# FCC PART 90
# EMI MEASUREMENT AND TEST REPORT

For

## AES Corporation

285 Nerbury Street, Peabody, Massachusetts, 01960, USA

**Model No: 7088**

**FCC ID: L9N-7088-UE**

| **This Report Concerns:** | **Equipment Type:** |
|---|---|
| ☒ Original Report | Transceiver |

| | |
|---|---|
| **Test Engineer:** | Paul Tan |
| **Report No.:** | BTR07071801-1 |
| **Report Date:** | 2007-07-31 |
| **Reviewed By:** | Chris Zeng |
| **Prepared By:** | Best Test Service (Shenzhen) Co., Ltd.<br>Flat 11E, Xinhaofang Building, 11018,Shennan Road,<br>Nanshan District, Shenzhen, China<br>Tel: +86-755-86182350<br>Fax: +86-755-86182353 |

## TABLE OF CONTENTS

# GENERAL INFORMATION

## Product Description for Equipment Under Test (EUT)

The AES Corporation.'s Model: 7088 or the "EUT" as referred to in this report is a Transceiver, which measures approximately 13cmL x 4.6cmW x 2.1cmH, powered by DC 13.8V battery.

The EUT operates at 400MHz-480MHz with maximum power of 36.97dBm (4.97W), have a BNC type antenna port, have two kinds of channel separation, one is 12.5KHz, the other is 25KHz.

**The test data gathered are from production sample serial number 060918743 provided by the manufacturer.*

## Objective

This report is prepared on behalf of AES Corporation. in accordance with Part 90 Subpart A, and Subpart I of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC Part 2 and Part 90 rules

## Related Grant/Submission

No Related Submittals.

## Test Methodology

All tests and measurements indicated in t his document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA/EIA 603 -C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio -Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

## Test Facility

All measurement facilities used to collect the data are located at Huatongwei Building , Keji Rd, 12 S, high-Tech Park, Nanshan District, Shenzhen, China.
The sites are constructed in conformance with the requirements of ANSI C63.7/634 and CISPR 22, The site was accredited by FCC(662850), A2LA( 2243.01) and CNAL (L1225)
All emissions measurement was performed at Shenzhen Huatongwei International Inspect. Co., Ltd.

## Test Equipment List

| Manufacturer | Description | Model | Serial Number | Cal. Date | Cal. Due.Date |
|---|---|---|---|---|---|
| ESPEC | Climate Chamber | EL-10KV | 05107008 | 2006-08-05 | 2007-08-05 |
| Rohde&Schwarz | EMI Test RECEIVER | ESIB26 | 100009 | 2006-08-05 | 2007-08-05 |
| HP | Modulation Analyzer | 8901B | 3104A03367 | 2006-08-05 | 2007-08-05 |
| Rohde&Schwarz | Audio Generator | SMT03 | 100059 | 2006-08-05 | 2007-08-05 |
| ROHDE & SCHWARZ | Ultra-Broadband Antenna | HL562 | 100015 | 2006-08-05 | 2007-08-05 |
| ROHDE & SCHWARZ | EMI TEST RECEIVER | ESI 26 | 100009 | 2006-08-05 | 2007-08-05 |
| ROHDE & SCHWARZ | RF TEST PANEL | TS / RSP | 335015/ 0017 | N/A | N/A |
| ETS | TURNTABLE | 2088 | 2149 | N/A | N/A |
| ETS | ANTENNA MAST | 2075 | 2346 | N/A | N/A |
| ROHDE & SCHWARZ | EMI TEST SOFTWARE | ES-K1 V1.71 | NA | N/A | N/A |
| SUNOL SCIENCE | Horn Antenna | DRH-118 | A052605 | 2006-08-05 | 2007-08-05 |
| SUNOL SCIENCE | Horn Antenna | DRH-118 | A052607 | 2006-08-05 | 2007-08-05 |
| Tektronix | Storage Oscilloscope | TDS3052 | B017447 | 2006-08-05 | 2007-08-05 |
| HP | Communication Tester | HP8920B | US35010135 | 2006-08-05 | 2007-08-05 |

*** Statement of Traceability:** All calibration has been performed using suitable standards traceable to NIM China.

# SYSTEM TEST CONFIGURATION

## Justification

The EUT was tested under typical operating modes to represent the worst-case results during the final qualification test.

## EUT Test Configuration

Set the channel to Low, Middle, and High channel in factory and then EUT was powered and fully operated by pushing PTT (Push To Talk) button to transmitting mode to test.
The EUT was Lie/ Stand/Side On the test table, and Lie is the worst mode, and the worst mode' s data was included in this report.

## Equipment Modifications

BEST Test Service (Shenzhen) Co., Ltd has not done any modification to the EUT.

## SUMMARY OF TEST RESULT

| FCC Rules | Description of Test | Test Result |
|---|---|---|
| 2.1046<br>90.205 | RF Output Power | Complied |
| 2.1047<br>90.207 | Modulation Characteristics | Complied |
| 2.1049<br>90.209 | Occupied Bandwidth | Complied |
| 2.1051<br>90.210 | Spurious Emission at Antenna Port | Complied |
| 2.1053<br>90.210 | Radiated Spurious Emission | Complied |
| 2.1055<br>90.213 | Frequency Stability | Complied |
| 90.214 | Transient Frequency Behavior | Complied |

# CONDUCTED OUTPUT POWER

## Applicable Standard

Per FCC §2.1046, §90.205 and §90.309: the maximum transmitter output power depends on HAAT and service area radius.

## Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuator.

## Test Results

| Channel | Frequency | Output Power in dBm | Output Power in W |
|---|---|---|---|
| 25KHz | | | |
| Low | 400.025 | 36.47 | 4.43 |
| Middle | 449.025 | 36.73 | 4.70 |
| High | 479.9875 | 36.97 | 4.97 |
| 12.5KHz | | | |
| Low | 400.0125 | 36.45 | 4.42 |
| Middle | 435.0125 | 36.75 | 4.73 |
| High | 469.9875 | 36.94 | 4.94 |

# MODULATION CHARACTERISTICS

## Applicable Standard

Per FCC § 2.1047, § 90.207,
Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.

## Test Procedure

A, Modulation Limit

1) Configure the EUT as shown in figure 1, adjust the audio input for 60% of rated system deviation at 1KHz using this level as a reference (0dB) and vary the input level from –20 to +20dB. Record the frequency deviation obtained as a function of the input level.

2) Repeat step 1 with input frequency changing to 300 and 2500Hz in sequence.

B, Audio Frequency Response

1). Configure the EUT as shown in figure 1
2). Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0dB).
3). Vary the Audio frequency from 100 Hz to 10 KHz and record the frequency deviation.
4) Audio Frequency Response =20log10 (Deviation of test frequency/Deviation of 1 KHz reference).

