TEST REPORT

of

FCC Part 90 and Part 2
FCC ID: WLD-DN430MT

Equipment Under Test	:	Main Transceiver
Model Name	:	Vellux Main
Serial No.	:	N/A
Applicant	:	Dunan Co., Ltd.
Manufacturer	:	Dunan Co., Ltd.
Date of Test(s)	:	2008-09-25 ~ 2008-10-31
Date of Issue	:	2008-10-31

In the configuration tested, the EUT complied with the standards specified above.

Tested By:	**Geoffrey Do**	**Date**	**2008-10-31**
Approved By	C. K. Kim **Jim Kim**	**Date**	**2008-10-31**

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SGS Testing Korea Co., Ltd. **18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea, 435-040**

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1. General information

1.1. Testing laboratory

SGS Testing Korea Co., Ltd.
Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040
www.electrolab.kr.sgs.com
Telephone : +82 +31 428 5700
FAX : +82 +31 427 2371

1.2.Details of applicant

Applicant : Dunan Co., Ltd.
Address : #304 Hansol B/D, 145-1, Gumi-dong, Bundang-gu, Seongnam-si, Gyunggi-do, Korea
Contact Person : Kwan-Hong Hong
Phone No. : 82-31-715-4513
Fax No. : 82-31-715-4531

1.3. Description of EUT

Kind of Product	Main Transceiver
Model Name	Vellux Main
Serial Number	N/A
Power Supply	AC 120 V
Frequency Range	433.050 MHz ~ 434.790 MHz(Tx/Rx)
Output power (mW)	15
Modulation Technique	FSK
Emission designator	F1D
Number of Channels	70
Operating Conditions	-20℃ ~ 50℃
Antenna Type	Connector type (Dipole Ant.)

1.4. Details of modification

-N/A

1.5. Test equipment list

Equipment	Manufacturer	Model	Cal due.
Signal Generator	Agilent	E4438C	May 09, 2009
Spectrum Analyzer	Agilent	E4440A	May 09, 2009
Spectrum Analyzer	H.P.	8565E	Oct. 01, 2009
Power Meter	Agilent	E4416A	May 09, 2009
Power Sensor	Agilent	E9327A	May 09, 2009
Modulation Analyzer	H.P	8901B	Oct. 09, 2009
Digital Oscilloscope	Tektrronix	TDS305413	Mar. 18, 2009
Four-port Junction pad	Anritsu	MA1612A	May 09, 2009
Dummy Load	BIRD	8404	May 09, 2009
Attenuator	Agilent	8494B	May 09, 2009
AC Power Supply	Daekwang	Slidacs	Oct. 01, 2009
Preamplifier	H.P.	8447F	Jul. 03, 2009
Preamplifier	Agilent	8449B	May 09, 2009
High Pass Filter	Mini-Circuits	WHK3.0/18G-10SS	Oct. 01, 2009
High Pass Filter	Wainwright	NHP-800+	May 09, 2009
Tem/Hum Chamber	Han-Gil	HGTP-4050	Oct. 02, 2009
Horn Antenna	SCHWARZBECK	BBHA9120D(0600)	Jul. 24, 2009
Dipole Antenna	975/958	VHAP/UHAP	Jan. 18, 2010

Equipment	Manufacturer	Model	Cal due.
Ultra Broadband Antenna	R & S	HL562	Oct. 02, 2009
Horn Antenna	R & S	HF 906	Nov. 13, 2009
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 3.5 m x 3.5 m)	Feb. 15, 2009

1.6. Summary of test results

The EUT has been tested according to the following specifications:

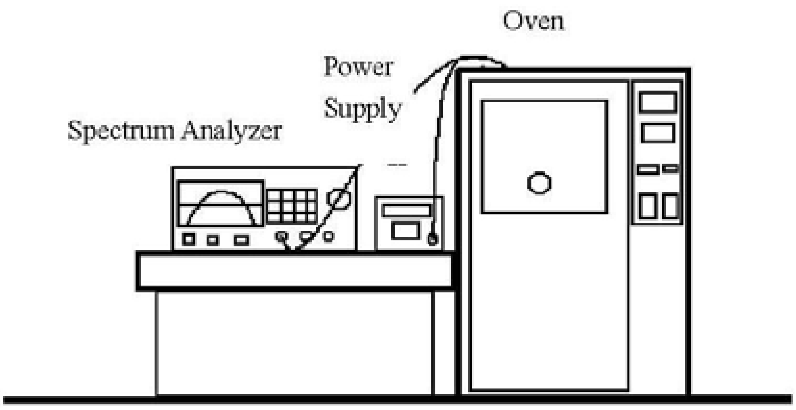
Applied standard : Part 90 and 2		
Standard section	**Test item**	**Result**
90.213	Frequency stability	Complied
90.205	Carrier output power	Complied
90.210	Emission mask	Complied
90.210	Radiated spurious emission	Complied
90.210	Conducted spurious emission	Complied
90.214	Transient frequency behavior	Complied
1.1307(b)(1)	RF exposure evaluation	Complied

1.7. Test report revision

Revision	Report number	Description
0	F690501/RF-RTL002297	Initial
1	F690501/RF-RTL002297-1	Addition: Occupied bandwidth (99%) Emission designator Test procedure version Revise : MPE

2. Frequency stability

2.1. Test setup



2.2. Limit

1. According to FCC Part 2 Section 2.1055(a)(1), the frequency stability shall be measured with variation of ambient temperature from –30℃ to +50℃ centigrade.
2. According to FCC Part 2 Section 2.1055(d)(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.
3. According to FCC Part 90 Section 90.213, the frequency tolerance must be maintained within 0.00025% for 25KHz channel separation.

2.3. Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The transmission time was measured with the spectrum analyzer using RBW=1 kHz, VBW=1 kHz.
3. Set the temperature of chamber to -30℃. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10℃ decreased per stage until the highest temperature 50℃ is measured, record all measured frequencies on each temperature step.

2.4. Test result

Ambient temperature : 24 ℃
Relative humidity : 42 % R.H.

Test voltage (V)	Reference frequency (MHz)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Limit (ppm)
AC 138 V	433.05	433.049881	-119	-0.27	2.5
AC 120 V		433.049876	-124	-0.29	2.5
AC 102 V		433.049878	-122	-0.28	2.5
AC 138 V	433.92	433.919892	-108	-0.25	2.5
AC 120 V		433.919889	-111	-0.26	2.5
AC 102 V		433.919897	-103	-0.24	2.5
AC 138 V	434.79	434.789885	-115	-0.26	2.5
AC 120 V		434.789888	-112	-0.26	2.5
AC 102 V		434.789882	-118	-0.27	2.5

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Operation frequency : 433.05 MHz

Temp. (℃)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Limit (ppm)
-30	433.049872	-128	-0.30	2.5
-20	433.049869	-131	-0.30	2.5
-10	433.049863	-137	-0.32	2.5
0	433.049862	-138	-0.32	2.5
10	433.049857	-143	-0.33	2.5
20	433.049873	-127	-0.29	2.5
30	433.049868	-132	-0.30	2.5
40	433.049861	-139	-0.32	2.5
50	433.049859	-141	-0.33	2.5

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Operation frequency : 433.92 MHz

Temp. (℃)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Limit (ppm)
-30	433.919942	-58	-0.13	2.5
-20	433.919913	-87	-0.20	2.5
-10	433.919911	-89	-0.21	2.5
0	433.919909	-91	-0.21	2.5
10	433.919905	-95	-0.22	2.5
20	433.919900	-100	-0.23	2.5
30	433.919896	-104	-0.24	2.5
40	433.919895	-105	-0.24	2.5
50	433.919901	-99	-0.23	2.5

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Operation frequency : 434.79 MHz

Temp. (℃)	Measure frequency (MHz)	Frequency deviation (Hz)	Frequency deviation (ppm)	Limit (ppm)
-30	434.789864	-136	-0.31	2.5
-20	434.789860	-140	-0.32	2.5
-10	434.789859	-141	-0.32	2.5
0	434.789859	-141	-0.32	2.5
10	434.789866	-134	-0.31	2.5
20	434.789860	-140	-0.32	2.5
30	434.789856	-144	-0.33	2.5
40	434.789854	-146	-0.34	2.5
50	434.789869	-131	-0.30	2.5

3. Carrier output power

3.1. Setup

EUT	Attenuation	Power meter

3.2. Limit

According to §90.205(r), the output power shall not exceed by more than 20 percent either the output power.

