

TEST REPORT

of

FCC Part 15 Subpart C

New Application; Class I PC; Class II PC

Product : TPMS Sensor
Brand: KYMCO
Model: 39660-LGC6-E00
Model Difference: N/A
FCC ID: 2AMA5-LJ-39660
FCC Rule Part: §15.231 (e)
Applicant: LIHJOEN SPEED METER CO.,LTD.
Address: NO.17,Ziqi Rd.,Fengshan Dist., Kaohsiung City83081 Taiwan

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:

No. 120, Lane 180, Hsin Ho Rd.

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Report No.: ISL-17LR119FC

Issue Date : 2017/05/24

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: LIHJOEN SPEED METER CO.,LTD.

Product Description: TPMS Sensor

Brand Name: KYMCO

FCC ID: 2AMA5-LJ-39660

FCC Rule Part: §15.231 (e)

Model No.: 39660-LGC6-E00

Model Difference: N/A

Date of test: 2017/04/28 ~ 2017/5/23

Date of EUT Received: 2017/04/28

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:



Date:

2017/05/24

Dino Chen / Engineer

Prepared By:



Date:

2017/05/24

Gigi Yeh / Engineer

Approved By:



Date:

2017/05/24

Vincent Su / Technical Manager

Version

| Version No. | Date | Description |
|-------------|------------|------------------------------|
| 00 | 2017/05/24 | Initial creation of document |
| | | |

Uncertainty of Measurement

| Description Of Test | Uncertainty |
|---------------------------------------|--|
| Conducted Emission (AC power line) | 2.586 dB |
| Field Strength of Spurious Radiation | <=30MHz: 2.96dB 30-1GHz: 4.22 dB 1-40 GHz: 4.08 dB |
| Conducted Power | 2.412 GHz: 1.30 dB 5.805 GHz: 1.55 dB |
| Power Density | 2.412 GHz: 1.30 dB 5.805 GHz: 1.67 dB |
| Frequency | 0.0032% |
| Time | 0.01% |
| DC Voltage | 1% |

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1. GENERAL INFORMATION

1.1 Product Description

| | |
|------------------|---------------------|
| Product Name | TPMS Sensor |
| Brand Name | KYMCO |
| Model Name | 39660-LGC6-E00 |
| Model Difference | N/A |
| Power Supply | 3Vdc by Battery |
| Device type | safety applications |

TX:

| | |
|----------------------------|--|
| Operating Frequency | 433.92 MHz |
| Transmit Power | 64.63dBuV/m at 3m |
| Modulation Technique | FSK |
| Number of Channels | 1 |
| Periodic Transmission Time | Transmission period : every 32.00s, Ton: 4.400s |
| Antenna Type | Fixed Antenna type |

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **2AMA5-LJ-39660** filing to comply with Section 15.231 (e) of the FCC Part 15, Subpart C.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in C63.10: 2013 and RSS-Gen Issue 4: 2014. 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, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.10: 2013. FCC Registration Number is: 872200; Designation 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 placed on a turn table which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10: 2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR 16-1-1 Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m/1.5m(Frequency above 1GHz) 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 according to the requirements in Section 6 and 11 of ANSI C63.10: 2013.

2.4 Limitation

(1) Conducted Emission

According to section RSS-Gen §8.8 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 (e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

| Fundamental frequency (MHz) | Field strength of fundamental (microvolts/meter) | Field strength of spurious emission (microvolts/meter) |
|-----------------------------|--|--|
| 40.66-40.70 | 1,000 | 100 |
| 70-130 | 500 | 50 |
| 130-174 | 500 to 1,500 ¹ | 50 to 150 ¹ |
| 174-260 | 1,500 | 150 |
| 260-470 | 1,500 to 5,000 ¹ | 150 to 500 ¹ |
| Above 470 | 5,000 | 500 |

¹Linear interpolations.

