

**Fig33. Dwell Time in 2480MHz,3Mbps**

## B.6 Number of Channel Hopping

### B.6.1 Description

According to §15.247(a)(1)(iii), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

### B.6.2 Test Procedures

#### Conducted Measurement

EUT was set for low, mid, high channel with modulated mode and highest RF output power

The spectrum analyzer was connected to the antenna terminal.

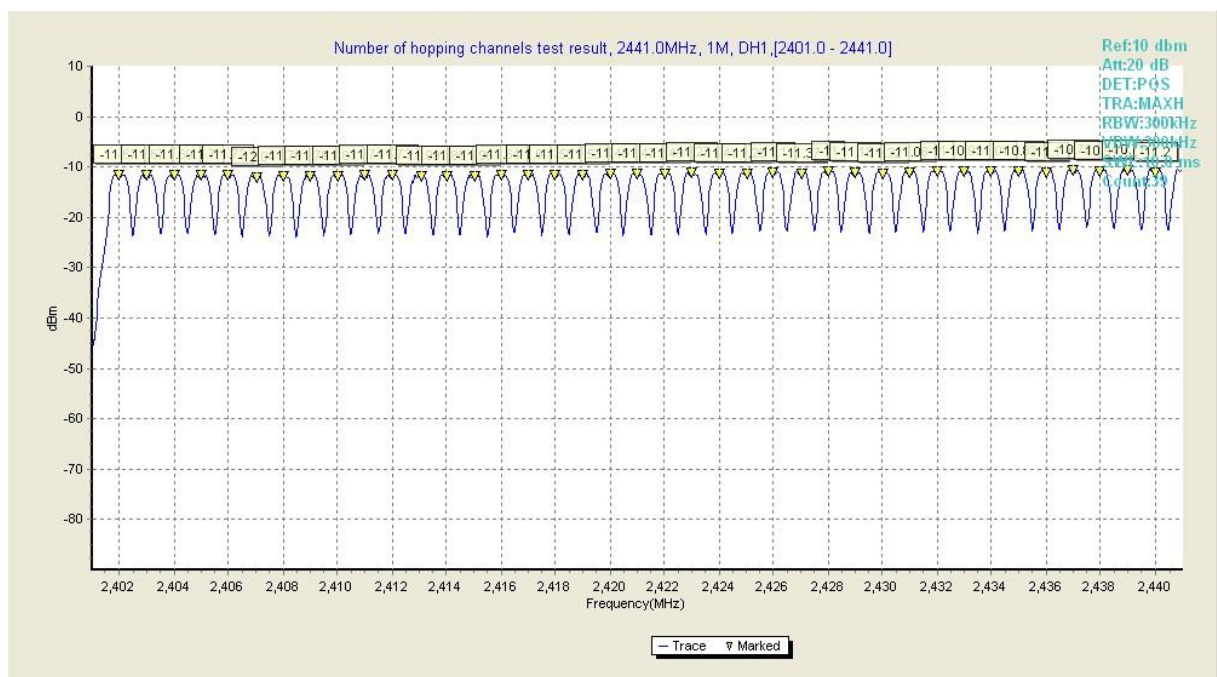
#### Procedures

- e) Place the EUT on the table and set it in transmitting mode and switch on frequency hopping function.
- f) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- g) Set the spectrum analyzer as Start=2400MHz, Stop=2483.5MHz, Span=the frequency band of operation, RBW $\geq$ 1% of the span, VBW $\geq$ RBW, Sweep=auto, Detector function=peak, Trace=max hold.
- h) Count the quantity of peaks to get the number of hopping channels.

### B.6.3 Test Results

#### GFSK Modulation

| Hopping Channel Frequency Range(MHz) | Limits(Channel) | Number of hopping Channel | Test Results | Verdict |
|--------------------------------------|-----------------|---------------------------|--------------|---------|
| 2402~2480                            | 15              | 79                        | Fig.34       | Pass    |



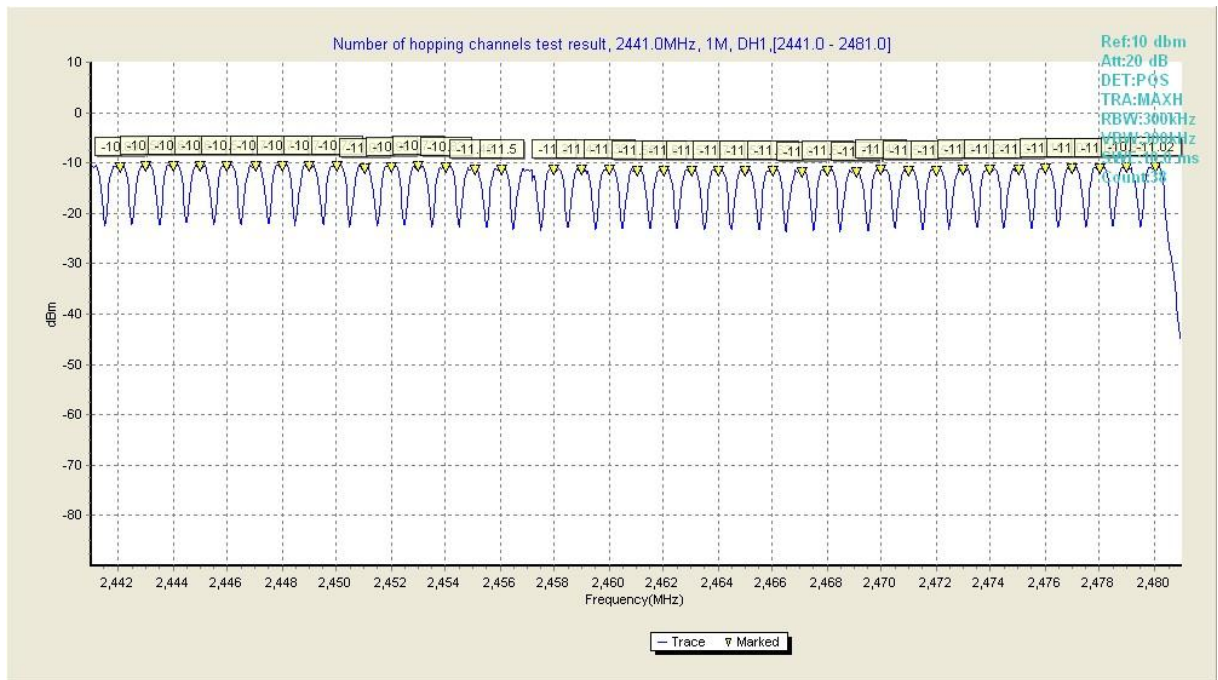
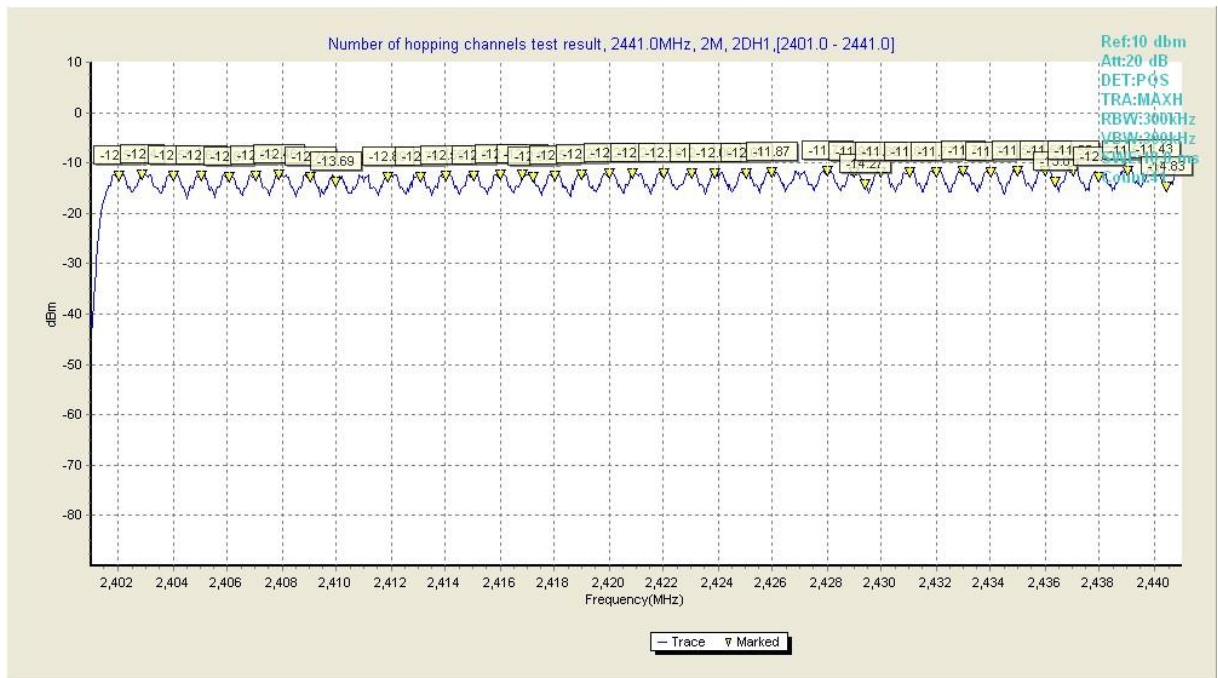


Fig34. Dwell Time in 1Mbps

## $\pi/4$ -DQPSK Modulation

| Hopping Channel Frequency Range(MHz) | Limits(Channel) | Number of hopping Channel | Test Results | Verdict |
|--------------------------------------|-----------------|---------------------------|--------------|---------|
| 2402~2480                            | 15              | 79                        | Fig.35       | Pass    |



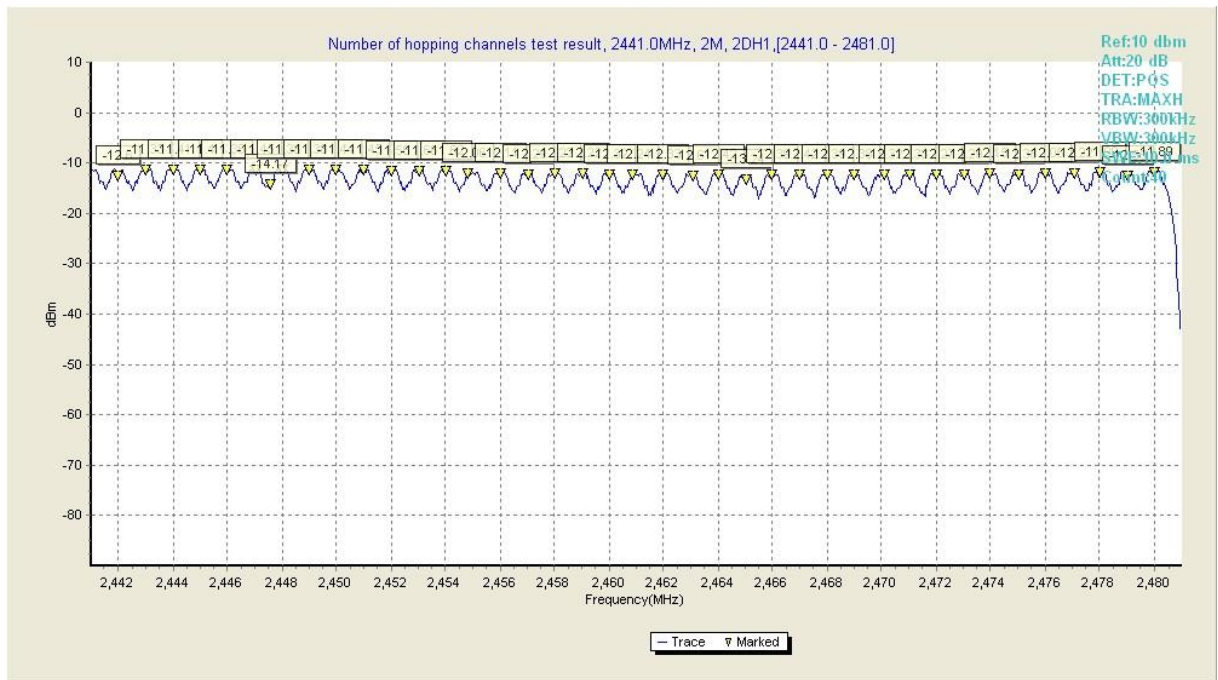
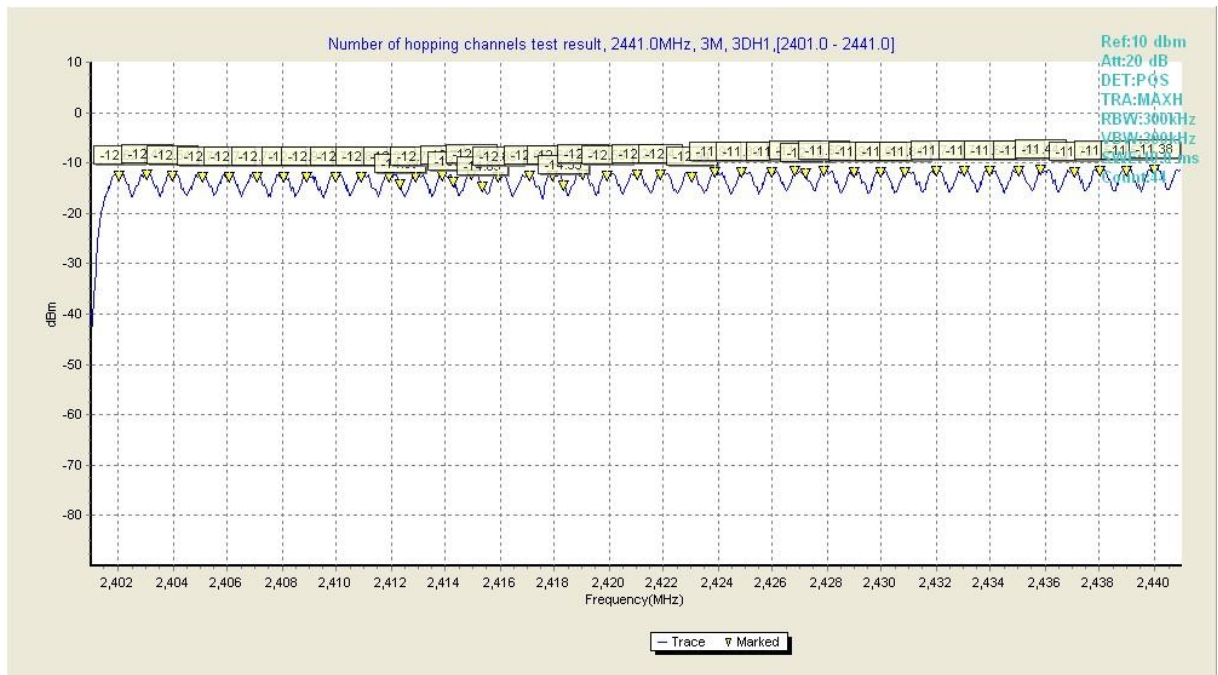
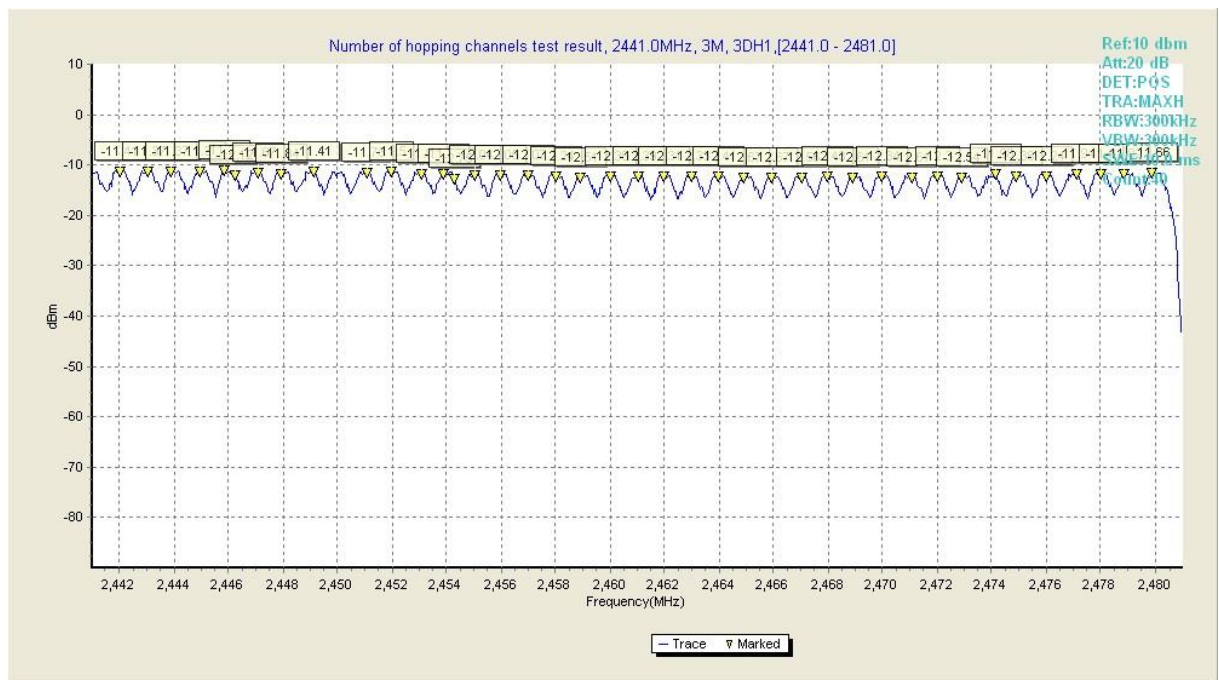


Fig35. Dwell Time in 2Mbps

## 8DPSK Modulation

| Hopping Channel Frequency Range(MHz) | Limits(Channel) | Number of hopping Channel | Test Results | Verdict |
|--------------------------------------|-----------------|---------------------------|--------------|---------|
| 2402~2480                            | 15              | 79                        | Fig.36       | Pass    |





**Fig36. Dwell Time in 3Mbps**

**B.7 Conducted Spurious Emissions****B.7.1 Description**

According to §15.247(d),

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

**B.7.2 Test Procedures****Conducted Measurement**

EUT was set for low, mid, high channel with modulated mode and highest RF output power

The spectrum analyzer was connected to the antenna terminal.