3.3. Test procedure

1. The transmitter output was connected to the power meter through an attenuator.
2. The test has been performed at the frequencies (low, middle, high channels of the EUT operating band) and full rated power levels of the transmitter.

3.4. Test result

Ambient temperature : 24 ℃
Relative humidity : 42 % R.H.

Power level: 15 mW

Frequency (MHz)	Conducted power (mW)	Limit (mW)
433.05	10.35	16.58
433.92	11.45	16.58
434.79	11.35	16.58

4. Conducted spurious emission

4.1. Setup

EUT	Attenuation	Spectrum Analyzer

4.2. Limit

According to §90.210, For 25 kHz channel: Spurious attenuated in dB= 43+ 10log(Power output in watts)
Alternatively, an equivalent absolute level of -13 dBm is taken.

5.3. Test procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using
   1) RBW : 100 kHz(< 1GHz), 1 MHz(> 1 GHz).
   2) VBW : 100 kHz(< 1GHz), 1 MHz(> 1 GHz).

5.4. Test result

Ambient temperature	:	24 ℃
Relative humidity	:	42 % R.H.

Please refer to the following.

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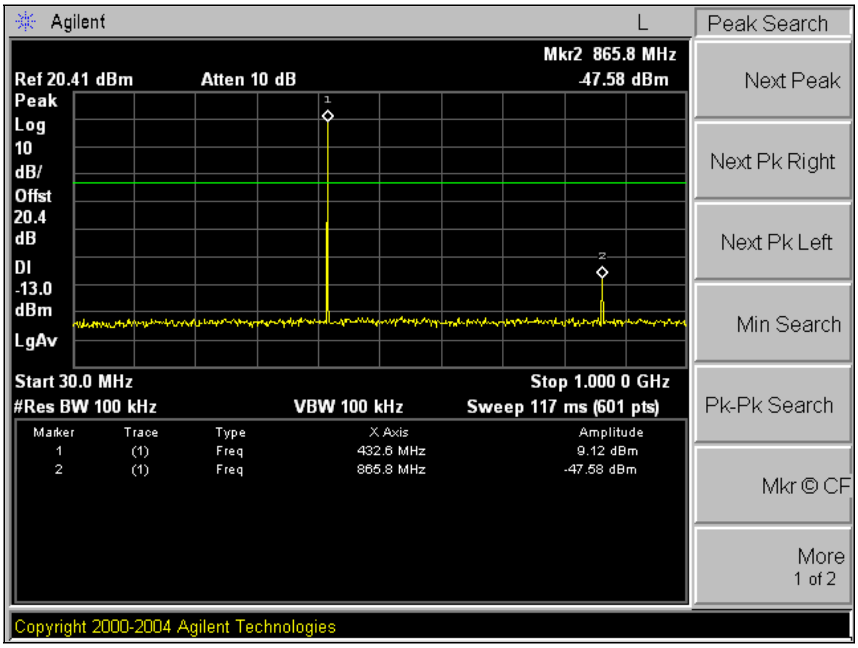
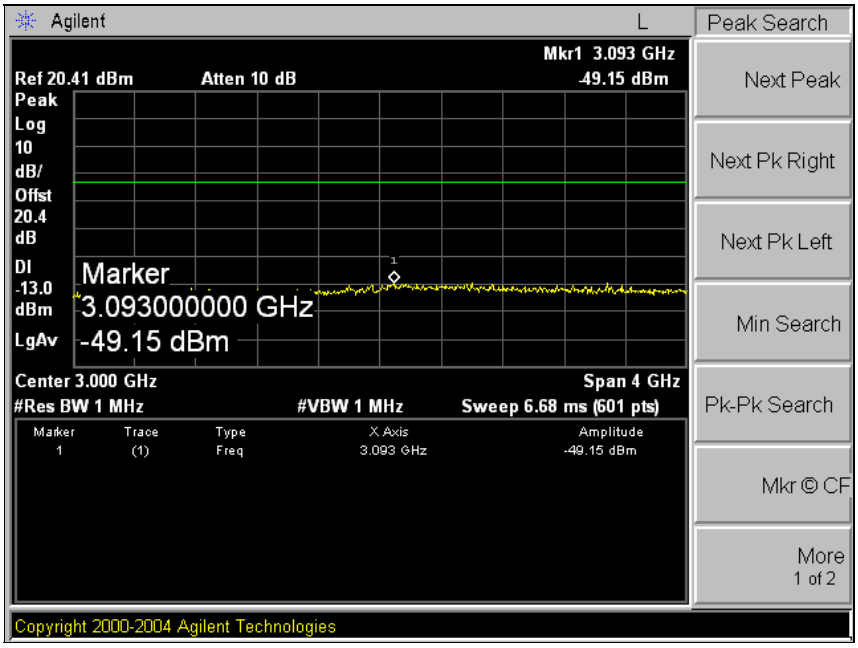
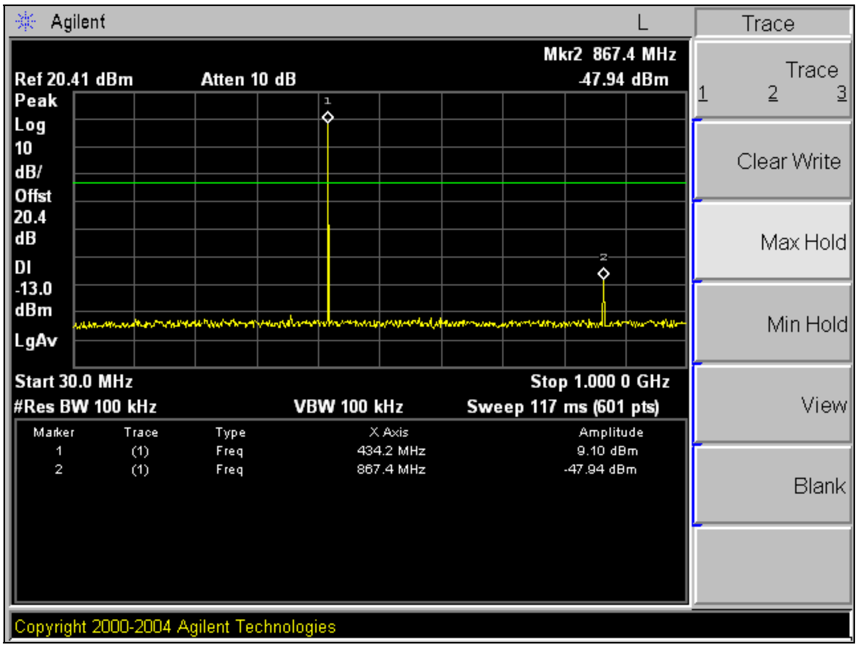
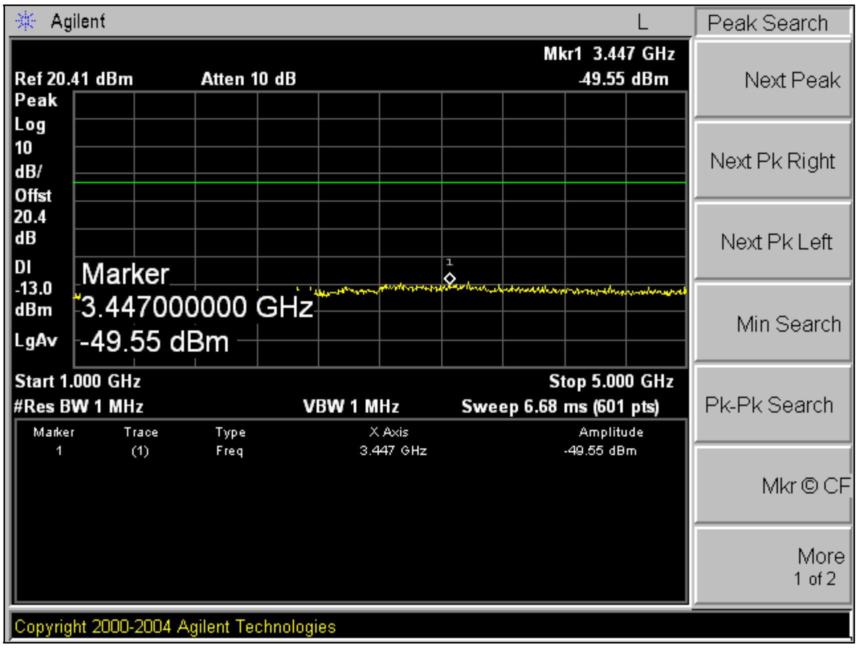
Low channel