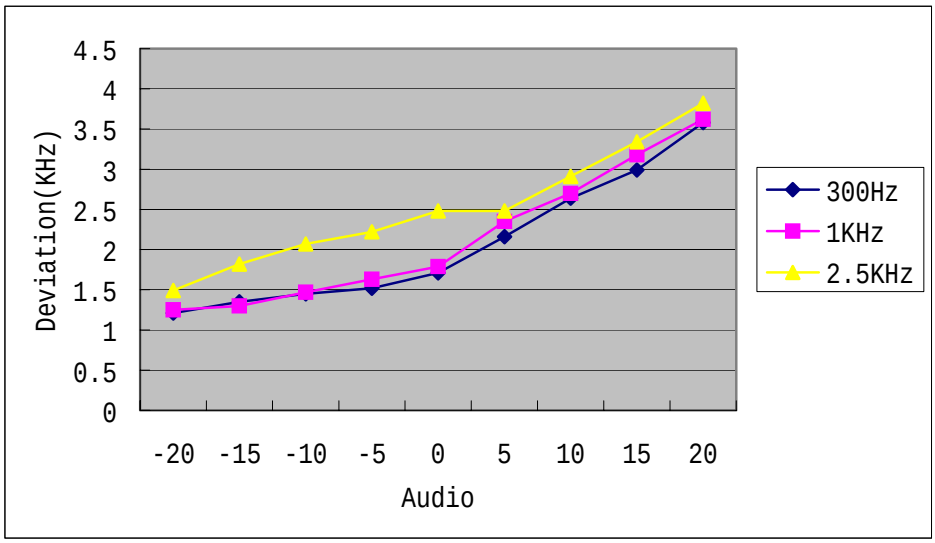
## Test Results:

| Environmental Conditions | |
|---|---|
| Temperature: | 25℃ |
| Relative Humidity: | 60% |
| ATM Pressure: | 1016 |

(a) Modulation Limit

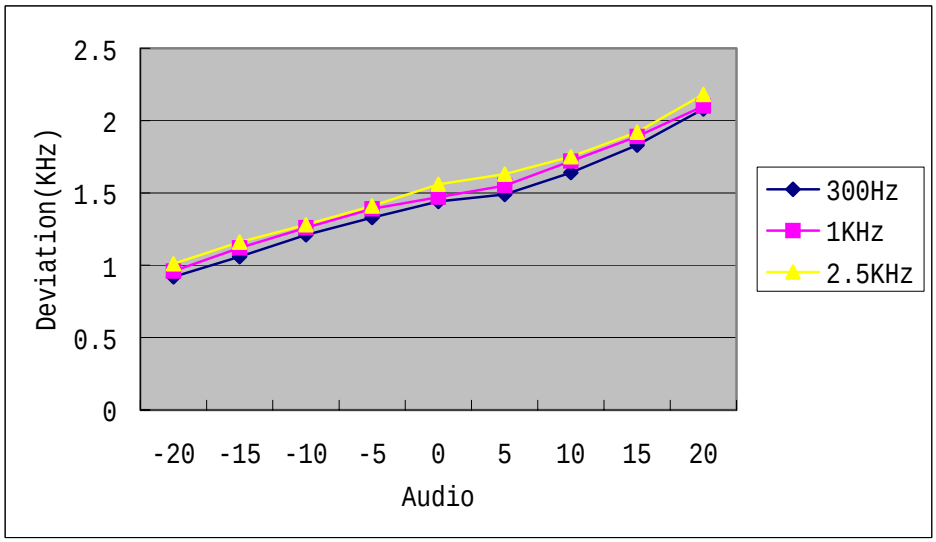
25 KHz Channel Separation

| Audio Input | 300Hz Deviation (KHz) | 1KHz Deviation (KHz) | 2.5KHz Deviation (KHz) |
|---|---|---|---|
| -20.0 | 1.21 | 1.25 | 1.49 |
| -15.0 | 1.35 | 1.3 | 1.82 |
| -10.0 | 1.45 | 1.47 | 2.07 |
| -5.0 | 1.52 | 1.63 | 2.22 |
| 0.0 | 1.71 | 1.79 | 2.48 |
| 5.0 | 2.16 | 2.35 | 2.48 |
| 10.0 | 2.64 | 2.70 | 2.91 |
| 15.0 | 2.99 | 3.18 | 3.34 |
| 20.0 | 3.58 | 3.62 | 3.82 |