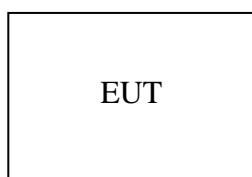
Remark: 1. Emission level in dBuV/m=20 log (uV/m)

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 ξ 15.205
4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of ξ 15.205, then the general radiated emission limits in ξ 15.209 apply.
5. For the band 130-174MHz, uV/m at 3meters = $22.72727 * F(\text{MHz}) - 2454.545$;
 For the band 260-470MHz uV/m at 3meters = $16.6667 * F(\text{MHz}) - 2833.333$;
 Where F is the frequency in MHz.
6. $433.92\text{MHz AV limit} = 16.6667 * 433.92(\text{MHz}) - 2833.333 = 4398.68 \text{ uV/m}$
 $= 72.86 \text{dBuV/m}$
7. $433.92\text{MHz Peak limit} = \text{AV Limit} + 20\text{dB} = 92.86\text{MHz}$

2.5 Configuration of Tested System

Fig. 1 Configuration of Tested System

Tx



Rx



Table 2-1 Equipment Used in Tested System

| Item | Equipment | Mfr/Brand | Model/ Type No. | Series No. | Data Cable | Power Cord |
|------|--------------|-----------|--------------------|------------|------------|---------------|
| 1. | Power supply | MRL | TH-3205 | N/A | N/A | Non-shielding |

3. SUMMARY OF TEST RESULTS

| FCC /IC Rules | Description Of Test | Result |
|---------------|------------------------------------|-----------|
| §15.207 | Conducted Emission | N/A |
| §15.231(e) | Radiated Emission | Compliant |
| §15.231(c) | 20dB Bandwidth | Compliant |
| | Duty Cycle Test (Pulse Modulation) | N/A |
| §15.231(e) | transmission time, silent period | Compliant |
| §15.203 | Antenna Requirement | Compliant |

4. Description of test modes

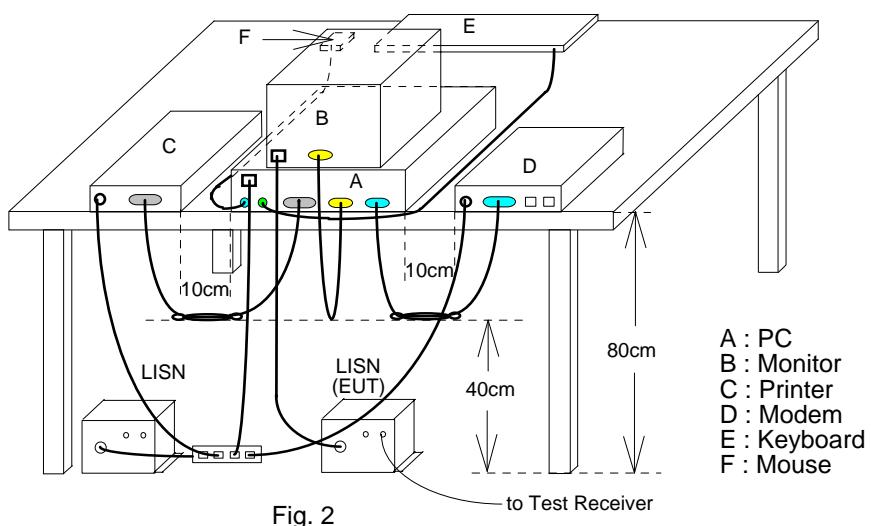
The EUT has been tested under engineering test mode condition and the EUT staying in continuous transmitting mode. The Frequency 433.92 MHz is chosen for testing.

5. AC CONDUCTED EMISSIONS TEST

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 04-3 Cable | WOKEN | CFD 300-NL | Conduction 04 -3 | 09/12/2016 | 09/11/2017 |
| EMI Receiver 16 | Rohde & Schwarz | ESCI | 101221 | 10/24/2016 | 10/23/2017 |
| LISN 18 | ROHDE & SCHWARZ | ENV216 | 101424 | 02/05/2017 | 02/04/2018 |
| LISN 19 | ROHDE & SCHWARZ | ENV216 | 101425 | 03/07/2017 | 03/06/2018 |
| Test Software | Farad | EZEMC Ver:ISL-03A2 | N/A | N/A | N/A |