Agilent
L
Peak Search
Mkr2 865.8 MHz
Ref 20.41 dBm
Atten 10 dB
-47.58 dBm
Peak
Log
10
dB/
Offst
20.4
dB
Dl
-13.0
dBm
LgAv
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr © CF
More
1 of 2
Start 30.0 MHz
Stop 1.000 0 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 117 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 432.6 MHz 9.12 dBm
2 (1) Freq 865.8 MHz -47.58 dBm
Copyright 2000-2004 Agilent Technologies

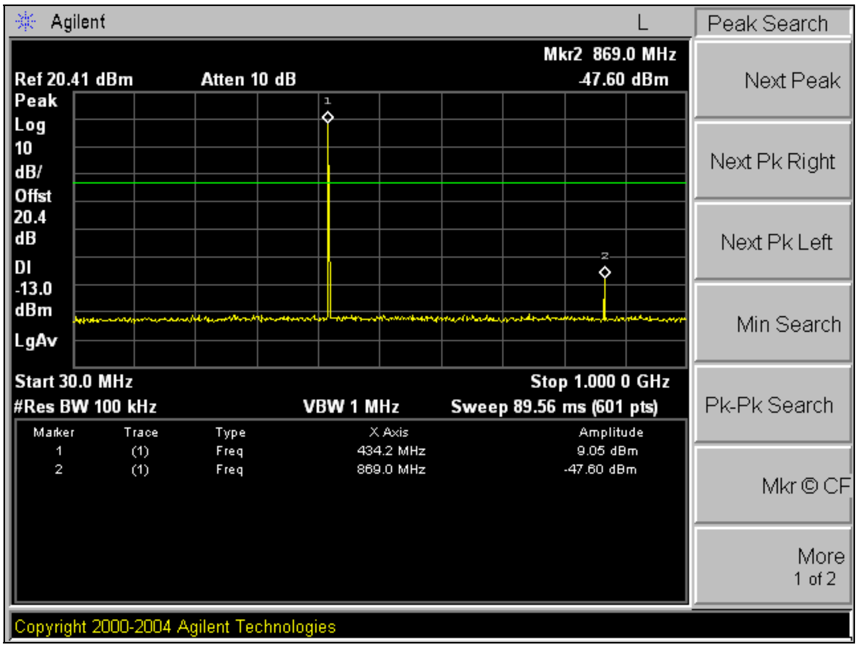

Agilent
L
Peak Search
Mkr1 3.093 GHz
Ref 20.41 dBm
Atten 10 dB
-49.15 dBm
Peak
Log
10
dB/
Offst
20.4
dB
Dl
-13.0
dBm
LgAv
Marker
3.093000000 GHz
-49.15 dBm
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr © CF
More
1 of 2
Center 3.000 GHz
Span 4 GHz
#Res BW 1 MHz
#VBW 1 MHz
Sweep 6.68 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 3.093 GHz -49.15 dBm
Copyright 2000-2004 Agilent Technologies

