

TEST REPORT

of

FCC Part 15 Subpart C

☒ New Application; ☐ Class I PC; ☐ Class II PC

Product : Tire Pressure Monitoring System (TPMS)

Brand: E-LEAD

Model: EL-409

Model Difference: N/A

FCC ID: QYK-EL409

FCC Rule Part: §15.231

Applicant: E-LEAD ELECTRONIC CO., LTD.

Address: NO. 37 Gungdung 1ST RD., Shengang
Shiang, Changhua, 509, TAIWAN, R.O.C.
(Chuan-Hsin Industrial Park)

Test Performed by:

International Standards Laboratory

<Lung-Tan LAB>

*Site Registration No.

BSMI: SL2-IN-E-0013; MRA TW1036; TAF: 0997; IC: IC4067B-3;

*Address:

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Report No.: **ISL-14LR127FC**

Issue Date : **2014/05/23**

Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein.

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VERIFICATION OF COMPLIANCE

Applicant: E-LEAD ELECTRONIC CO., LTD.
Product Description: Tire Pressure Monitoring System (TPMS)
Brand Name: E-LEAD
FCC ID: QYK-EL409
FCC Rule Part: §15.231
Model No.: EL-409
Model Difference: N/A
Date of test: 2014/05/14 ~ 2014/05/23
Date of EUT Received: 2014/05/14

We hereby certify that:

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

Test By:

Dion Chen

Date:

2014/05/23

Dion Chang / Engineer

Prepared By:

Eva Kao

Date:

2014/05/23

Eva Kao / Technical Supervisor

Approved By:

Vincent Su

Date:

2014/05/23

Vincent Su / Technical Manager

Version

Version No.	Date	Description
00	2014/05/23	Initial creation of document

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1. GENERAL INFORMATION

1.1 Product Description

Product Name	Tire Pressure Monitoring System (TPMS)
Brand Name	E-LEAD
Model Name	EL-409
Model Difference	N/A
Power Supply	3.7V from battery*1
Device type	safety applications

TX:

Operating Frequency	433.92 MHz
Transmit Power	80.06dBuV/m at 3m
Modulation Technique	FSK
Number of Channels	1
Operating Mode	Point-to-Point
Periodic Transmission Time	1 Transmission every 10s, Total Transmission Time <1 s per hour
Antenna Type	TX: PIFA Antenna

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **QYK-EL409** filing to comply with Section 15.231 of the FCC Part 15, Subpart C Rules.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2009. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of **International Standards Laboratory** <Lung-Tan LAB> No. 120, Lane 180, San Ho Tsuen, Hsin Ho Rd., Lung-Tan Hsiang, Tao Yuan County 325, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2009. FCC Registration Number is: TW1036, Canada Registration Number: 4067B-3.

1.5 Special Accessories

Not available for this EUT intended for grant.

1.6 Equipment Modifications

Not available for this EUT intended for grant.

2. SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT (Transmitter) was tested with a test program to fix the Tx frequency that was for the purpose of the measurements. For more information please see test data and APPENDIX 1 for set-up photographs.

2.3 Test Procedure

2.3.1 Conducted Emissions (Not apply in the report)

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 7, 13 of ANSI C63.4-2009 and RSS-Gen:2010. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna. according to the requirements in Section 8 and 13 of ANSI C63.4-2009.

2.4 Limitation

(1) Conducted Emission

According to section 15.207(a) Conducted Emission Limits is as following.

Frequency range MHz	Limits dB (uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

(2) Radiated Emission

According to 15.231(b), the field strength of emissions from Intentional Radiators operated under this section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)
40.66 - 40.70	67.04	2,250	47	2,25
70 - 130	61.94	1,250	41.9	1,25
130 - 174	* 61.94 - 71.48	* 1,250 -3,750	* 41.94 -51.48	* 1,25 -3,75
174 - 260	71.48	3,750	51.48	3,75
260 - 470	* 71.48 - 81.94	* 3,750 - 12,500	* 51.48 - 61.94	* 3,75 - 12,50
above 470	81.94	12,500	61.94	12,50