5.4 Measurement Result:

N/A

6. RADIATED EMISSION TEST

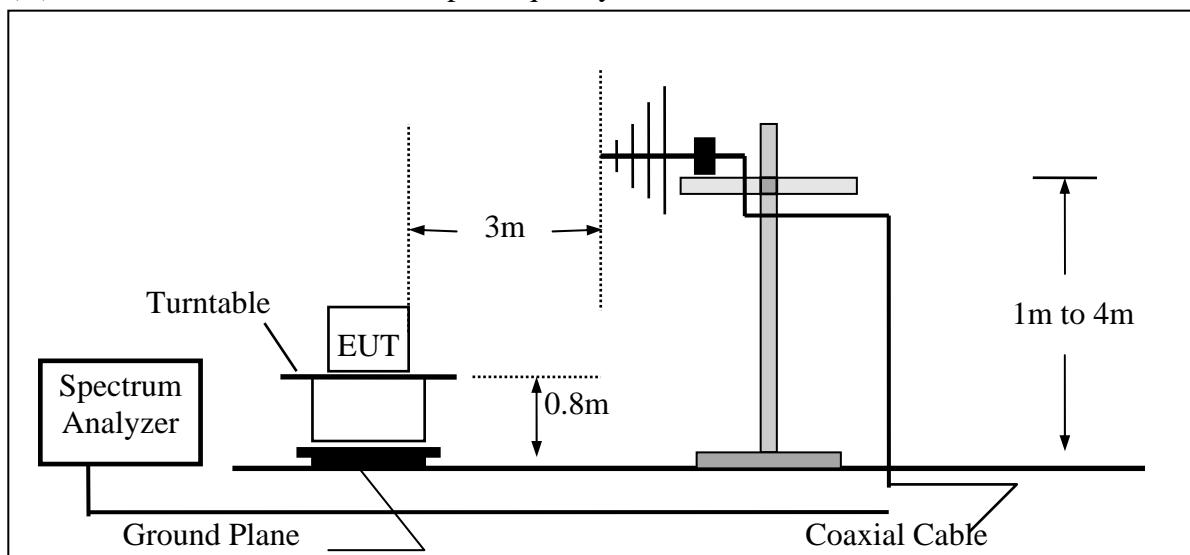
15.231 (e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

6.1 Measurement Procedure

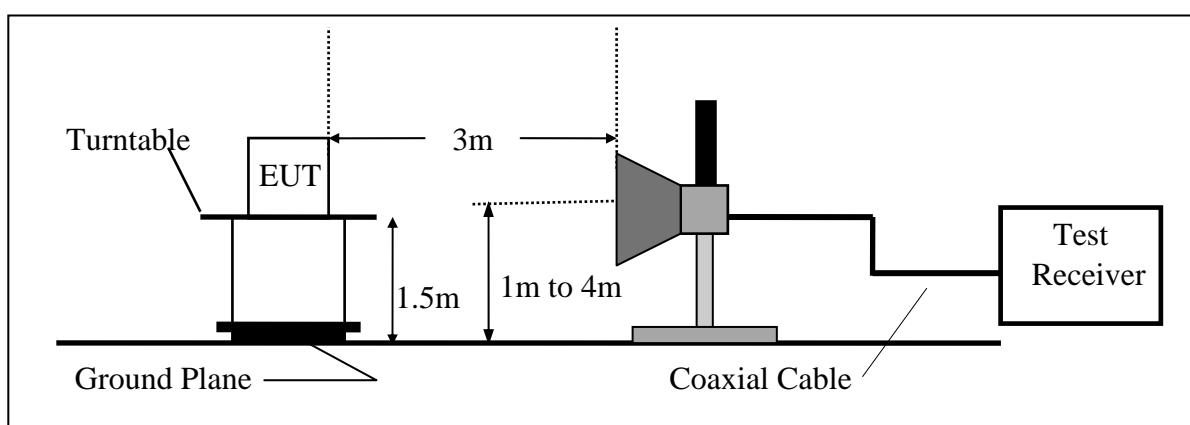
1. The EUT was placed on a turn table which is 0.8/1.5m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat 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:

| Chamber 19 | | | | | |
|---------------------------------|--------------|--------------------|-----------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Spectrum Analyzer 21(3Hz-44GHz) | Agilent | N9030A | MY51360021 | 11/14/2016 | 11/13/2017 |
| Loop Antenna (9K-30M) | A.H.SYSTEM | SAS-564 | 294 | 06/17/2015 | 06/16/2017 |
| Bilog Antenna (30M-1G) | SCHWARZBECK | VULB9168 w 5dB Att | 736 | 07/22/2016 | 07/21/2017 |
| Horn antenna (1G-18G) | SCHWARZBECK | 9120D | 9120D-1627 | 07/22/2016 | 07/21/2017 |
| Horn antenna (18G-26G) | Com-power | AH-826 | 081001 | 07/24/2015 | 07/23/2017 |
| Preamplifier (9k-1000M) | HP | 8447F | 3113A06362 | 11/13/2016 | 11/12/2017 |
| Preamplifier(1G-26G) | Agilent | 8449B | 3008A02471 | 08/25/2016 | 08/24/2017 |
| Preamplifier (26G-40G) | MITEQ | JS4-26004000-27-5A | 818471 | 07/23/2015 | 07/22/2017 |
| RF Cable (9k-18G) | HUBER SUHNER | SUCOFLEX 104A | MY1397/4A | 08/25/2016 | 08/24/2017 |
| RF cable (18G~40G) | HUBER SUHNER | Sucoflex 102 | 27963/2&37421/2 | 11/03/2015 | 11/02/2017 |

