

FCC PART 15.231  
EMI MEASUREMENT AND TEST REPORT

For  
NINGBO DOOYA MECHANIC & ELECTRONIC TECHNOLOGY CO., LTD.  
LOUTOU INDUSTRIAL AREA, ZHENHAI NINGBO, ZHEJIANG, China

**FCC ID: VYY-DC1600**

July 1, 2014

|  |  |
|--|--|
| This Report Concerns:<br>Original Report | Equipment Type:<br>control system  |
| Test Engineer:                           | Lisa Chen <i>Lisa Chen</i>   |
| Report No.:                              | BSL14060579Y-1ER-4   |
| Receive EUT<br>Date/Test Date:           | June 28, 2014 / June 29,2014 - July 1, 2014  |
| Reviewed By:                             | Sky Zhang <i>Sky Zhang</i>   |
| Prepared By:                             | <b>BSL Testing Co.,LTD.</b><br>NO. 24, ZH Park, Nantou, Shenzhen, 518000 China<br>Tel: 86- 755-26508703<br>Fax: 86- 755-26508703 |

**Note:** The test report is specially limited to the above company and this particular sample only.  
It may not be duplicated without prior written consent of BSL Testing Co.,LTD.  
This report must not be used by the client to claim product certification,approval,or  
endorsement by NVLAP, NIST or any agency of the US Government.

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## 1. GENERAL INFORMATION

### 1.1. Report information

- 1.1.1. This report is not a certificate of quality; it only applies to the sample of the specific product/equipment given at the time of its testing. The results are not used to indicate or imply that they are application to the similar items. In addition, such results must not be used to indicate or imply that BSL approves recommends or endorses the manufacture, supplier or use of such product/equipment, or that BSL in any way guarantees the later performance of the product/equipment.
- 1.1.2. The sample/s mentioned in this report is/are supplied by Applicant, BSL therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture or any information supplied.
- 1.1.3. Additional copies of the report are available to the Applicant at an additional fee. No third part can obtain a copy of this report through BSL, unless the applicant has authorized BSL in writing to do so.

#### Test Facility -

The test site used to collect the radiated data is located on the address of BSL Testing Co.,LTD.

(FCC Registered Test Site Number: 191509) on

NO. 24, ZH Park, Nantou, Shenzhen, 518000 China

The Test Site is constructed and calibrated to meet the FCC requirements.

### 1.2. Measurement Uncertainty

The reported uncertainty of measurement  $y \pm U$ , where expanded uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95 %.

| No. | Item                          | Uncertainty |
|-----|-------------------------------|-------------|
| 1   | Conducted Emission Test       | +/-1.25dB   |
| 2   | RF Power, Conducted           | +/-0.20dB   |
| 3   | Spurious emissions, conducted | +/-0.33dB   |
| 4   | All emissions, radiated (<1G) | +/-3.47dB   |
| 5   | All emissions, radiated (>1G) | +/-3.82dB   |
| 6   | Temperature                   | +/-0.5°CdB  |
| 7   | Humidity                      | +/-2%       |

## 2. PRODUCT DESCRIPTION

### 2.1. EUT Description

|                    |  |
|--------------------|--|
| Description        | : control system   |
| Applicant          | : NINGBO DOOYA MECHANIC & ELECTRONIC TECHNOLOGY CO., LTD.<br>LOUTOU INDUSTRIAL AREA, ZHENHAI NINGBO, ZHEJIANG, China |
| Manufacturer       | : NINGBO DOOYA MECHANIC & ELECTRONIC TECHNOLOGY CO., LTD.<br>LOUTOU INDUSTRIAL AREA, ZHENHAI NINGBO, ZHEJIANG, China |
| Model Number       | : DC1600, 1600A, DC1660, DC1667, DC1668, DC1668A, DC166C, DC2700, DC2760, DC1668D, DC1668E                           |
| Frequency          | : 433.79MHz  |
| Number of Channels | : 1 Channel  |
| Power Supply       | : DC 3V battery<br>(The new battery is used during the measurement)  |

The series products, model name: DC1600, 1600A, DC1660, DC1667, DC1668, DC1668A, DC166C, DC2700, DC2760, DC1668D, DC1668E have the same circuit diagram, PCB layout, software, RF Module, Features and functionality. The differences are the model name, so, we select DC1600 to test.

## 2.2. Block Diagram of EUT Configuration



## 2.3. Support Equipment List

| Name | Model No | S/N | Manufacturer | Used (Y/N) |
|------|----------|-----|--------------|------------|
|      |          |     |              |            |
|      |          |     |              |            |
|      |          |     |              |            |

## 2.4. Test Conditions

| Items                      | Required (IEC 68-1) | Actual   |
|----------------------------|---------------------|----------|
| Temperature (°C)           | 15-35               | 20-25    |
| Humidity (%RH)             | 25-75               | 50-63    |
| Barometric pressure (mbar) | 860-1060            | 950-1000 |

### 3. TEST RESULTS SUMMARY

| Standard Section | Test Item                  | Judgment |
|------------------|----------------------------|----------|
| 15.207           | Conducted Emission         | N/A      |
| 15.203           | Antenna Requirement        | Pass     |
| 15.231b          | Radiated Spurious Emission | Pass     |
| 15.231c          | Occupied Bandwidth         | Pass     |
| 15.231a          | Deactivation Testing       | Pass     |

Remark: "N/A" means "Not applicable".

Statement: All testing was performed using the test procedures found in ANSI C63.4-2003.

#### **Modifications**

No modification was made.