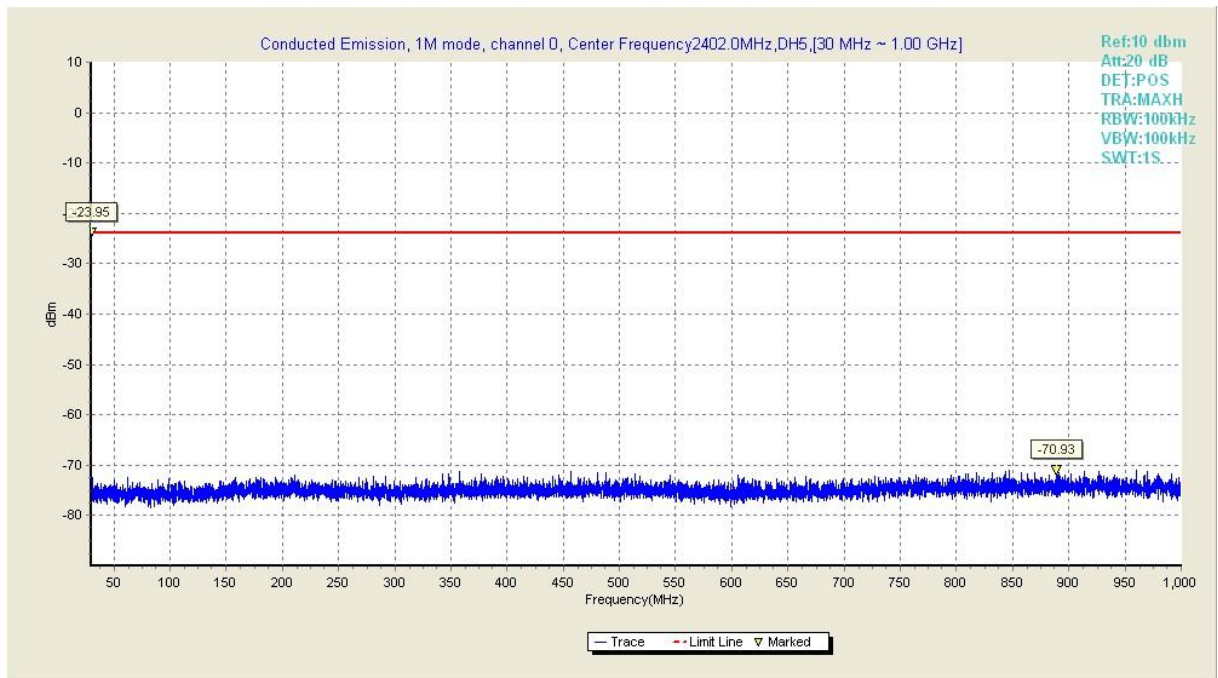
**Procedures**

- a) The EUT was connected to SA by a low loss cable.
- b) Set RBW=100 kHz, VBW $\geq$  RBW, scan up to 10th harmonics. All harmonics/Spurs emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

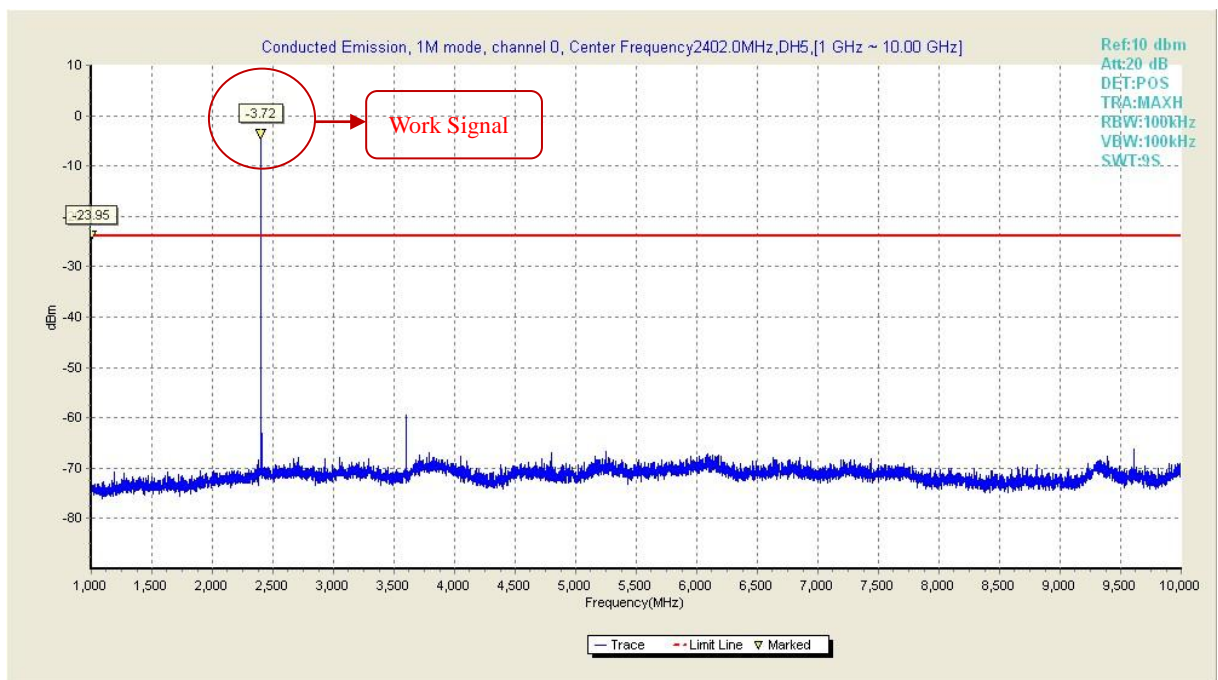
**B.7.3 Test Result****GFSK Modulation**

| Channel | Frequency Range | Test Results | Verdict |
|---------|-----------------|--------------|---------|
| 0       | 30MHz ~ 1GHz    | Fig.37       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.38       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.38       | Pass    |
| 39      | 30MHz ~ 1GHz    | Fig.39       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.40       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.41       | Pass    |
| 78      | 30MHz ~ 1GHz    | Fig.42       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.43       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.44       | Pass    |

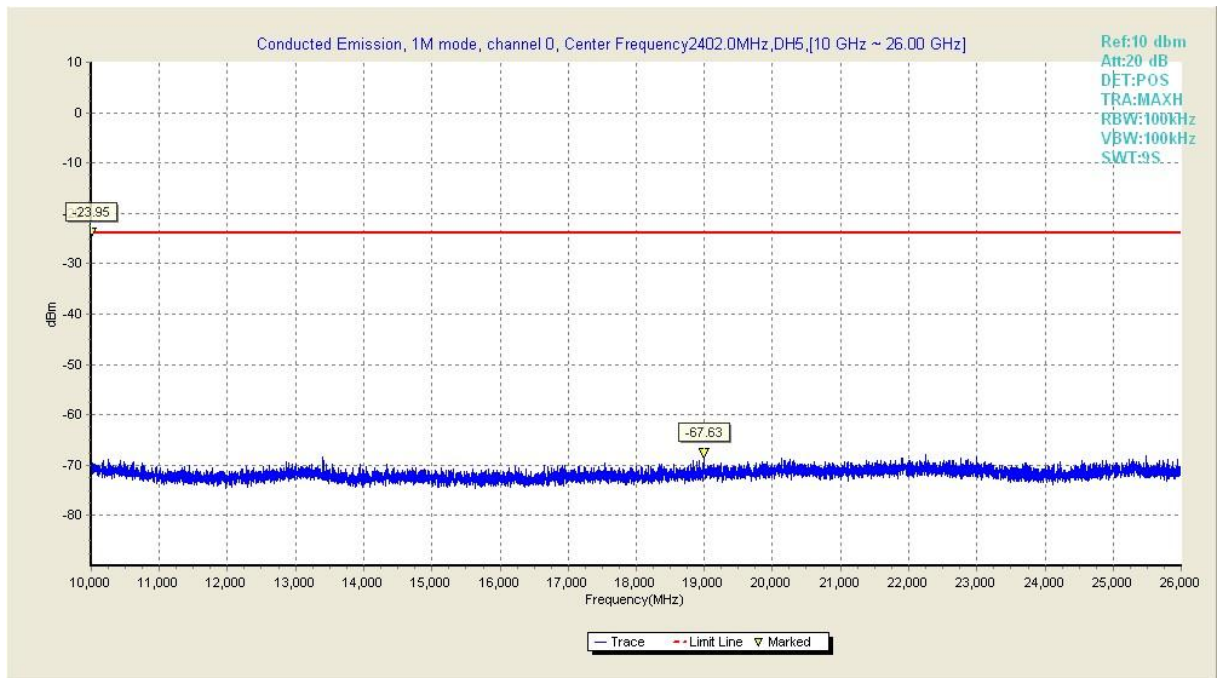




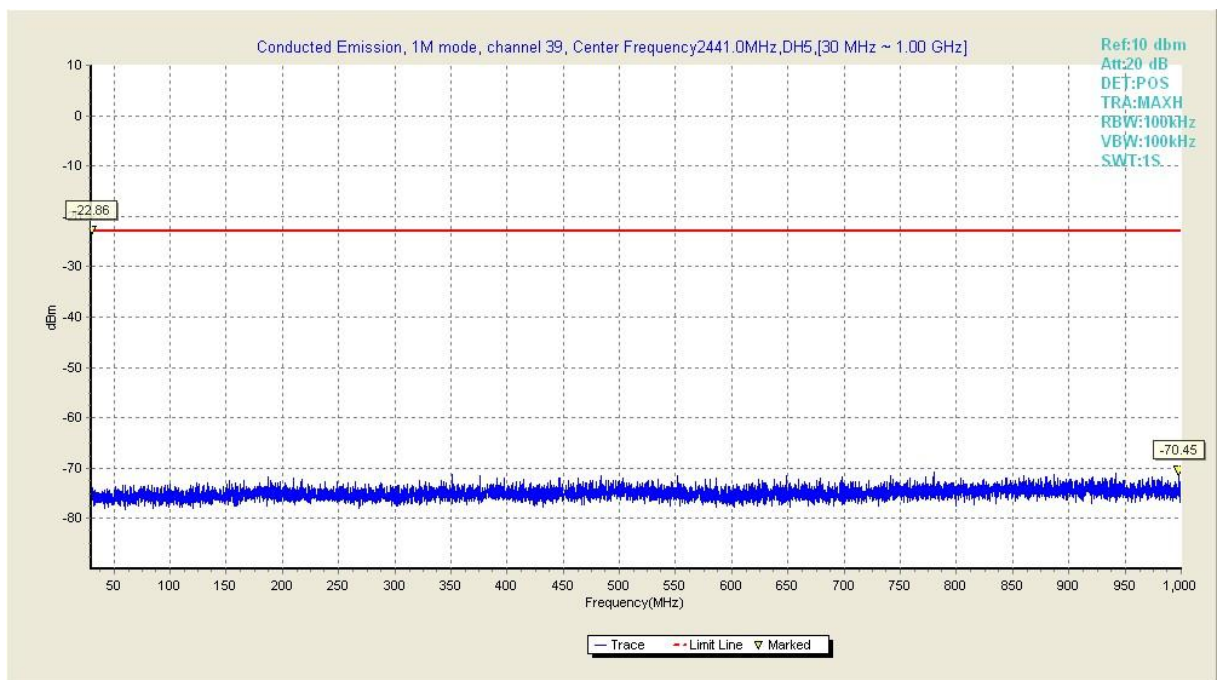
**Fig.37 Conducted Emission in 1M mode ,channel 0, (30 MHz ~ 1 GHz)**



