

# EMC TEST REPORT

**Report No.** : EME-071148  
**Model No.** : ST323C, ST323F  
**Issued Date** : Mar. 17, 2008

**Applicant:** Measure Technology Co., Ltd.  
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Hsien, Taiwan

**Test By:** Intertek Testing Services Taiwan Ltd.  
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**Summary of Tests**

**Wireless Temperature Monitor -Model: ST323C**  
**FCC ID: QLQST323**

| Test                   | Reference         | Results |
|------------------------|-------------------|---------|
| Radiated Emission test | 15.231(b), 15.209 | Pass    |
| Measured bandwidth     | 15.231(c)         | Pass    |



## 1. General information

### 1.1 Identification of the EUT

Manufacturer : Mesure Technology Co., Ltd.  
Product : Wireless Temperature Monitor  
Model No. : ST323C  
FCC ID. : QLQST323  
Frequency Range : 433.92MHz  
Channel Number : 1  
Frequency of each channel : 433.92MHz  
Type of Modulation : ASK  
Power Supply : DC 3V from battery  
Power Cord : N/A  
Sample Received : Mar. 03, 2008  
Test Date(s) : Mar. 03, 2008

A DoC report has been generated for the client.

### 1.2 Additional information about the EUT

The EUT is a Wireless Temperature Monitor , and was defined as information technology equipment.

According to the hardware aspect, the model as below is series model to ST323C (EUT), the difference between main model and series model are listed as below.

| Model Number | Difference                    |
|--------------|-------------------------------|
| ST323C       | Temperature unit (Centigrade) |
| ST323F       | Temperature unit (Fahrenheit) |

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

### 1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain : 0dBi max  
Antenna Type : Monopole Antenna  
Connector Type : Female



## **2. Test specifications**

### **2.1 Test standard**

The EUT was performed according to the requirement in FCC Part 15C 15.231 and according to the procedures in ANSI C63.4.2003

### **2.2 Operation mode**

EUT was used a new 3Vdc mercury battery and operated under normal operation mode.



## 2.3 Test equipment

| Equipment                         | Brand           | Frequency range | Model No.        | Intertek ID No. | Next Cal. Date |
|-----------------------------------|-----------------|-----------------|------------------|-----------------|----------------|
| EMI Test Receiver                 | Rohde & Schwarz | 9kHz~2.75GHz    | ESCS 30          | EC1303          | 04/17/2008     |
| Spectrum Analyzer                 | Rohde & Schwarz | 9kHz~30GHz      | FSP 30           | EC1353          | 07/24/2008     |
| Spectrum Analyzer                 | Rohde & Schwarz | 20Hz~40GHz      | FSEK 30          | EC1365          | 11/01/2008     |
| Horn Antenna                      | SCHWARZBECK     | 1GHz~18GHz      | BBHA 9120 D      | EC1371          | 12/22/2008     |
| Horn Antenna                      | SCHWARZBECK     | 14GHz~40GHz     | BBHA 9170        | EC1351          | 07/08/2008     |
| Bilog Antenna                     | SCHWARZBECK     | 25MHz~2GHz      | VULB 9168        | EC1347          | 12/23/2008     |
| Pre-Amplifier                     | MITEQ           | 100MHz~26.5GHz  | 919981           | EC1373          | 02/11/2009     |
| Wideband Peak Power Meter/ Sensor | Anritsu         | 100MHz~18GHz    | ML2497A/ MA2491A | EC1396          | 11/10/2008     |
| Controller                        | HDGmbH          | N/A             | CM 100           | EP1346          | N/A            |
| Antenna Tower                     | HDGmbH          | N/A             | MA 240           | EP1347          | N/A            |
| LISN                              | Rohde & Schwarz | 9KHz~30MHz      | ESH3-Z5          | EC1344          | 01/13/2009     |

Note: 1. The above equipments are within the valid calibration period.