#### 4. TEST EQUIPMENT USED

| EQUIPMENT/FACILITIES          | MANUFACTURER     | MODEL                | SERIAL NO. | DATE OF CAL. | CAL. INTERVAL |
|-------------------------------|------------------|----------------------|------------|--------------|---------------|
| 3m Semi-Anechoic Chamber      | Chengyu Electron | 9 (L)*6 (W)* 6 (H)   | BSL086     | Aug. 23 2013 | 1 Year        |
| EMI Test Receiver             | Rohde & Schwarz  | ESCI3                | BSL001     | Sep. 27 2013 | 1 Year        |
| BiConiLog Antenna             | Rohde & Schwarz  | HL562                | BSL009     | Sep. 27 2013 | 1 Year        |
| Double -ridged waveguide horn | Rohde & Schwarz  | 9120D                | BSL008     | Aug. 27 2013 | 1 Year        |
| Horn Antenna                  | ETS-LINDGREN     | 3160                 | BSL072     | Dec. 27 2013 | 1 Year        |
| Cable                         | Rohde & Schwarz  | N/A                  | BSL045     | Aug. 27 2013 | 1 Year        |
| Cable                         | Rohde & Schwarz  | N/A                  | BSL046     | Aug. 27 2013 | 1 Year        |
| Cable                         | Rohde & Schwarz  | N/A                  | BSL047     | Aug. 27 2013 | 1 Year        |
| Amplifier(100kHz-40G Hz)      | R&S              | SMR40                | BSL007     | Sep. 27 2013 | 1 Year        |
| Band filter                   | Amindeon         | 82346                | BSL049     | Aug. 27 2013 | 1 Year        |
| Active Loop Antenna           | EMTES            | EM15                 | BSL011     | Sep. 27 2013 | 1 Year        |
| Coaxial Switch                | YUANFANG         | TA218B               | BSL004     | Aug. 27 2013 | 1 Year        |
| Spectrum analyzer             | Rohde & Schwarz  | FSP40                | BSL049     | Sep. 27 2013 | 1 Year        |
| Shielding Room                | zhongyu Electron | 7.0(L)x3.0(W)x3.0(H) | BSL085     | Sep. 26 2013 | 1 Year        |
| EMI Test Receiver             | R&S              | ESPI                 | BSL002     | Sep. 27 2013 | 1 Year        |
| 10dB Pulse Limita             | R&S              | N/A                  | BSL003     | Sep. 27 2013 | 1 Year        |
| Coaxial Switch                | YUANFANG         | TA218B               | BSL004     | Aug. 27 2013 | 1 Year        |
| LISN                          | Rohde & Schwarz  | ESH3-Y5              | BSL005     | Sep. 27 2013 | 1 Year        |
| Coaxial Cable                 | YUANFANG         | N/A                  | BSL048     | Aug. 27 2013 | 1 Year        |
| EMI TEST SOFTWARE             | AUDIX            | E3                   | N/A        | N/A          | N/A           |

## **5. ANTENNA REQUIREMENT**

### **5.1. Standard Applicable**

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

### **5.2. Antenna Connected Construction**

According to § 15.203, An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The antenna used in this product is PCB antenna. The antenna is permanently attached. Refer to the product photo.

### **5.3. Result**

Compliance



## 6. CONDUCTED POWER LINE TEST

### 6.1. Test Equipment

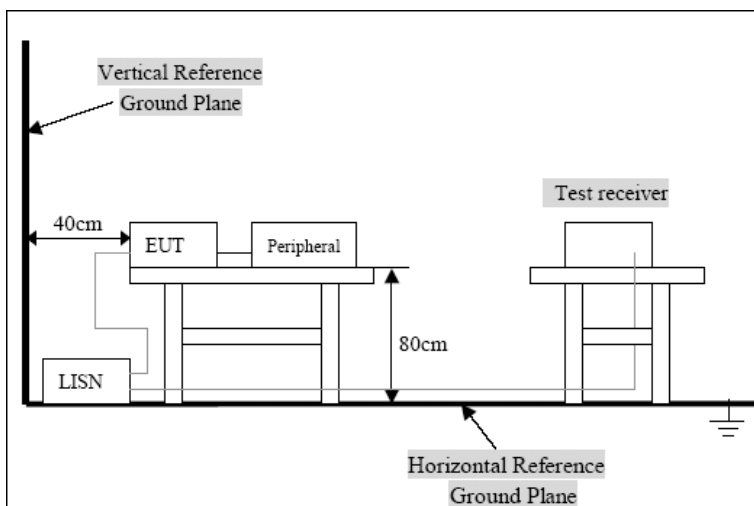
Please refer to section 4 this report.

### 6.2. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/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 of A.C. 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 ASIN C63.4:2003 on conducted measurement. Conducted emissions were measured over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

### 6.3. Test Setup



For the actual test configuration, please refer to the related items-Photos of testing

### 6.4. Conducted Power line Emission Limits

| FCC Part 15 Paragraph 15.207 (dBuV) |               |               |
|-------------------------------------|---------------|---------------|
| Frequency Range (MHZ)               | Class A QP/AV | Class B QP/AV |
| 0.15-0.5                            | 79/66         | 65-56/56-46   |
| 0.5-5.0                             | 73/60         | 56-46         |
| 5.0-3.0                             | 73/60         | 60-50         |

**Note:** In the above table, the tighter limit applies at the band edges.

## **6.5. Conducted Power Line Test Result**

Note: It is powered by the battery, conduction emission test is not applicable.

## 7. RADIATED EMISSION TEST

### 7.1. Test Equipment

Please refer to section 4 this report.

### 7.2. Test Procedure

The EUT and its simulators are placed on a turntable, which is 0.8 meter high above ground. The turntable can rotate 360 degrees to determine the position of the maximum emission level. EUT is set 3.0 meters away from the receiving antenna, which is mounted on an antenna tower. The antenna can be moved up and down between 1.0 meter and 4 meters to find out the maximum emission level.

Calibrated Loop antenna is used as receiving antenna for frequencies below 30MHz, Calibrated Bilog antenna is used as receiving antenna for frequencies between 30 MHz and 1 GHz, Calibrated Horn antenna is used as receiving antenna for frequencies above 1000MHz. Both horizontal and vertical polarizations of the antenna are set on measurement. In order to find the maximum emission levels, all of the interface cables must be manipulated according to ANSI C63.4: 2003 on radiated emission measurement.