**Fig.38 Conducted Emission in 1M mode ,channel 0, (1 GHz ~ 10 GHz)**

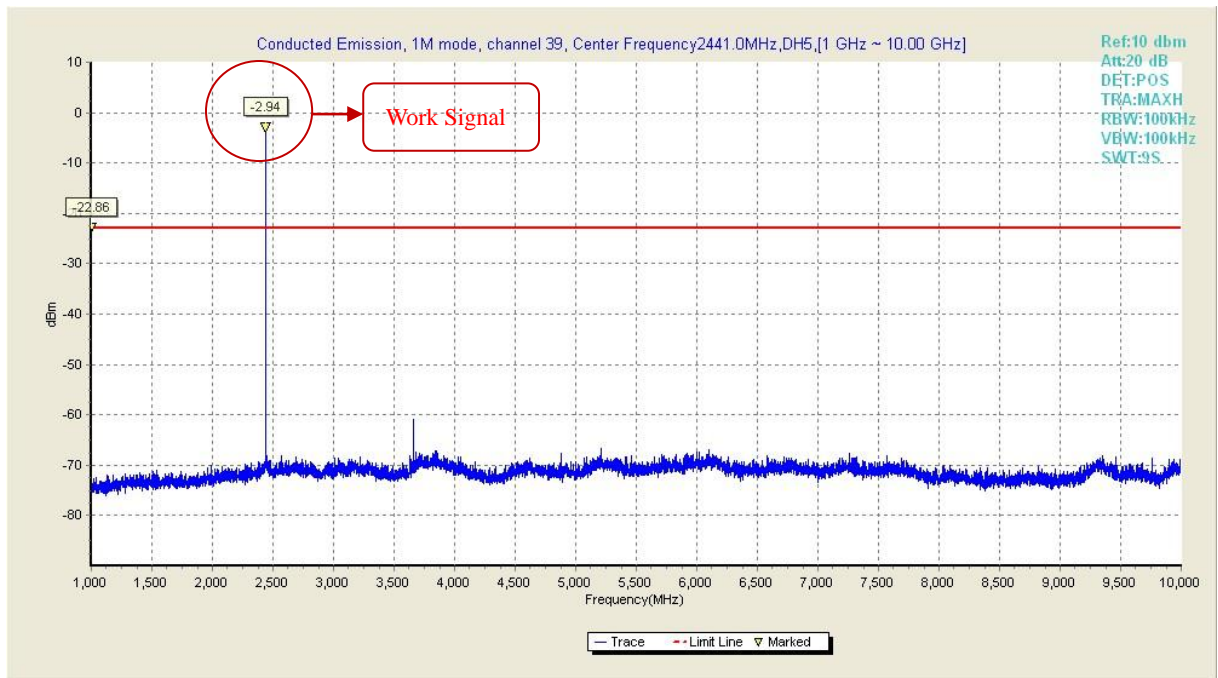


**Fig.39 Conducted Emission in 1M mode ,channel 0, (10 GHz ~ 26 GHz)**

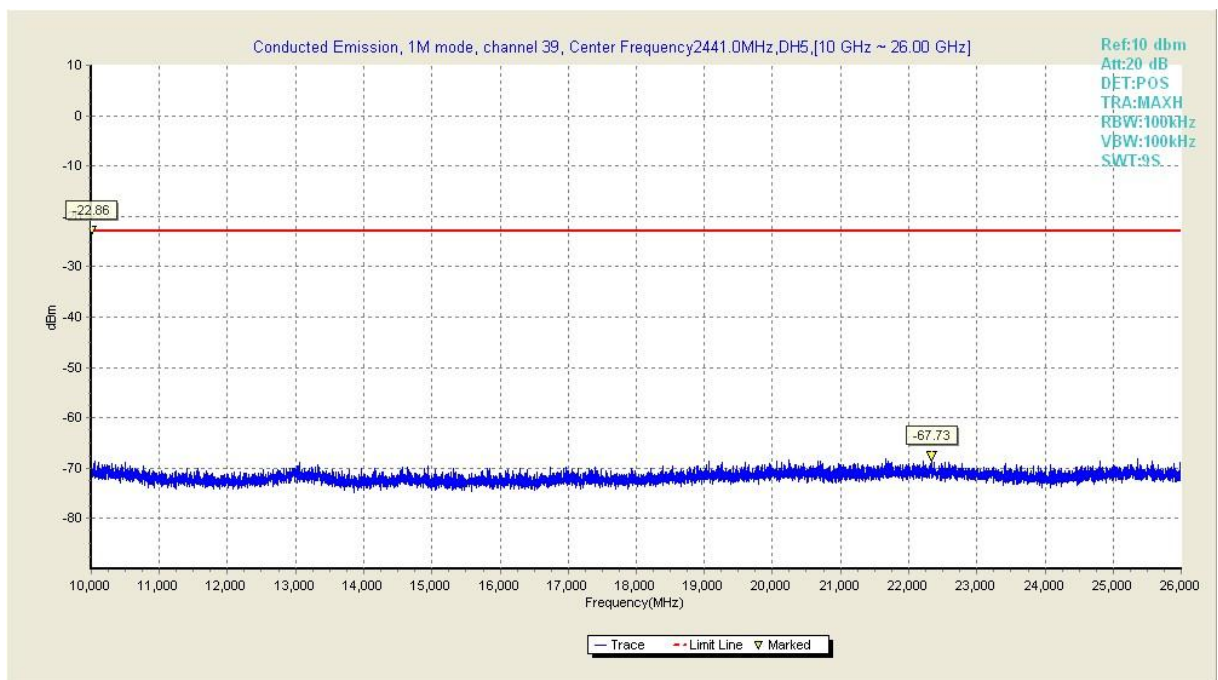


**Fig.40 Conducted Emission in 1M mode ,channel 39, (30 MHz ~ 1 GHz)**

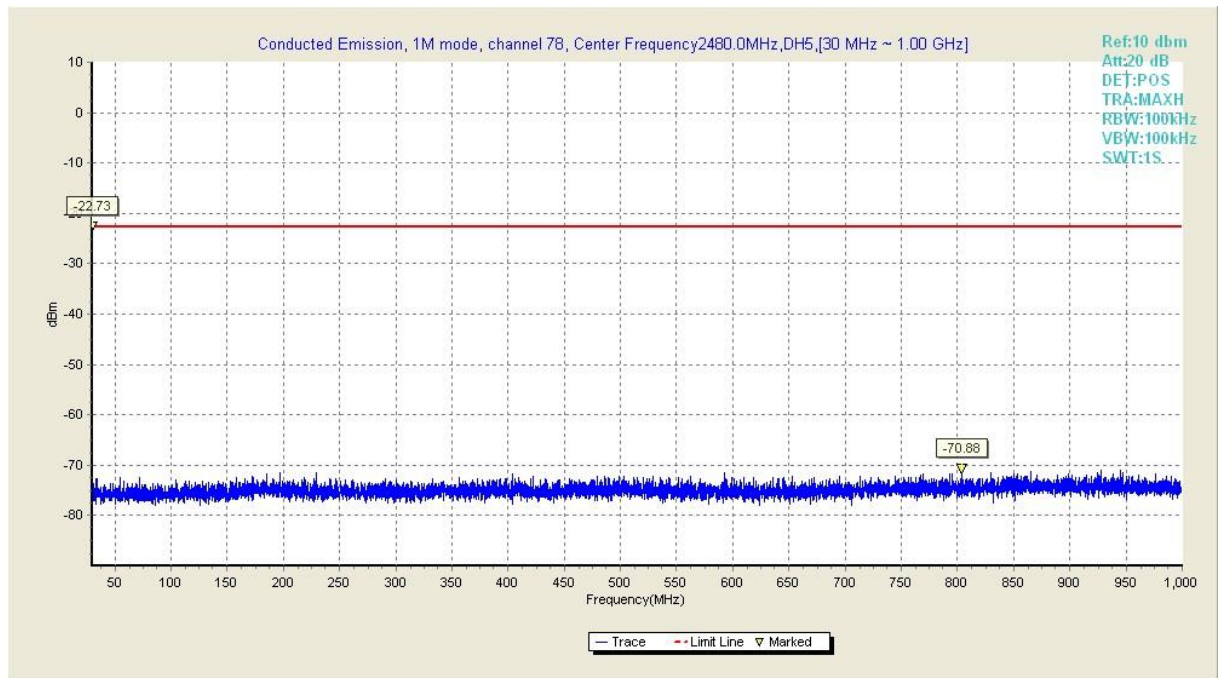




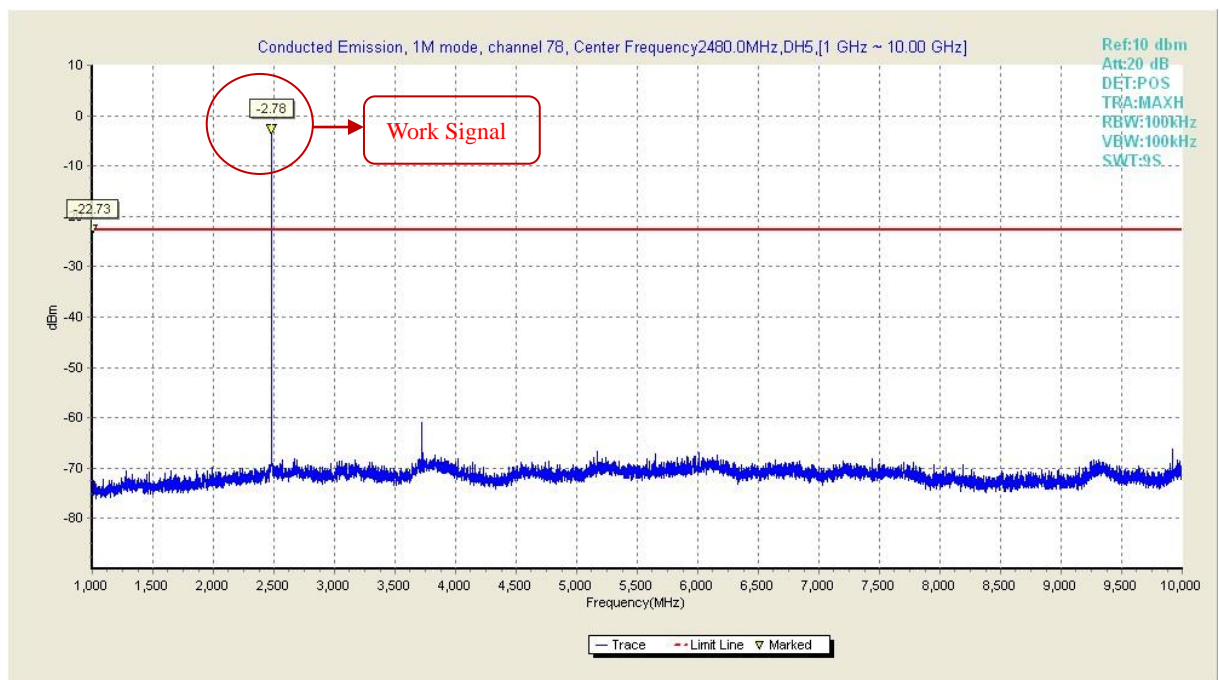
**Fig.41 Conducted Emission in 1M mode ,channel 39, (1 GHz ~ 10 GHz)**



**Fig.42 Conducted Emission in 1M mode ,channel 39, (10 GHz ~ 26 GHz)**



**Fig.43 Conducted Emission in 1M mode ,channel 78, (30 MHz ~ 1 GHz)**



**Fig.44 Conducted Emission in 1M mode ,channel 78, (1 GHz ~ 10 GHz)**

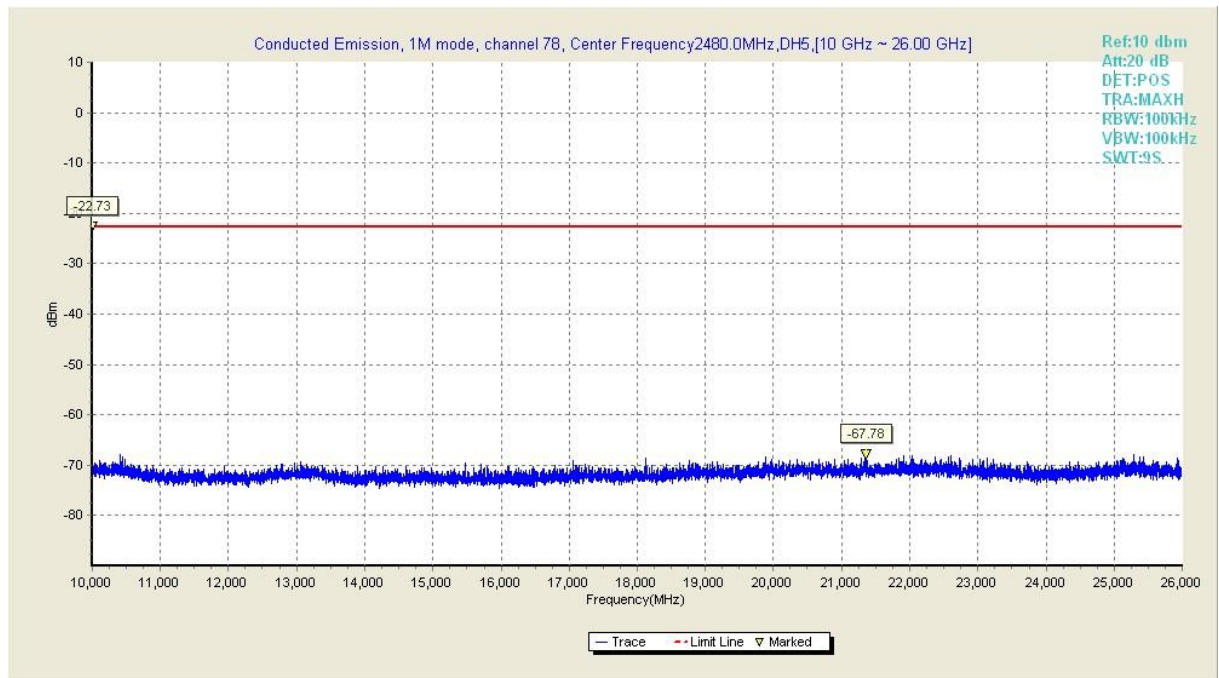
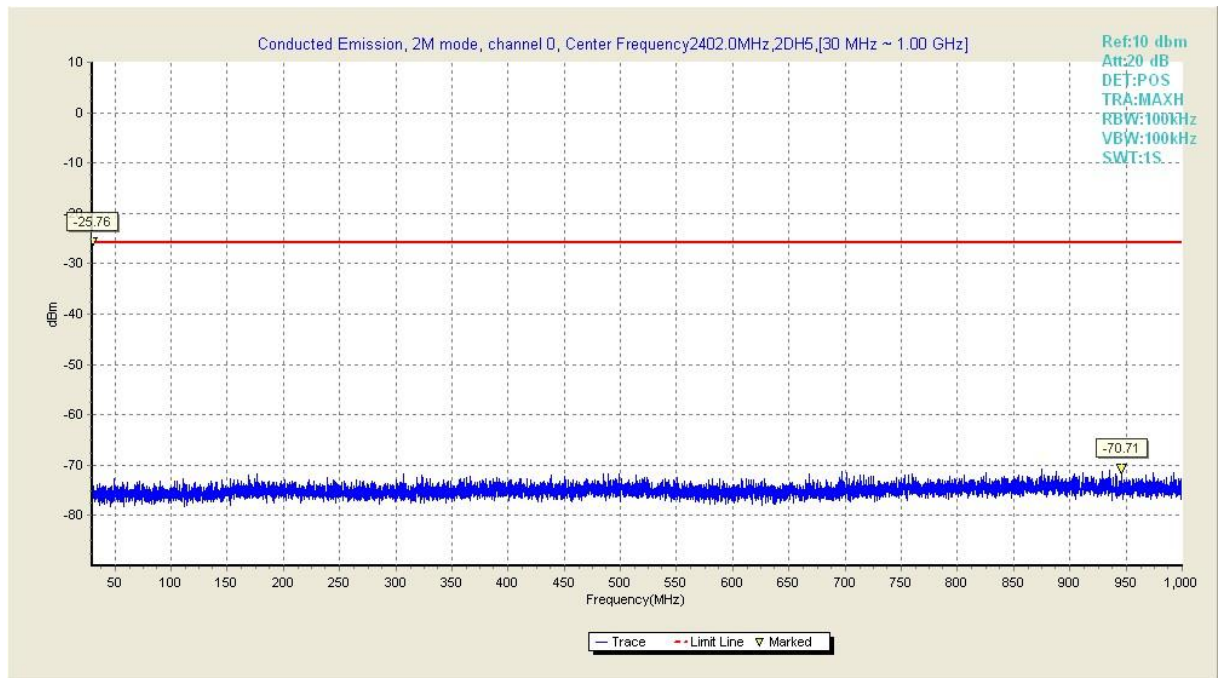


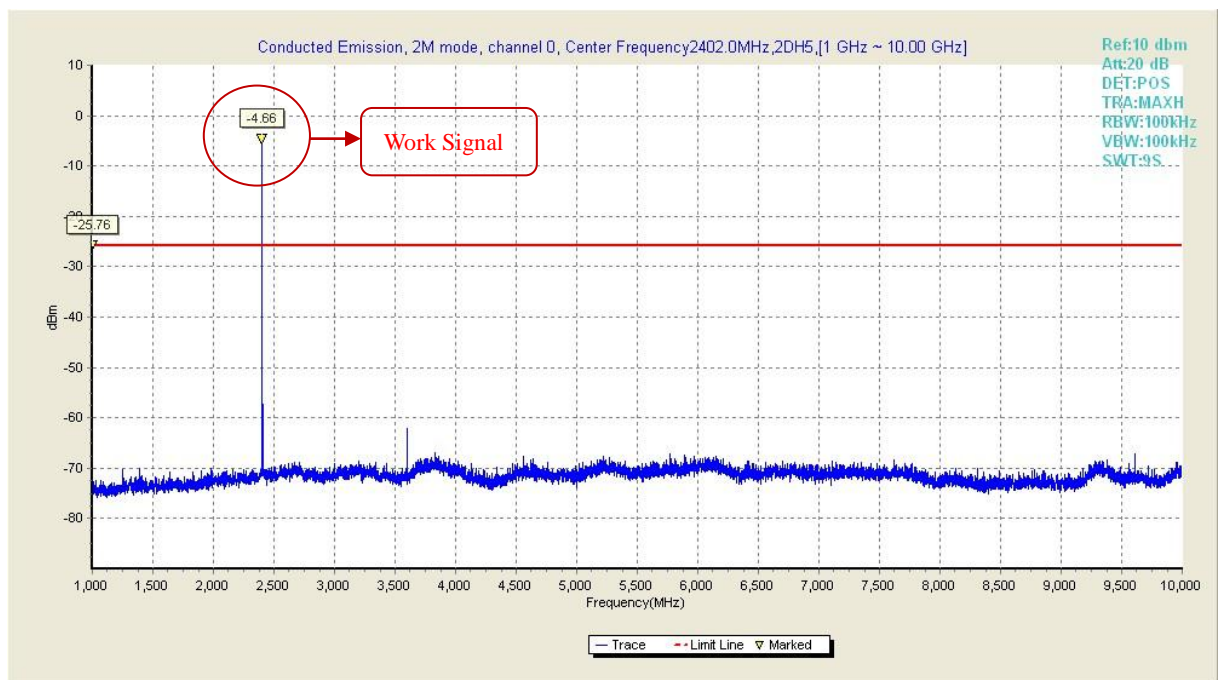
Fig.45 Conducted Emission in 1M mode ,channel 78, (10 GHz ~ 26 GHz)

## $\pi/4$ -DQPSK Modulation

| Channel | Frequency Range | Test Results | Verdict |
|---------|-----------------|--------------|---------|
| 0       | 30MHz ~ 1GHz    | Fig.46       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.47       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.48       | Pass    |
| 39      | 30MHz ~ 1GHz    | Fig.49       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.50       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.51       | Pass    |
| 78      | 30MHz ~ 1GHz    | Fig.52       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.53       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.54       | Pass    |