### 3. Radiated emission test FCC 15.231 (b)

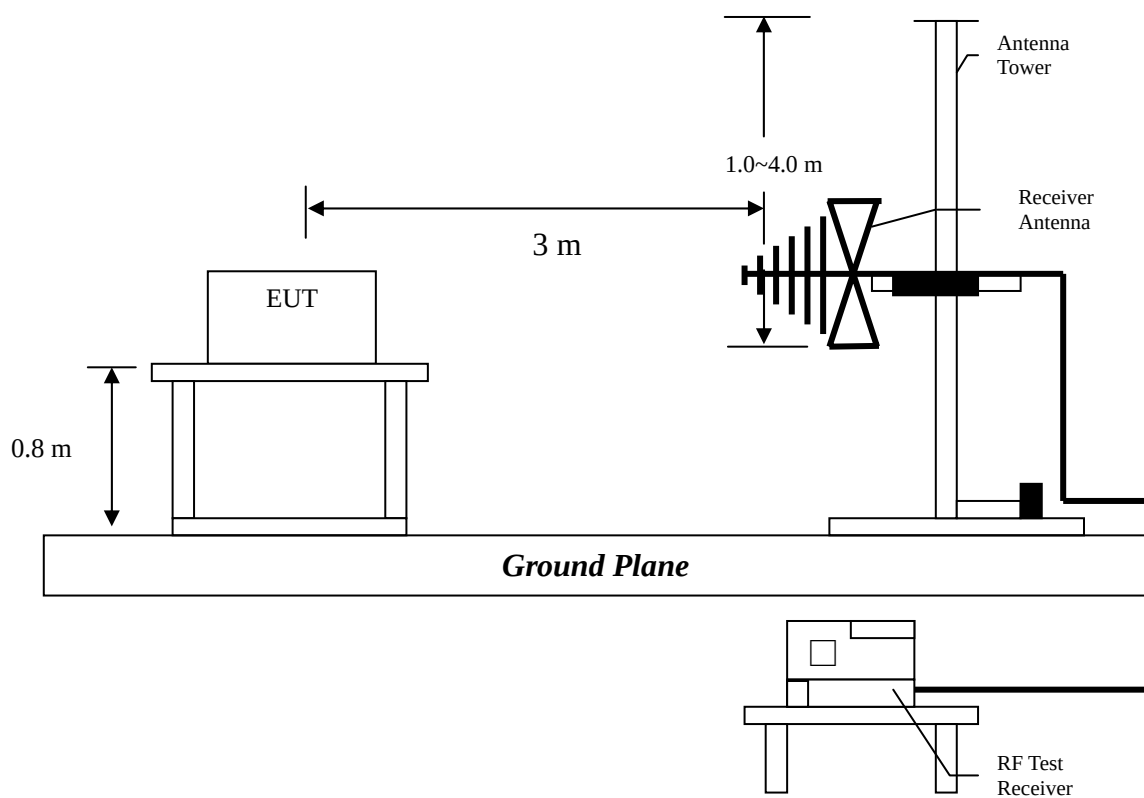
#### 3.1 Operating environment

|                      |      |     |
|----------------------|------|-----|
| Temperature:         | 24   | °C  |
| Relative Humidity:   | 55   | %   |
| Atmospheric Pressure | 1023 | hPa |