The bandwidth of test receiver is set at 9kHz in below 30MHz. and set at 120kHz in 30-1000MHz, and 1MHz in above 1000MHz.

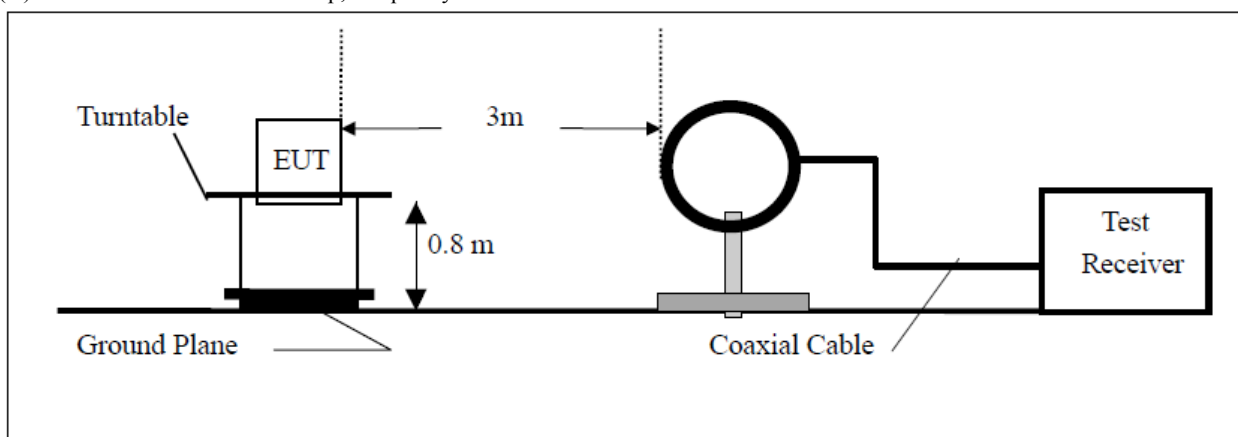
The frequency range from 9kHz to 25GHz is checked.

The final measurement in band 9-90kHz, 110-490kHz and above 1000MHz is performed with Peak detector and Average detector. Except those frequency bands mention above, the final measurement for frequencies below 1000MHz is performed with Quasi Peak detector.

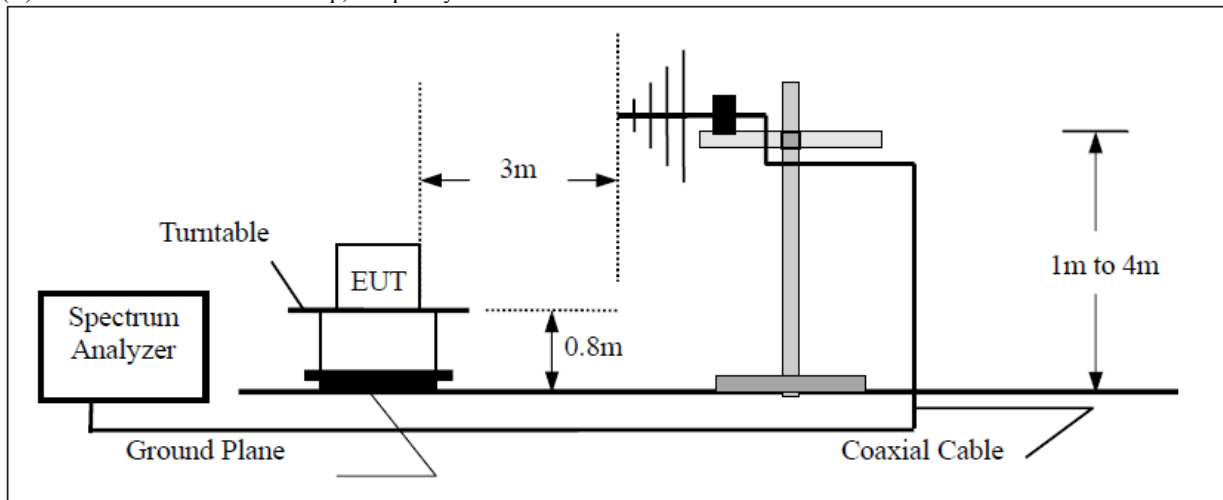
Through three orthogonal axes to determine which attitude and equipment arrangement produces the highest emission relative to the limit. And X direction is worst mode

### 7.3. Radiated Test Setup

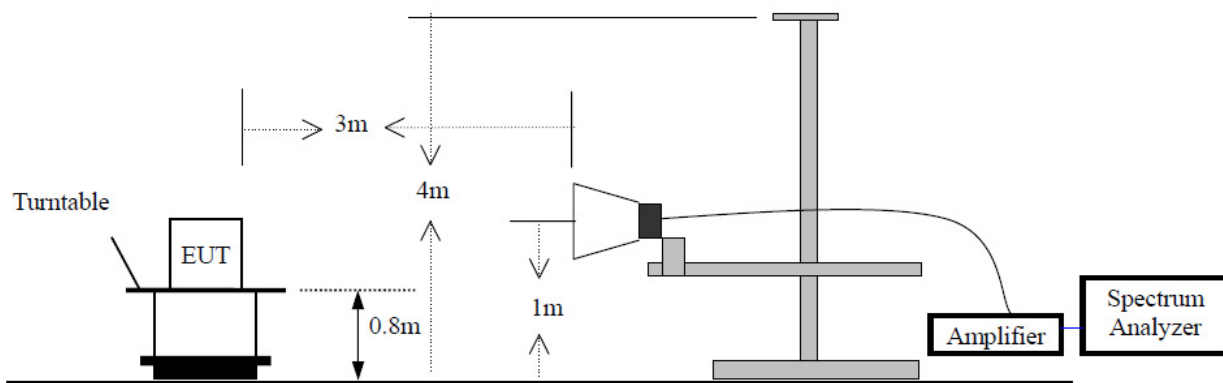
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