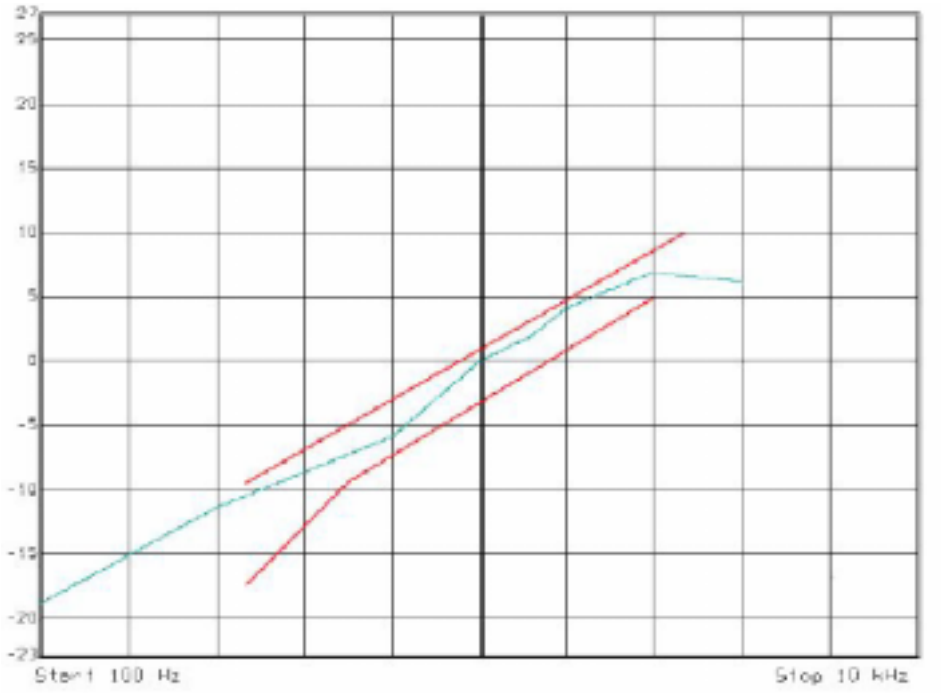



12.5 KHz Channel Separations

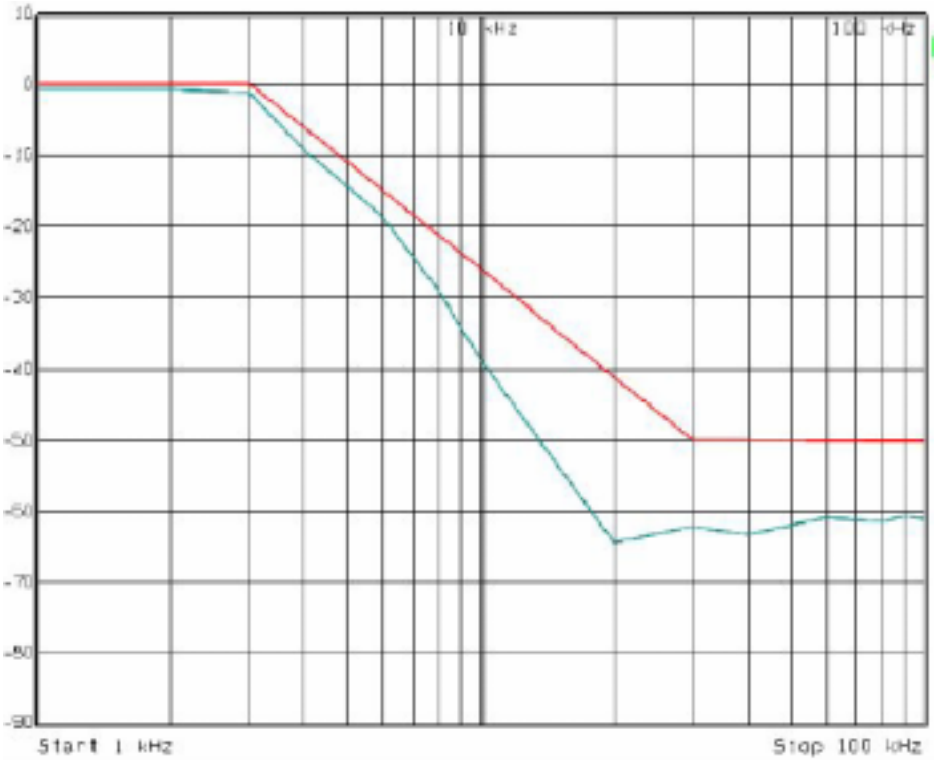
| Audio Input | 300Hz Deviation (KHz) | 1KHz Deviation (KHz) | 2.5 KHz Deviation (KHz) |
|---|---|---|---|
| -20.0 | 0.92 | 0.96 | 1.01 |
| -15.0 | 1.06 | 1.12 | 1.16 |
| -10.0 | 1.21 | 1.26 | 1.28 |
| -5.0 | 1.33 | 1.39 | 1.41 |
| 0.0 | 1.44 | 1.47 | 1.56 |
| 5.0 | 1.49 | 1.55 | 1.63 |
| 10.0 | 1.64 | 1.72 | 1.75 |
| 15.0 | 1.83 | 1.89 | 1.92 |
| 20.0 | 2.08 | 2.10 | 2.18 |



(b) Audio Frequency Response:




Audio Low Pass Filter Response



# OCCUPIED BANDWIDTH OF EMISSION

## Provision Applicable

Per FCC §2.1049, §90.209(b)(5), and §90.210 (b), the authorized bandwidth is 20kHz for operating band within 25-50 MHz.

For any frequency removed from the center of the assigned channel by more than 50 percent up to and including 100 percent of the authorized bandwidth, at least 25 dB.

On any frequency removed from the center of the assigned channel by more than 100 percent up to and including 250 percent, at least 35 dB.

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

43 + 10 log(P)_dB

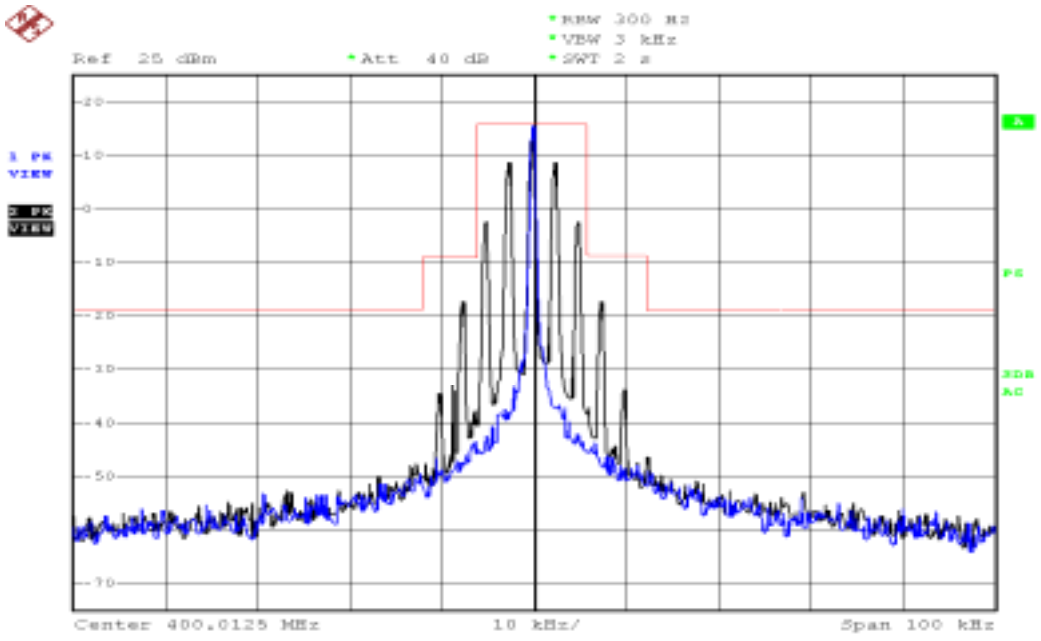
## Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation. The RBW of the spectrum analyzer was set at 300Hz, and the spectrum was recorded in ± 50KHz from the carrier Frequency.

## Test Results

Test Result: Pass
Please refer the following curve and plots.

25KHz Channel Separation

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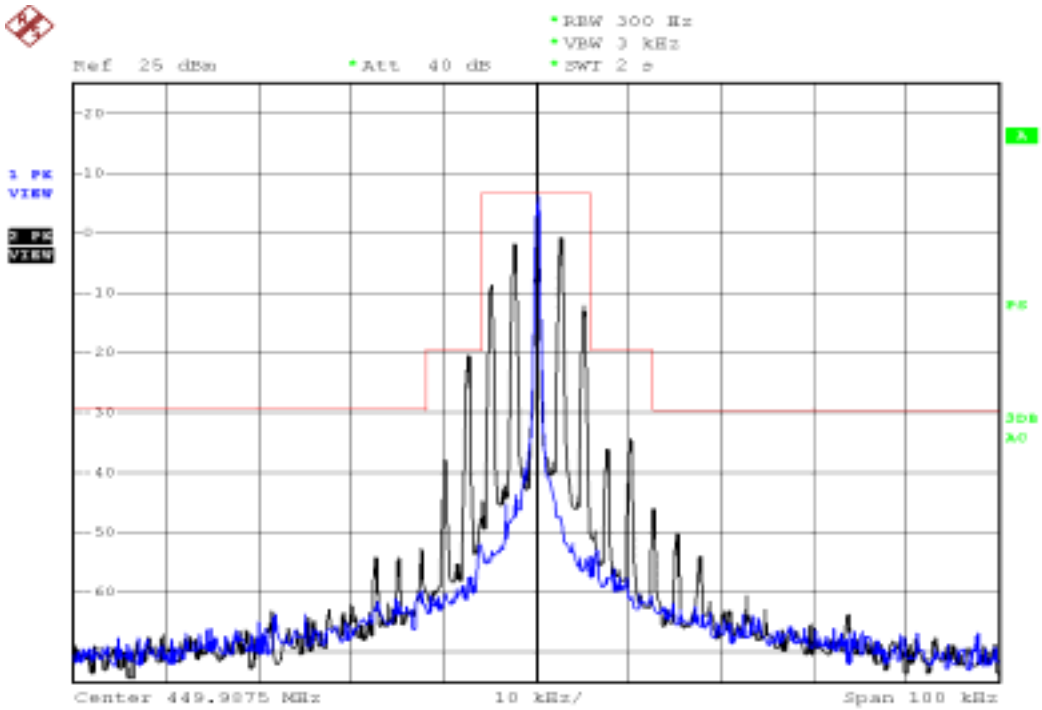