- Remark:
1. Emission level in dBuV/m=20 log (uV/m)
 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
 3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205
 4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of §15.205, then the general radiated emission limits in § 15.209 apply.
 5. For the band 130-174MHz, uV/m at 3meters = $56.81818(F) - 6136.3636$;
For the band 260-470MHz uV/m at 3meters = $41.6667(F) - 7083.3333$;
Where F is the frequency in MHz.
 6. $433.92\text{MHz limit} = 41.6667 * 433.92 - 7083.3333 = 10996.681 \text{ uV/m}$
= 80.8dBuV/m

2.5 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

**EUT
(TX)**

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	N/A					

3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207	Conducted Emission	N/A
§15.231(b)	Radiated Emission	Compliant
§15.231(c)	20dB Bandwidth	Compliant
	Duty Cycle Test (Pulse Modulation)	Compliant
§15.231(a3)	transmission time, silent period	Compliant

4. Description of test modes

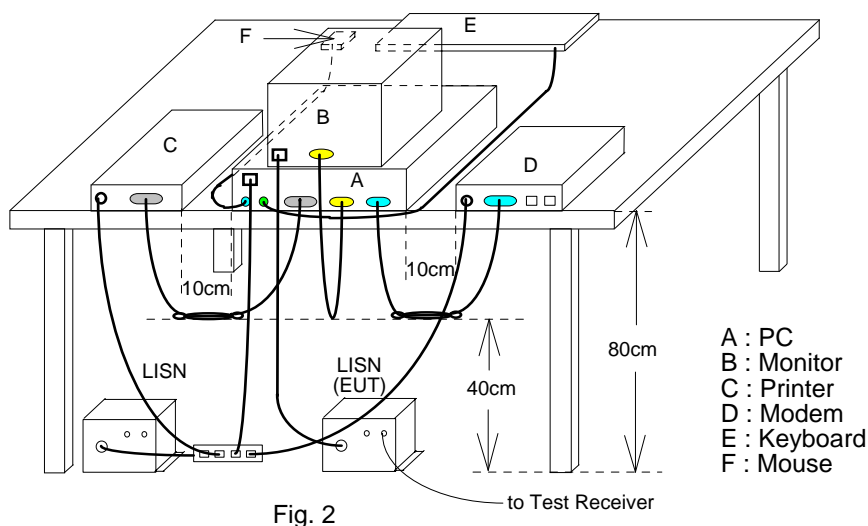
The EUT has been tested under engineering test mode condition. and the EUT staying in continuous transmitting mode. The Frequency 433.92 MHz is chosen for testing.

5. CONDUCTED EMISSIONS TEST (NOT APPLY IN THE REPORT)

5.1 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

5.2 Test SET-UP (Block Diagram of Configuration)



5.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Conduction 04-1 Cable	WOKEN	CFD 300-NL	Conduction 04-1	09/24/2013	09/23/2014
EMI Receiver 16	Rohde & Schwarz	ESCI	101221	06/13/2013	06/12/2014
LISN 18	ROHDE & SCHWARZ	ENV216	101424	03/13/2014	03/12/2015
LISN 19	ROHDE & SCHWARZ	ENV216	101425	03/13/2014	03/12/2015