## 7.4. Radiated Emission Limit

All emission from a digital device, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strength specified below :

### A. Fundamental and Harmonics Radiated Emissions FCC 15.231 Limit

| Fundamental Frequency (MHz) | Field Strength of fundamental (microvolts/meter) | Field Strength of Unwanted Emissions (microvolts/meter) |
|-----------------------------|--|---|
| 40.66 - 40.70               | 2250.00  | 225.00  |
| 70 - 130                    | 1250.00  | 125.00  |
| 130 - 174                   | 1,250 to 3,750 **                                | 125 to 375 **   |
| 174 - 260                   | 3750.00  | 375.00  |
| 260 - 470                   | 3,750 to 12,500 **                               | 375 to 1,250 **   |
| Above 470                   | 12500.00   | 1250.00   |

Note:

- (1) RF Voltage (dBuV)=20 log Voltage(uV)
- (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.
- (3) The emission limit in this paragraph is based on measurement instrumentation employing an average detector. Measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

### B. Spurious Radiated Emissions.

| Frequency (MHz) | Limit   |   |                          | The final measurement in band 9-90kHz, 110-490kHz and above 1000MHz is performed with Average detector. Except those frequency bands mention above, the final measurement for frequencies below 1000MHz is performed with Quasi Peak detector. |
|-----------------|---|---|--------------------------|--|
|                 | Field Strength of Quasi-peak Value (microvolts/m) | Field Strength of Quasi-peak Value (dB $\mu$ V/m) | Measurement distance (m) |  |
| 0.009 - 0.490   | 2400/F(kHz)                                       | /   | 300                      |  |
| 0.490 - 1.705   | 24000/F(kHz)                                      | /   | 30                       |  |
| 1.705-30        | 30  | 29.5  | 30                       |  |
| 30 - 88         | 100   | 40  | 3                        |  |
| 88 - 216        | 150   | 43.5  | 3                        |  |
| 216 - 960       | 200   | 46  | 3                        |  |
| Above 960       | 500   | 54  | 3                        |  |

Note: (1) RF Voltage (dBuV)=20 log Voltage(uV)

- (2) In the Above Table, the tighter limit applies at the band edges.
- (3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

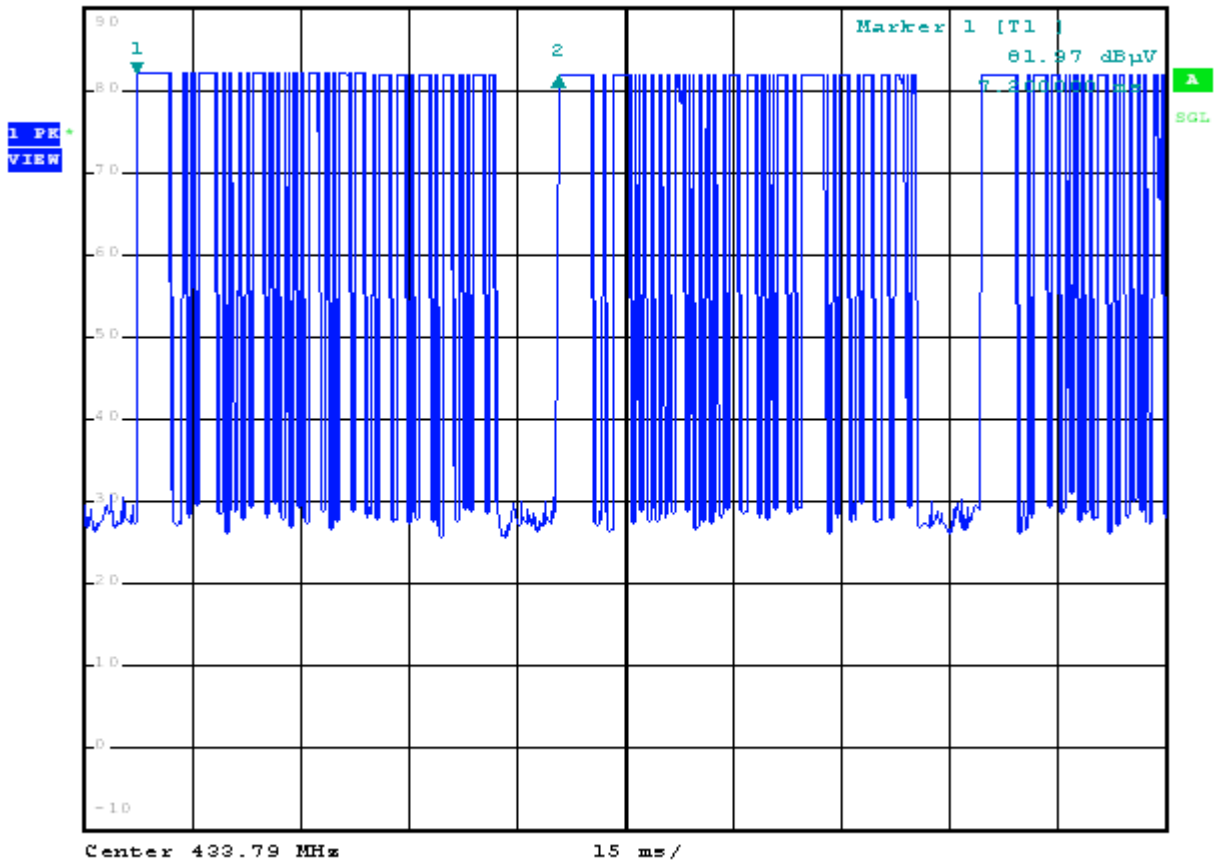
### 7.5. Radiated Emission Test Result

Pass

The period time



RBW 100 kHz Delta 2 [T1 ]  
VBW 300 kHz -0.12 dB  
Ref 90 dBμV Att 20 dB SWT 150 ms 58.500000 ms