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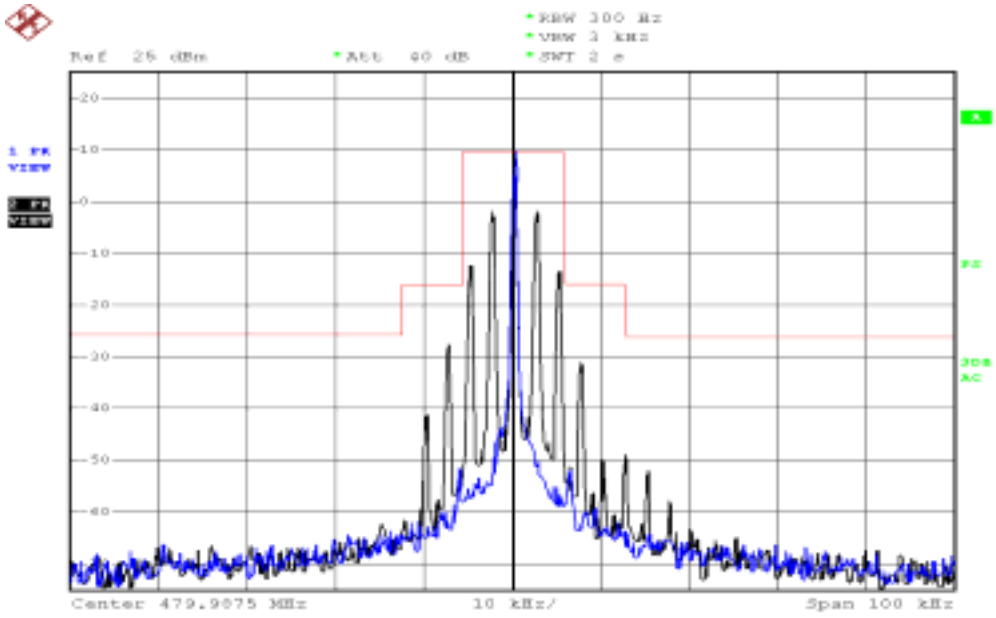
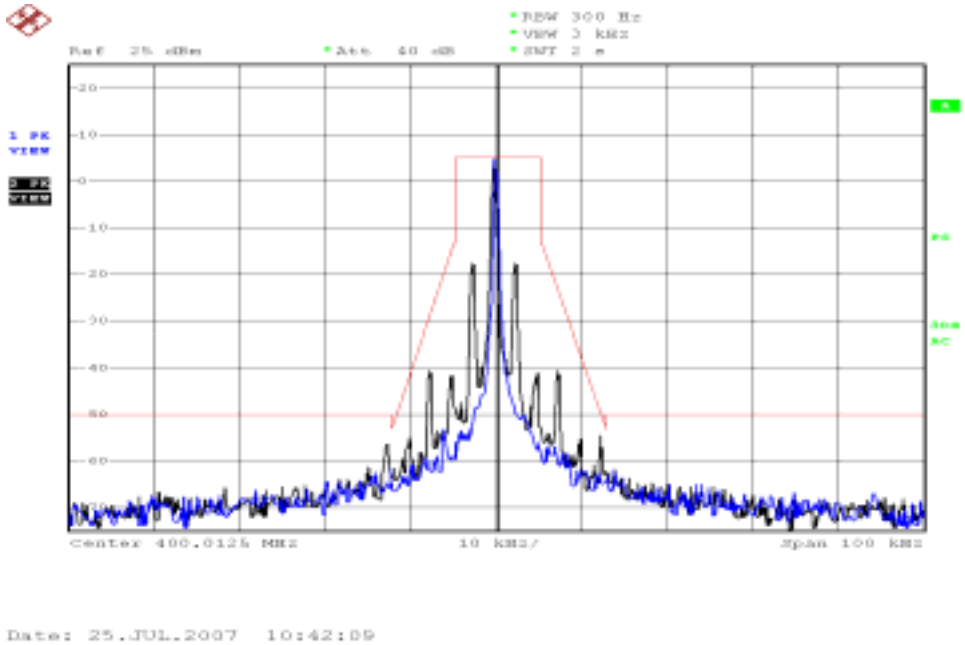
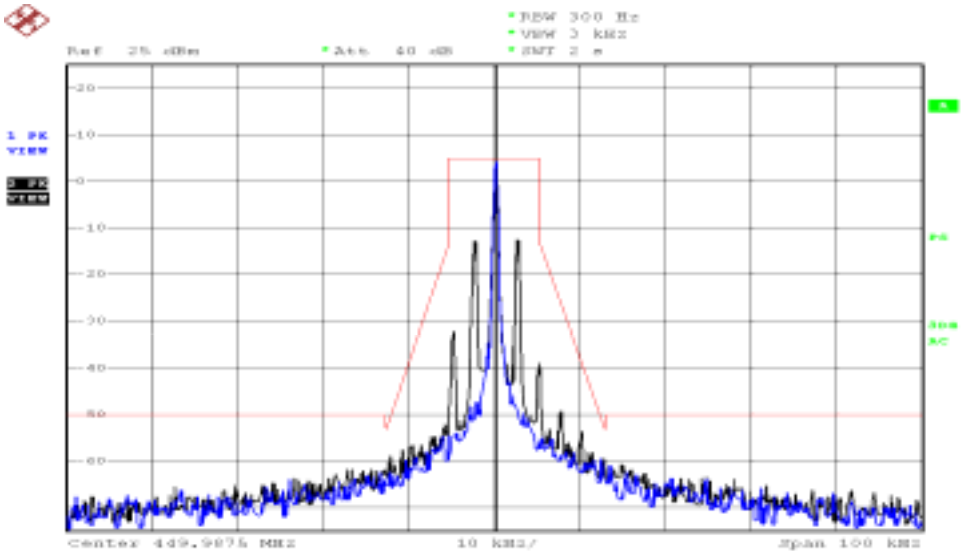