5.4 Measurement Result:

N/A

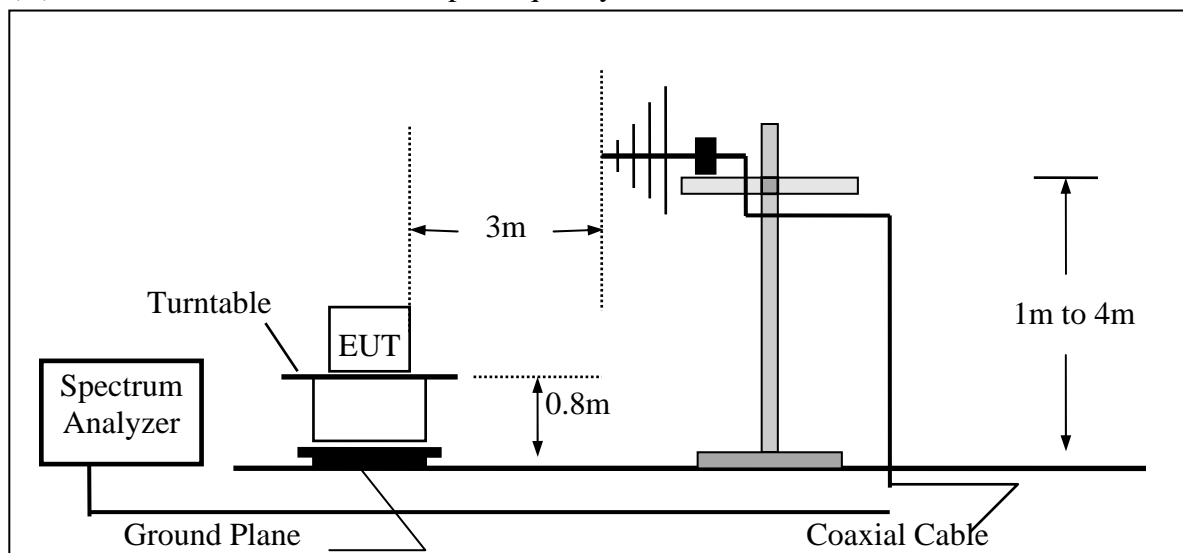
6. RADIATED EMISSION TEST

6.1 Measurement Procedure

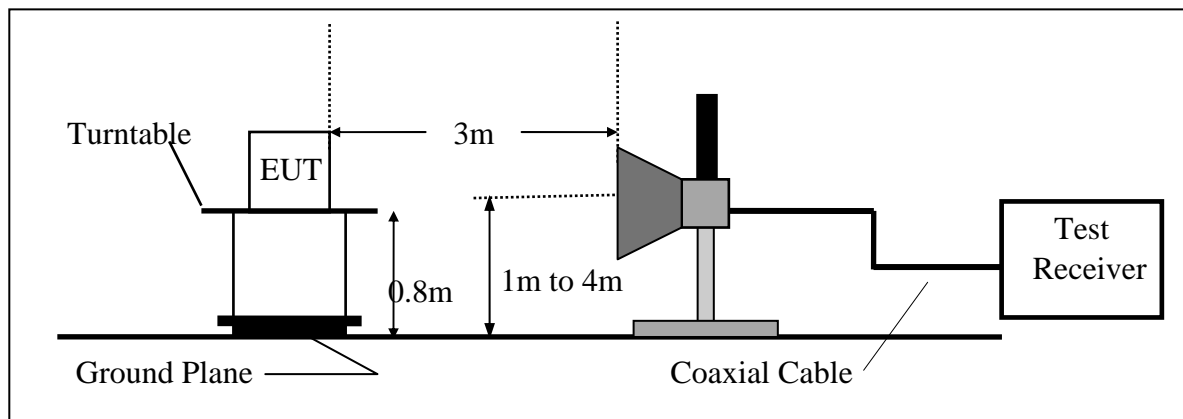
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

6.2 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



6.3 Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer 21(26.5GHz)	Agilent	N9010A	MY49060537	07/18/2013	07/17/2014
Spectrum Analyzer 20(6.5GHz)	Agilent	E4443A	MY48250315	05/26/2013	05/25/2014
Spectrum Analyzer 22(43GHz)	R&S	FSU43	100143	05/03/2014	05/02/2015
Loop Antenna9K-30M	A.H.SYSTEM	SAS-564	294	03/07/2013	03/06/2015
Bilog Antenna30-1G	Schaffner	CBL 6112B	2756	01/15/2014	01/14/2015
Horn antenna1-18G(06)	EMCO	3117	0006665	11/04/2013	11/03/2014
Preamplifier9-1000M	HP	8447D	NA	02/19/2014	02/18/2015
Cable1-18G	HUBER SUHNER	Sucoflex 106	NA	02/06/2014	02/05/2015
Cable UP to 1G	HUBER SUHNER	RG 214/U	NA	10/08/2013	10/07/2014