Date: 30.JUN.2014 16:04:42

long signal and short signal time

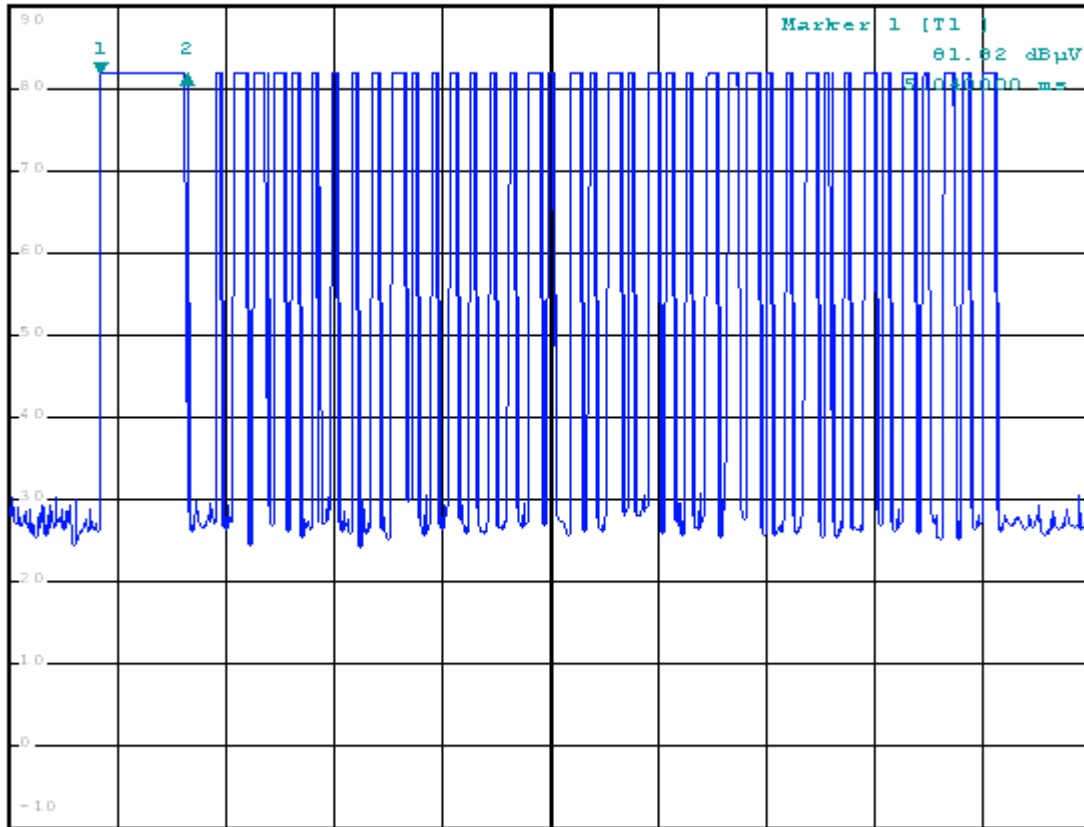


RBW 100 kHz Delta 2 [T1 ]  
VBW 300 kHz -0.04 dB  
SWT 60 ms 4.800000 ms

Ref 90 dBμV

Att 20 dB

1 PR+  
CLRWR



Center 433.79 MHz

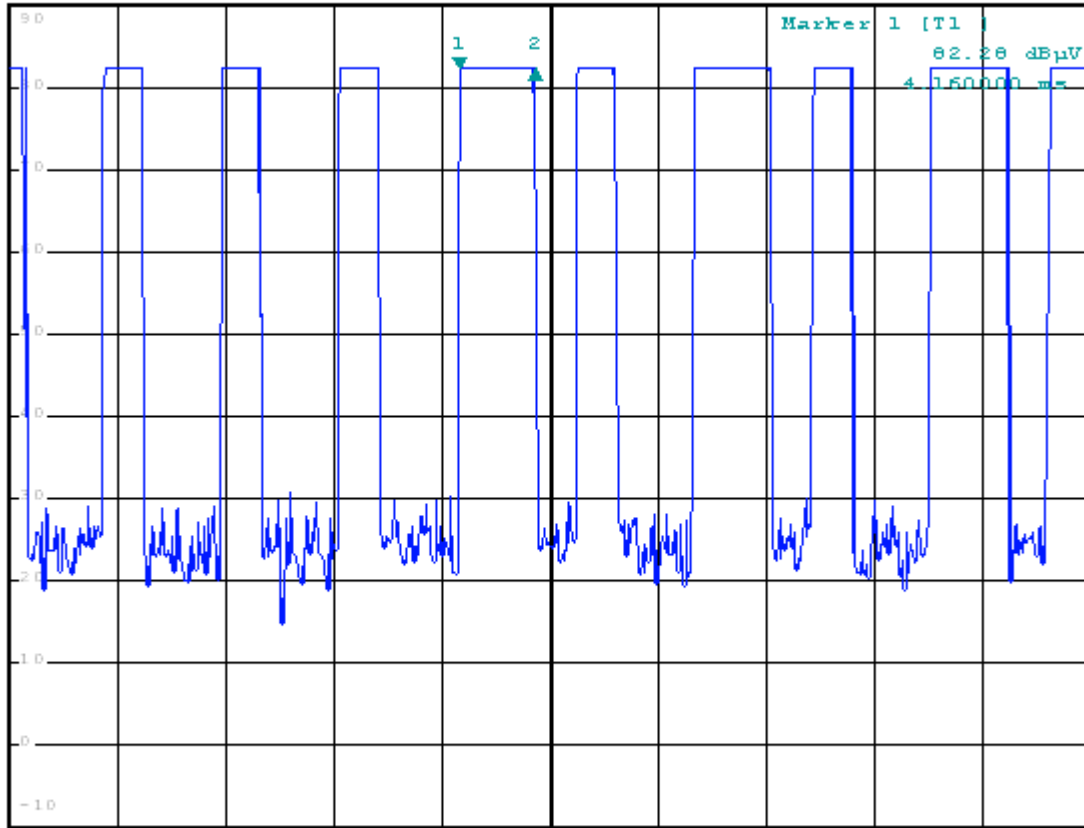
6 ms/

Date: 30 JUN 2014 16:07:14



REW 100 kHz Delta 2 [T1 ]  
VBW 300 kHz -0.00 dB  
Ref 90 dBμV Att 20 dB SWT 10 ms 700.000000 μs