12.5KHz Channel Separation



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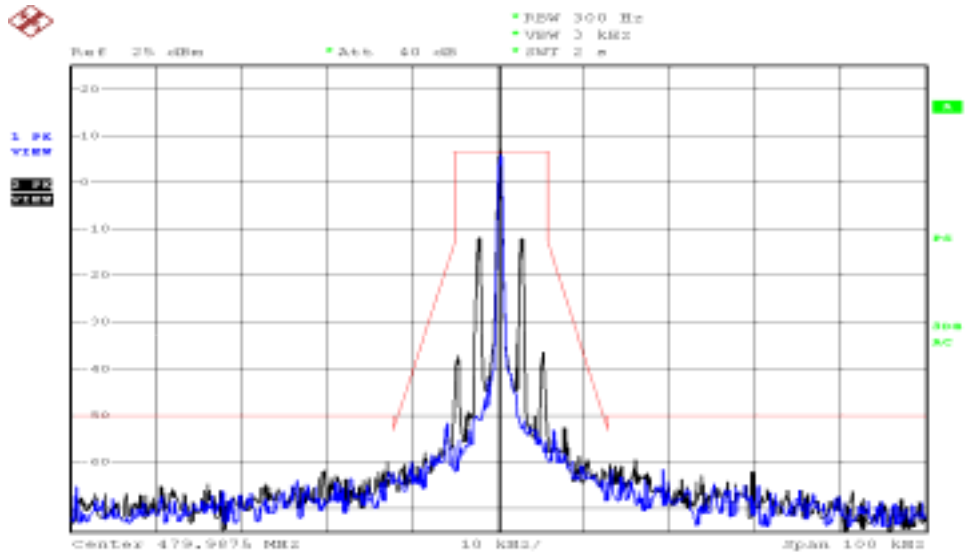


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# RADIATED SPURIOUS EMISSION

## Provision Applicable

Per FCC §2.1051and FCC §90.210(b)

For 25 KHz channel separation, on any frequency removed from the center of the assigned channel by more than 250 percent at least: 43 + 10 log (P) dB

For 12.5 KHz Channel Separation, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f d in kHz) of more than 12.5 kHz at least: 50+10 log (P) dB

## Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 $Log_{10}$ (power out in Watts)

## Test Result

All spurious emission is more than 20dB below the limit, so the test data were omitted.

Low Channel:

| EUT | | | | | Generator | | | | | | Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicated | | Table | Test Antenna | | Substitution | | Substitution Antenna | Correction Factor | | Absolute level dBm | FCC 90 | |
| Frequency MHz | Ampl. dBμV/m | Angle Degree | Height Meter | Polar H/ V | Frequency MHz | Level dBm | Polar H/V | Antenna dB | Cable dB | | Limit dBm | Margin dB |
| Primary scan 30 - 5000 MHz, 25KHz | | | | | | | | | | | | |
| 800.050 | 37.30 | 335 | 1.6 | v | 800.050 | -40.1 | v | 0 | 0.1 | -40.2 | -13 | 27..2 |
| 800.050 | 36.85 | 178 | 1.5 | h | 800.050 | -40.3 | h | 0 | 0.1 | -40.4 | -13 | 27.4 |
| 1200.075 | 41.82 | 0 | 1.5 | v | 1200.075 | -50.2 | v | 6.3 | 0.2 | -44.1 | -13 | 31.1 |
| 1200.075 | 42.62 | 330 | 1.5 | h | 1200.075 | -50.5 | h | 6.3 | 0.2 | -44.4 | -13 | 39.4 |
| 1600.100 | 40.93 | 270 | 1.7 | v | 1600.100 | -52.6 | v | 6.8 | 0.2 | -46.0 | -13 | 33.0 |
| 1600.100 | 36.75 | 0 | 1.6 | v | 1600.100 | -53.0 | v | 6.8 | 0.2 | -46.4 | -13 | 33.4 |
| 2000.125 | 37.72 | 30 | 1.6 | h | 2000.125 | -56.7 | h | 7.2 | 0.3 | -49.8 | -13 | 36.8 |
| 2000.125 | 38.64 | 330 | 1.6 | h | 2000.125 | -57.6 | h | 7.2 | 0.3 | -50.7 | -13 | 37.7 |
| Primary scan 30 - 5000 MHz, 12.5KHz | | | | | | | | | | | | |
| 800.0025 | 38.45 | 327 | 1.6 | v | 800.050 | -40.0 | v | 0 | 0.1 | -40.1 | -20 | 20.1 |
| 800.025 | 38.02 | 175 | 1.5 | h | 800.050 | -40.9 | h | 0 | 0.1 | -41.0 | -20 | 21.0 |
| 1200.0375 | 42.09 | 12 | 1.5 | v | 1200.075 | -49.2 | v | 6.3 | 0.2 | -43.1 | -20 | 23.1 |
| 1200.0375 | 42.93 | 315 | 1.5 | h | 1200.075 | -50.0 | h | 6.3 | 0.2 | -43.9 | -20 | 23.9 |
| 1600.050 | 41.63 | 222 | 1.7 | v | 1600.100 | -52.2 | v | 6.8 | 0.2 | -45.6 | -20 | 25.6 |
| 1600.050 | 37.78 | 184 | 1.6 | v | 1600.100 | -52.5 | v | 6.8 | 0.2 | -45.9 | -20 | 25.9 |
| 2000.0625 | 38.65 | 76 | 1.6 | h | 2000.125 | -56.1 | h | 7.2 | 0.3 | -49.2 | -20 | 29.2 |
| 2000.0625 | 38.94 | 168 | 1.6 | h | 2000.125 | -57.5 | h | 7.2 | 0.3 | -50.6 | -20 | 30.6 |

Middle Channel:

| EUT | | | | | Generator | | | | | | Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicated | | Table | Test Antenna | | Substitution | | Substitution Antenna | Correction Factor | | Absolute level dBm | FCC 90 | |
| Frequency MHz | Ampl. dBμV/m | Angle Degree | Height Meter | Polar H/ V | Frequency MHz | Level dBm | Polar H/V | Antenna dB | Cable dB | | Limit dBm | Margin dB |
| Primary scan 30 - 5000 MHz, 25KHz | | | | | | | | | | | | |
| 899.950 | 37.60 | 307 | 1.6 | v | 899.950 | -42.2 | v | 0 | 0.1 | -42.3 | -13 | 29.3 |
| 899.950 | 36.76 | 196 | 1.8 | h | 899.950 | -41.9 | h | 0 | 0.1 | -42.0 | -13 | 29.0 |
| 1349.925 | 41.45 | 59 | 1.7 | v | 1349.925 | -51.8 | v | 6.5 | 0.2 | -45.5 | -13 | 32.5 |
| 1349.925 | 41.79 | 62 | 1.8 | h | 1349.925 | -52.8 | h | 6.5 | 0.2 | -46.5 | -13 | 33.5 |
| 1799.900 | 40.63 | 339 | 1.7 | v | 1799.900 | -53.4 | v | 6.9 | 0.2 | -46.7 | -13 | 33.7 |
| 1799.900 | 39.59 | 358 | 1.6 | h | 1799.900 | -53.9 | h | 6.9 | 0.2 | -47.2 | -13 | 34.2 |
| 2249.875 | 38.87 | 29 | 1.7 | v | 2249.875 | -56.3 | v | 7.3 | 0.3 | -49.3 | -13 | 36.3 |
| 2249.875 | 38.26 | 06 | 1.8 | h | 2249.875 | -56.8 | h | 7.3 | 0.3 | -49.8 | -13 | 36.8 |