6.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Average Value = Peak Value + 20 Log (Ton/Tp)Pulse Modulation Duty Cycle Correction Factor

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

6.5 Measurement Result

Fundamental Measurement Result

Operation Mode:	Transmitting Mode	Test Date:	2014/05/15
Fundamental Frequency:	433.92MHz	Test By:	Dino
Temp:	25 °C	Hum.:	60%

Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
433.92	72.48	-8.56	63.92	100.83	-36.91	Peak	VERTICAL
433.92	60.92	-8.56	52.36	80.82	-28.46	Average	HORIZONTAL
433.92	88.62	-8.56	80.06	100.83	-20.77	Peak	HORIZONTAL

Remark:

- 1 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 2 The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz, VBW=300KHz.
- 3 Average Value = Peak Value + 20 Log (Ton/Tp)Pulse Modulation Duty Cycle Correction Factor

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode: Transmitting Mode

Test Date: 2014/05/15

Fundamental Frequency: 433.92MHz

Test By: Dino

Temperature : 25 °C

Humidity : 65 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	93.05	37.43	-18.21	19.22	43.50	-24.28	Peak	VERTICAL
2	284.14	31.67	-11.52	20.15	46.00	-25.85	Peak	VERTICAL
3	614.91	26.99	-5.49	21.50	46.00	-24.50	Peak	VERTICAL
4	767.20	26.85	-2.80	24.05	46.00	-21.95	Peak	VERTICAL
5	867.84	43.49	-1.44	42.05	60.00	-17.95	Peak	VERTICAL
6	932.10	26.54	-0.21	26.33	46.00	-19.67	Peak	VERTICAL
1	134.76	31.11	-13.08	18.03	43.50	-25.47	Peak	HORIZONTAL
2	283.17	29.33	-11.54	17.79	46.00	-28.21	Peak	HORIZONTAL
3	454.86	42.01	-8.16	33.85	46.00	-12.15	Peak	HORIZONTAL
4	541.19	29.52	-7.05	22.47	46.00	-23.53	Peak	HORIZONTAL
5	772.05	26.88	-2.76	24.12	46.00	-21.88	Peak	HORIZONTAL
6	867.84	46.59	-1.44	45.15	60.00	-14.85	Peak	HORIZONTAL

Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz, VBW=300KHz.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode: Transmitting Mode

Test Date: 2014/05/15

Fundamental Frequency: 433.92MHz

Test By: Dino

Temperature : 25 °C

Humidity : 65 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	1301.76	38.58	-15.81	22.77	54.00	-31.23	Average	VERTICAL
2	1301.76	66.26	-15.81	50.45	74.00	-23.55	Peak	VERTICAL
3	1735.68	36.32	-13.75	22.57	60.00	-37.43	Average	VERTICAL
4	1735.68	64.32	-13.75	50.57	80.00	-29.43	Peak	VERTICAL
5	2169.60	35.87	-11.61	24.26	60.00	-35.74	Average	VERTICAL
6	2169.60	63.57	-11.61	51.96	80.00	-28.04	Peak	VERTICAL
7	2603.52	49.34	-10.44	38.90	80.00	-41.10	Peak	VERTICAL
8	3037.44	33.91	-8.95	24.96	60.00	-35.04	Average	VERTICAL
9	3037.44	61.61	-8.95	52.66	80.00	-27.34	Peak	VERTICAL
10	3471.36	30.93	-7.25	23.68	54.00	-30.32	Average	VERTICAL
11	3471.36	58.64	-7.25	51.39	74.00	-22.61	Peak	VERTICAL
12	3905.28	28.39	-5.36	23.03	54.00	-30.97	Average	VERTICAL
13	3905.28	56.09	-5.36	50.73	74.00	-23.27	Peak	VERTICAL
14	4339.20	51.15	-3.68	47.47	74.00	-26.53	Peak	VERTICAL

Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 "F" denotes fundamental frequency; "H" denotes harmonics frequency. "S" denotes spurious frequency.
- 4 Measurement of data within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode: Transmitting Mode