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: | 2017/05/18 |
| Fundamental Frequency: | 433.92MHz | Test By: | Dino |
| Temp: | 25 | Hum.: | 60% |

| Freq MHz | Reading dBuV | Factor dB | Level dBuV/m | Limit dBuV/m | Over Limit dB | Remark | Pol V/H |
|-------------|-----------------|--------------|-----------------|-----------------|---------------------|--------|------------|
| 433.88 | 65.37 | -1.68 | 63.69 | 92.86 | -29.17 | Peak | VERTICAL |
| | | | | | | | |
| 433.88 | 66.31 | -1.68 | 64.63 | 92.86 | -28.23 | 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: 2017/05/18

Fundamental Frequency: 433.92MHz Test By: Dino

Temperature : 25 Humidity : 60 %

| No | Freq MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Over Limit dB | Remark | Pol V/H |
|----|----------|--------------|-------------|--------------|--------------|---------------|--------|------------|
| 1 | 48.43 | 26.50 | -5.17 | 21.33 | 40.00 | -18.67 | Peak | VERTICAL |
| 2 | 155.13 | 26.43 | -4.91 | 21.52 | 43.50 | -21.98 | Peak | VERTICAL |
| 3 | 365.62 | 27.64 | -2.91 | 24.73 | 46.00 | -21.27 | Peak | VERTICAL |
| 4 | 513.06 | 35.95 | -0.36 | 35.59 | 46.00 | -10.41 | Peak | VERTICAL |
| 5 | 709.00 | 29.19 | 2.80 | 31.99 | 46.00 | -14.01 | Peak | VERTICAL |
| 6 | 867.84 | 26.01 | 5.38 | 31.39 | 52.86 | -21.47 | Peak | VERTICAL |
| | | | | | | | | |
| 1 | 50.37 | 26.42 | -5.20 | 21.22 | 40.00 | -18.78 | Peak | HORIZONTAL |
| 2 | 163.86 | 26.58 | -4.91 | 21.67 | 43.50 | -21.83 | Peak | HORIZONTAL |
| 3 | 516.94 | 33.46 | -0.23 | 33.23 | 46.00 | -12.77 | Peak | HORIZONTAL |
| 4 | 637.22 | 27.62 | 1.88 | 29.50 | 46.00 | -16.50 | Peak | HORIZONTAL |
| 5 | 709.00 | 30.89 | 2.80 | 33.69 | 46.00 | -12.31 | Peak | HORIZONTAL |
| 6 | 867.84 | 26.50 | 5.38 | 31.88 | 52.86 | -20.98 | 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: 2017/05/18
 Fundamental Frequency: 433.92MHz Test By: Dino
 Temperature : 25 Humidity : 60 %

| No | Freq MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Over Limit dB | Remark | Pol V/H |
|----|----------|--------------|-------------|--------------|--------------|---------------|---------|------------|
| 1 | 1301.76 | 45.69 | -7.79 | 37.90 | 74.00 | -36.10 | Peak | VERTICAL |
| 2 | 1735.68 | 55.68 | -6.95 | 48.73 | 74.00 | -25.27 | Peak | VERTICAL |
| 3 | 2169.60 | 43.66 | -3.42 | 40.24 | 74.00 | -33.76 | Peak | VERTICAL |
| 4 | 2603.52 | 44.17 | -2.82 | 41.35 | 74.00 | -32.65 | Peak | VERTICAL |
| 5 | 3037.44 | 42.87 | -1.82 | 41.05 | 74.00 | -32.95 | Peak | VERTICAL |
| 6 | 3471.36 | 43.77 | -1.17 | 42.60 | 74.00 | -31.40 | Peak | VERTICAL |
| | | | | | | | | |
| 1 | 1301.76 | 49.58 | -7.79 | 41.79 | 74.00 | -32.21 | Peak | HORIZONTAL |
| 2 | 1735.68 | 46.39 | -6.95 | 39.44 | 54.00 | -14.56 | Average | HORIZONTAL |
| 3 | 1735.68 | 62.04 | -6.95 | 55.09 | 74.00 | -18.91 | Peak | HORIZONTAL |
| 4 | 2169.60 | 45.29 | -3.42 | 41.87 | 74.00 | -32.13 | Peak | HORIZONTAL |
| 5 | 2603.52 | 44.40 | -2.82 | 41.58 | 74.00 | -32.42 | Peak | HORIZONTAL |
| 6 | 3037.44 | 43.83 | -1.82 | 42.01 | 74.00 | -31.99 | Peak | HORIZONTAL |
| 7 | 3471.36 | 48.65 | -1.17 | 47.48 | 74.00 | -26.52 | Peak | HORIZONTAL |
| 8 | 3905.28 | 42.99 | 0.38 | 43.37 | 74.00 | -30.63 | Peak | HORIZONTAL |
| 9 | 4339.20 | 43.11 | 1.71 | 44.82 | 74.00 | -29.18 | 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= 10KHz, VBW= 30KHz, Span =3MHz.
4. Set SPA Max hold. Mark peak, -20dB. 99% Bandwidth