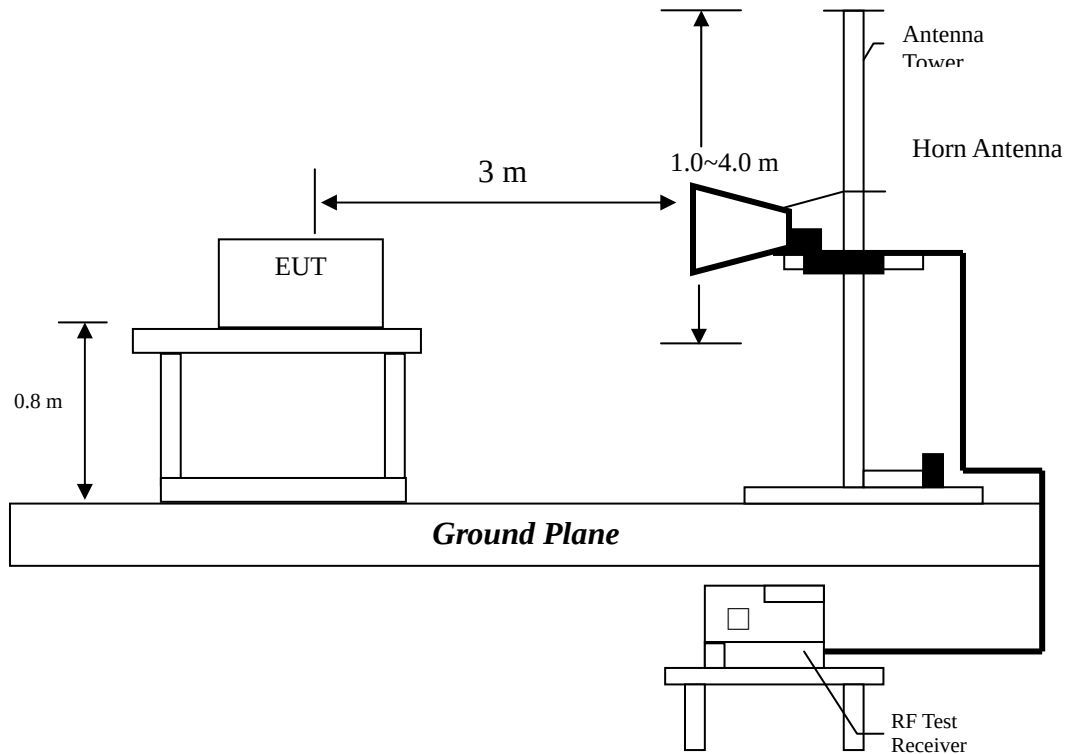
#### 3.2 Test setup & procedure

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

The frequency spectrum from 30MHz to 1000MHz was investigated.



The frequency spectrum from over 1GHz was investigated.



The signal is maximized through rotation and placement in the three orthogonal axes. Radiated emission measurements were performed from 30MHz to 25GHz. 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 wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.



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

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



**Setup 1**



**Setup 2**



**Setup 3**

After verifying three axes, we found the maximum electromagnetic field was occurred at setup 1 configuration. The final test data was executed under this configuration.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

### 3.3 Radiated emission limit

#### 3.3.1 Fundamental and harmonics emission limits

| Frequency (MHz) | Field Strength of Fundamental |             | Field Strength of Harmonics |             |
|-----------------|-------------------------------|-------------|-----------------------------|-------------|
|                 | (uV/m@3m)                     | (dBuV/m@3m) | (uV/m@3m)                   | (dBuV/m@3m) |
| 433.92          | 4398.68                       | 72.8        | 439.86                      | 52.8        |

### 3.3.2 General radiated emission limit

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<br>MHz | 15.209 Limits<br>(dB $\mu$ V/m@3m) |
|------------------|------------------------------------|
| 30-88            | 40                                 |
| 88-216           | 43.5                               |
| 216-960          | 46                                 |
| Above 960        | 54                                 |

Remark:

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

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

### 3.4 Calculation of Average Factor

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured in 100 ms or the repetition cycle, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer in zero span mode at 100 resolution bandwidth.

Averaging factor in dB =  $20\log(\text{duty cycle})$

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 103 ms

The number of short pulses in each period (24) multiplied by the duration of each short pulses (0.19ms) = 4.56 ms

The number of long pulses in each period (4) multiplied by the duration of each long pulses (0.37ms) = 1.48 ms

Effective period of the cycle =  $4.56 + 1.48 = 6.04$  ms

DC =  $6.04 \text{ ms} / 100 \text{ ms} = 0.0604$

Therefore, the averaging factor is found by  $20 \log_{10} 0.0604 = -24.37 \text{ dB}$