Test Date: 2014/05/15

Fundamental Frequency: 433.92MHz

Test By: Dino

Temperature : 25 °C

Humidity : 65 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	1301.76	40.29	-15.81	24.48	54.00	-29.52	Average	HORIZONTAL
2	1301.76	67.99	-15.81	52.18	74.00	-21.82	Peak	HORIZONTAL
3	1735.68	38.50	-13.75	24.75	60.00	-35.25	Average	HORIZONTAL
4	1735.68	66.20	-13.75	52.45	80.00	-27.55	Peak	HORIZONTAL
5	2169.60	39.61	-11.61	28.00	60.00	-32.00	Average	HORIZONTAL
6	2169.60	67.31	-11.61	55.70	80.00	-24.30	Peak	HORIZONTAL
7	2603.52	53.44	-10.44	43.00	80.00	-37.00	Peak	HORIZONTAL
8	3037.44	36.47	-8.95	27.52	60.00	-32.48	Average	HORIZONTAL
9	3037.44	64.17	-8.95	55.22	80.00	-24.78	Peak	HORIZONTAL
10	3471.36	57.70	-7.25	50.45	74.00	-23.55	Peak	HORIZONTAL
11	3905.28	55.89	-5.36	50.53	74.00	-23.47	Peak	HORIZONTAL
12	4339.20	49.02	-3.68	45.34	74.00	-28.66	Peak	HORIZONTAL

Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 “F” denotes fundamental frequency; “H” denotes harmonics frequency. “S” denotes spurious frequency.
- 4 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

7. 20DB OCCUPIED BANDWIDTH

7.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10KHz, Span =100KHz.
4. Set SPA Max hold. Mark peak, -20dB.

7.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Measurement.

7.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

7.4 Measurement Results

Refer to attached data chart.

The center frequency f_c is **433.92MHz**, according to the Rules, section 15.231(C), the Bandwidth of Center Frequency at-20dB should be calculated as following:

$$433.92 \times 0.0025 = 1.0848(\text{MHz})$$

So, the Uper/Lower frequencies limit should be specified as:

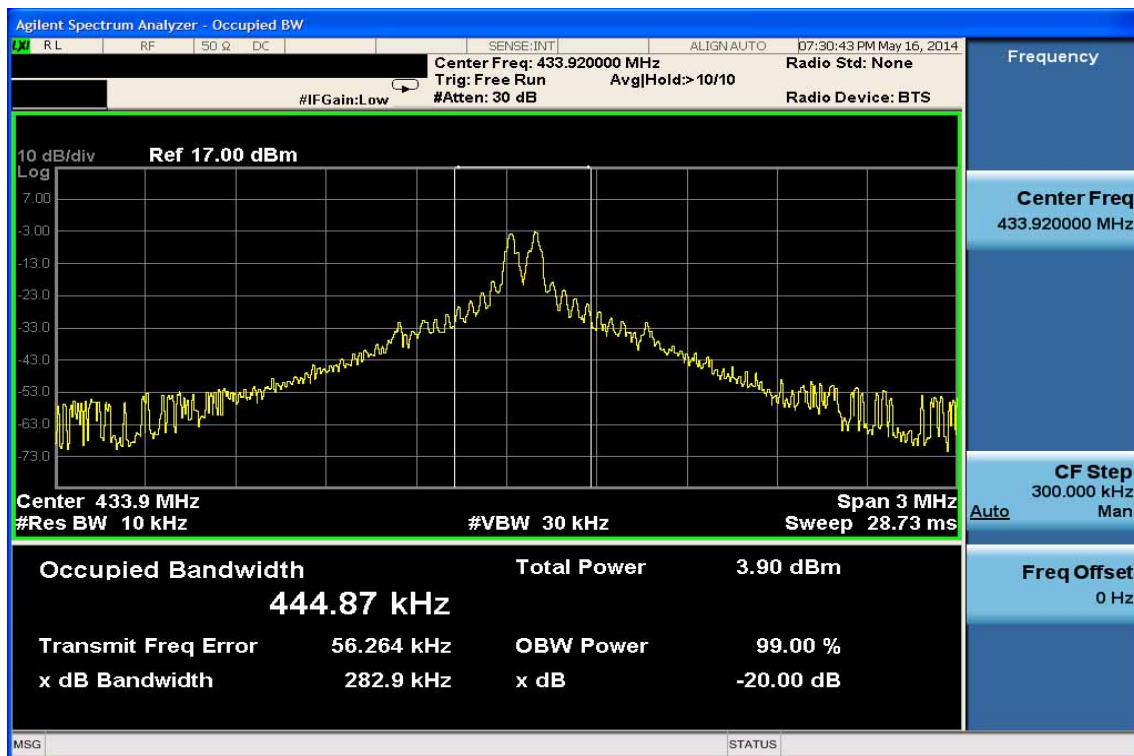
$$f_{(U)} = f_c + \Delta f/2 = 433.92 + 0.5424 = 434.46(\text{MHz})$$

