gain	Factor		Level	@ 3 m	
	(MHz)	(MHz)	Detector	(H/V)	(dB)	(dB/m)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
GFSK	2310~ 2390	2358.00	PK	Н	38.013	31.698	64.155	57.84	74	-16.16
		2358.00	AV	Н	38.013	31.698	51.415	45.10	54	-8.90
	-	2402.00	PK	Н	38.025	31.907	107.147	101.03	-	101.03
		2402.00	AV	Н	38.025	31.907	85.347	79.23	-	79.23
		2480.00	PK	Н	38.045	32.278	107.387	101.62	-	101.62
	-	2480.00	AV	Н	38.045	32.278	85.447	79.68	-	79.68
	2483.5~ 2500	2483.50	PK	Н	38.046	32.294	69.731	63.98	74	-10.02
		2483.50	AV	Н	38.046	32.294	59.461	53.71	54	-0.29

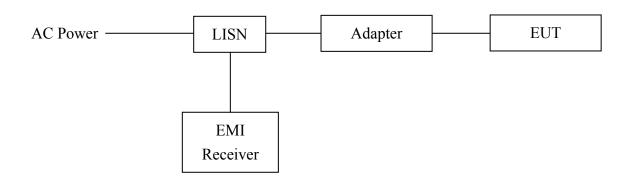


#### 9. Power Line Conducted Emission Test §FCC 15.207

#### **9.1 Operating Environment**

Temperature: 23 °C Relative Humidity: 52 % Atmospheric Pressure 1008 hPa Test Date: Jul. 19, 2013

#### 9.2 Test Setup & Procedure



#### The test procedure was according to ANSI C63.4/2003.

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 50 ohm/50uH coupling impedance with 50 ohm termination.

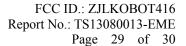
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/2003 on conducted measurement. The bandwidth of the field strength meter (R & S Test Receiver ESCS 30) is set at 9 kHz.

The EUT configuration refers to the "Conducted set-up photo.pdf".

#### 9.3 Emission Limit

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

<sup>\*</sup>Decreases with the logarithm of the frequency.





# 9.4 Power Line Conducted Emission Test Data

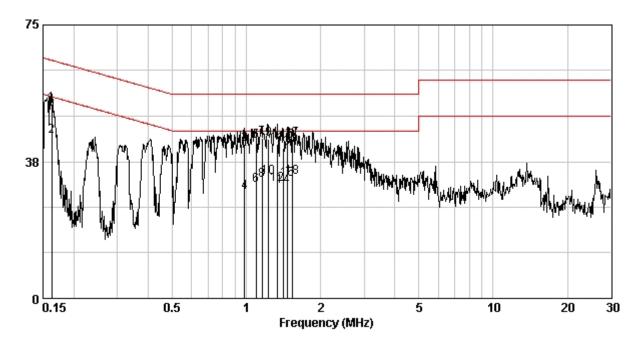
Phase: Line Model No.: T416

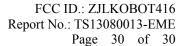
**Test Condition:** Adapter mode

Frequency	Corr. Factor	Level Op	Limit Qp	Level Av	Limit Av		rgin HB)
(MHz)	(dB)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	Qp `	Av
0.162	0.13	53.43	65.34	44.63	55.34	-11.91	-10.71
0.984 1.094	0.20 0.21	42.22 43.11	56.00 56.00	29.23 31.15	46.00 46.00	-13.78 -12.89	-16.77 -14.85
1.160	0.21	44.08	56.00	32.38	46.00	-11.92	-13.62
1.229 1.331	0.22 0.23	43.66 42.21	56.00 56.00	33.15 31.23	46.00 46.00	-12.34 -13.79	-12.85 -14.77
1.411	0.23	41.11	56.00	30.74	46.00	-14.89	-15.26
1.472 1.544	0.24 0.24	43.07 43.59	56.00 56.00	32.80 33.26	46.00 46.00	-12.93 -12.41	-13.20 -12.74

#### Remark:

- 1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
- 2. Margin (dB) = Level (dBuV) Limit (dBuV)







Phase: Neutral Model No.: T416

**Test Condition:** Adapter mode

Frequency	Corr. Factor	Level Qp	Limit Qp	Level Av	Limit Av		rgin dB)
(MHz)	(dB)	(dBu∜)	(dBuV)	(dBuV)	(dBu∜)	Qр	Av
0.159	0.10	54.81	65.52	46.39	55.52	-10.71	-9.12
0.229 0.312	0.11 0.12	40.79 40.87	62.48 59.93	31.01 32.66	52.48 49.93	-21.69 -19.06	-21.47 -17.26
1.065 1.303	0.17 0.19	41.72 44.60	56.00 56.00	30.06 34.89	46.00 46.00	-14.28 -11.40	-15.94 -11.11
1.396	0.19	43.96	56.00	32.96	46.00	-12.04	-13.04
1.472	0.20	43.54	56.00	33.63	46.00	-12.46	-12.37
1.560 1.878	0.21 0.22	42.81 41.92	56.00 56.00	32.81 32.30	46.00 46.00	-13.19 -14.08	-13.19 -13.70

### Remark:

- 1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
- 2. Margin (dB) = Level (dBuV) Limit (dBuV)