### 3.5 Transmitting Time

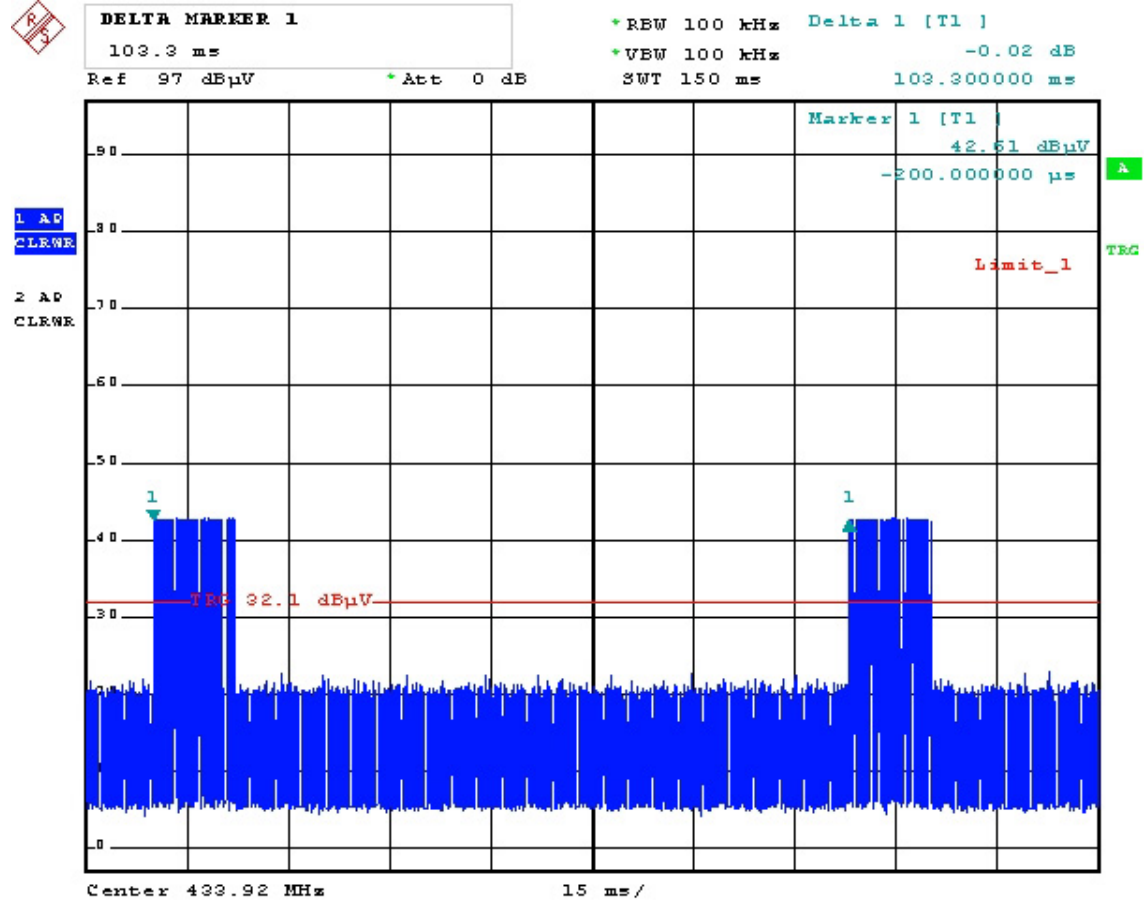
The total duration of transmissions does not exceed more than two seconds per hour for each transmitter.