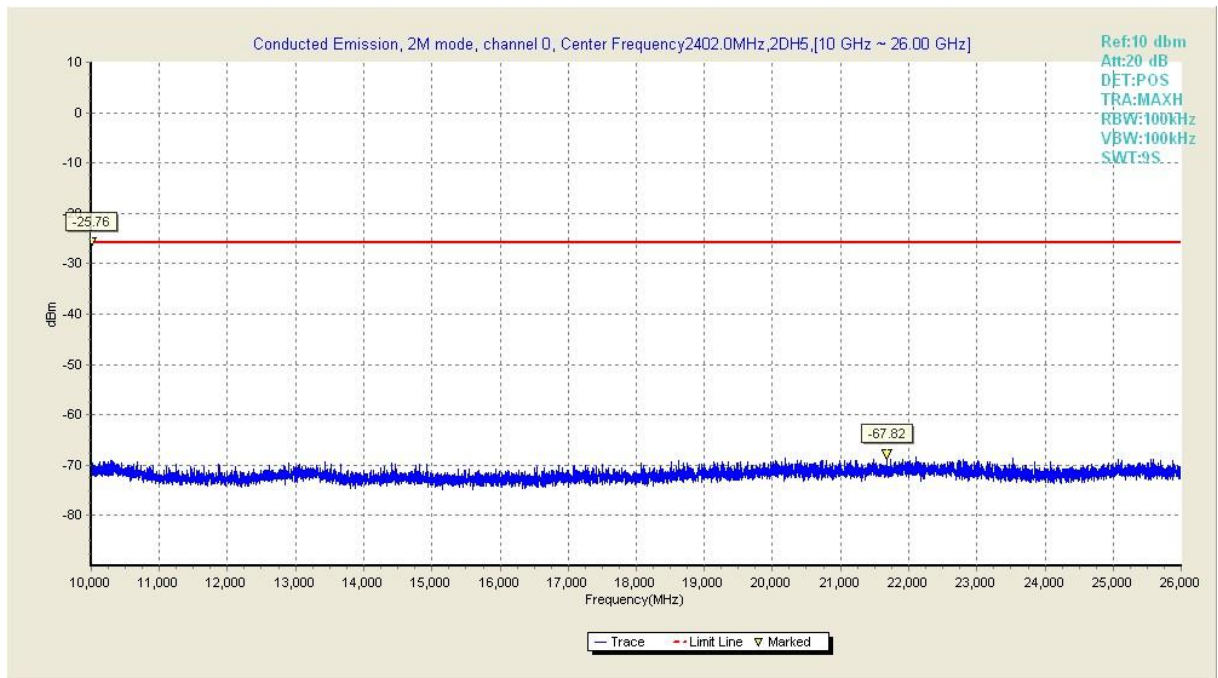


**Fig.46 Conducted Emission in 2M mode ,channel 0, (30 MHz ~ 1 GHz)**

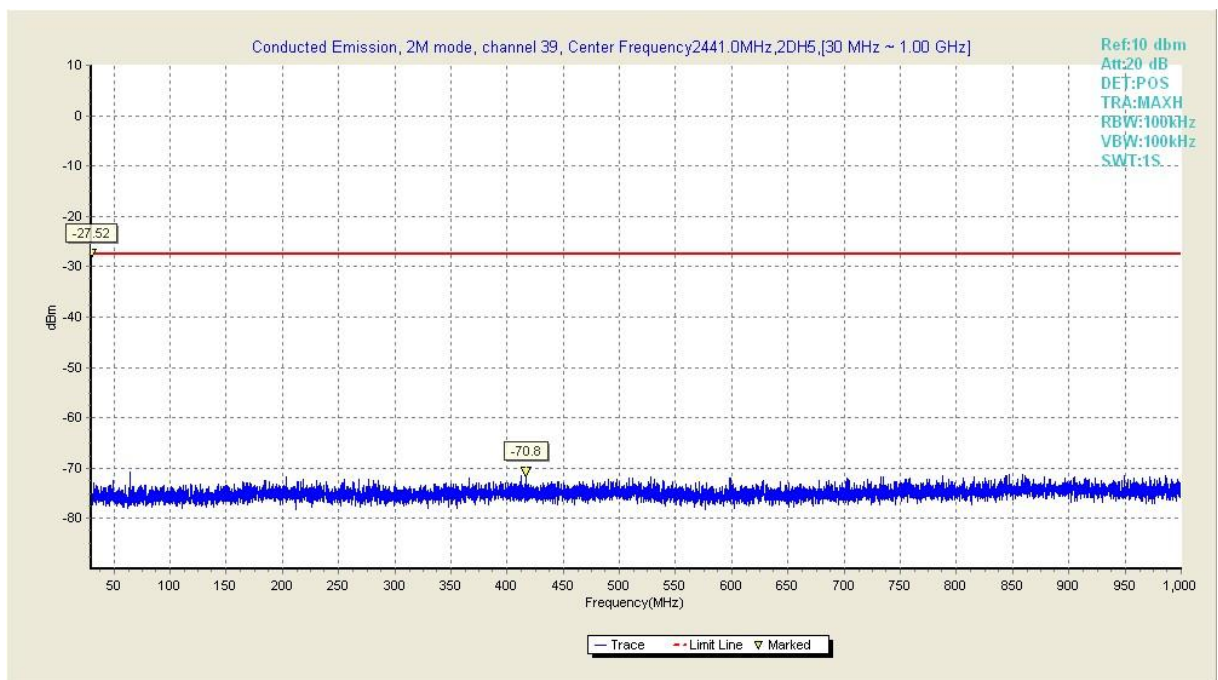


**Fig.47 Conducted Emission in 2M mode ,channel 0, (1 GHz ~ 10 GHz)**



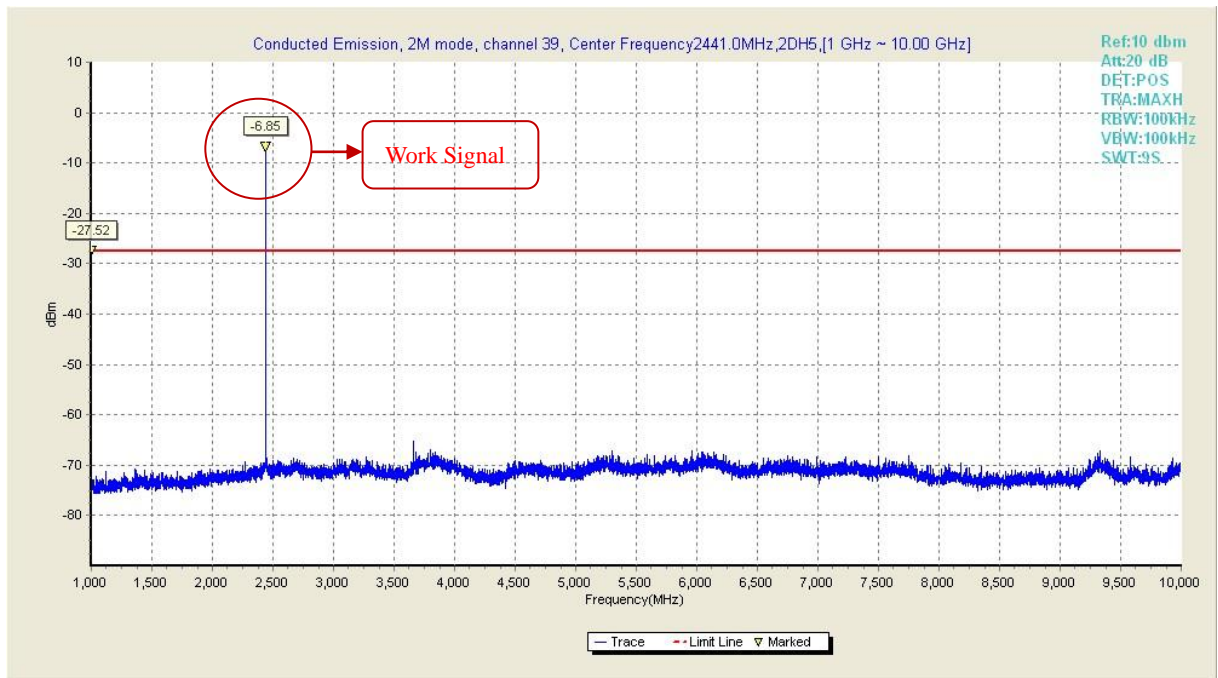


**Fig.48** Conducted Emission in 2M mode ,channel 0, (10 GHz ~ 26 GHz)

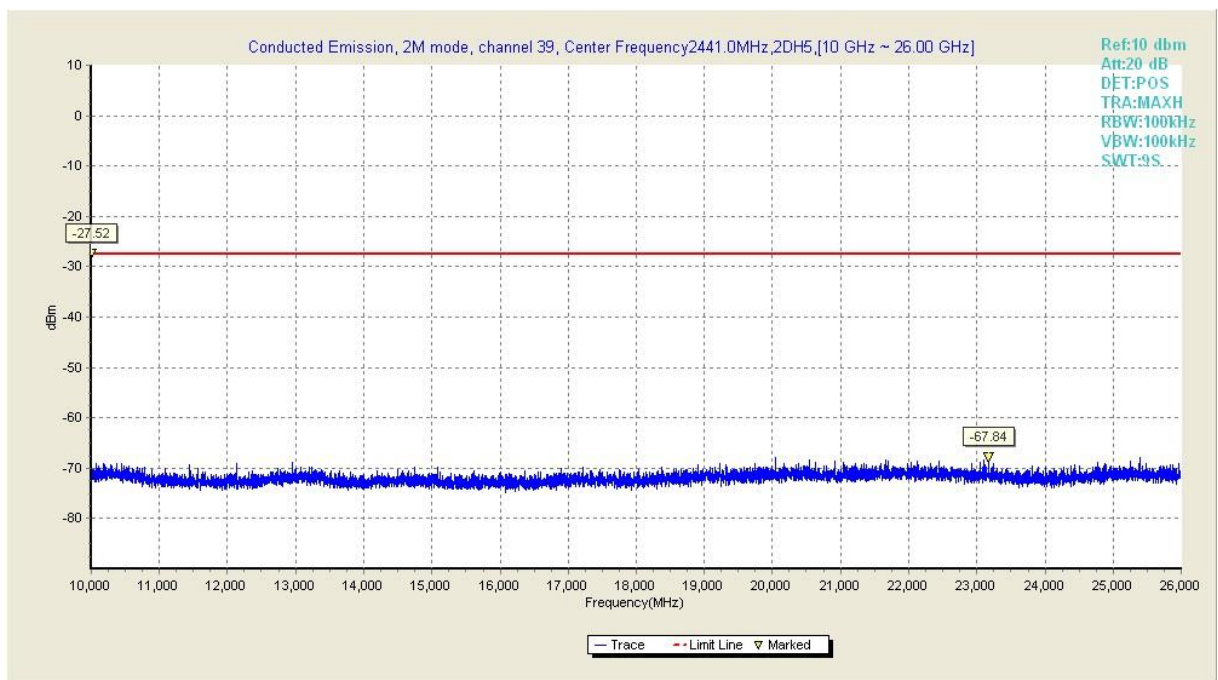


**Fig.49** Conducted Emission in 2M mode ,channel 39, (30 MHz ~ 1 GHz)

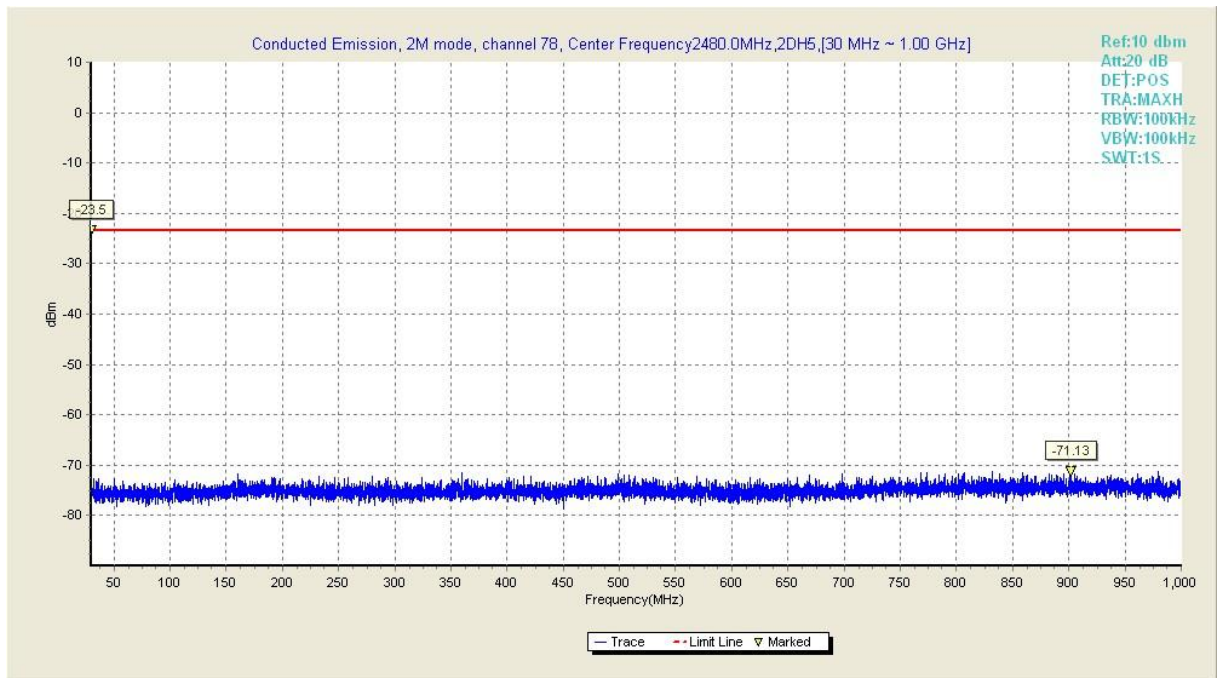




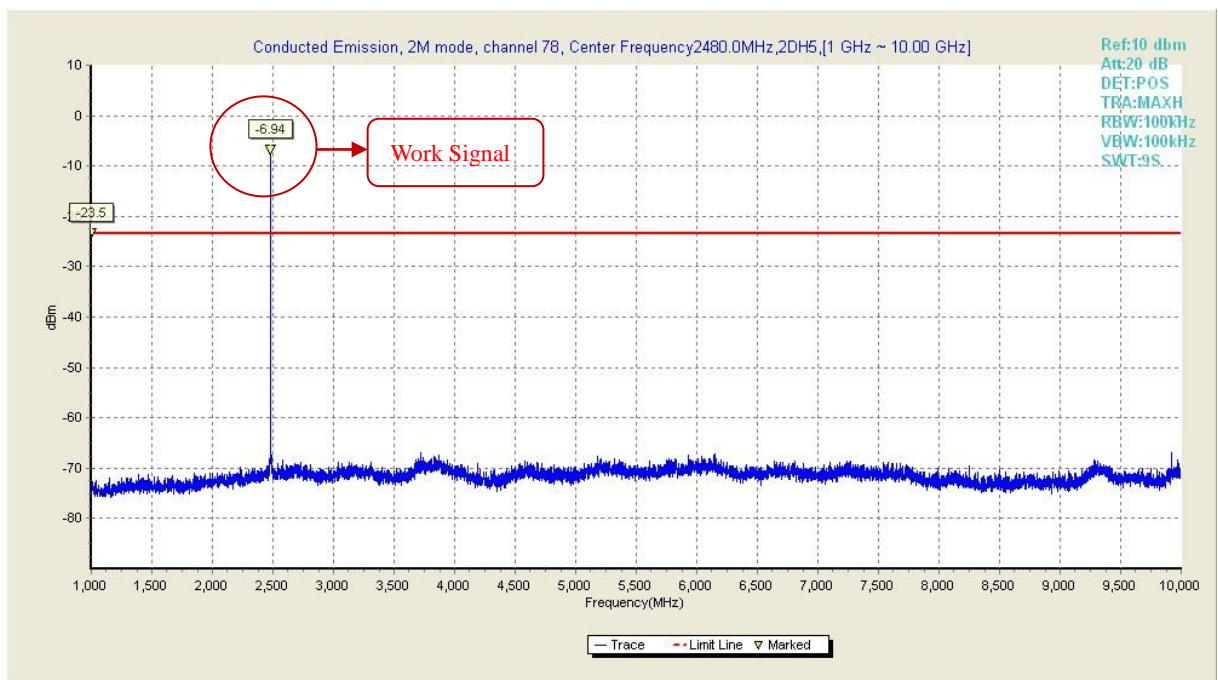
**Fig.50 Conducted Emission in 2M mode ,channel 39, (1 GHz ~ 10 GHz)**