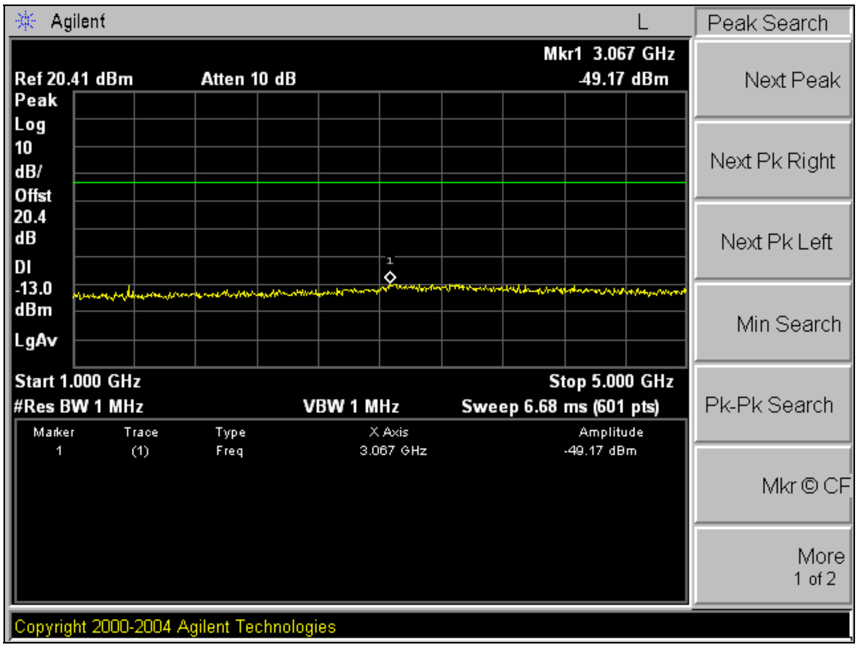
Middle channel





High channel

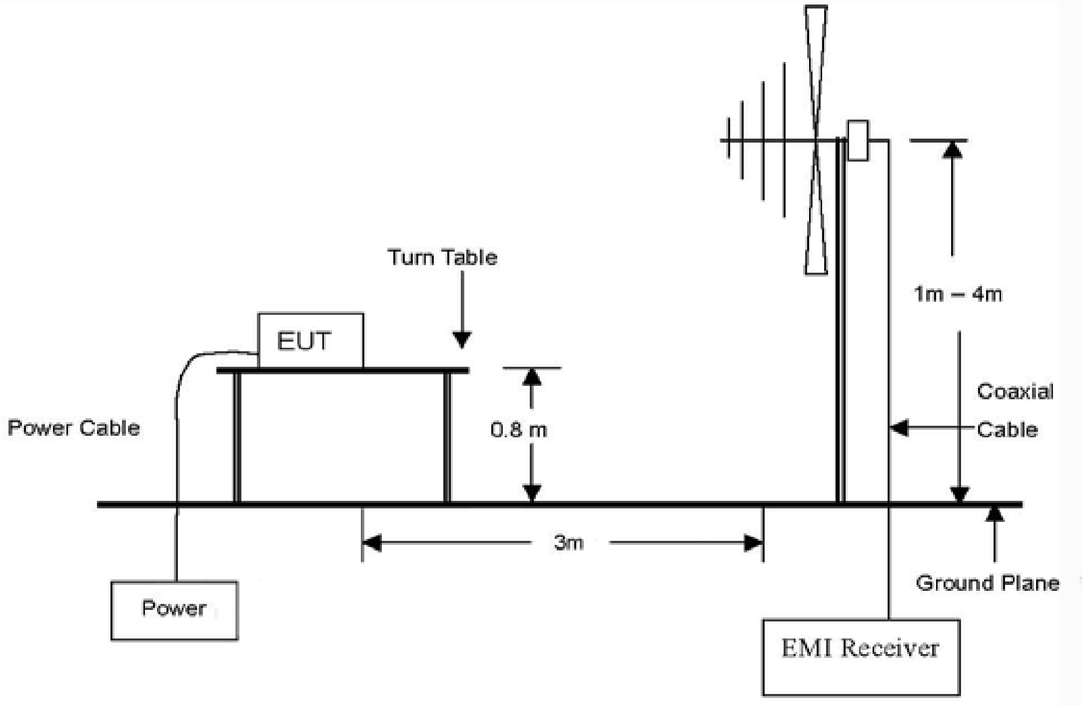




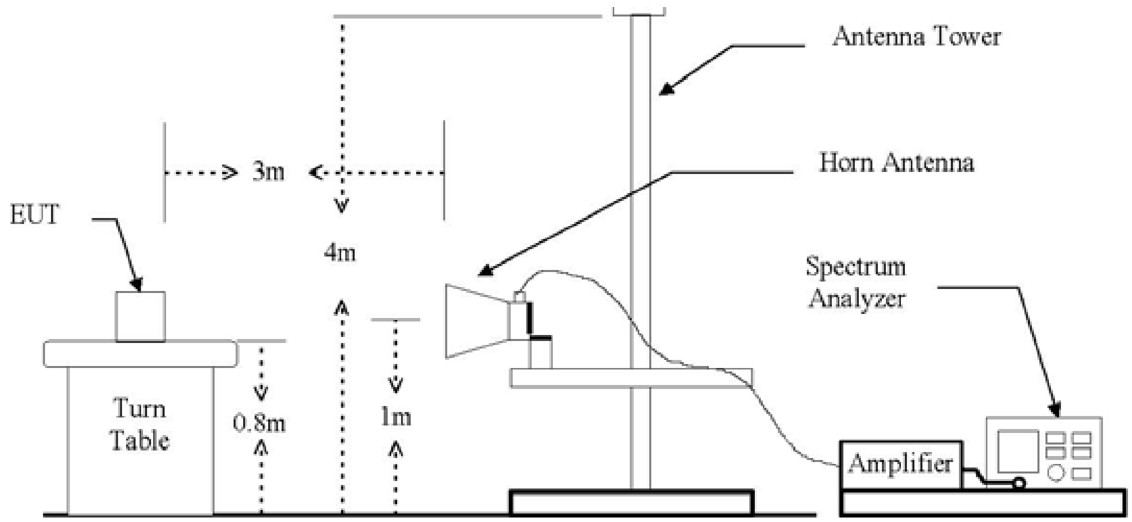
5. Radiated spurious emission

5.1. Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 5 GHz Emissions.



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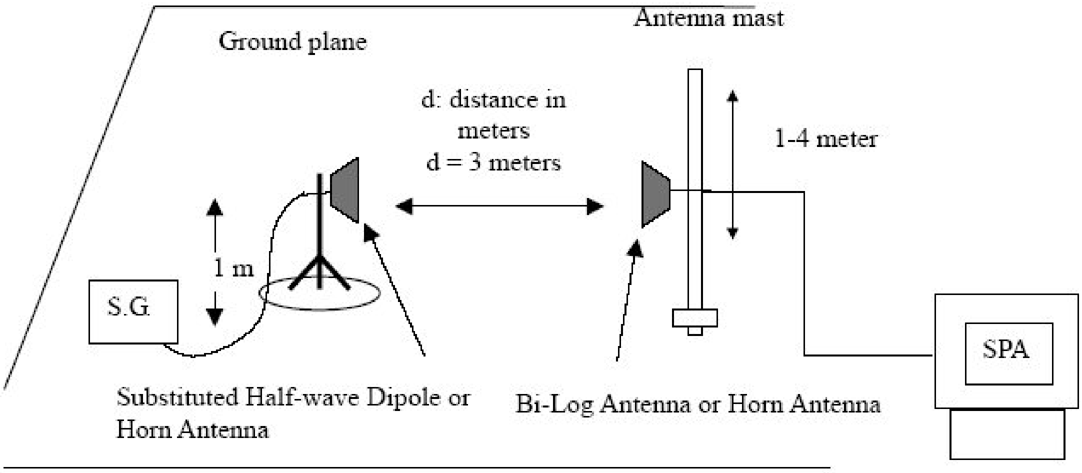
The diagram below shows the test setup for substituted method



5.2. Limit

According to §90.210, For 25 kHz channel: Spurious attenuated in dB= 43+ 10log(Power output in watts)
Alternatively, an equivalent absolute level of -13 dBm is taken.

5.3. Test procedure : Based on ANSI/TIA EIA 603C 2004

1. On a test site, the EUT shall be placed at 80cm height on a turn table, and in the position closest to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3m from EUT to correspond to the fundamental frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the peak detector is used for the measurement.
4. During the measurement of the EUT, the bandwidth of the fundamental frequency was measured with the spectrum analyzer using
   1) RBW : 100 kHz(< 1GHz), 1 MHz(> 1 GHz).
   2) VBW : 100 kHz(< 1GHz), 1 MHz(> 1 GHz).
5. The transmitter shall be switched on, the measuring receiver shall be tuned to the frequency of the transmitter under test.
6. The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
7. The transmitter shall then the rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
8. The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.
9. The maximum signal level detected by the measuring receiver shall be noted.
10. The EUT was replaced by half-wave dipole(below 1000 MHz) or horn antenna(above 1000 MHz) connected to a signal generator.
11. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase he sensitivity of the measuring receiver.
12. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
13. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring received, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
14. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
15. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

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5.4 Test result

Ambient temperature : 22 ℃
Relative humidity : 46 % R.H.

Channel	Freq. (MHz)	Ant. Pol. (H/V)	Cable loss (dB)	S.G Level (dBm)	Ant. gain (dBd)	E.R.P. (dBm)	Limit (dBm)
Low	848.80	H	0.83	-50.82	-10.53	-60.52	-13.00
	1299.15	V	1.00	-60.36	4.70	-56.66	-13.00
	1732.20	V	1.33	-63.11	6.22	-58.22	-13.00
Middle	836.60	H	0.83	-50.19	-10.48	-59.84	-13.00
	1301.76	V	1.00	-59.30	4.71	-55.59	-13.00
	1735.68	V	1.33	-62.41	6.24	-57.50	-13.00
High	869.58	H	0.83	-49.12	-10.60	-58.89	-13.00
	1304.37	V	1.00	-58.07	4.71	-54.36	-13.00
	1739.16	V	1.33	-62.17	6.25	-57.25	-13.00

▣ All spurious emission at low, middle and high channel are not detected above 1800 MHz.