$6.04 \text{ ms} \times 240 = 1449.6 \text{ ms} (1.4496 \text{ s})$

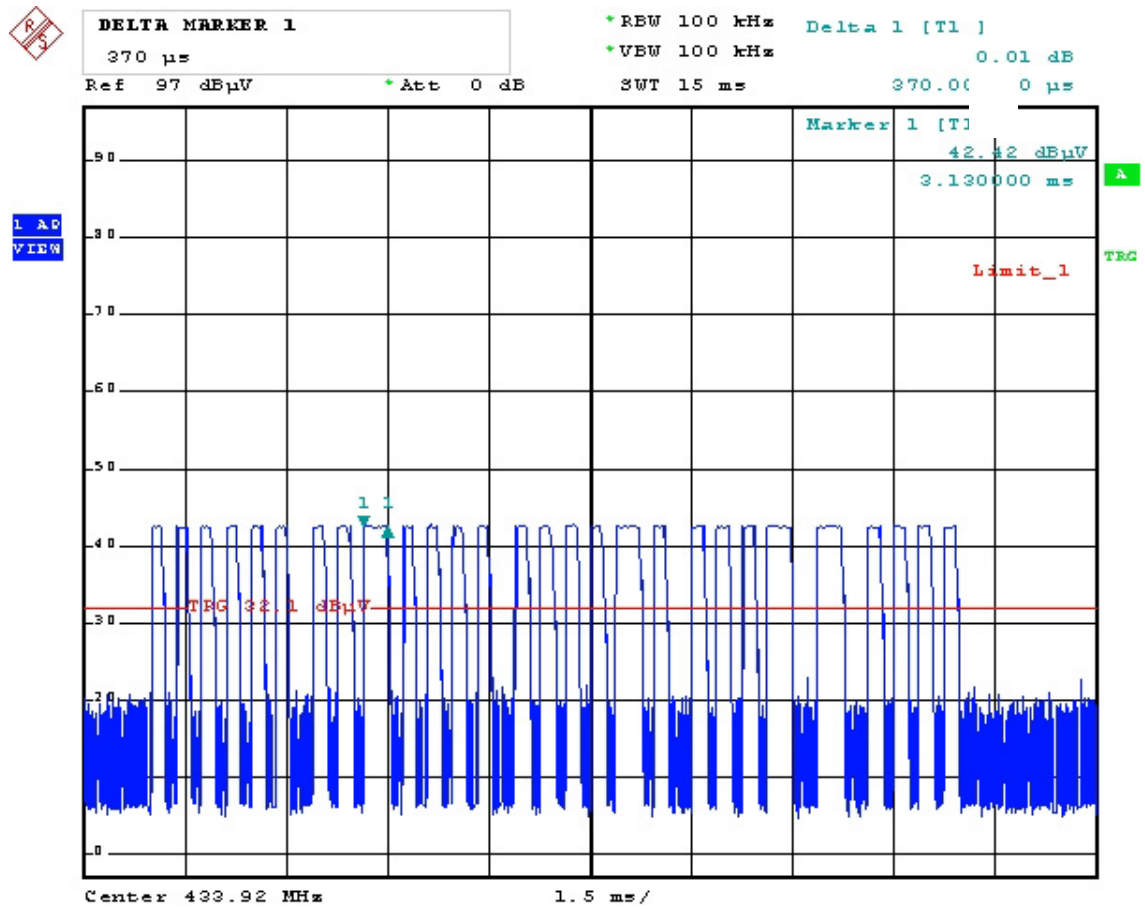
Note: 240 means that the device was transmitted once for each 15 seconds.  
So there are 240 times of transmitting during one hour.

Please see the plot below.