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:

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

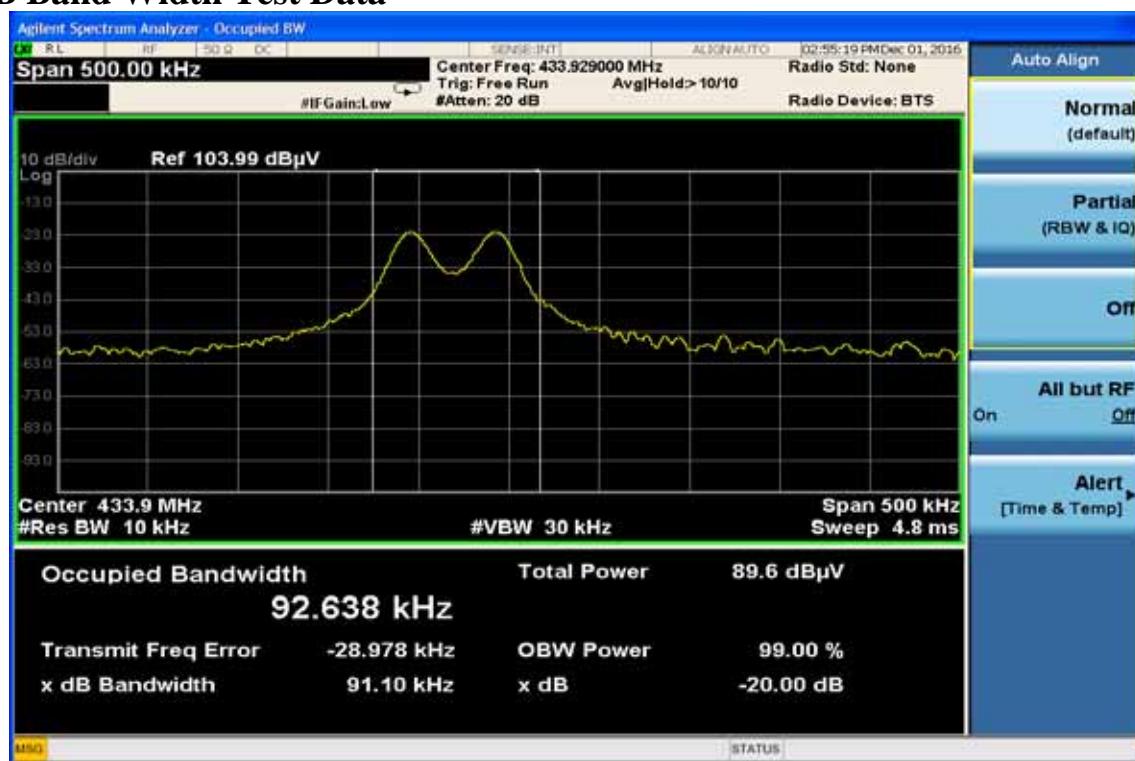
So, the Uper/Lower frequencies limit should be specified as:

$$\begin{aligned}f_{(U)} &= f_c + \Delta f/2 = 433.92 + 0.5424 = 434.46(\text{MHz}) \\f_{(L)} &= f_c - \Delta f/2 = 433.92 - 0.5424 = 433.377 (\text{MHz})\end{aligned}$$

7.5 Measurement Result:

91.1 KHz < limit 1.0848MHz

20dB Band Width Test Data



8. DUTY CYCLE (AVERAGE CORRECTION FACTOR) 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= 1.0MHz, 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: N/A

Duty cycle correction factor is not used for average value.