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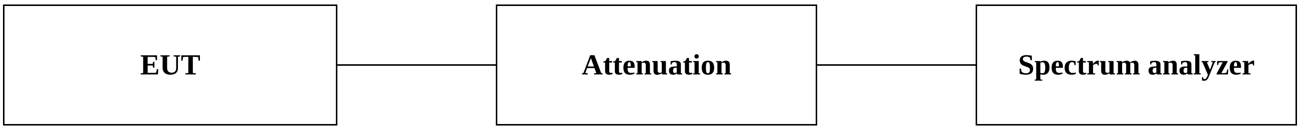
6.1. Emission mask

6.1. Setup



6.2. Limit

According to §90.210(c) Emission Mask C.
For transmitters that are not equipped with an audio low-pass filter, the power of any emis-sion must be attenuated below the unmodulated carrier output power (P) as follows:
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fdin kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fdin kHz) of more than 10 kHz, but not more than 250 percent of the authorized band-width: At least 29 log (fd2/11) dB or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

6.3. Test procedure

1. The transmitter output is connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using
   1) RBW and VBW : 100 Hz
   2) SPAN : 200 kHz
3. Mark the frequency with maximum peak power as the center of the display of the spectrum analyzer.
4. Record the power spectrum analyzer and compare to the mask.

6.4. Test result

Ambient temperature	:	22	℃
Relative humidity	:	45	% R.H.

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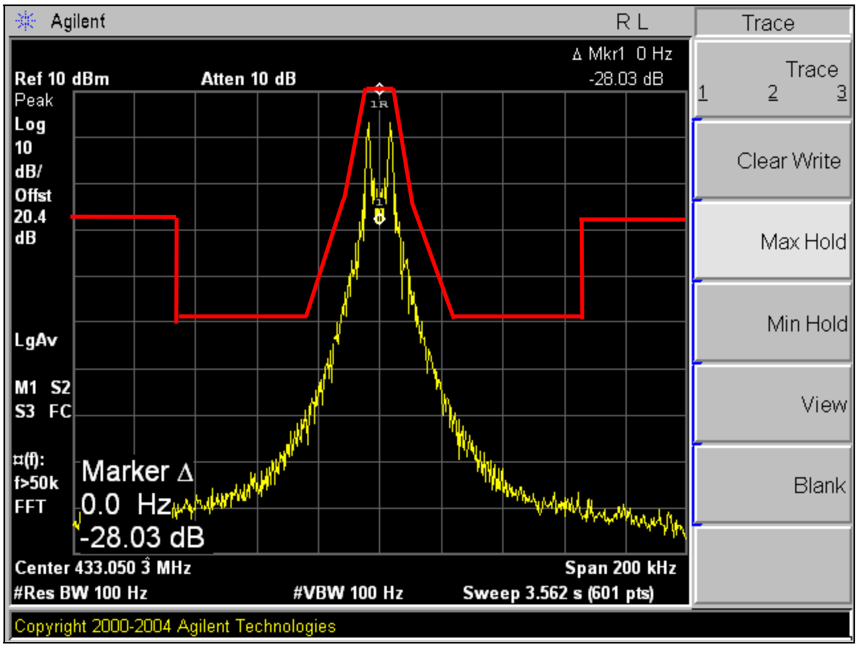
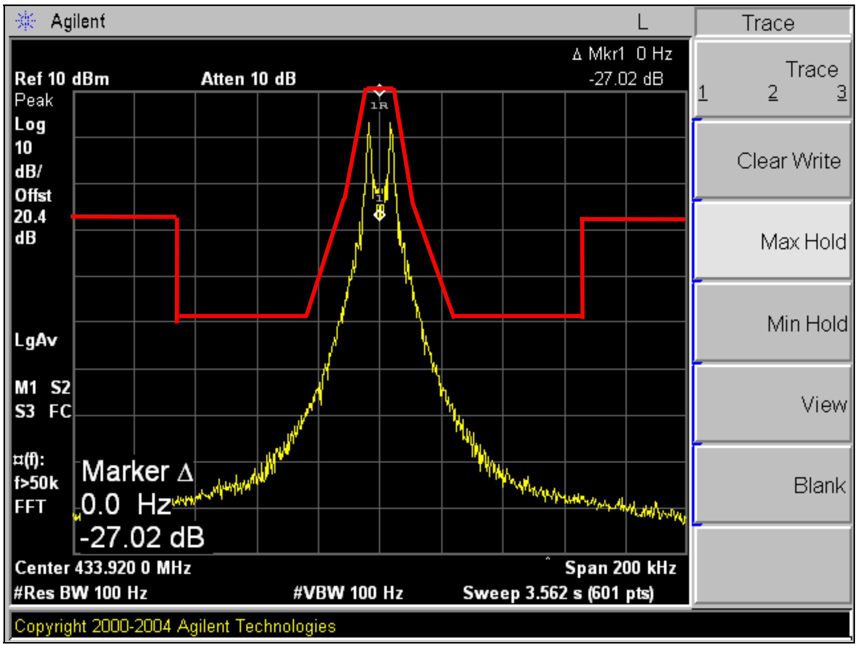
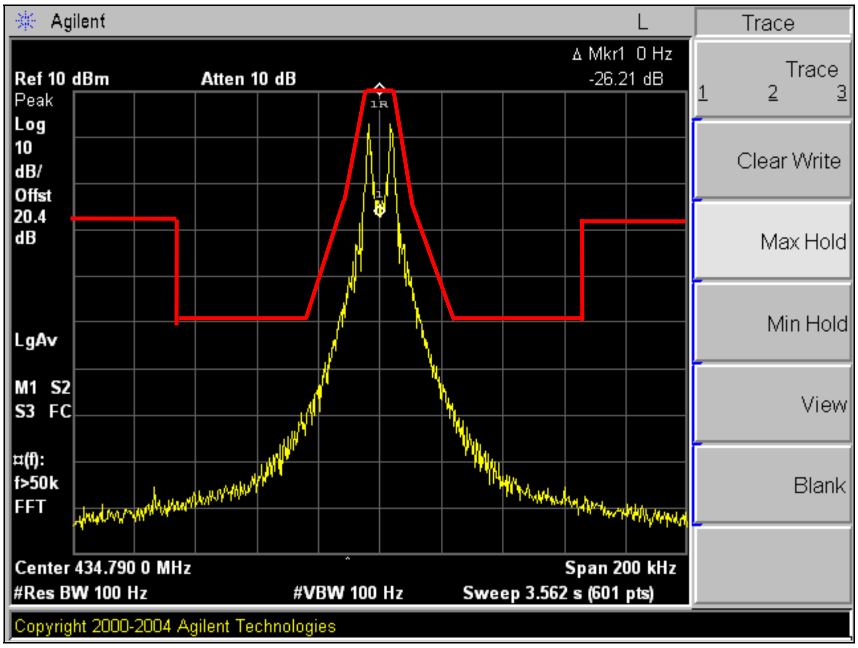
Operation frequency : 433.05 MHz
Channel spacing : 25 kHz