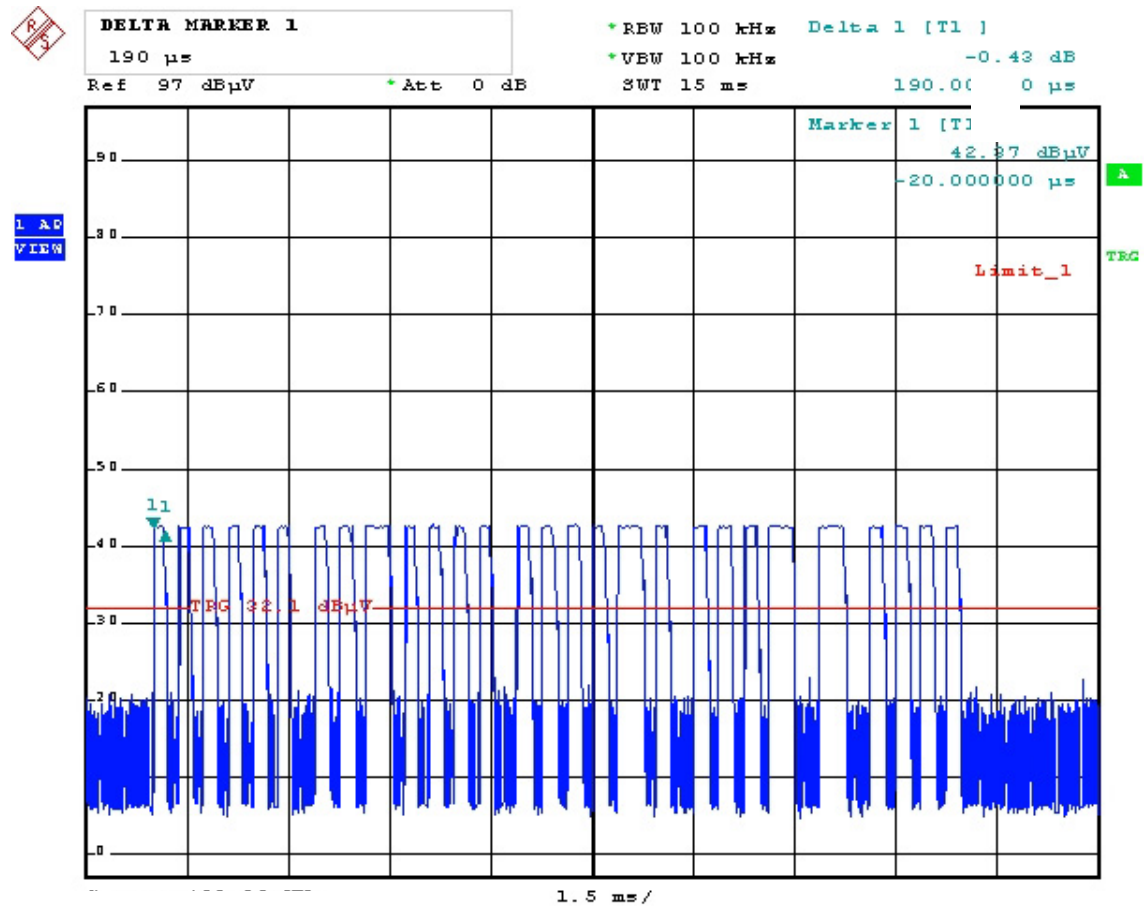
1 cycle



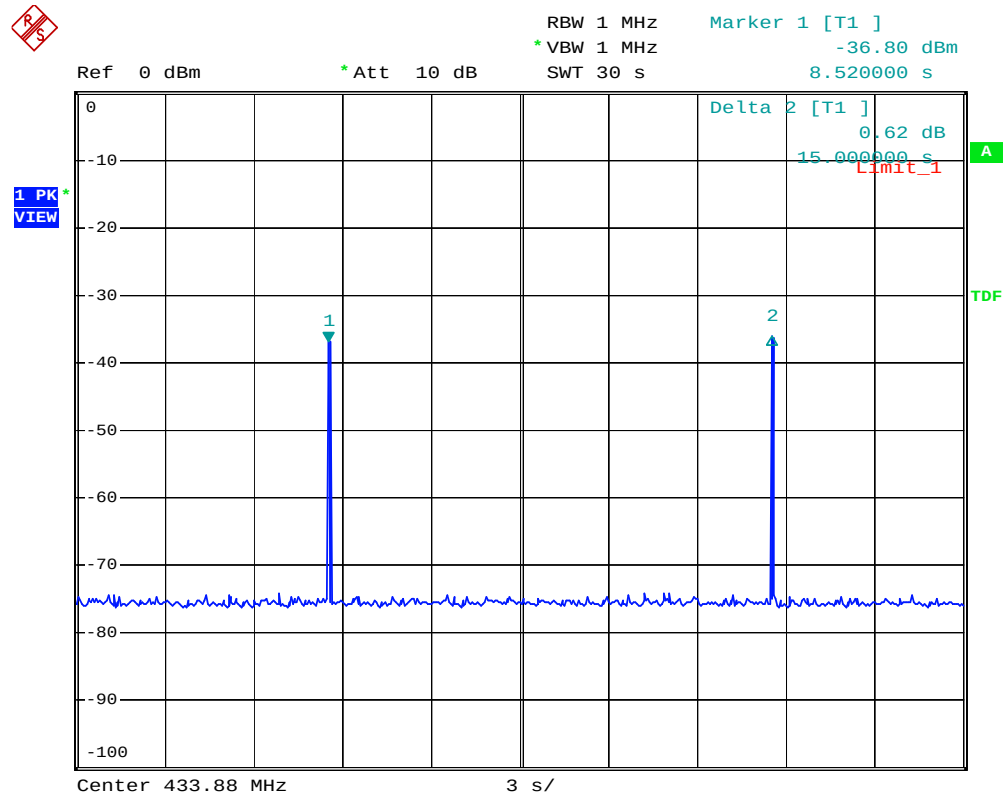
## Large pulse



**Small pulse**



1 period



### 3.6 Radiated emission test data FCC 15.231

#### 3.6.1 Measurement results: frequencies equal to or less than 1 GHz

EUT : ST323C  
Worst Case : Tx at 433.92MHz with setup 1

| Frequency<br>(MHz) | Spectrum<br>Analyzer<br>Detector | Antenna<br>Polariz.<br>(H/V) | Correction<br>Factor<br>(dB/m) | Reading<br>(dBuV) | Average<br>Factor<br>(dB) | Corrected<br>Level<br>(dBuV/m) | Limit<br>@ 3 m<br>(dBuV/m) | Margin<br>(dB) |
|--------------------|----------------------------------|------------------------------|--------------------------------|-------------------|---------------------------|--------------------------------|----------------------------|----------------|
| 432.520            | PK                               | V                            | 17.64                          | 56.95             | 0.00                      | 74.59                          | 92.80                      | -18.21         |
| 433.520            | AV                               | V                            | 17.64                          | 56.95             | -24.37                    | 50.22                          | 72.80                      | -22.58         |
| 867.110            | PK                               | V                            | 23.70                          | 32.16             | 0.00                      | 55.86                          | 72.80                      | -16.94         |
| 867.110            | AV                               | V                            | 23.70                          | 32.16             | -24.37                    | 31.49                          | 52.80                      | -21.31         |
| 432.520            | PK                               | H                            | 18.12                          | 66.21             | 0.00                      | 84.33                          | 92.80                      | -8.47          |
| 433.520            | AV                               | H                            | 18.12                          | 66.21             | -24.37                    | 59.96                          | 72.80                      | -12.84         |
| 867.110            | PK                               | H                            | 24.12                          | 42.06             | 0.00                      | 66.18                          | 72.80                      | -6.62          |
| 867.110            | AV                               | H                            | 24.12                          | 42.06             | -24.37                    | 41.81                          | 52.80                      | -11.00         |

Remark:

1. Corrected Level = Reading + Correction Factor + Average Factor
2. Correction Factor = Antenna Factor + Cable Loss
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.



### 3.6.2 Measurement results: frequencies above 1GHz

EUT : ST323C  
Worst Case : Tx at 433.92MHz with setup 1

| Frequency<br>(MHz) | Spectrum<br>Analyzer<br>Detector | Antenna<br>Polariz.<br>(H/V) | Correction<br>Factor<br>(dB/m) | Reading<br>(dBuV) | Average<br>Factor<br>(dB) | Corrected<br>Level<br>(dBuV/m) | Limit<br>@ 3 m<br>(dBuV/m) | Margin<br>(dB) |
|--------------------|----------------------------------|------------------------------|--------------------------------|-------------------|---------------------------|--------------------------------|----------------------------|----------------|