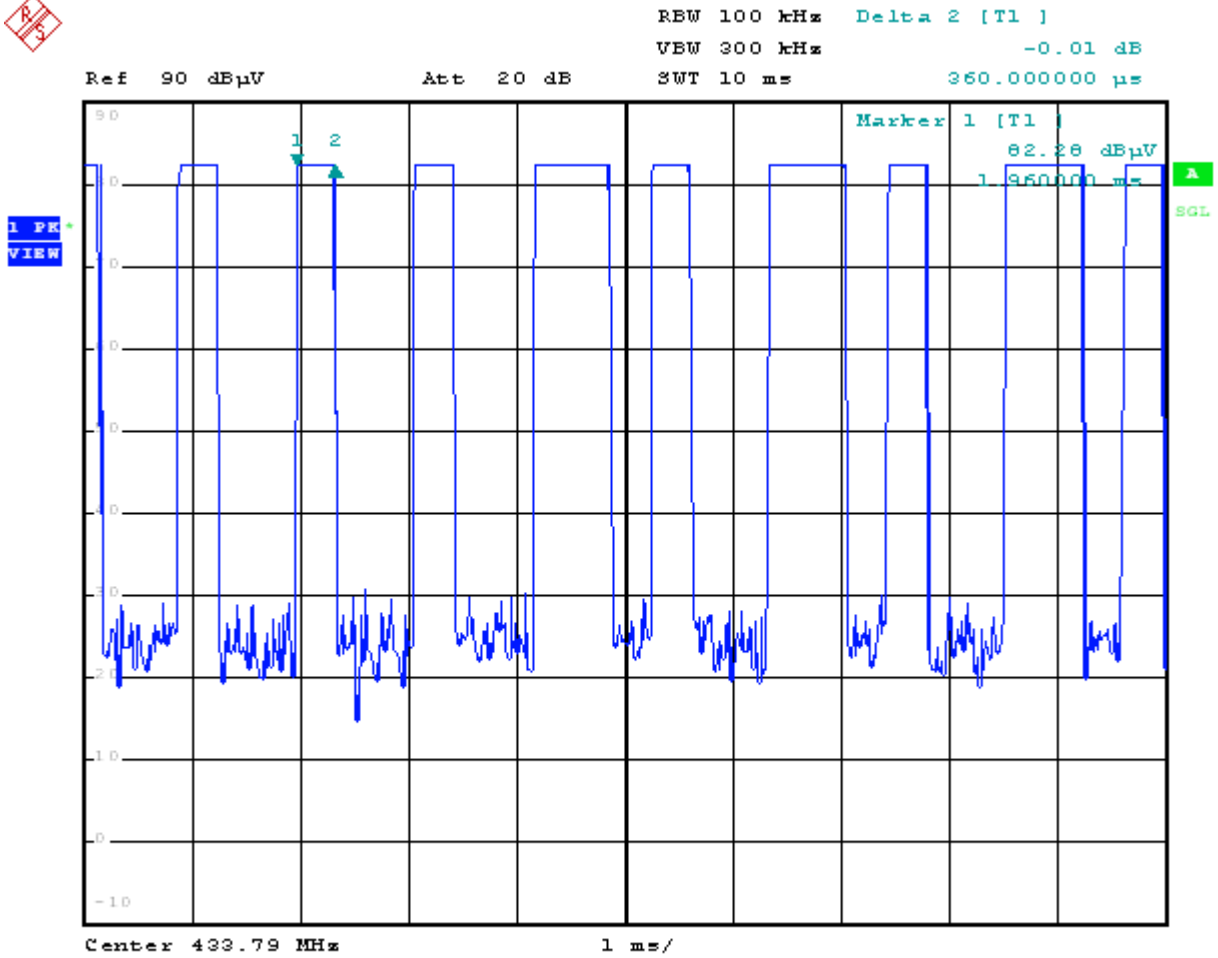
1 PK+  
VIEW



Center 433.79 MHz 1 ms/

Date: 30.JUN.2014 16:10:20





Date: 30. JUN. 2014 16:09:37

The period time = 58.5 ms

Ton1=4.8 ms

Ton2=0.7 ms

Ton3=0.36 ms

Ton of The period time = (4.8×1) + (0.7×16) + (0.36×24) ms=24.64 ms

The duty cycle = Ton / The period time =24.64ms/ 58.5ms= 0.42 ms

Therefore, the average factor is found by 20log (The duty cycle) =20log (0.42) = -7.54dB

## Radiated Emissions Data

Test Result:PASS

For below 9kHz-30MHz Spurious

| Freq.<br>(MHz) | Emission(dBuV/m)<br>PK / AV | HORIZ/<br>VERT | Limits(dBuV/m)<br>PK / AV | Margin<br>(dB) |
|----------------|-----------------------------|----------------|---------------------------|----------------|
| -              | -                           | HORIZ          | -                         | -              |
| -              | -                           | VERT           | -                         | -              |

Note:

1. Emissions attenuated more than 20 dB below the permissible value are not reported.

For 30M-5GHz Spurious

Corrected Factor = Antenna Factor + Cable Loss – Amplifier Gain

### HORIZONTAL

| Frequency | Average Factor | Field Strength | Field Strength | Limit (PK) | Limit(AV) | State |
|-----------|----------------|----------------|----------------|------------|-----------|-------|
| MHz       | dB             | dBuV/m         | dBuV/m<br>(AV) | dBuV/m     | dBuV/m    |       |
| 433.790   | -7.54          | 82.83(PK)      | 75.29          | 100.83(PK) | 80.83     | pass  |
| 867.580   | -7.54          | 60.72(PK)      | 53.18          | 80.83(PK)  | 60.83     | pass  |
| *1301.370 | -7.54          | 56.21(PK)      | 48.67          | 74.00(PK)  | 54.00     | pass  |
| 1735.160  | -7.54          | 59.17(PK)      | 51.63          | 80.83(PK)  | 60.83     | pass  |
| 2168.950  | -7.54          | 54.62(PK)      | 47.08          | 80.83(PK)  | 60.83     | pass  |
| --        | --             | --             | --             | 80.83(PK)  | 60.83     | pass  |

### VERTICAL

| Frequency | Average Factor | Field Strength | Field Strength | Limit(PK)  | Limit(AV) | State |
|-----------|----------------|----------------|----------------|------------|-----------|-------|
| MHz       | dB             | dBuV/m<br>(PK) | dBuV/m<br>(AV) | dBuV/m     | dBuV/m    |       |
| 433.790   | -7.54          | 79.62(PK)      | 72.08          | 100.83(PK) | 80.83     | pass  |
| 867.580   | -7.54          | 57.37(PK)      | 49.83          | 80.83(PK)  | 60.83     | pass  |
| *1301.370 | -7.54          | 53.85(PK)      | 46.31          | 74.00(PK)  | 54.00     | pass  |
| 1735.160  | -7.54          | 55.43(PK)      | 47.89          | 80.83(PK)  | 60.83     | pass  |
| 2168.950  | -7.54          | 52.21(PK)      | 44.67          | 80.83(PK)  | 60.83     | pass  |
| --        | --             | --             | --             | 80.83(PK)  | 60.83     | pass  |

### NOTE:

1. Emissions attenuated more than 20 dB below the permissible value are not reported.
2. Field Strength(AV) = Field Strength(PK)+Average Factor.
3. \*: Denotes restricted band of operation.

## **8. 20DB OCCUPIED BANDWIDTH**

### **8.1. Test Equipment**

Please refer to Section 5 this report.

### **8.2. Test Procedure**

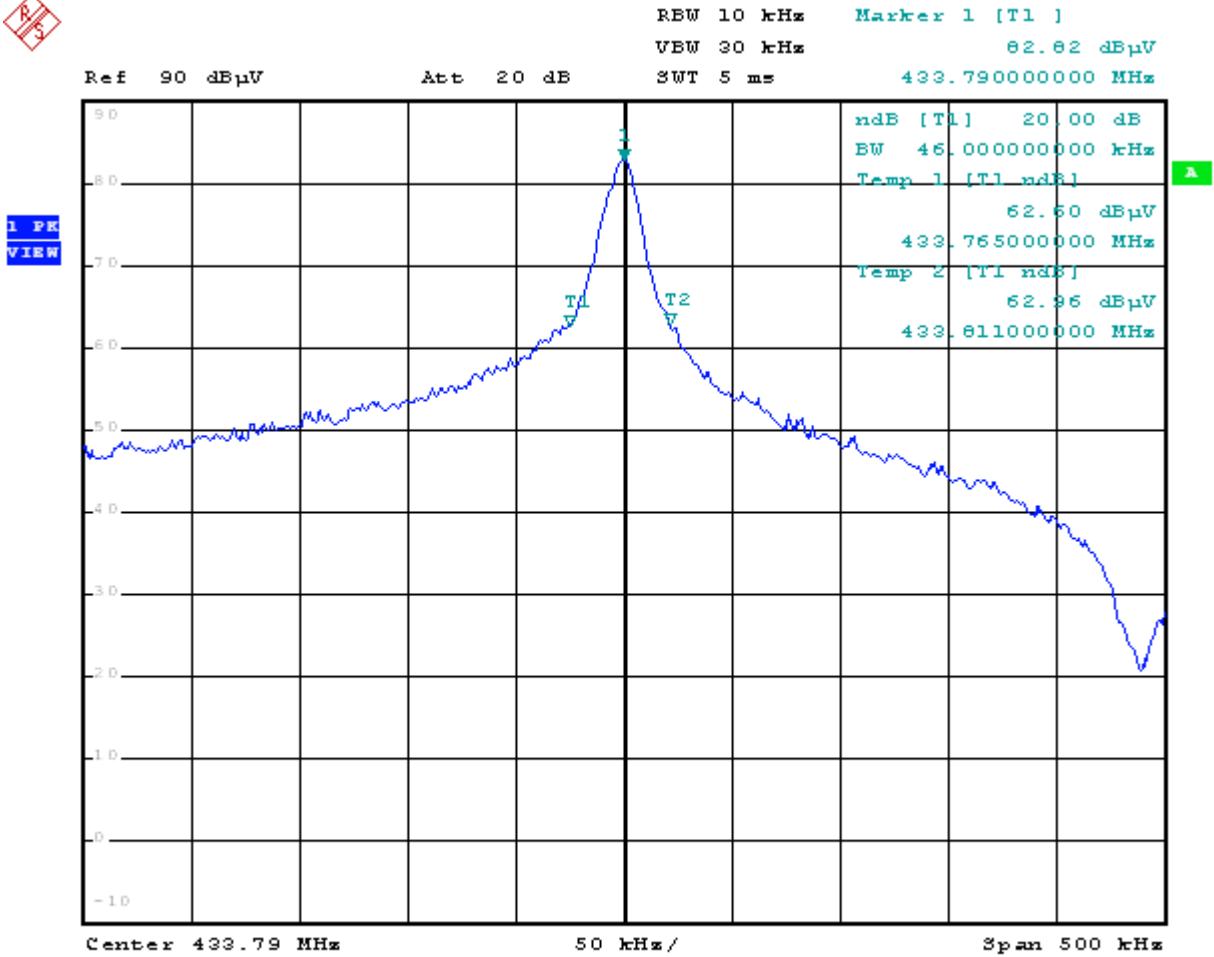
1. The EUT was tested according C63.4-2003. The radiated test was performed at FCC Registration laboratory.
2. With the EUT's antenna attached, the EUT's 20dB Bandwidth power was received by the test antenna which was connected to the spectrum analyzer with the START and STOP frequencies set to the EUT's operation band.