$$f_{(L)} = f_c - \Delta f/2 = 433.92 - 0.5424 = 433.377 (\text{MHz})$$

Measurement Result:

-20dB bandwidth = 282.9kHz within allowed frequency range.

20dB Band Width Test Data



8. DUTY CYCLE MEASUREMENT

8.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 100KHz, Span =0 Hz. Adjacent sweep.
4. Set SPA View. Mark delta.

8.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Measurement.

8.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

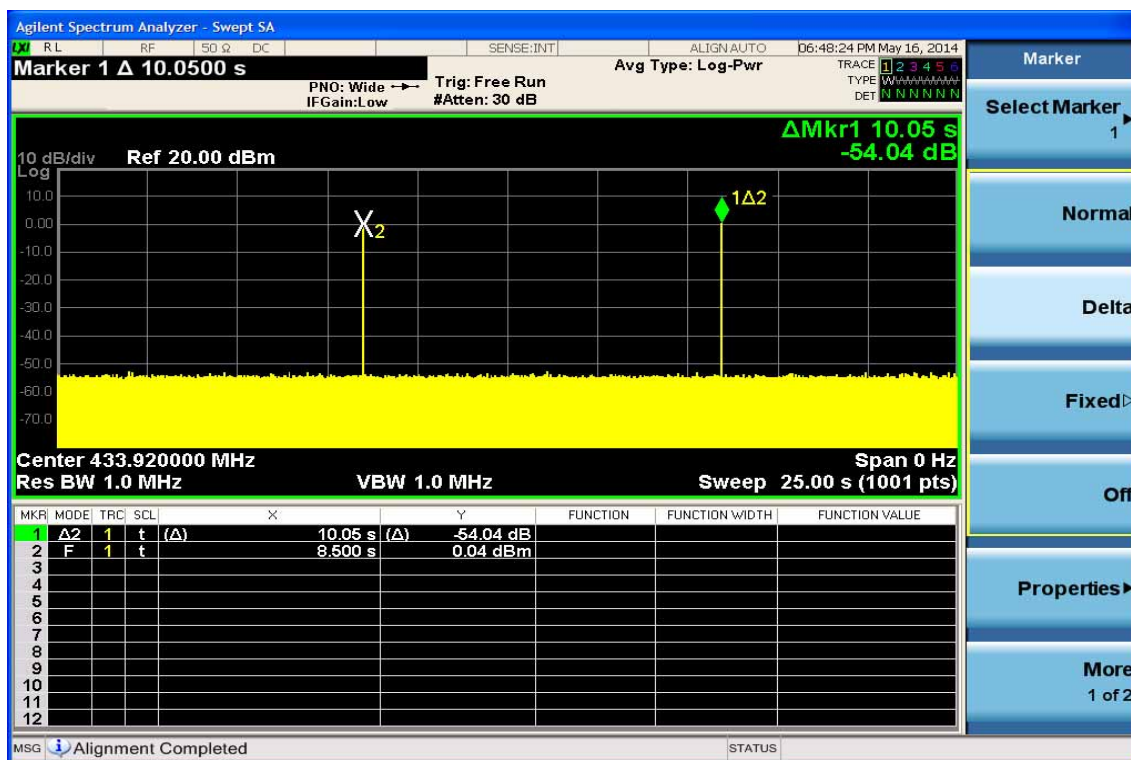
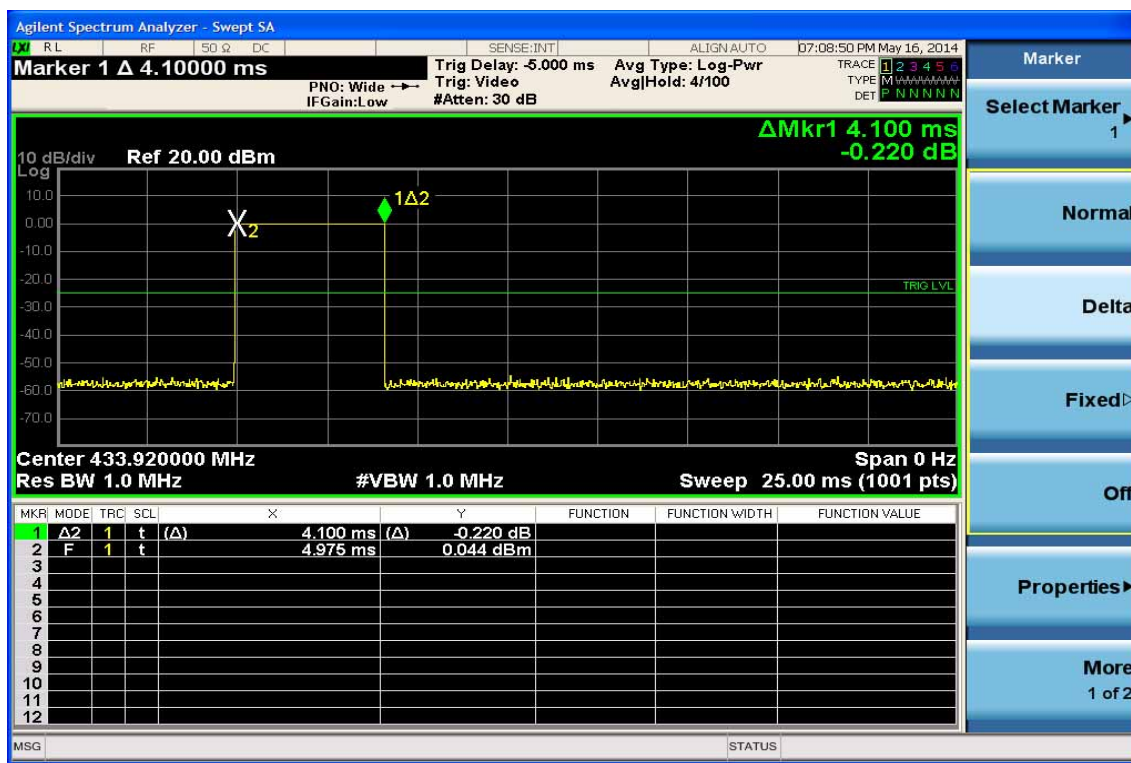
8.4 Measurement Results:

$T_{on} = 4.1(\text{ms})$

$T_p > 100(\text{ms})$,

Average Correction Factory = $20\log(T_{on}/T_p) = 20\log(4.1/100) = -27.7\text{ dB}$

Ton Measurement: $T_p > 100\text{ms}$



9. RELEASE TIME MEASUREMENT:

15.231 (a)(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

9.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 1MHz, Span =0Hz
3. Set EUT Power on as normal operation
4. Set SPA Max hold. Delta Mark.

9.2 Test SET-UP (Block Diagram of Configuration)

Same as 6.2 Radiated Emission Measurement.

9.3 Measurement Equipment Used:

Same as 6.3 Radiated Emission Measurement.

9.4 Measurement Results

Total transmission time of transmissions calculation:

1hr = 3600s

One transmission every 10s

$3600(s)/10(s) = 360$ times

Ton transmission time: 4.1ms

$360 * 4.1(ms) = 1.476(s)$, less than 2 s per hours, the result PASS.