| 1302.400           | PK                               | V                            | 28.69                          | 30.97             | 0.00                      | 59.66                          | 74.00                      | -14.34         |
| 1303.400           | AV                               | V                            | 28.69                          | 30.97             | -24.37                    | 35.29                          | 54.00                      | -18.71         |
| 2167.600           | PK                               | V                            | 31.07                          | 28.47             | 0.00                      | 59.54                          | 74.00                      | -14.46         |
| 2167.600           | AV                               | V                            | 31.07                          | 28.47             | -24.37                    | 35.17                          | 54.00                      | -18.83         |
| 2604.400           | PK                               | V                            | 32.77                          | 28.26             | 0.00                      | 61.03                          | 74.00                      | -12.97         |
| 2604.400           | AV                               | V                            | 32.77                          | 28.26             | -24.37                    | 36.66                          | 54.00                      | -17.34         |
| 1302.400           | PK                               | H                            | 28.69                          | 37.96             | 0.00                      | 66.65                          | 74.00                      | -7.35          |
| 1302.400           | AV                               | H                            | 28.69                          | 37.96             | -24.37                    | 42.28                          | 54.00                      | -11.72         |
| 1735.600           | PK                               | H                            | 29.71                          | 34.78             | 0.00                      | 64.49                          | 74.00                      | -9.51          |
| 1735.600           | AV                               | H                            | 29.71                          | 34.78             | -24.37                    | 40.12                          | 54.00                      | -13.88         |
| 2167.600           | PK                               | H                            | 31.07                          | 34.07             | 0.00                      | 65.14                          | 74.00                      | -8.86          |
| 2167.600           | AV                               | H                            | 31.07                          | 34.07             | -24.37                    | 40.77                          | 54.00                      | -13.23         |
| 2604.400           | PK                               | H                            | 32.77                          | 34.87             | 0.00                      | 67.64                          | 74.00                      | -6.36          |
| 2604.400           | AV                               | H                            | 32.77                          | 34.87             | -24.37                    | 43.27                          | 54.00                      | -10.73         |

#### Remark:

1. Corrected Level = Reading + Correction Factor + Average Factor
2. Correction Factor = Antenna Factor + Cable Loss
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.