Operation frequency : 433.92 MHz
Channel spacing : 25 kHz



Operation frequency : 434.09 MHz
Channel spacing : 25 kHz



6. Occupied bandwidth

6.1. Setup

EUT		Attenuation		Spectrum Analyzer

4.2. Limit

None

5.3. Test procedure

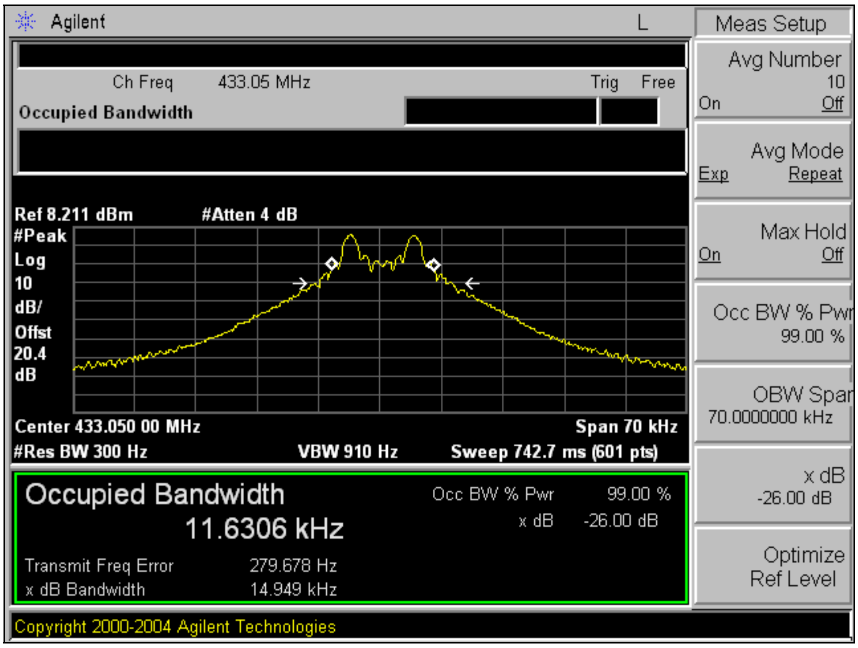
1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using
   1) RBW : 300 kHz
   2) VBW : 3 time

5.4. Test result

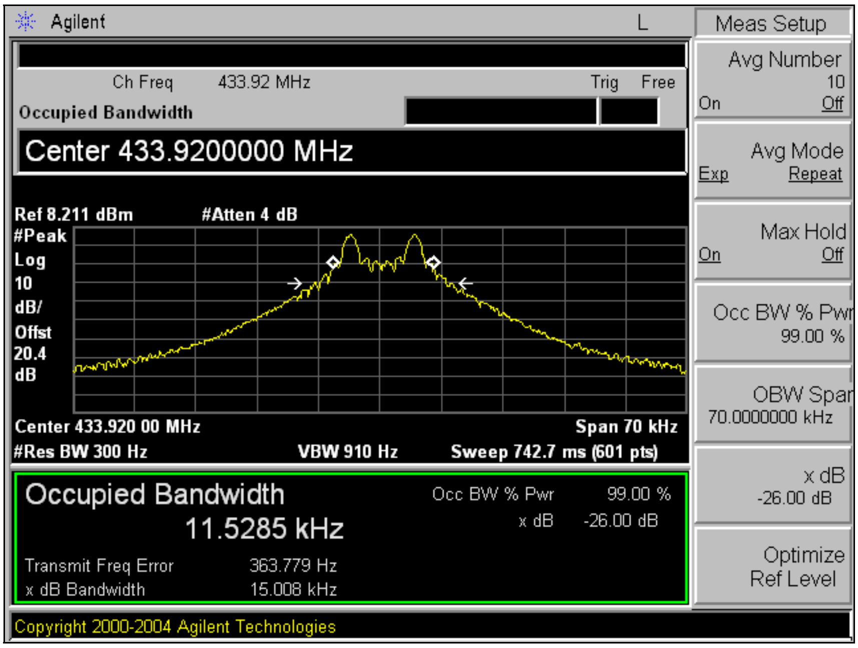
Ambient temperature	:	24	℃
Relative humidity	:	42	% R.H.

Please refer to the following.

Low channel



Middle channel



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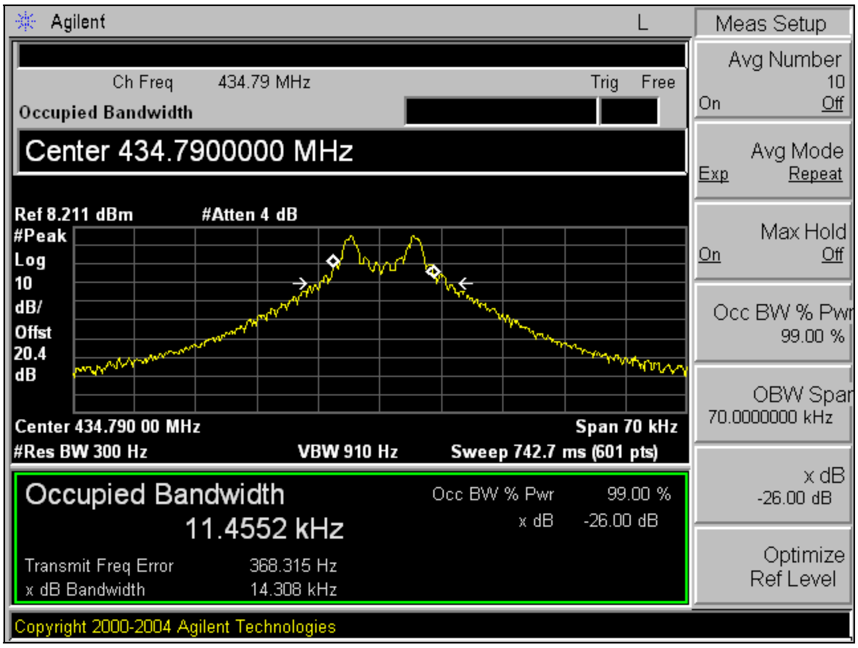
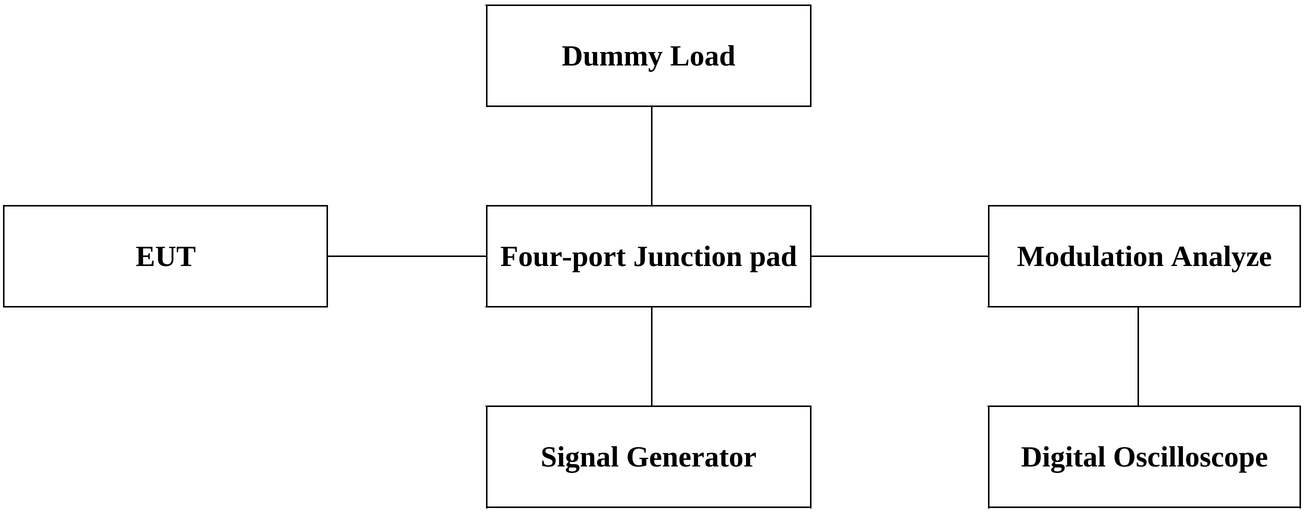
High channel