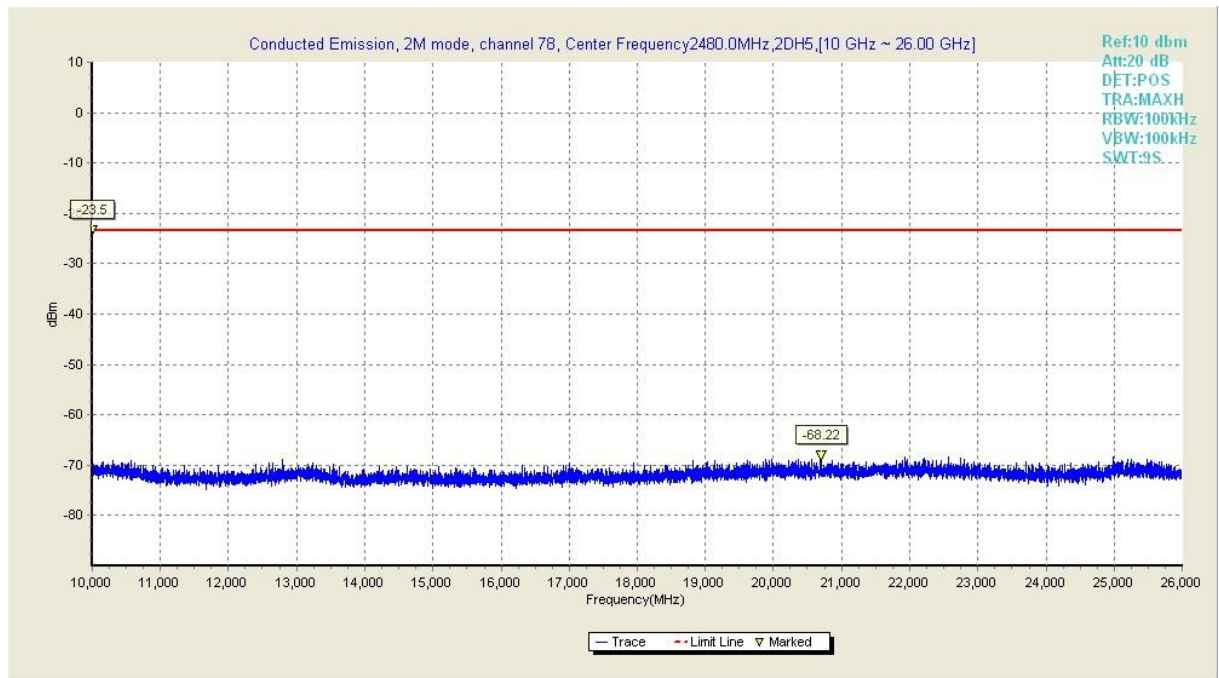
**Fig.51 Conducted Emission in 2M mode ,channel 39, (10 GHz ~ 26 GHz)**



**Fig.52 Conducted Emission in 2M mode ,channel 78, (30 MHz ~ 1 GHz)**



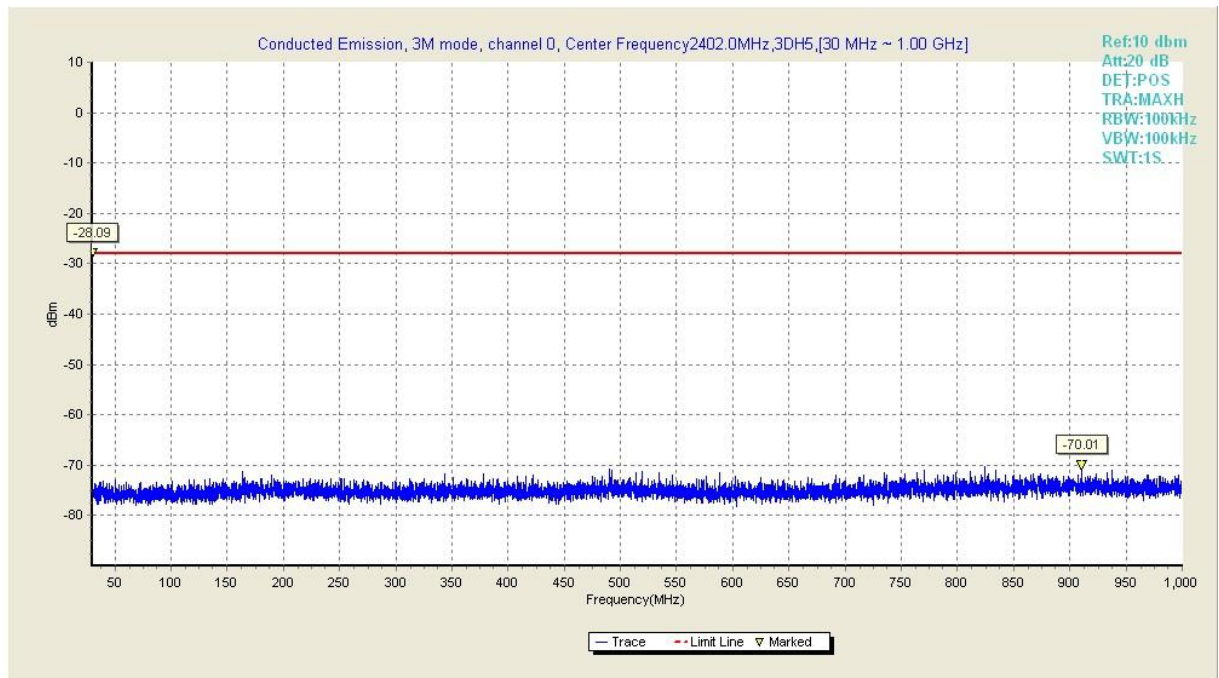
**Fig.53 Conducted Emission in 2M mode ,channel 78, (1 GHz ~ 10 GHz)**



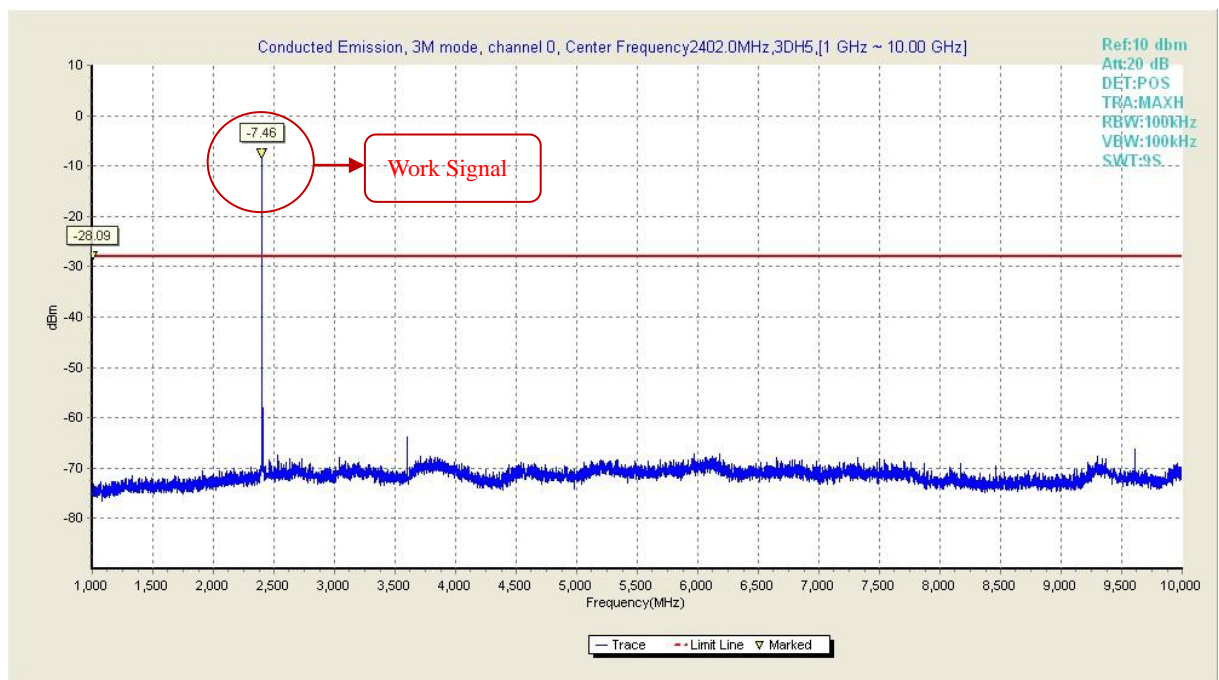
**Fig.54 Conducted Emission in 2M mode ,channel 78, (10 GHz ~ 26 GHz)**

## 8DPSK Modulation

| Channel | Frequency Range | Test Results | Verdict |
|---------|-----------------|--------------|---------|
| 0       | 30MHz ~ 1GHz    | Fig.55       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.56       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.57       | Pass    |
| 39      | 30MHz ~ 1GHz    | Fig.58       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.59       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.60       | Pass    |
| 78      | 30MHz ~ 1GHz    | Fig.61       | Pass    |
|         | 1GHz ~ 10GHz    | Fig.62       | Pass    |
|         | 10GHz ~ 26GHz   | Fig.63       | Pass    |