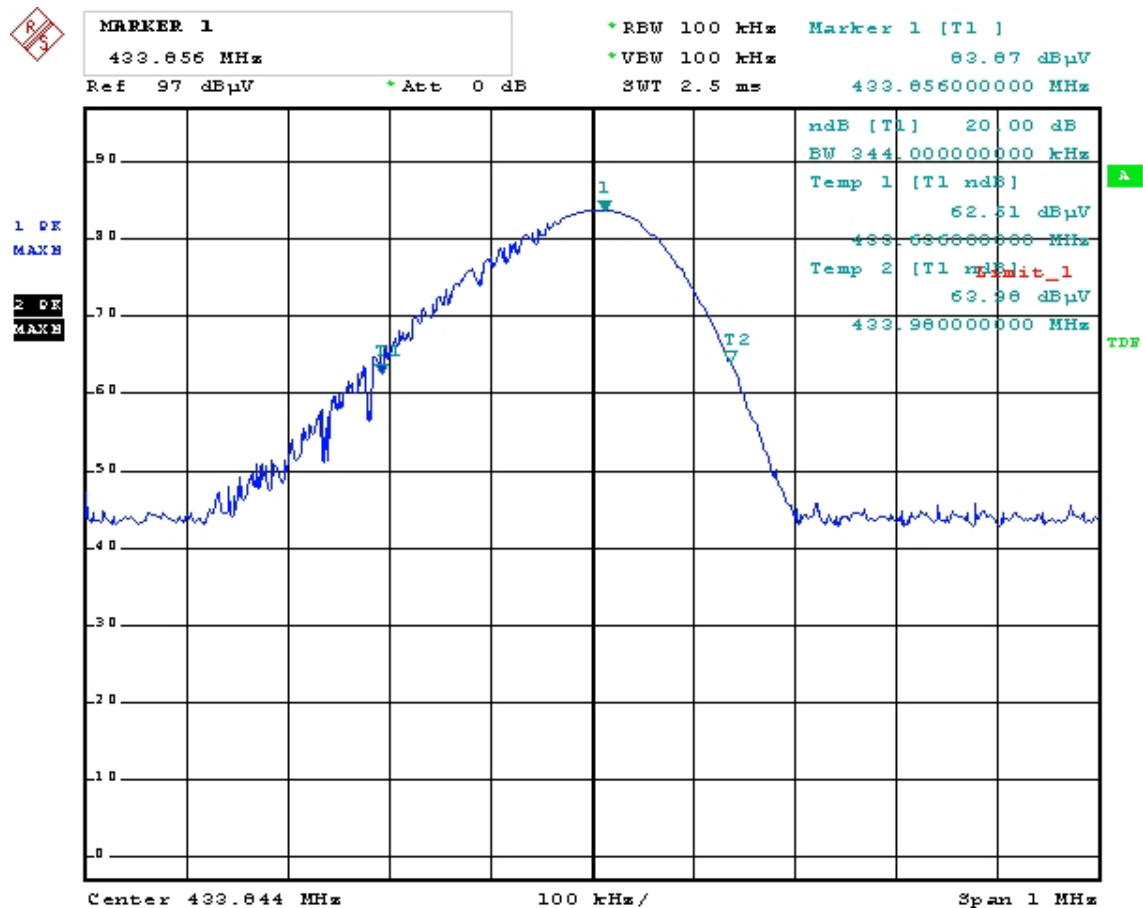
#### 4. Measured bandwidth FCC 15.231 (C)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. Bandwidth is determined at the points 20dB down from the modulated carrier.

$$B.W(20dBc) \text{ Limit} = 0.25\% \times f(\text{MHz}) = 0.25\% \times 433.93\text{MHz} = 1.0848\text{MHz}$$

From the plot, the bandwidth is observed to be 344.00kHz, at 20dBc where the bandwidth limit is 1.0848MHz.

Please see the plot below.



Date: 21.APR.2008 11:36:44