8. Transient frequency behavior of the Transmitter

8.1. Test setup



8.2. Limit

Time intervals [1, 2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient frequency behaviour for equipment designed to operate on 25 kHz channel			
t_1[4] ---------------------------	±25.0 kHz	5.0 ms	10.0 ms
t_2 ---------------------------	±12.5 kHz	20.0 ms	25.0 ms
t_3[4] ---------------------------	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channel			
t_1[4] ---------------------------	±12.5 kHz	5.0 ms	10.0 ms
t_2 ---------------------------	±6.25 kHz	20.0 ms	25.0 ms
t_3[4] ---------------------------	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 6.25 kHz Channel			
t_1[4] ---------------------------	±6.25 kHz	5.0 ms	10.0 ms
t_2 ---------------------------	±3.125 kHz	20.0 ms	25.0 ms
t_3[4] ---------------------------	±6.25 kHz	5.0 ms	10.0 ms

[1] $_{on}$ is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{off} is the instant when the 1kHz test signal starts to rise.
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency .
[4] If the transmitter carrier output power rating is 6watts or less, the frequency difference during this time may exceed the maximum frequency difference for this period.

8.3. Test procedure

1. Set the test receiver to measure FM deviation with the audio bandwidth set at ≤50 Hz to ≥15,000 Hz, and tune the RF frequency to the transmitter assigned frequency.
2. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±25 kHz deviation and set its output level to -100dBm.
3. Key the transmitter.
4. Supply sufficient attenuation via the RF attenuator to provide an input level to the test receiver that is 40 dB below the test receiver maximum allowed input power when the transmitter is operating at its rated power level.
5. Unkey the transmitter.
6. Adjust the RF level of the signal generator to provide RF power into the RF power meter equal to the level this signal generator RF level shall be maintained throughout the rest of the measurement.
7. Connect the output of the RF combiner network to the input of the Modulation analyzer.
8. Set the horizontal sweep rate on the storage oscilloscope to 10 milliseconds per division and adjust the display to continuously view the 1000 Hz tone. Adjust the vertical amplitude control of the oscilloscope to display the 1000 Hz at ±4 divisions vertically centered on the display.
9. Key the transmitter and observe the stored display. once the modulation Analyzer demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1 kHz test signal is completely suppressed (including any capture time due to phasing) is considered to be t_{on} .
   The trace should be maintained within the allowed divisions during the period t1 and t2 . See the figure in the appropriate standards section.
10. During the time from the end of t2 to the beginning of t3 the frequency difference should not exceed the limits set by the FCC in 47 CFR 90.214 and outlined in 3.2.2. The allowed limit is equal to the transmitter frequency times its FCC frequency tolerance times ±4 display divisions divided by 25 kHz.
11. Key the transmitter and observe the stored display. The trace should be maintained within the allowed divisions after the end of t2 and remain within it until the end of the trace. See the figure in the appropriate standards sections.
12. To test the transient frequency behavior during the period t3 the transmitter shall be keyed.
13. Adjust the oscilloscope trigger controls so it will trigger on a decreasing magnitude from the Modulation analyzer, at 1 division from the right side of the display, when the transmitter is turned off. Set the controls to store the display. The moment when the 1 kHz test signal starts to rise is considered to provide to t_{off}.
14. The transmitter shall be unkeyed.
15. Observe the display. The trace should remain within the allowed divisions during period t3. See the figures in the appropriate standards section.

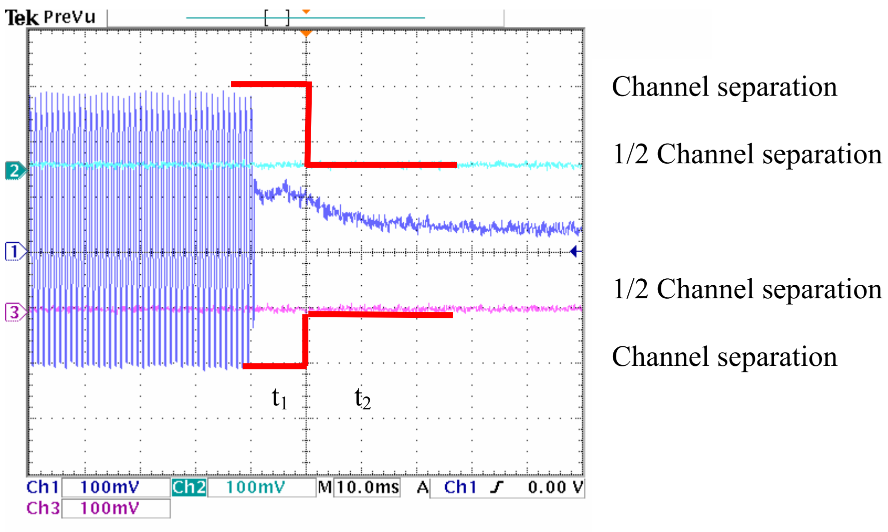
8.4. Test result

Ambient temperature	:	22 ℃
Relative humidity	:	45 % R.H.

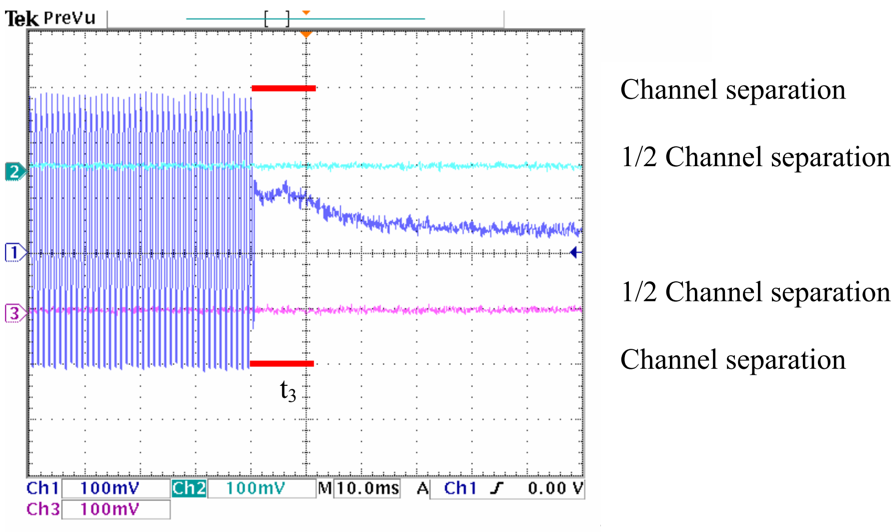
Please refer to the following.