| Primary scan 30 - 5000 MHz, 12.5KHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 899.975 | 38.92 | 315 | 1.6 | v | 899.975 | -41.2 | v | 0 | 0.1 | -41.3 | -20 | 21.3 |
| 899.975 | 38.06 | 228 | 1.8 | h | 899.975 | -41.3 | h | 0 | 0.1 | -41.4 | -20 | 21.4 |
| 1349.9625 | 42.77 | 76 | 1.7 | v | 1349.9625 | -51.0 | v | 6.5 | 0.2 | -44.7 | -20 | 24.7 |
| 1349.9625 | 43.86 | 86 | 1.8 | h | 1349.9625 | -52.5 | h | 6.5 | 0.2 | -46.2 | -20 | 26.2 |
| 1799.950 | 41.15 | 55 | 1.7 | v | 1799.950 | -53.1 | v | 6.9 | 0.2 | -46.4 | -20 | 26.4 |
| 1799.950 | 40.98 | 271 | 1.6 | h | 1799.950 | -53.1 | h | 6.9 | 0.2 | -46.4 | -20 | 26.4 |
| 2249.9375 | 39.25 | 99 | 1.7 | v | 2249.9375 | -55.9 | v | 7.3 | 0.3 | -48.9 | -20 | 28.9 |
| 2249.9375 | 39.12 | 154 | 1.8 | h | 2249.9375 | -56.9 | h | 7.3 | 0.3 | -49.9 | -20 | 29.9 |

High Channel:

| EUT | | | | | Generator | | | | | | Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicated | | Table | Test Antenna | | Substitution | | Substitution Antenna | Correction Factor | | Absolute level dBm | FCC 90 | |
| Frequency MHz | Ampl. dBμV/m | Angle Degree | Height Meter | Polar H/ V | Frequency MHz | Level dBm | Polar H/V | Antenna dB | Cable dB | | Limit dBm | Margin dB |
| Primary scan 30 - 5000 MHz, 12.5KHz | | | | | | | | | | | | |
| 959.950 | 37.41 | 279 | 1.7 | v | 959.950 | -40.9 | v | 0 | 0.1 | -41.0 | -13 | 28.0 |
| 939.950 | 36.93 | 266 | 1.7 | h | 939.950 | -40.7 | h | 0 | 0.1 | -40.8 | -13 | 27.8 |
| 1439.925 | 43.40 | 0 | 1.6 | v | 1439.925 | -50.9 | v | 6.6 | 0.2 | -44.5 | -13 | 31.5 |
| 1439.925 | 42.13 | 328 | 1.7 | h | 1439.925 | -50.6 | h | 6.6 | 0.2 | -44.2 | -13 | 31.2 |
| 1919.90 | 41.14 | 265 | 1.7 | v | 1919.90 | -52.9 | v | 7.1 | 0.2 | -46.0 | -13 | 33.0 |
| 1919.90 | 40.27 | 0 | 1.6 | v | 1919.90 | -53.6 | v | 7.1 | 0.2 | -46.7 | -13 | 33.7 |
| 2399.875 | 38.85 | 33 | 1.6 | h | 2399.875 | -56.8 | h | 7.6 | 0.3 | -49.5 | -13 | 36.5 |
| 2399.875 | 37.72 | 267 | 1.6 | h | 2399.875 | -57.0 | h | 7.6 | 0.3 | -49.7 | -13 | 36.7 |
| Primary scan 30 - 5000 MHz, 12.5KHz | | | | | | | | | | | | |
| 959.975 | 36.62 | 350 | 1.6 | v | 959.975 | -40.2 | v | 0 | 0.1 | -40.3 | -20 | 20.3 |
| 959.975 | 36.71 | 41 | 1.7 | h | 959.975 | -39.9 | h | 0 | 0.1 | -40.0 | -20 | 20.0 |
| 1439.9625 | 44.76 | 27 | 1.6 | v | 1439.9625 | -50.0 | v | 6.6 | 0.2 | -43.4 | -20 | 23.4 |
| 1439.9625 | 43.85 | 39 | 1.6 | h | 1439.9625 | -50.8 | h | 6.6 | 0.2 | -44.4 | -20 | 24.4 |
| 1919.950 | 42.79 | 69 | 1.7 | v | 1919.950 | -51.9 | v | 7.1 | 0.2 | -45.0 | -20 | 25.0 |
| 1919.950 | 42.39 | 72 | 1.6 | v | 1919.950 | -53.3 | v | 7.1 | 0.2 | -46.4 | -20 | 26.4 |
| 2399.9375 | 39.71 | 49 | 1.6 | h | 2399.9375 | -56.8 | h | 7.6 | 0.3 | -49.5 | -20 | 29.5 |
| 2399.9375 | 38.65 | 186 | 1.6 | h | 2399.9375 | -56.2 | h | 7.6 | 0.3 | -48.9 | -20 | 28.9 |

Note :Test in three orthogonal plane.
Dipole antenna for frequency below 1000MHz, Horn antenna for frequency above 1000MHz
Transmitter standby spurious emissions are same as receiver spurious emission.

**Result**: Pass

# SPURIOUS EMISSION AT ANTENNA TERMINAL

## Standard Applicable

Per FCC §2.1051and FCC §90.210(b)

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

43 + 10 log (P) dB

## Measurement Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

## Test Result

| Spurious Emission At Antenna Port | | Limit (dBm) |
|---|---|---|
| Frequency (MHz) | Level (dBm) | |
| 25KHz Channel Separation, Low Channel | | |
| 800.050 | -42.6 | -13 |
| 1200.075 | -41.6 | -13 |
| 1600.100 | -46.7 | -13 |
| 2000.125 | -53.6 | -13 |
| 2400.150 | -56.1 | -13 |
| 25KHz Channel Separation, Middle Channel | | |
| 899.95 | -44.7 | -13 |
| 1349.925 | -45.1 | -13 |
| 1799.90 | -46.1 | -13 |
| 2249.875 | -49.9 | -13 |
| 2699.85 | -54.7 | -13 |
| 25KHz Channel Separation, High Channel | | |
| 959.95 | -45.2 | -13 |
| 1439.925 | -46.3 | -13 |
| 1919.9 | -49.1 | -13 |
| 2399.875 | -53.3 | -13 |
| 2879.85 | -56.7 | -13 |

| Spurious Emission At Antenna Port | | Limit (dBm) |
|---|---|---|
| Frequency (MHz) | Level (dBm) | |
| 12.5KHz Channel Separation, Low Channel | | |
| 800.025 | -46.2 | -20 |
| 1200.0375 | -44.8 | -20 |
| 1600.050 | -47.6 | -20 |
| 2000.0625 | -50.2 | -20 |
| 2400.075 | -53.9 | -20 |
| 12.5KHz Channel Separation, Middle Channel | | |
| 899.975 | -44.3 | -20 |
| 1349.9625 | -45.9 | -20 |
| 1799.95 | -47.4 | -20 |
| 2249.9375 | -51.5 | -20 |
| 2699.925 | -57.6 | -20 |
| 12.5KHz Channel Separation, High Channel | | |
| 919.975 | -46.8 | -20 |
| 1439.9625 | -47.3 | -20 |
| 1919.95 | -48.0 | -20 |
| 2399.9375 | -52.2 | -20 |
| 2879.925 | -56.9 | -20 |

# FREQUENCY STABILITY MEASUREMENT

## Provision Applicable

According to §90.213, for operating band within 421-512MHz and output power > 2 watts, the frequency stability limit is 2.5 ppm.
According to FCC Part 2 Section 2.1055 (a)(2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.