### **8.3. FCC 15.231(c) 20dB Bandwidth Limit**

Per 15.231( c ), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Therefore, the bandwidth of the emission limit is  $433.8\text{MHz} \times 0.25\% = 1.085\text{MHz}$ . Bandwidth is determined at the points 20 dB down from the modulated carrier.

### 8.4. Test Result

Temperature : 25°C Humidity: 55%RH  
 Limit = 433.8MHz\*0.25% = 1.085MHz  
 Test data: 46.0 kHz Test Result: PASS



Date: 30. JUN. 2014 17:59:07

## 9. DEACTIVATION TESTING

### 9.1. Test Equipment

Please refer to Section 5 this report.

### 9.2. Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Set center frequency=433.79MHz

Set SPAN=0Hz

Set RBW=100kHz

Set VBW=300kHz

Set SWEET TIME>5s

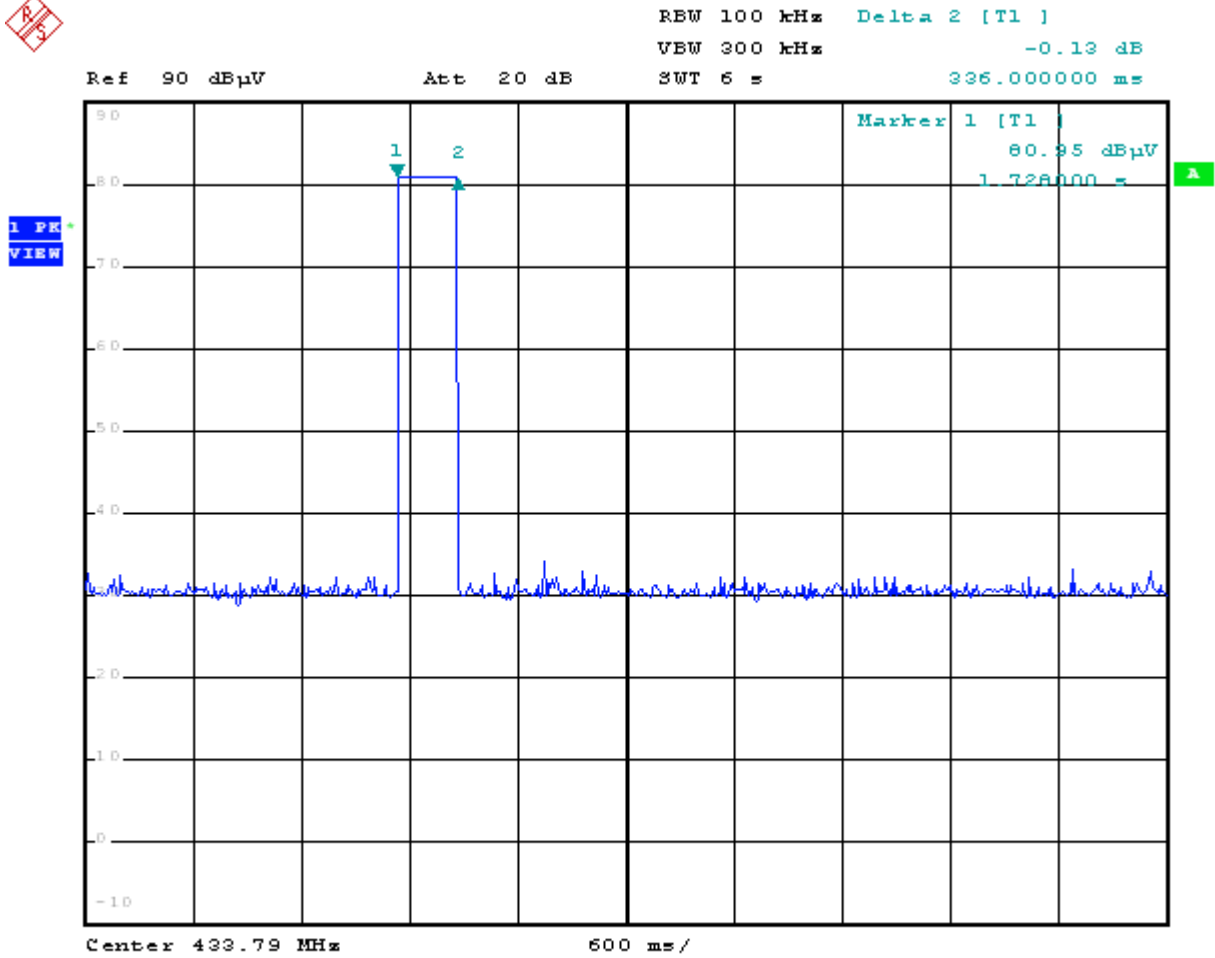
### 9.3. Deactivation Testing Requirement

Per 15.231(a) (1), a manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

**Note: The relevant Buttons of this EUT are already performed, and only the worst evaluated results are recorded in this report.**

### 9.4. Test Result

Temperature: 25°C Humidity: 55%RH  
 The transmitter transmitting time not more than 5 seconds  
 Test time: 0.336 s Test Result: PASS



Date: 30. JUN. 2014 10:30:22

**End Of The Report**