9. SILENT PERIOD TIME MEASUREMENT:

15.231 (e)

devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

RSS 210 A1.1.5

(2) In addition, devices operated under the provisions of this section (A1.1.5) shall be capable of automatically limiting their operation so that the duration of each transmission shall not be greater than 1 second and the silent period between transmissions shall be at least 30 times the duration of the transmission, but in no case less than 10 seconds. However, devices that are designed for limited

use for the purpose of initial programming, reprogramming or installation, and not for regular operations, may operate up to 5 seconds provided that such devices are used only occasionally in connection with each unit being programmed or installed.

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:

Ton: 16.5 ms, < 1s

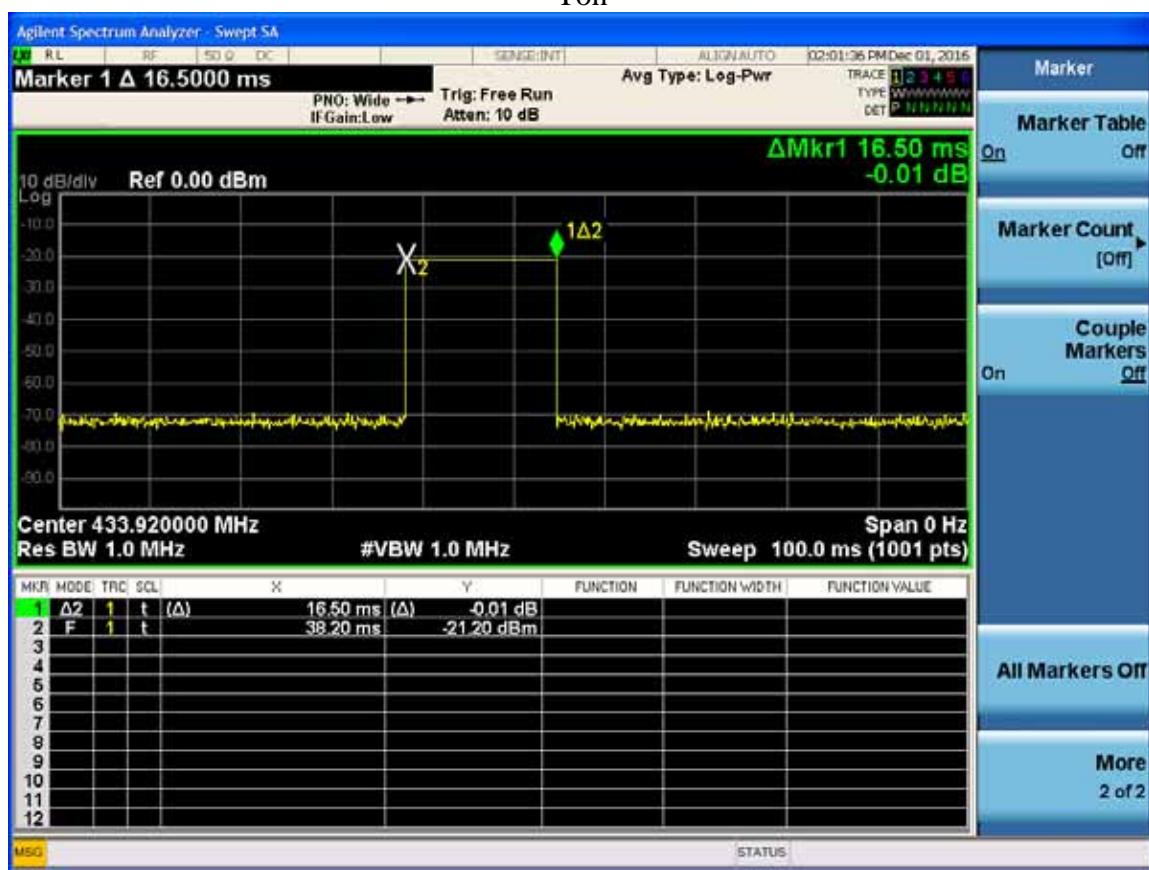
Tp: 32s

silent period limit: 10s or 16.5ms *30 = 10s

T silent period = 32.0s - 16.5ms = 32s > 10s

The result : PASS.

Ton



Tp