## Test Procedure

### Frequency stability versus environmental temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed through attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

### Frequency Stability versus Input Voltage

At room temperature (25±1°C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for end , 100% and 85% of the nominal operating input voltage.

## Test Results

### Frequency Stability versus Input Voltage, Battery operation end point voltage is 9.6 V

For 25 KHz Channel Separation

| Test Condition | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|
| Temperature (°C) | | | |
| 25 | 400.02497 | -0.08 | ±5.0 |
| 25 | 449.97496 | -0.09 | ±5.0 |
| 25 | 479.97497 | -0.06 | ±5.0 |

For 12.5 KHz Channel Separation

| Test Condition | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|
| Temperature (°C) | | | |
| 25 | 400.01247 | -0.07 | ±2.5 |
| 25 | 449.98748 | -0.04 | ±2.5 |
| 25 | 479.98747 | -0.06 | ±2.5 |

**Frequency stability versus environmental temperature**

Low Channel
25KHz Channel Separation

| Test Condition | | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|---|
| Temperature (℃) | Voltage (V) | | | |
| 50 | 13.8 | 400.024977 | 0.07 | ±5.0 |
| 40 | 13.8 | 400.024976 | 0.06 | ±5.0 |
| 30 | 13.8 | 400.024981 | 0.05 | ±5.0 |
| 20 | 13.8 | 400.024982 | 0.04 | ±5.0 |
| 10 | 13.8 | 400.024982 | 0.04 | ±5.0 |
| 0 | 13.8 | 400.024984 | 0.04 | ±5.0 |
| -10 | 13.8 | 400.024984 | 0.04 | ±5.0 |
| -20 | 13.8 | 400.024983 | 0.04 | ±5.0 |
| -30 | 13.8 | 400.024982 | 0.04 | ±5.0 |

12.5KHz Channel Separation

| Test Condition | | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|---|
| Temperature (℃) | Voltage (V) | | | |
| 50 | 13.8 | 400.012478 | -0.05 | ±2.5 |
| 40 | 13.8 | 400.012469 | -0.08 | ±2.5 |
| 30 | 13.8 | 400.012472 | -0.07 | ±2.5 |
| 20 | 13.8 | 400.012472 | -0.07 | ±2.5 |
| 10 | 13.8 | 400.012473 | -0.07 | ±2.5 |
| 0 | 13.8 | 400.012473 | -0.07 | ±2.5 |
| -10 | 13.8 | 400.012474 | -0.06 | ±2.5 |
| -20 | 13.8 | 400.012472 | -0.07 | ±2.5 |
| -30 | 13.8 | 400.012473 | -0.07 | ±2.5 |

Middle Channel:
25KHz Channel Separation

| Test Condition | | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|---|
| Temperature (℃) | Voltage (V) | | | |
| 50 | 13.8 | 449.97496 | 0.09 | ±5.0 |
| 40 | 13.8 | 449.97499 | 0.02 | ±5.0 |
| 30 | 13.8 | 449.97497 | 0.07 | ±5.0 |
| 20 | 13.8 | 449.97497 | 0.07 | ±5.0 |
| 10 | 13.8 | 449.97498 | 0.04 | ±5.0 |
| 0 | 13.8 | 449.97498 | 0.04 | ±5.0 |
| -10 | 13.8 | 449.97499 | 0.02 | ±5.0 |
| -20 | 13.8 | 449.97497 | 0.07 | ±5.0 |
| -30 | 13.8 | 449.97497 | 0.07 | ±5.0 |

12.5KHz Channel Separation

| Test Condition | | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|---|
| Temperature (℃) | Voltage (V) | | | |
| 50 | 13.8 | 449.98748 | 0.04 | ±2.5 |
| 40 | 13.8 | 449.98748 | 0.04 | ±2.5 |
| 30 | 13.8 | 449.98747 | 0.07 | ±2.5 |
| 20 | 13.8 | 449.98747 | 0.07 | ±2.5 |
| 10 | 13.8 | 449.98748 | 0.04 | ±2.5 |
| 0 | 13.8 | 449.98747 | 0.07 | ±2.5 |
| -10 | 13.8 | 449.98748 | 0.04 | ±2.5 |
| -20 | 13.8 | 449.98748 | 0.04 | ±2.5 |
| -30 | 13.8 | 449.98748 | 0.04 | ±2.5 |

High Channel
25KHz Channel Separation

| Test Condition | | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|---|
| Temperature (℃) | Voltage (V) | | | |
| 50 | 13.8 | 479.97496 | 0.08 | ±5.0 |
| 40 | 13.8 | 479.97497 | 0.06 | ±5.0 |
| 30 | 13.8 | 479.97497 | 0.06 | ±5.0 |
| 20 | 13.8 | 479.97496 | 0.08 | ±5.0 |
| 10 | 13.8 | 479.97496 | 0.08 | ±5.0 |
| 0 | 13.8 | 479.97496 | 0.08 | ±5.0 |
| -10 | 13.8 | 479.97498 | 0.04 | ±5.0 |
| -20 | 13.8 | 479.97497 | 0.06 | ±5.0 |
| -30 | 13.8 | 479.97498 | 0.04 | ±5.0 |

12.5KHz Channel Separation

| Test Condition | | Frequency Measured (MHz) | Frequency Error (ppm) | Limit (ppm) |
|---|---|---|---|---|
| Temperature (℃) | Voltage (V) | | | |
| 50 | 13.8 | 479.98748 | 0.04 | ±2.5 |
| 40 | 13.8 | 479.98748 | 0.04 | ±2.5 |
| 30 | 13.8 | 479.98747 | 0.06 | ±2.5 |
| 20 | 13.8 | 479.98747 | 0.06 | ±2.5 |
| 10 | 13.8 | 479.98749 | 0.02 | ±2.5 |
| 0 | 13.8 | 479.98746 | 0.08 | ±2.5 |
| -10 | 13.8 | 479.98747 | 0.06 | ±2.5 |
| -20 | 13.8 | 479.98747 | 0.06 | ±2.5 |
| -30 | 13.8 | 479.98746 | 0.08 | ±2.5 |

# TRANSIENT FREQUENCY BEHAVIOUR OF THE TRANSMITTER

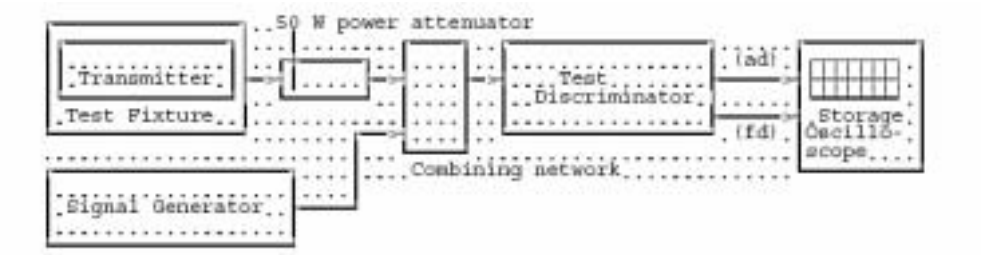
## Standard Applicable

The transient periods are given in following table:

| Frequency Range | 30 MHz to 300 MHz | Above 300 MHz to 500 MHz | Above 500 MHz to 1000MHz |
|---|---|---|---|
| $t_1$(ms) | 5.0 | 10.0 | 20.0 |
| $t_2$(ms) | 20.0 | 25.0 | 50.0 |
| $t_3$(ms) | 5.0 | 10.0 | 10.0 |

## Test Measurement

The transmitter shall be placed in the test fixture and the measurement shown in following figure shall be used.