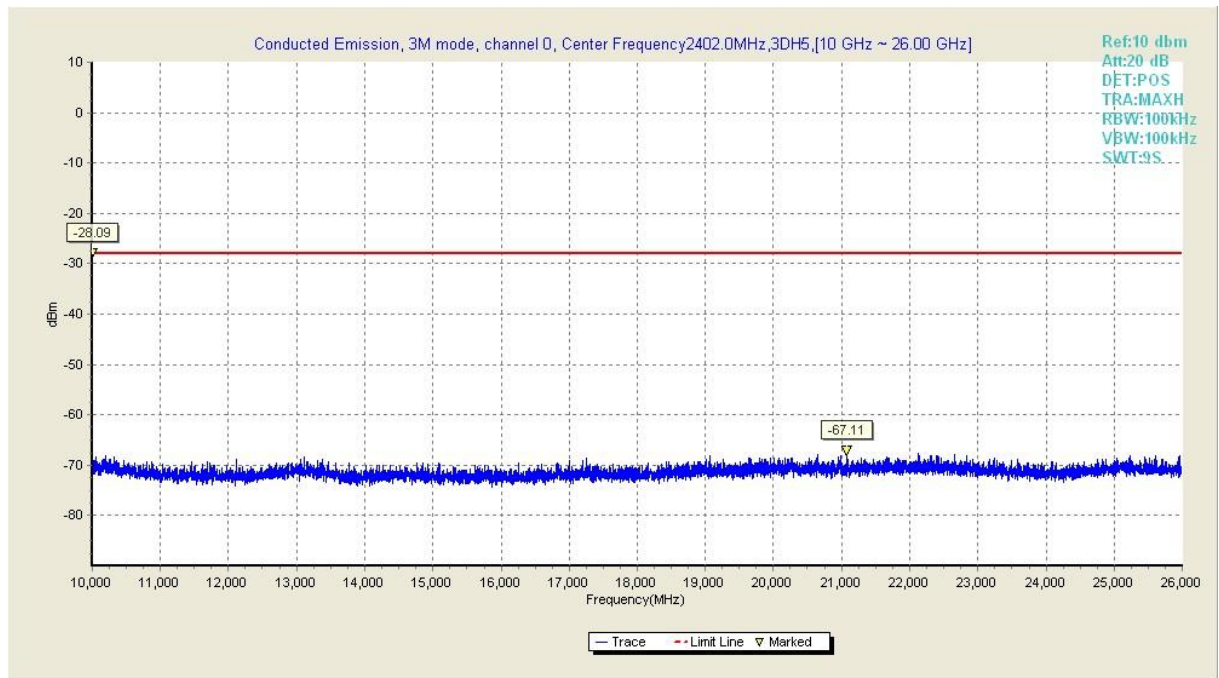


**Fig.55 Conducted Emission in 3M mode ,channel 0, (30 MHz ~ 1 GHz)**

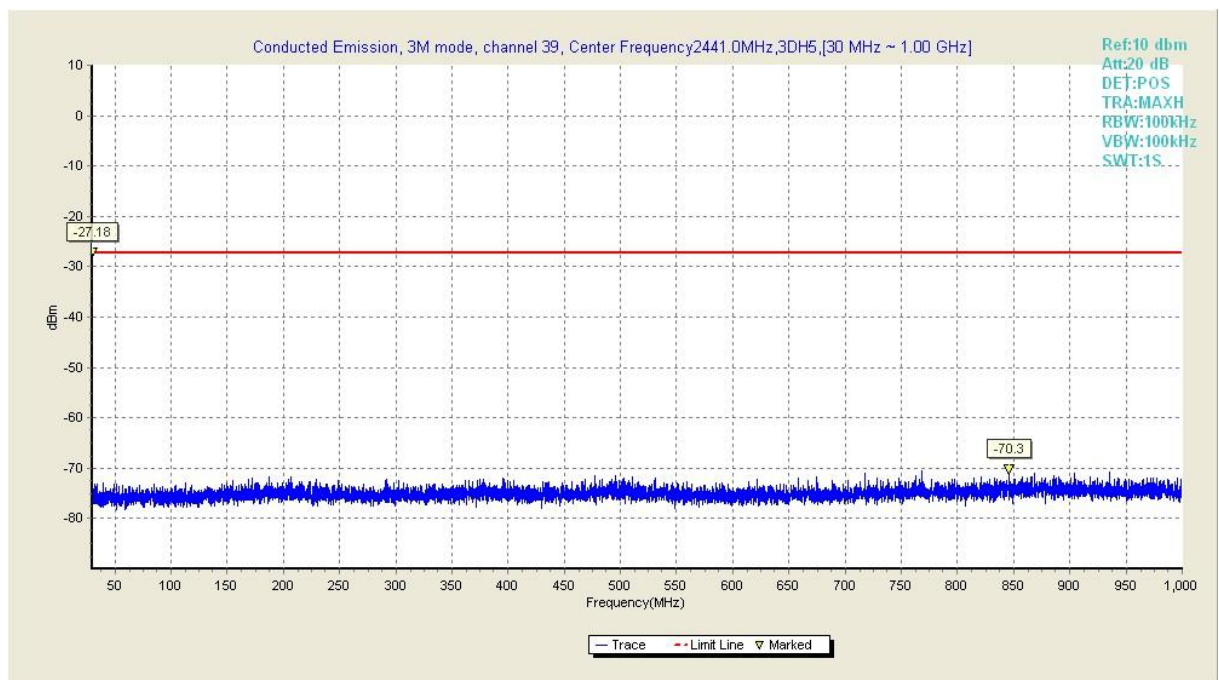


**Fig.56 Conducted Emission in 3M mode ,channel 0, (1 GHz ~ 10 GHz)**



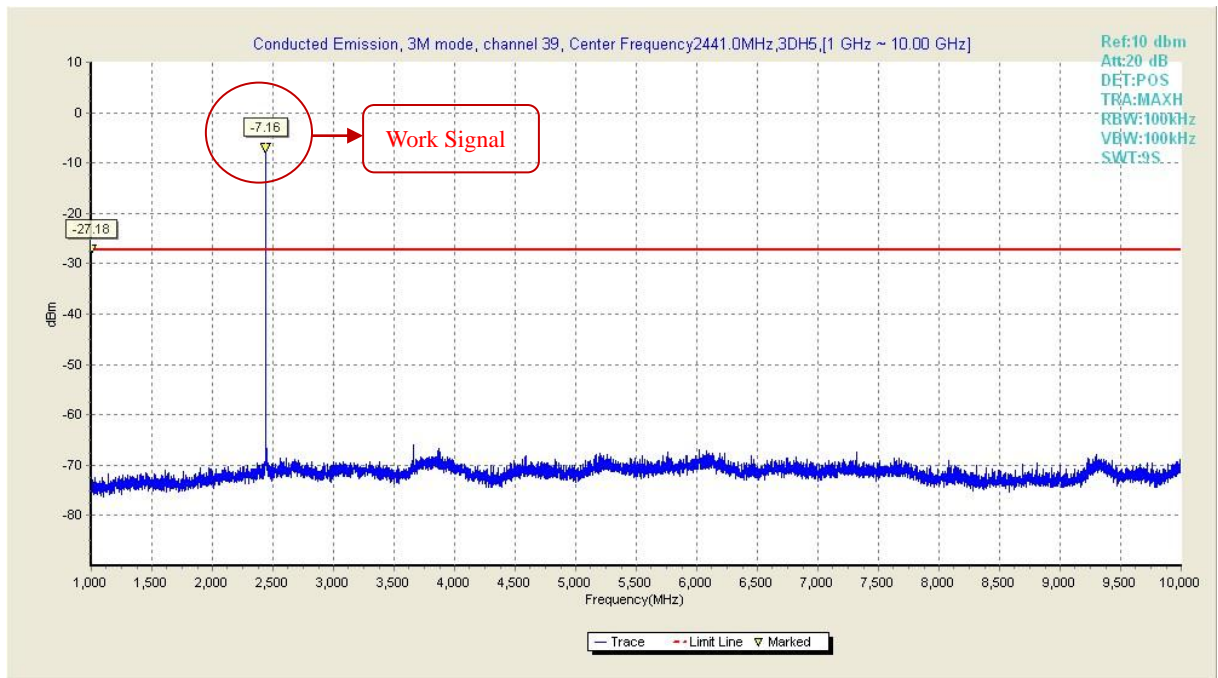


**Fig.57** Conducted Emission in 3M mode ,channel 0, (10 GHz ~ 26 GHz)

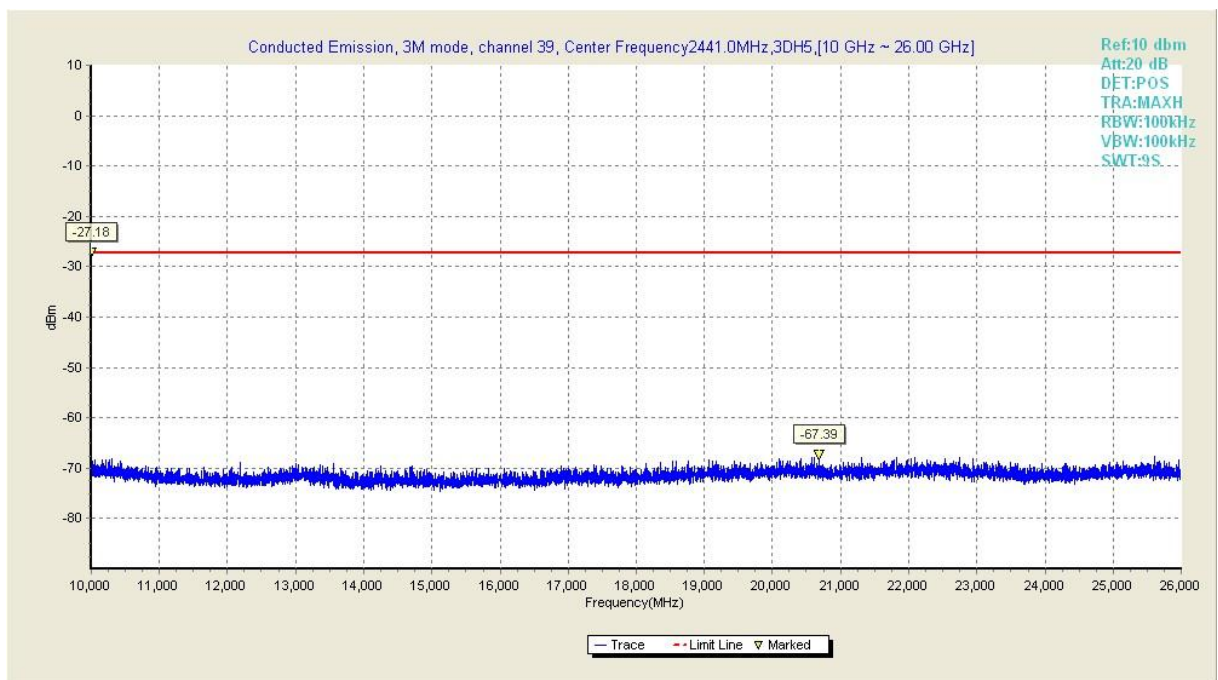


**Fig.58** Conducted Emission in 3M mode ,channel 39, (30 MHz ~ 1 GHz)

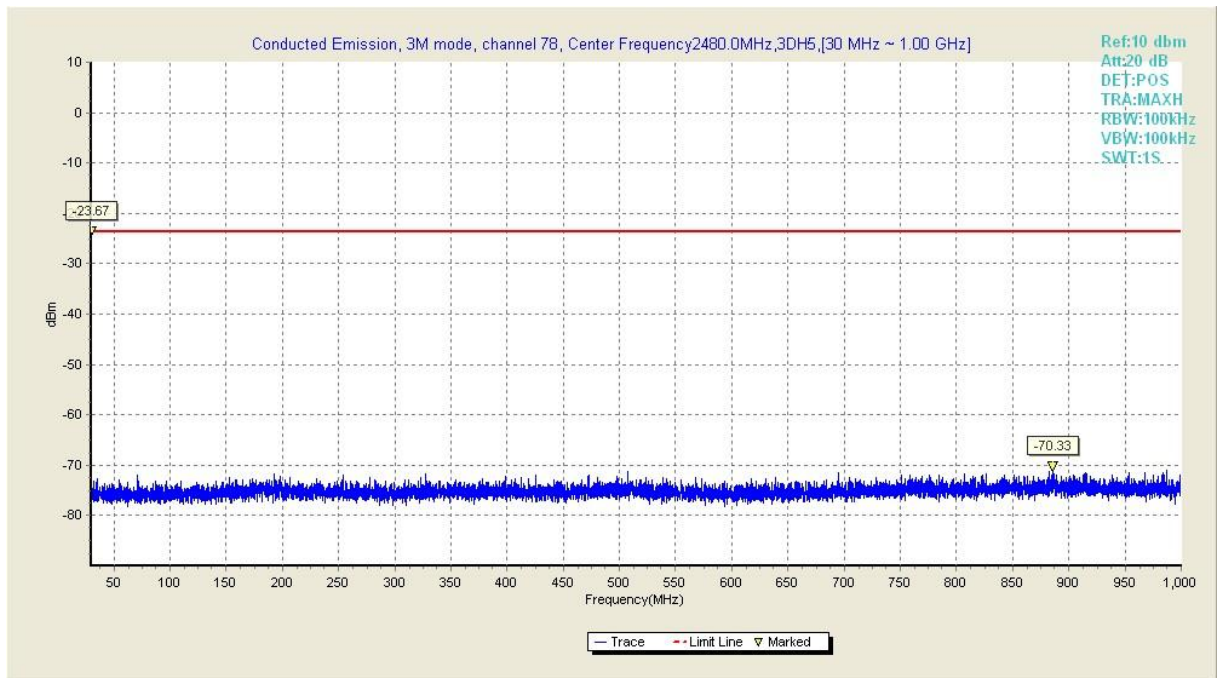




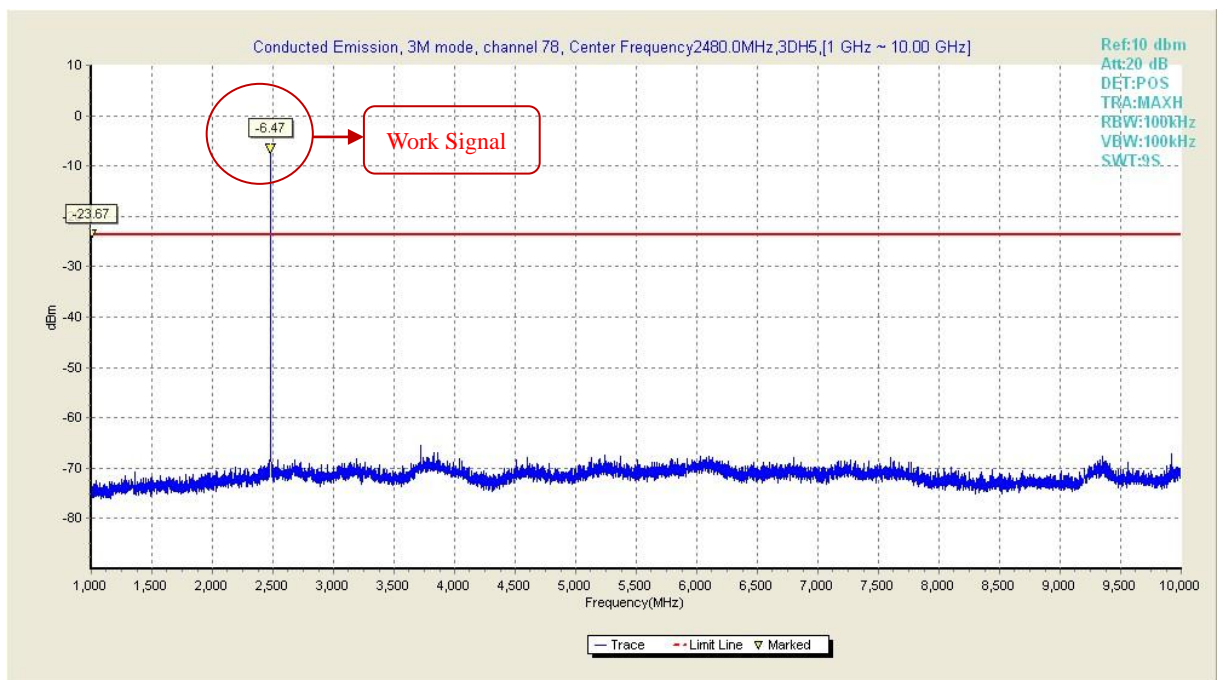
**Fig.59 Conducted Emission in 3M mode ,channel 39, (1 GHz ~ 10 GHz)**



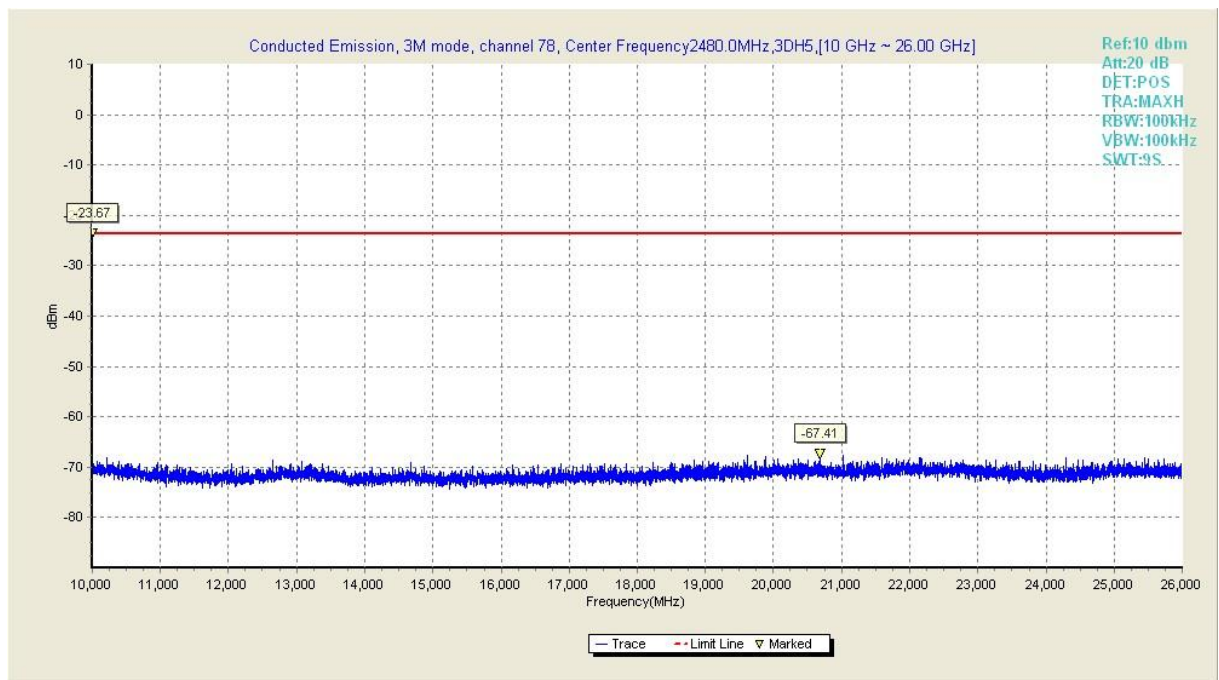
**Fig.60 Conducted Emission in 3M mode ,channel 39, (10 GHz ~ 26 GHz)**



**Fig.61 Conducted Emission in 3M mode ,channel 78, (30 MHz ~ 1 GHz)**



**Fig.62 Conducted Emission in 3M mode ,channel 78, (1 GHz ~ 12 GHz)**



**Fig.63 Conducted Emission in 3M mode ,channel 78, (10 GHz ~ 26 GHz)**

## B.8 AC Conducted Emission

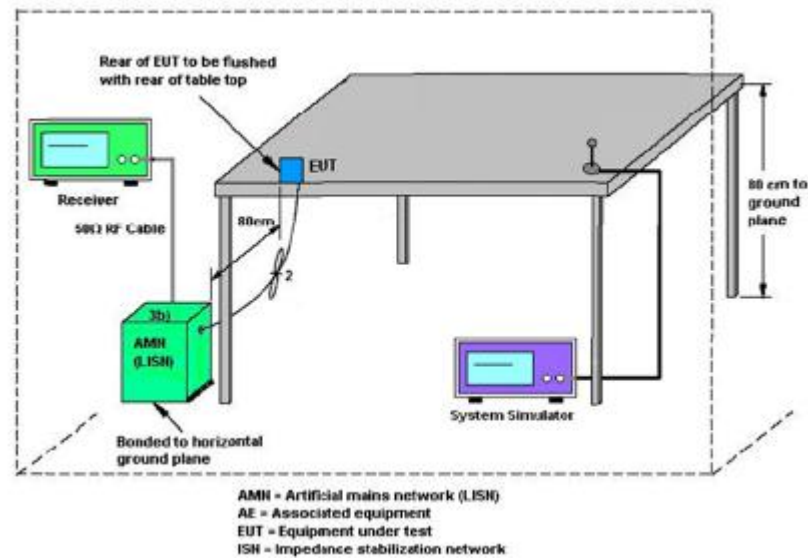
### B.8.1 Description

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits

### B.8.2 Test Procedure

- The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The FCC states that a 50 ohm, 50 microhenry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

### B.8.3 Test Setup



**B.8.4 Test Results****Limit**

| Frequency of Emission(MHz)                 | Conducted Limit(dB $\mu$ V) |           |
|--|-----------------------------|-----------|
|  | Quasi –Peak                 | Average   |
| 0.15-0.5                                   | 66 to 56*                   | 56 to 46* |
| 0.5-5                                      | 56                          | 46        |
| 5-30                                       | 60                          | 50        |
| *Decreases with logarithm of the frequency |                             |           |



Line L

Scan Settings (1 Range)

| Frequencies |        |       | Receiver Settings |        |       |        |
|-------------|--------|-------|-------------------|--------|-------|--------|
| Start       | Stop   | Step  | Res BW            | M-Time | Atten | Preamp |
| 150 kHz     | 30 MHz | 4 kHz | 9kHz (6dB)        | 15 ms  | Auto  | Off    |

Final Measurement

Detectors:

AV, QP

Meas Time:

1 s

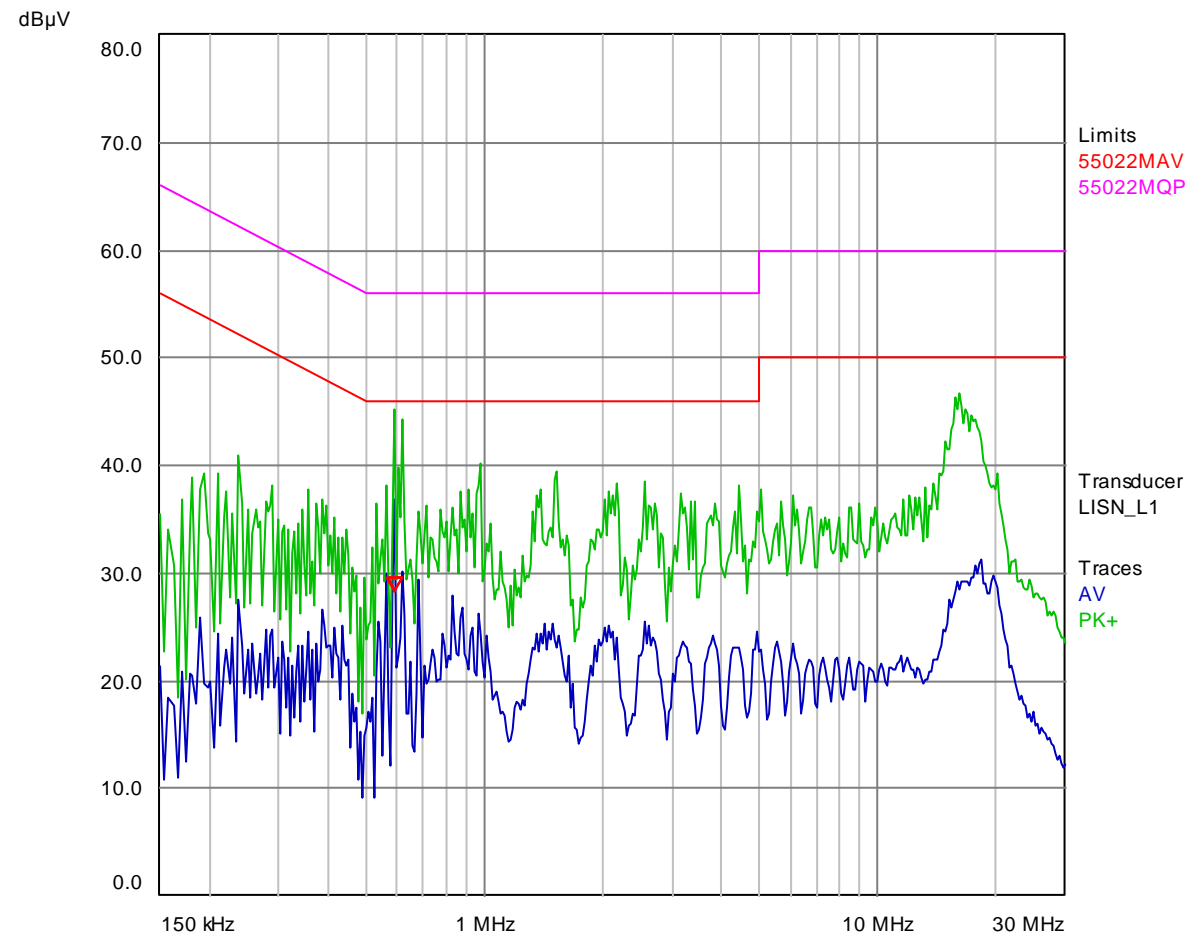
Peaks:

6

Acc. Margin:

10 dB

Pre-measurement Graph



Final Measurement Results

| Trace | Frequency (MHz) | Level (dBµV) | Limit (dBµV) | Delta Limit (dB) | Delta Ref (dB) | Comment |
|-------|-----------------|--------------|--------------|------------------|----------------|---------|
| 1 AV  | 0.59            | 28.35        | 46.00        | -17.65           |                | L1 / on |

\* = limit exceeded

Line N

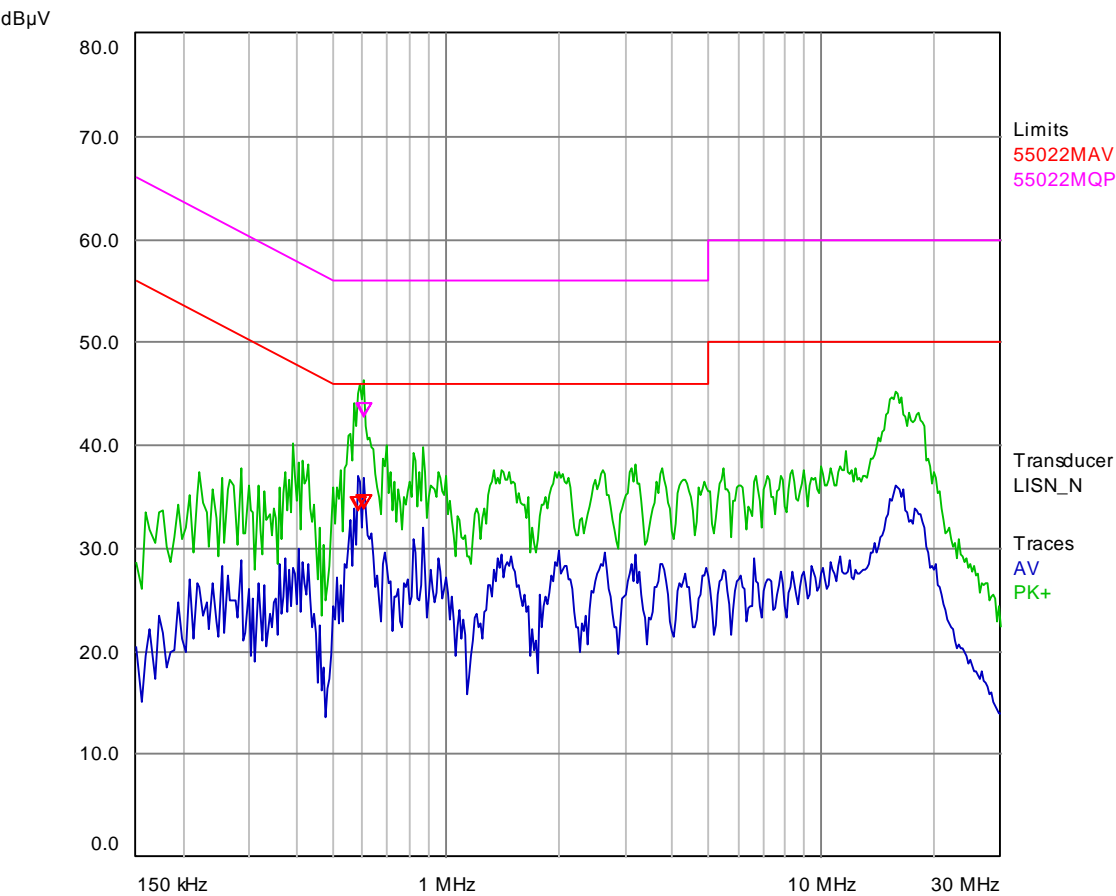
Scan Settings (1 Range)

| Frequencies |        |         | Receiver Settings |        |       |        |
|-------------|--------|---------|-------------------|--------|-------|--------|
| Start       | Stop   | Step    | Res BW            | M-Time | Atten | Preamp |
| 150 kHz     | 30 MHz | 4.5 kHz | 9 kHz (6dB)       | 15 ms  | Auto  | Off    |

Final Measurement

|            |        |              |       |
|------------|--------|--------------|-------|
| Detectors: | AV, QP | Meas Time:   | 1 s   |
| Peaks:     | 6      | Acc. Margin: | 10 dB |

Pre-measurement Graph



**Final Measurement Results**

| Trace | Frequency (MHz) | Level (dBμV) | Limit (dBμV) | Delta Limit (dB) | Delta Ref (dB) | Comment |
|-------|-----------------|--------------|--------------|------------------|----------------|---------|
| 1 AV  | 0.582           | 33.74        | 46.00        | -12.26           |                | N / on  |
| 1 AV  | 0.6045          | 33.91        | 46.00        | -12.09           |                | N / on  |
| 2 QP  | 0.6045          | 42.78        | 56.00        | -13.22           |                | N / on  |

\* = limit exceeded

**B.9 Radiated Emission****B.9.1 Limit of Radiated Emission**

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below

| Frequency(MHz) | Field Strength(microvolts/meters) | Measurement Distance(Meters) |
|----------------|-----------------------------------|------------------------------|
| 0.009-0.490    | 2400/F(kHz)                       | 3000                         |
| 0.490-1.705    | 24000/F(kHz)                      | 30                           |
| 1.705-30.0     | 30                                | 30                           |
| 30-88          | 100                               | 3                            |
| 88-216         | 150                               | 3                            |
| 216-960        | 200                               | 3                            |
| above 960      | 500                               | 3                            |

**B.9.2 Test Procedure**

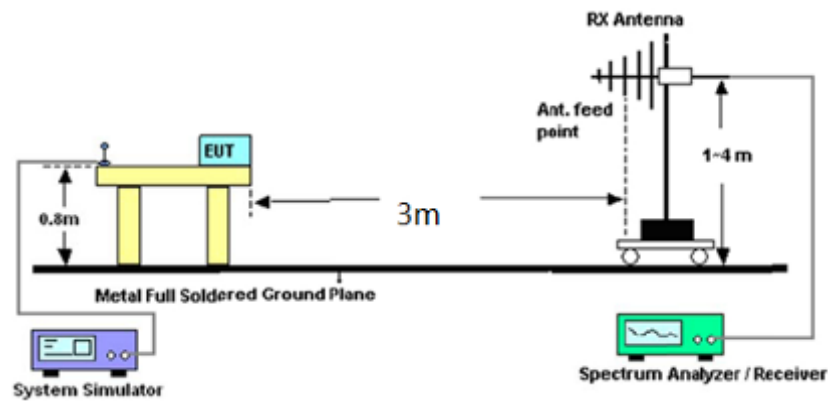
- a. The EUT was placed on a turntable with 1.5meter above ground.
- b. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- c. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The height of the antenna is varied between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
- e. For each suspected emission, the EUT was arranged to its worst case and then tune the antenna tower(from 1 m to 4 m)and turntable(from 0 degree to 360 degrees)to find the maximum reading.
- f. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode. SA setting: Span= wide enough to fully capture the emission being measured; RBW=1MHz (f > 1GHz), RBW=100kHz (f<1GHz), VBW≥ RBW, Sweep time=auto, Trace= Max hold. Above 18GHz shall be extrapolated to specified distance using an extrapolation factor 20dB/decade from 3m to 1m.
- g. If the emission level of the EUT in peak mode was 20dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the quasi-peak method and reported.

h. Emission level (dB $\mu$ V/m) = 20 log Emission level ( $\mu$ V/m).

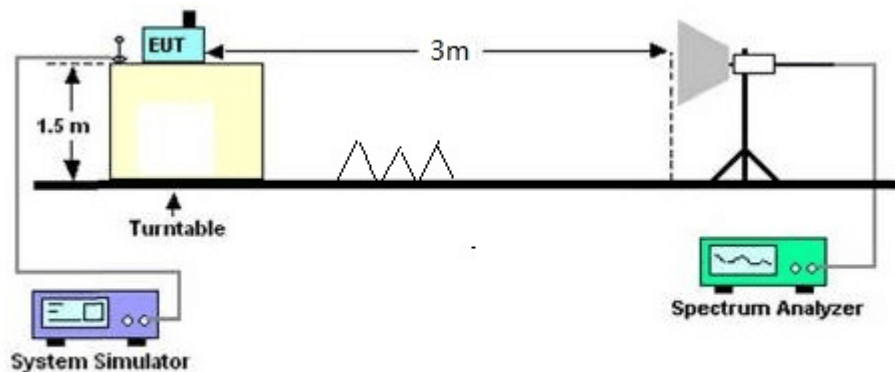
## B.9.3 Test Setup

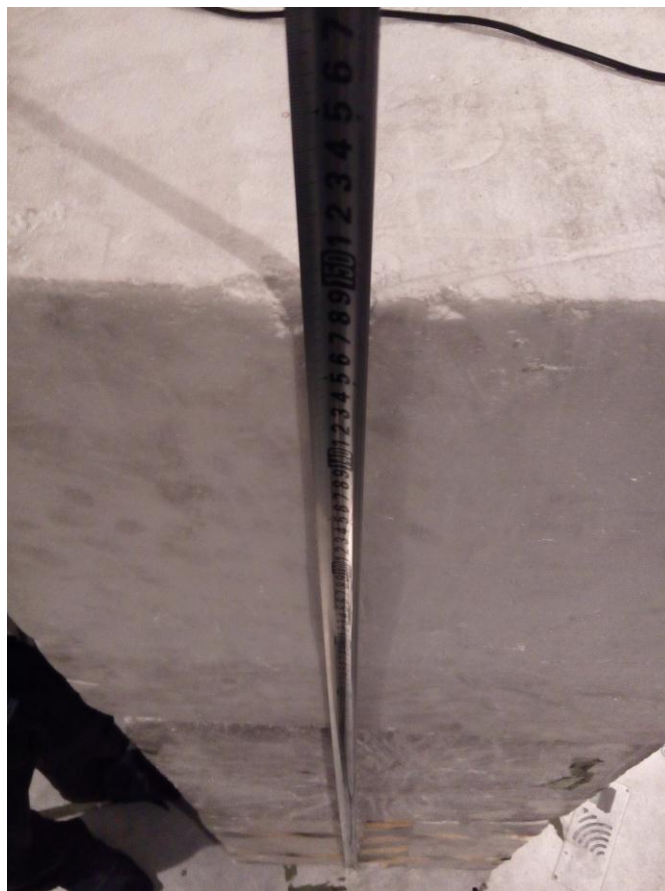
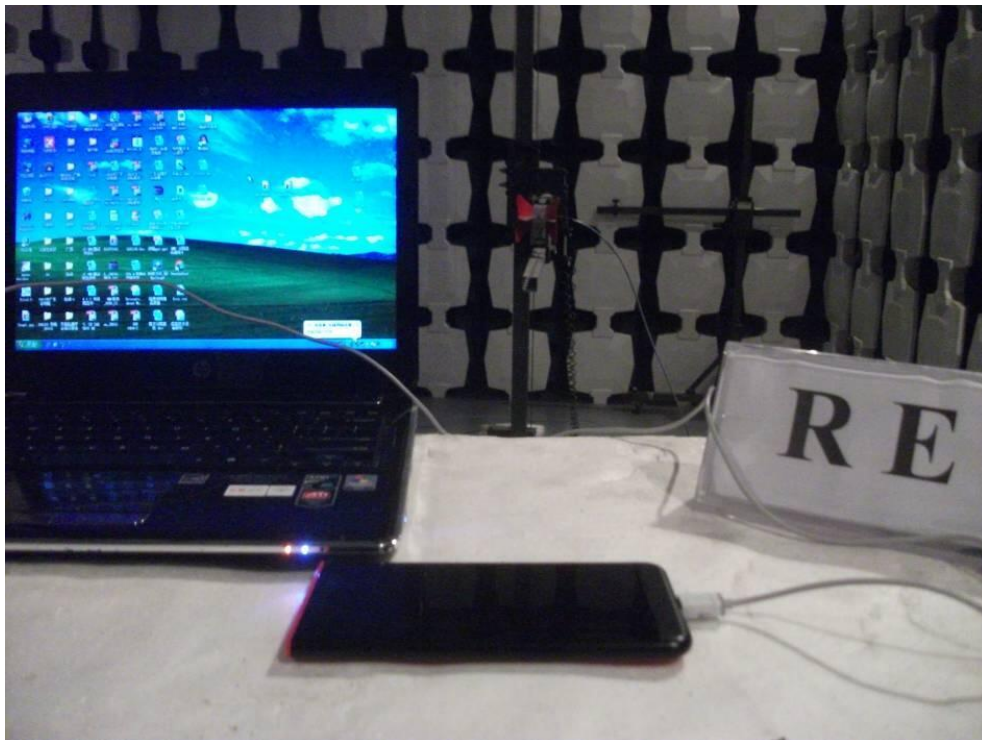
| Frequency Band(MHz) | Function | Resolution Bandwidth | Video Bandwidth |
|---------------------|----------|----------------------|-----------------|
| 30 to 1000          | QP       | 100kHz               | 100kHz          |
| Above 1000          | Peak     | 1MHz                 | 1MHz            |
|                     | Average  | 1MHz                 | 10Hz            |