Operation frequency : 433.05 MHz
Channel spacing : 25 kHz

Switching from off to on (t_1 & t_2)

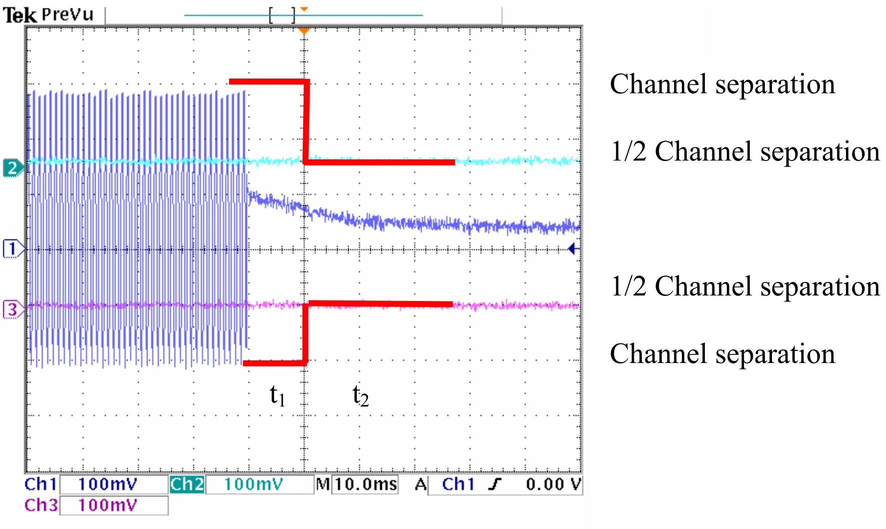


Switching from on to off (t_3)

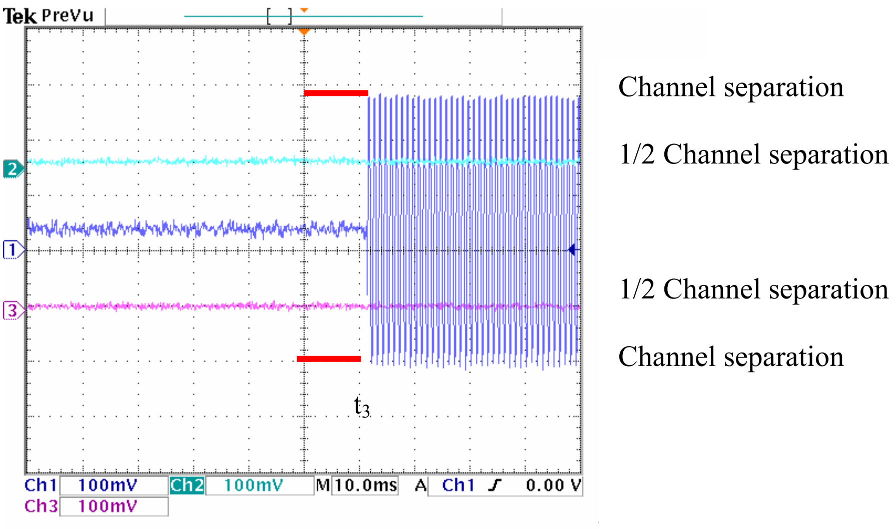


Operation frequency : 433.92 MHz
Channel spacing : 25 kHz

Switching from off to on (t_1 & t_2)



Switching from on to off (t_3)



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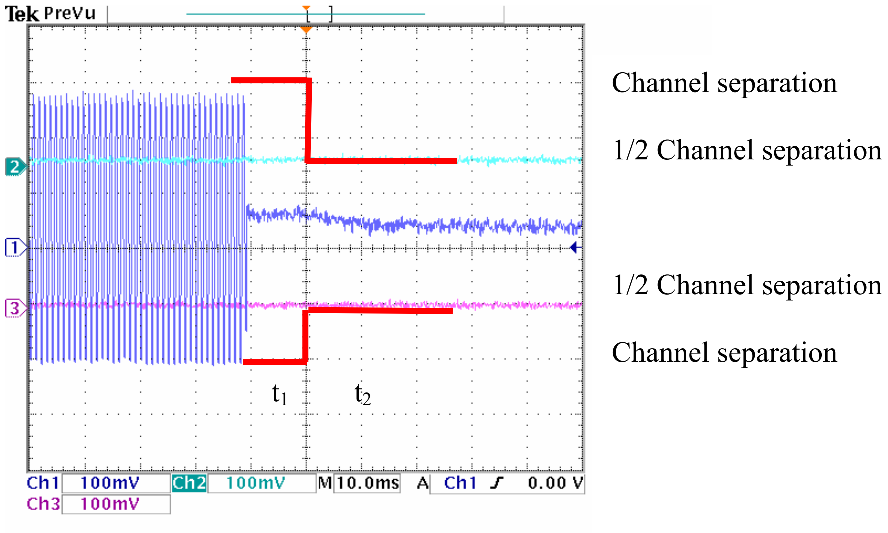
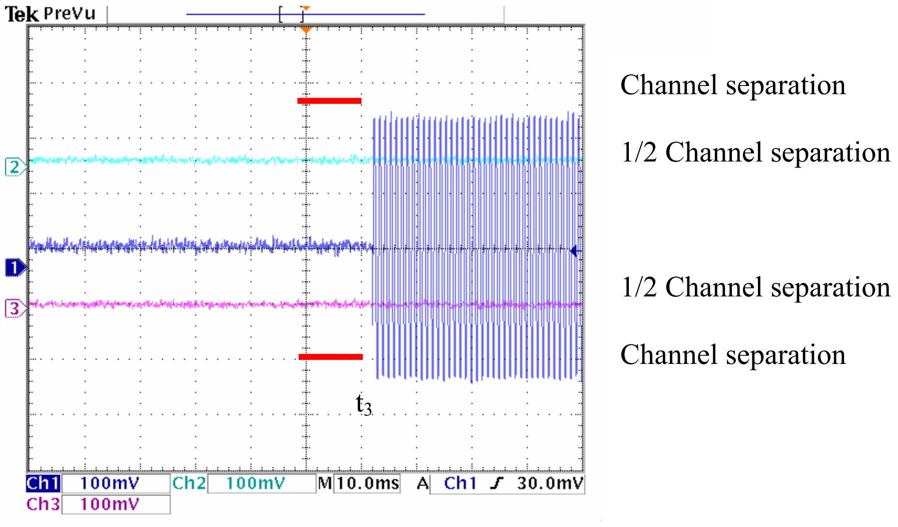
Operation frequency : 434.79 MHz
Channel spacing : 25 kHz

Switching from off to on (t_1 & t_2)



Switching from on to off (t_3)



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9. RF Exposure evaluation

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in § 1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength(V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Average time
(A) Limits for Occupational /Control Exposures				
300 – 1500	--	--	F/300	6
1500 - 100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1500	--	--	F/1500	6
1500 - 100000	--	--	1	30

9.1. Friis transmission formula : Pd = (Pout*G)/(4*pi*R^2)

Where
Pd = power density in mW/cm^2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
Pi = 3.1416
R = distance between observation point and center of the radiator in cm
Pd the limit of MPE, f/300 mW/cm^2. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

9.2. Test result of RF exposure evaluation

Test Item ： RF Exposure Evaluation Data
Test Mode ： Normal Operation

Channel	Frequency (MHz)	Peak output power (dBm)	Antenna gain (dBi)	Power density at 20cm (mW/cm^2)	Limit (mW/cm^2)
Low	433.05	10.15	-3.10	0.00101	1.4435
Middle	433.92	10.59	-3.10	0.00112	1.4464
High	434.79	10.55	-3.10	0.00111	1.4493