Two signals shall be connected to the test discriminator via a combining network.

The transmitter output from the test fixture shall be connected a to a 50 Ω power anteuator.

The output of the power attenuator shall be connected to the test discriminator via one input of the combining network.

A test signal generator shall be connected to the second input of the combining network.

The test signal shall be adjusted to the nominal frequency of the transmitter.

The test signal shall be modulated by a frequency of 1 kHz with a deviation equal to ± the value of the relevant channel separation.

**The test signal level shall be adjusted to correspond to 0.1% of the power of the transmitter under test measured at the input of the test discriminator. This level shall be maintained throughout the measurement.**

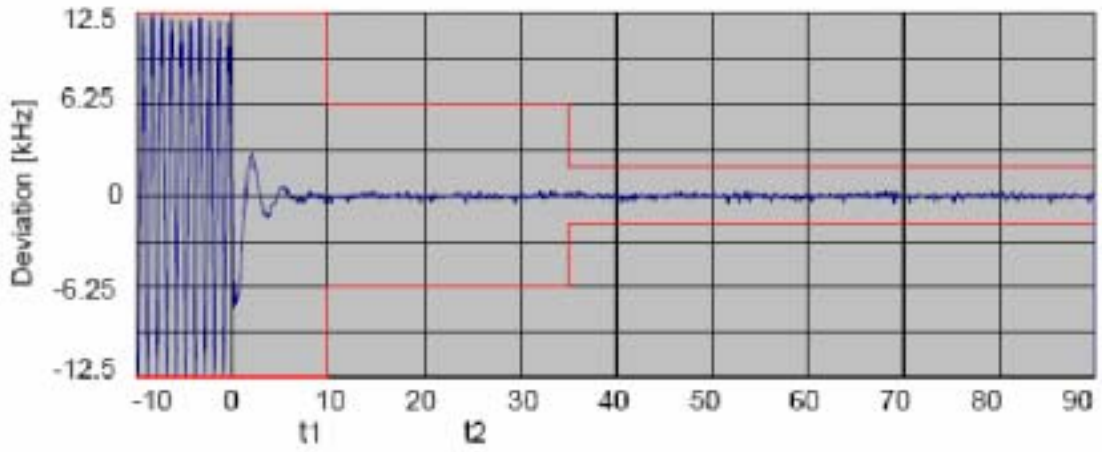
The amplitude difference (ad) and the frequency difference (fd) output of the test discriminator shall be connected to a storage oscilloscope.

## Test Results

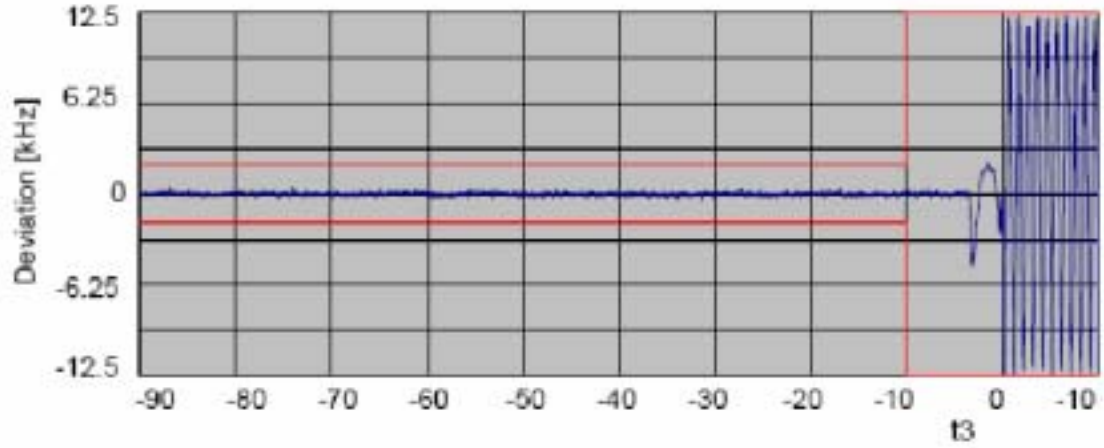
PASS

Please refer to the following plots.

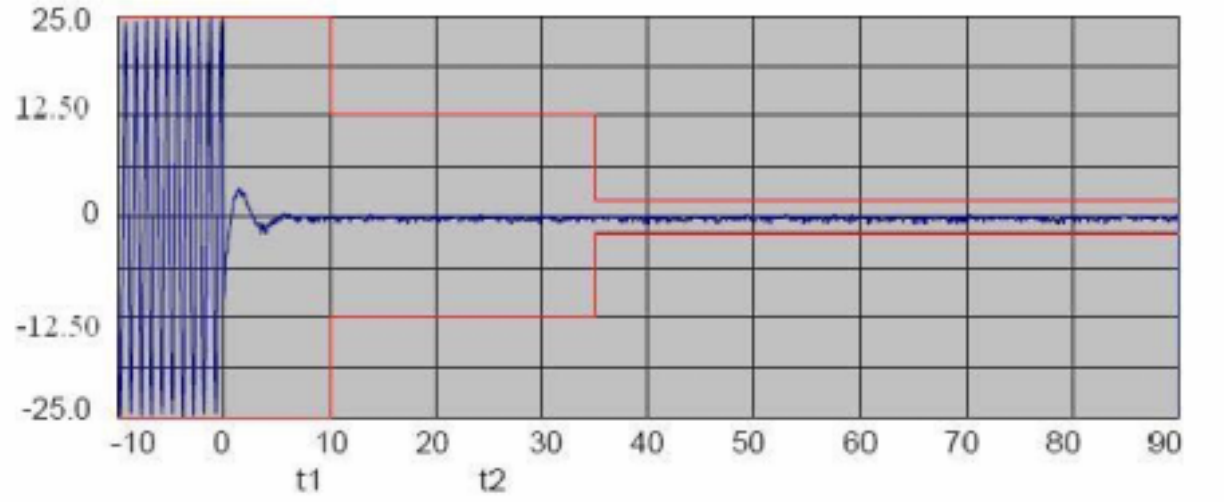
Transmitter Frequency Behaviour @ 12.5 KHz Channel Separation------Off – On




Transmitter Frequency Behaviour @ 12.5 KHz Channel Separation------On - Off



Transmitter Frequency Behaviour @ 25 KHz Channel Separation------Off – On




Transmitter Frequency Behaviour @ 25KHZ Channel Separation------On – Off