### Radiated Emissions Frequency: Below 1GHz

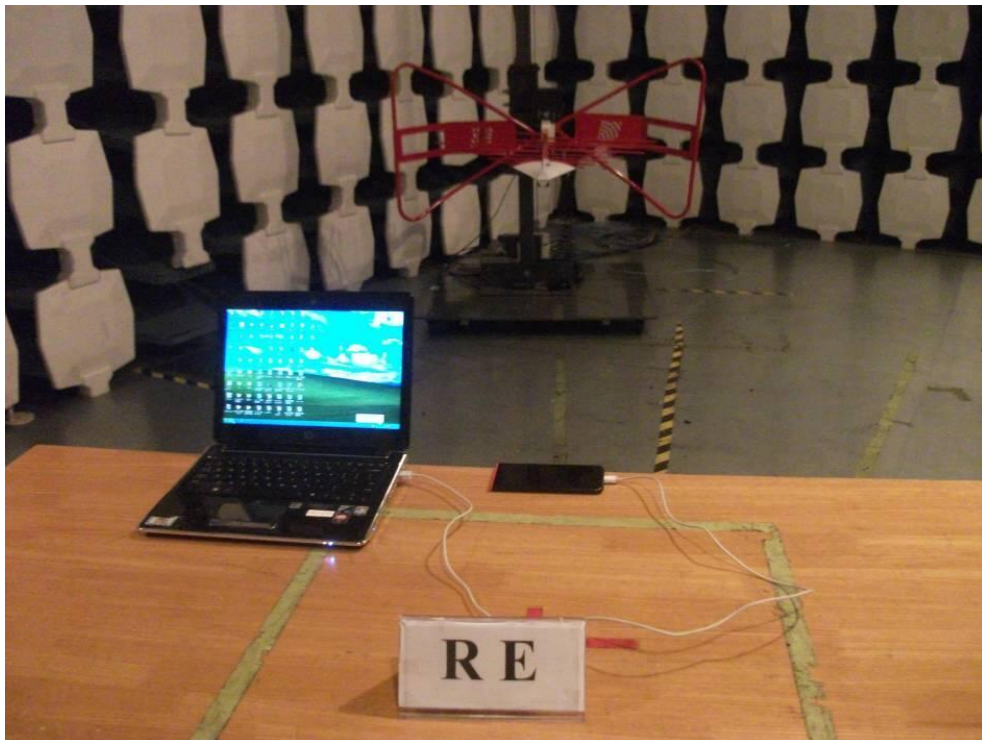


### Radiated Emissions Frequency: above 1GHz









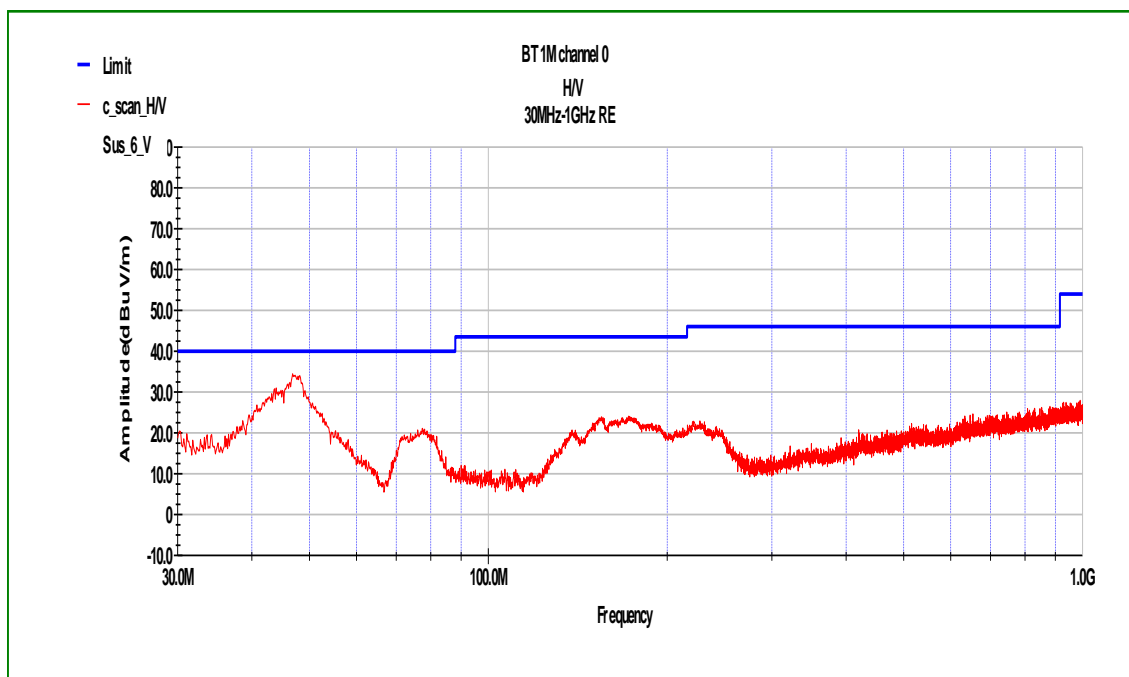
#### B.9.4 Test Results

The low frequency, which started from 9kHz to 30MHz and the high frequency, which started from 18GHz to 26GHz, were pre-scanned and which was 20dB lower than limit line per 15.31(0) were not reported.

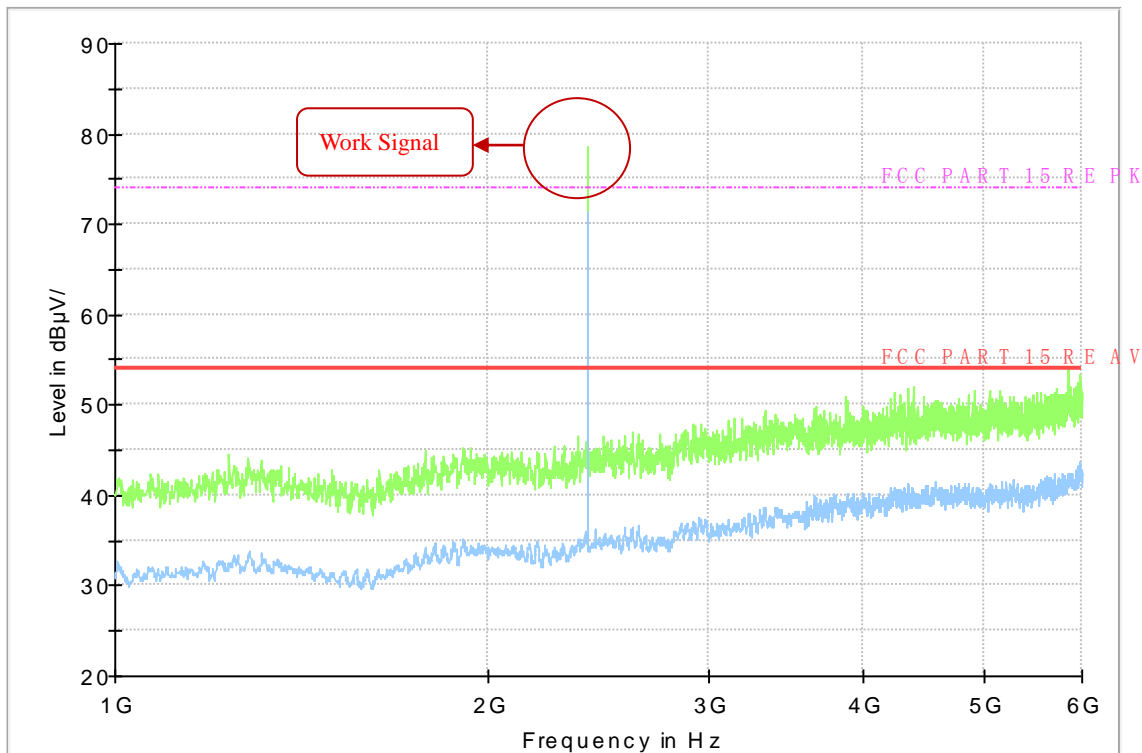
**Worst case data rate: 1M**

**Test Mode: Traffic**

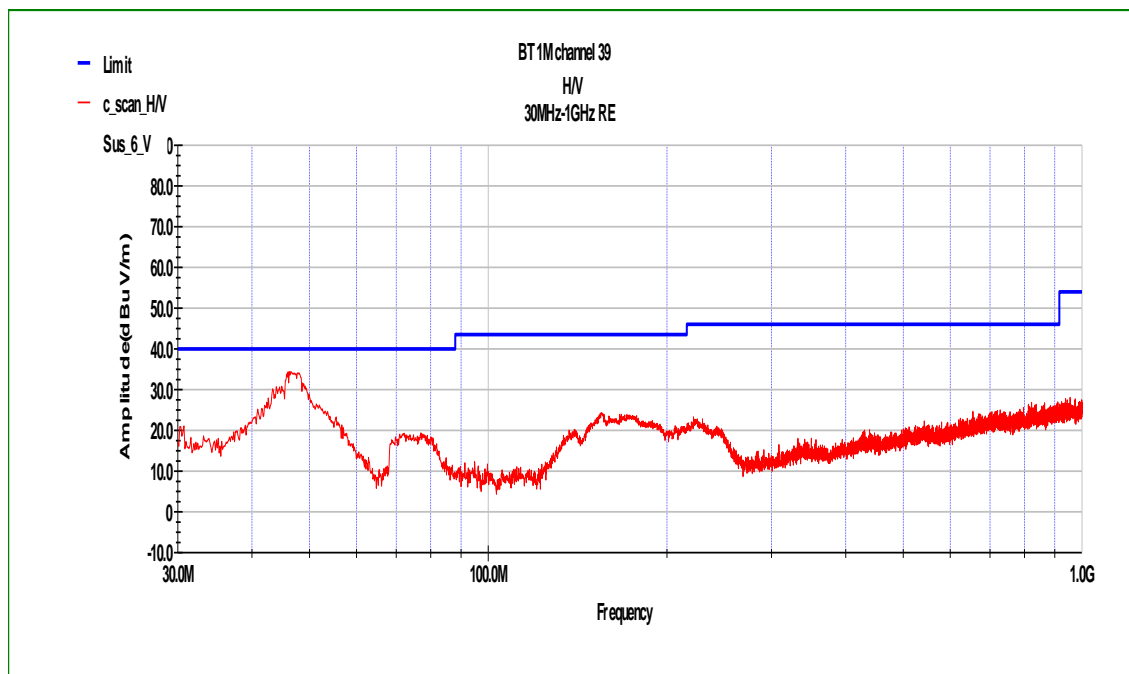
**Verdict: Pass**



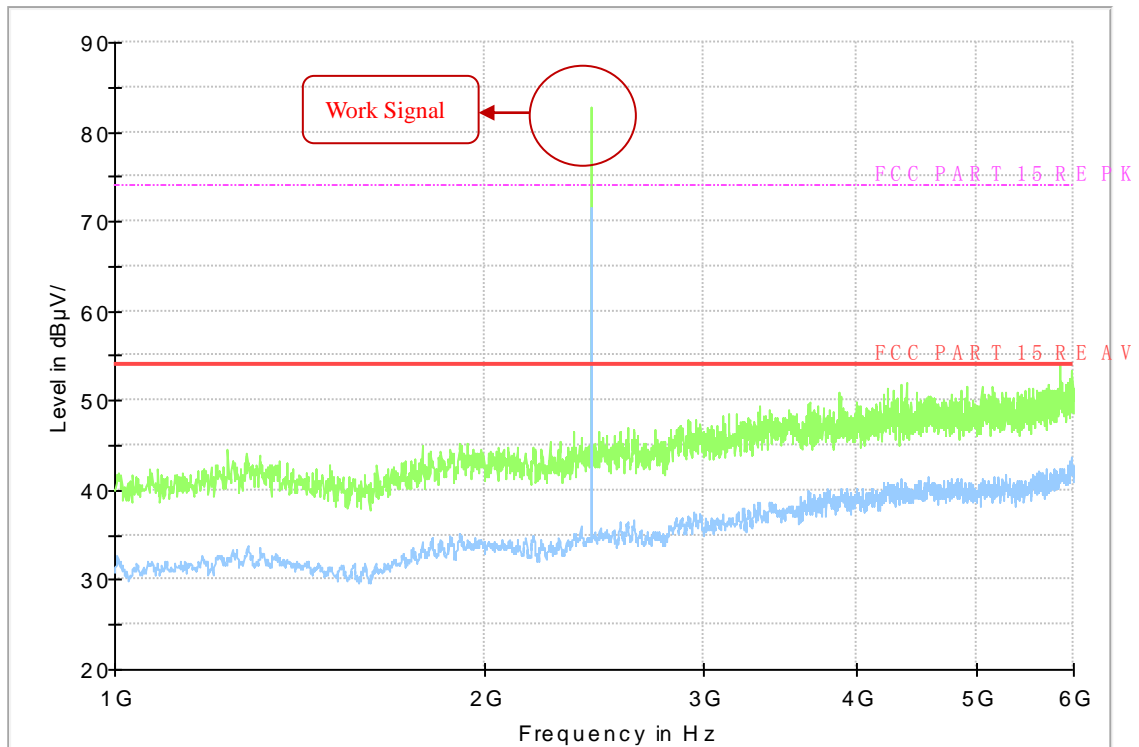
**Fig.65 Radiated Emission of channel 0 in 30MHz-1GHz**



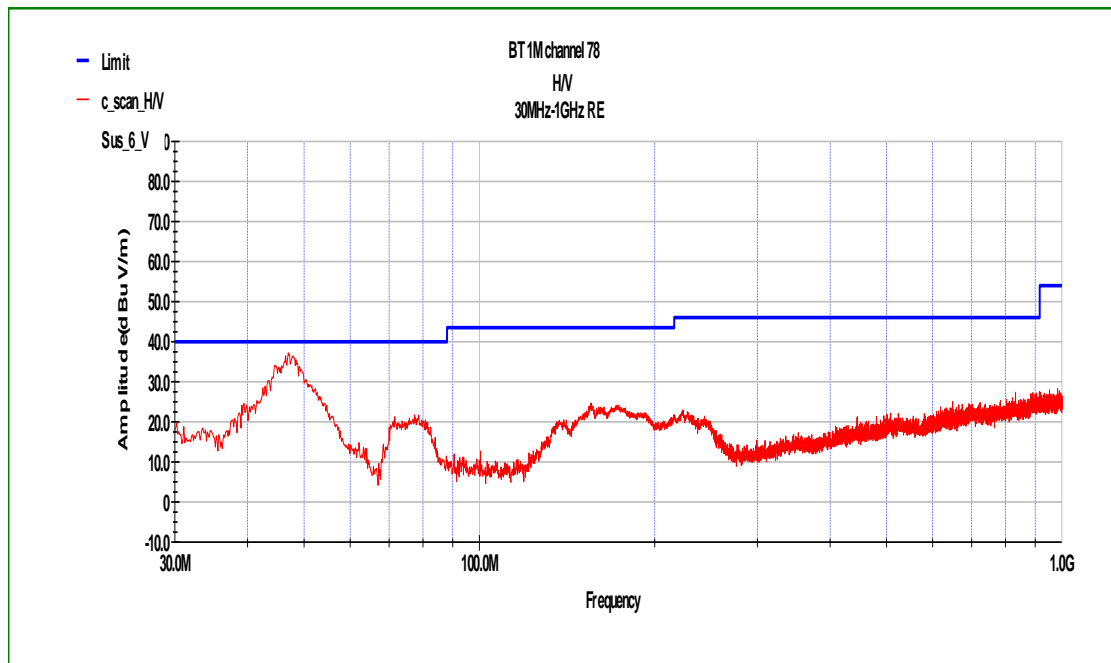
**Fig.63 Radiated Emission of channel 0 in 1GHz-6GHz**



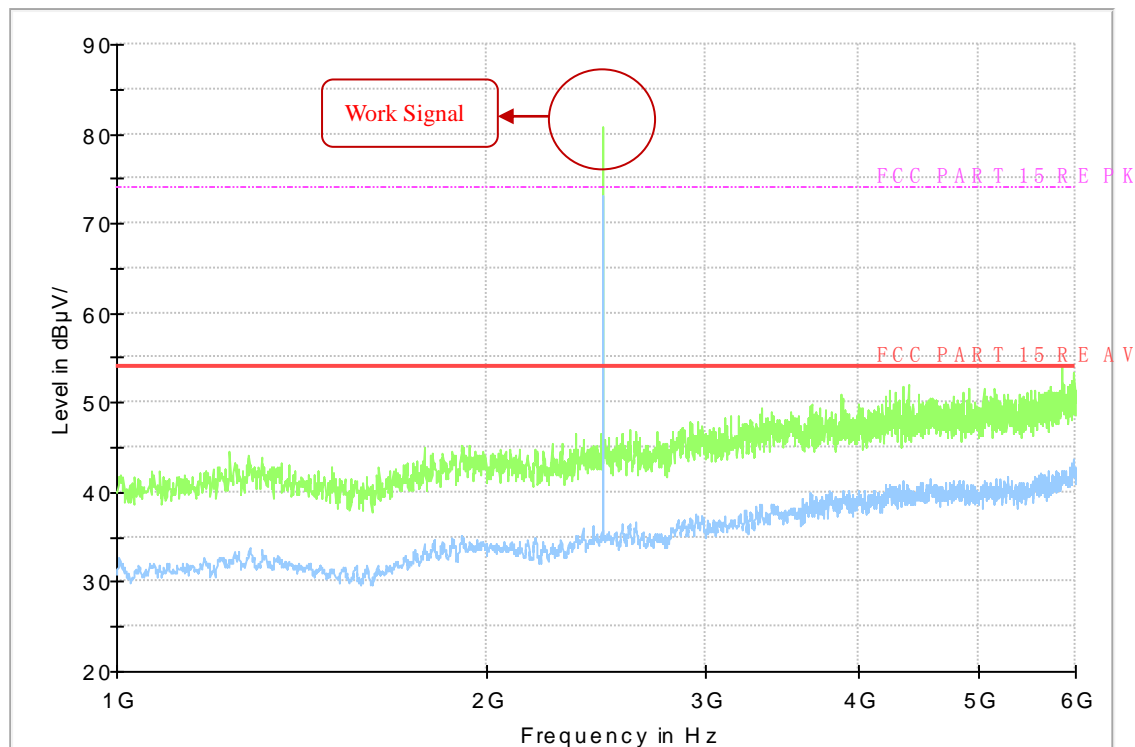
**Fig.66 Radiated Emission of channel 39 in 30MHz-1GHz**



**Fig.67 Radiated Emission of channel 39 in 1GHz-6GHz**



**Fig.68 Radiated Emission of channel 78 in 30MHz-1GHz**



**Fig.69 Radiated Emission of channel 78 in 1GHz-6GHz**

## B.10 Antenna Requirements

### B.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 FCC rule.

### B.10.2 Antenna Connected construction

The Antenna type used in this product is PIFA Antenna without connector and it is considered to meet antenna requirement.

### B.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6dBi, Therefore, it is not necessary to reduced maximum peak output power limit.

## ANNEX C: Report Revision History

| Report NO. | Report version | Description | Issue Date |
|------------|----------------|-------------|------------|
| 150934-BT  | NONE           | Original    | 2015.11.27 |
|            |                |             |            |
|            |                |             |            |

**\*\*\*END OF REPORT\*\*\***